CASUALTY ACTUARIAL SOCIETY

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Solutions.

2020

SYLLABUS OF BASIC EDUCATION

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casact.org

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REVISION HISTORY

Revision	Issue Date	Description of Revision
0	11/18/2019	Initial publication
1	02/14/2020	Examination Discipline updated
2	05/06/2020	Various changes reflecting cancellation of April examinations caused by the coronavirus (COVID-19) outbreak • Announcement-1 • Examination Schedule-1&2
3	06/10/2020	Waiver policy granted for CAA examinations revised
4	06/15/2020	Examination Discipline updated
5	06/22/2020	Membership requirements updated

Items in the *Syllabus of Basic Education* printed in **red** indicate an update, clarification, or change since initial publication.

ANOUNCEMENTS FOR 2020

Exam Registration

Candidates may find online exam registration and related information on the Exam Registration page of the CAS website.

There is only one registration deadline for each exam. **No late registrations will be accepted**. The exam dates and registration deadlines are available in the "2020 Examination Schedule" section. Please allow at least 10 working days for your mailed application to reach its destination. Whether payment is made by personal or company check, it is the candidate's responsibility to ensure that the application and fee are received by the stated deadline. **Exceptions will not be made**.

Exam 1—Probability

The CAS recognizes the exam waivers granted by the Canadian Institute of Actuaries (CIA) University Accreditation Program (UAP). The CIA has recently revised the program to allow credit for Exam 1. Starting with courses given in summer of 2019, the CIA will recognize courses completed with a minimum grade requirement at many of the 11 accredited universities. The CAS will only grant waivers for CIA UAP exam credits that were awarded based on work at universities in Canada.

For credit granted through the CIA's University Accreditation Program, the list of candidates granted waivers by the CIA is provided to the CAS following the end of a semester. The CAS automatically updates its records. No further action is required of candidates.

The CAS will continue to grant UAP credit for Exams 2 and 3F.

2020 Spring (April) Examinations and Coronavirus (COVID-19) Outbreak

As a result of the coronavirus (COVID-19) outbreak, the CAS has made the difficult decision to cancel the exams originally scheduled to be held in April. Exams 7 and 9, which are normally administered in April, will be administered in October instead. Exam 8 will be administered in Spring 2021, as well as October 2020.

See Examination Schedule, pages 1 and 2, for details.

Refunds

Candidates may cancel a Spring exam and then register for a Fall exam when registration for Fall exams opens this summer. Full refunds will be provided for Spring exam registrations; please cancel your exam via email to refund@casact.org. The deadline for full refunds for a Spring exam cancellation is the date that registration opens for Fall exams this summer; this date will be announced as soon as possible. Following this date, a refund fee will apply.

Please note that candidates who plan to sit for the same exam in the Fall are discouraged from cancelling and re-registering.

Note: *This Syllabus is subject to change in the future.*

The Syllabus for each examination is defined in the form of Learning Objectives, Knowledge Statements, and Readings. The Learning Objectives present the learning goals for the underlying subjects being tested and set forth, usually in broad terms, what the candidate should be able to do in actual practice. The Knowledge Statements describe the body of knowledge corresponding to the exam subject and are illustrative of the scope of each Learning Objective. The Readings are recommended resources that support the Learning Objectives and may assist candidates to prepare for the examination. The CAS is not responsible for any errors or omissions found in the content of the resources identified in the Readings.

INTRODUCTION

Principles of the Casualty Actuarial Society for Basic Education

The primary purpose of the Casualty Actuarial Society (CAS) basic education process is to ascertain whether candidates for the CAS designations have satisfied CAS learning objectives. The CAS Board of Directors adopted the following principles on May 6, 2001.

1. Basic education will remain a cornerstone of the CAS.
2. The CAS will assure that its members have the knowledge of those areas needed to practice effectively in the broad and expanding range of property, casualty, and similar business and financial risks (general insurance).
3. The CAS is committed to a depth of knowledge of techniques associated with the broad range of property, casualty, and similar business and financial risks.
4. The CAS will provide the basic education necessary to meet qualification standards to sign statements of actuarial opinion for general insurance and related specialties in at least the U.S. and Canada.
5. The education process will provide a balance among theoretical concepts, practical applications, and business acumen, to prepare our members to deliver high-quality service to meet current and projected future needs of employers and clients.
6. The CAS will approve the syllabus and examination standards used in determining eligibility for CAS membership.
7. Demonstration of mastery of the skill sets required of members is critical to basic education.
8. The CAS is committed to maintaining self-study as one route for attainment of designations.
9. The CAS will pursue strong working relationships with academia and professionals in related fields.
10. The CAS will attract a pool of strong candidates from a variety of backgrounds to the actuarial profession.
11. The CAS supports the goal of developing a global shared foundation of actuarial education, including joint sponsorship of examinations where consistent with other principles.
12. The CAS, as an educator of general insurance and related specialties, will remain a significant contributor to the worldwide actuarial profession.

Syllabus Goals and Objectives

One of the primary objectives of the Casualty Actuarial Society (CAS) is the development of qualified professionals in the field of casualty actuarial science. The CAS conducts an educational and examination program for prospective members in order to achieve this objective.

The syllabus goals and objectives are as follows:

1. To develop a general understanding of the social, political, regulatory, legal, economic, and financial environment of the business of property and casualty insurance and similar risk assessment as well as the historical development of that environment.

2. To develop a thorough understanding of the fundamental mathematical concepts applicable to solving insurance and similar risk assessment problems, and to develop a high degree of skill in their applications.

3. To develop a comprehensive understanding of the business of property and casualty insurance, including underwriting, claims, marketing, and finance, as well as how these functions are performed and interrelated.

4. To develop a working knowledge of property and casualty insurance policies and contracts.

5. To develop an expert knowledge of a broad range of techniques to solve problems and to develop the ability to discern the appropriateness of techniques for particular applications based on knowledge of the underlying assumptions, strengths, and weaknesses.

6. To develop an expert knowledge of a broad range of relevant and standard actuarial practices in order to present a framework for the use of problem-solving techniques.

7. To encourage a sense of inquisitiveness and creativity toward problem solving in order to foster an appreciation of the art in actuarial science.

Note: *The items in this Syllabus were chosen for their educational value. They are intended to expose the candidate to a wide range of information and to a variety of methods, opinions, and practices in the casualty actuarial field. Inclusion of material in the Syllabus does not imply that the CAS endorses the views, methodologies, or techniques therein.*

Education and Examination System

The CAS vice president-admissions supervises the CAS education and examination system. The vice president-admissions is supported by two standing admissions committees, as described below, and ad-hoc task forces formed to address specific admission-related issues.

CAS Candidate Liaison Committee

The Candidate Liaison Committee strives to focus on issues of importance to candidates who are taking CAS Examinations. The committee serves as a direct point of contact for candidates to voice individual or group concerns regarding the education and examination process. It also provides a means for an exchange of information between candidates and the admissions committees via *Future Fellows*, a quarterly newsletter,

and the *Future Fellows* blog. Candidate representatives who are actively involved in the examination process serve as advisors to the committee.

CAS Syllabus & Examination Committee

The Syllabus & Examination Committee determines the scope and content of the CAS *Syllabus* and course of readings for CAS Examinations. It also organizes, manages, administers, and grades the CAS Examinations. The committee also establishes the standards to be achieved by successful candidates.

The chairperson supervises the committee and is responsible for the overall development of the *Syllabus of Basic Education* and the administration of the CAS Examinations. The committee is composed of Fellows who represent a broad spectrum of CAS members including insurers, consultants, regulators, and academics. One or more members specialize in the material for each examination part. Several senior committee officers with the title of general officer assist the chairperson. The committee is subdivided into Examination Part Committees, each headed by an examination part chairperson. Two or more vice-chairs assist the examination part chairperson – these vice-chairs take responsibility for the main distinct operations of the examination part team, e.g., syllabus development, examination creation, and exam administration.

Members of the Canadian Institute of Actuaries (CIA) that are also Fellows serve on the Examination Part Committee for Exam 6-Canada for examination creation and administration. The CIA's Exam 6 Canada Syllabus Subcommittee develops the syllabus for that exam.

The following provides details about the CAS-specific syllabi and examinations:

- The responsibility for each CAS examination syllabus is assigned to an Examination Part Committee that reviews the individual exam syllabi regularly. Both short- and long-term goals for improvement are developed. Textbooks and articles may be designated for inclusion. If the committee determines that new study material needs to be developed or that existing material needs to be revised, the committee may commission the creation of Study Notes for inclusion. Every effort is made to develop material that is appropriate, relevant, up-to-date, concise, and well written. Suggestions for improvement are always welcome and should be directed to the Syllabus and Examination Committee at the CAS Office address

- The responsibility for each CAS examination is assigned to an Examination Part Committee that writes, grades, and maintains the standards for that examination. One or more examination consultants who are CAS members and are experts on the material covered by that examination assist each part committee. A proofreader who concentrates on uniformity and grammar also assists the part committees. In addition, academic consultants who are independent experts from the academic community assist some part committees.

- Each examination is drafted by the responsible Examination Part Committee to test candidates' knowledge of the items listed in the syllabus for the specific exam. The individual part committee, examination consultants, one of the Examination Committee general officers, the Examination Committee chairperson, and, in some cases, academic consultants review each examination to assure its quality.

- Every effort is made to ensure that the questions fall within the scope of the individual exam syllabus. Complete coverage of all material is not practical for every examination every year. The goal is to produce examinations that contain representative, high-quality questions that test candidates' knowledge of the material. Trick questions are deliberately avoided, and the wording of each question is considered

carefully to eliminate ambiguities. Preliminary versions of each examination are thoroughly reviewed in relation to all of these factors before the final examination is approved.

Ad-hoc Task Forces

As needed, ad-hoc task forces are formed to provide targeted research, analysis, and recommendations to the CAS Executive Council and Board of Directors, so they are better able to ensure that the goals of the education and examination system are met, and that the education and examination system meets the needs of the Society, its members, its potential members, and other stakeholders.

2020 EXAMINATION SCHEDULE

Exams for Online Courses 1 and 2 by Computer-Based Testing

	EXAM DATES	DURATION	START TIME	EXAM REFUND DEADLINE
January-March Test Window	Jan. 15 – March 15, 2020	2 Hours	Various	Three business days prior to scheduled exam—fees apply.
April-June Test Window	April 15 – **June 30, 2020**			
July-September Test Window	July 15 – Sept. 15, 2020			
October-December Test Window	Oct. 15 – Dec. 15, 2020			

October/November 2020 Exam Administration

Exam	EXAM DATES	DURATION	START TIME	REGISTRATION DEADLINE	REFUND DEADLINE*
MAS-I	**November 10, 2020**	4 Hours	See note below.	August 21, 2020	October 9, 2020
MAS-II	**November 13, 2020**	4 Hours	See note below.	August 21, 2020	October 9, 2020
Exam 5	October 19, 2020	4 Hours	8:30 a.m.	August 21, 2020	October 2, 2020
Exams 6-Canada and 6-U.S.	October 20, 2020				
Exam 7	**October 5, 2020**				
Exam 8	October 21, 2020				
Exam 9	**October 6, 2020**				

***Refund deadlines vary by exam. No exceptions will be made.**

SP9 Exam Administration for CERA Designation

Exam	EXAM DATES	DURATION	START TIME	REGISTRATION DEADLINE	REFUND DEADLINE
October Administration	**October 5, 2020**	3 Hours	Check Entry Permit	July 24, 2020	July 23, 2020

Important Schedule Notes

- Starting times listed for examinations refer to local time.
- **Starting times listed for examinations refer to local time except for Exams MAS-I and MAS-II, which are using a computer-based examination environment. For Exams MAS-I and MAS-II, candidates will schedule their individual start time with Pearson Vue test centers.**
- **For Exams 5 through 9, there will be a 15-minute reading period prior to the commencement of the timed exams. Exams MAS-I and MAS-II will not have a reading period.**
- **Waivers for various preliminary exams are accepted from the Actuarial Society of South Africa, the Actuaries Institute (Australia), the Canadian Institute of Actuaries, the China Association of Actuaries, and the Institute and Faculty of Actuaries, and the Society of Actuaries. See the Waivers of Examination page of the CAS website for a complete waiver explanation.**
- To meet the CAS requirements for CERA, candidates should submit their registration to the CAS for Institute and Faculty of Actuaries (U.K.) Exam SP9.

ASSOCIATESHIP REQUIREMENTS

Validation by Educational Experience

VEE-Accounting and Finance
VEE-Economics

Online Courses

Online Course 1	Risk Management and Insurance Operations (same as The Institutes Course CA1)
Online Course 2	Insurance Accounting, Coverage Analysis, Insurance Law, and Insurance Regulation (same as The Institutes Course CA2)

Examinations

Exam 1	Probability
Exam 2	Financial Mathematics
Exam 3F	Financial Economics
Exam MAS-I	Modern Actuarial Statistics-I
Exam MAS-II	Modern Actuarial Statistics-II
Exam 5	Basic Techniques for Ratemaking and Estimating Claim Liabilities
Exam 6	Regulation and Financial Reporting (Nation-Specific)

Course on Professionalism

FELLOWSHIP REQUIREMENTS

Fellowship requires all Associateship requirements plus the following:

Exam 7	Estimation of Policy Liabilities, Insurance Company Valuation, and ERM
Exam 8	Advanced Ratemaking
Exam 9	Financial Risk and Rate of Return

CERA DESIGNATION REQUIREMENTS

The CERA designation requires all Associateship requirements plus the following:

Exam 7 Estimation of Policy Liabilities, Insurance Company Valuation, and ERM

Exam 9 Financial Risk and Rate of Return

Enterprise Risk Management and Modeling Seminar

Exam SP9 of the Institute and Faculty of Actuaries (U.K.) on Enterprise Risk Management

EXAMINATION RULES

A. Registration

Administration of Examinations

The CAS basic education structure has Validation by Educational Experience (VEE) requirements, two online courses, several examinations (see Basic Education Summary), and the Course on Professionalism. Credit for Exams 1, 2, and 3F is granted based on exam options as defined in the individual exam syllabi. The two online courses are available through The Institutes. The CAS exclusively administers Exams MAS-I, MAS-II, and 5 through 9 and the Course on Professionalism. The Canadian Institute of Actuaries (CIA) co-sponsors all the examinations except Exam 6-United States and Exam 6-Actuarial Institute of Chinese Taipei.

Filing of Applications and Deadlines

Exams 1, 2, and 3F

For Exams 1, 2, and 3F, the candidate should follow the application process and deadlines of the sponsoring organizations.

Exams MAS-I, MAS-II, and 5 through 9

All candidates filing for an examination(s) must submit a signed application for each examination period. Both online registration and application forms are linked at each of the individual Examination pages under the "Exams and Admissions" section of the CAS website. Payment must accompany each application to be valid. **Applications must be received by the registration deadlines stated in the Examination Schedule of this *Syllabus*.** Please allow at least 10 working days for your mailed application to reach its destination. Whether payment is made by personal or company check, **it is the candidate's responsibility to ensure that the application and fee are received by the stated deadline. Exceptions will not be made**.

Submitting applications: Candidates may submit examination registrations for Exams MAS-I, MAS-II, and 5 through 9 by mail or online. Applications must be received by the published deadlines.

Candidates submitting a hard copy of their registration should mail them as follows:

Mail application with check or money order in U.S. funds or Canadian equivalent (payable to "Casualty Actuarial Society") to:	*Send application with credit card payment (Visa, MasterCard, or American Express) and all overnight deliveries to:*
Casualty Actuarial Society P.O. Box 425 Merrifield, VA 22116-0425	Casualty Actuarial Society 4350 N. Fairfax Drive, Suite 250 Arlington, Virginia 22203 Telephone: 703.276.3100

Candidates submitting their registrations online for Exams MAS-I, MAS-II, and 5 through 9 must pay by credit card. All credit card payments will be processed in U.S. funds.

Candidates will be sent an acknowledgment of receipt of their application within three weeks of the date that the application form was received at the CAS Office beginning in early February for April/May Examinations and early August for October/November Examinations. This acknowledgment is the candidate's receipt of exam fees paid. Please retain this acknowledgment for tax purposes if needed. **Candidates that have not received an acknowledgment prior to the registration deadline should contact the CAS Office or their accounting department to ensure that their applications reached the CAS Office.** The candidate can also verify their registration by logging into their CAS account and checking their profile.

Online Courses 1 and 2

CAS Online Courses 1/CA1 and 2/CA2 are available through The Institutes. When candidates register for the individual online course, the fee includes one attempt at the exam. Before registering for the exam, candidates must obtain their Master ID number from the CAS—it will be required to register for the exam. After progressing through the online course, candidates arrange for their exam by contacting:

The Institutes, Customer Success group
720 Providence Road, Suite 100
Malvern, PA 19355-3433
Telephone: (800) 644-2101 or (610) 644-2100 ext. 6000
E-mail: CustomerSuccess@TheInstitutes.org
CAS Online Courses page at The Institutes website: www.aicpcu.org/cas.htm

Name

Candidates must use their legal name on all examination registration materials and when corresponding with the CAS. Any change in name must be accompanied by acceptable documentation.

Fees

Examination fees must be paid each time a candidate registers for an exam. Payment options are described in a previous section, Filing of Applications and Deadlines. A $20 surcharge will be assessed for all returned checks. The charts below show the examination fee schedules at the time of publication. All fees are listed in U.S. dollars and are subject to change. Other fees that may apply include fees for change of center, refund, and/or a special exam center.

Exams 1, 2, and 3F

Contact the sponsoring organization.

Exams MAS-I, MAS-II, and 5 through 9 and Online Courses 1 and 2

2020 Examination Fees		
	Candidates	**Full-Time Students**
Exam MAS-I & MAS-II	$450	$360
Exams 5, 6C, 6U, 7, 8, and 9	$675	$540
Online Courses 1 & 2 Retest†	$450	$450
Exam SP9	$675	$650

Other Fees	
Refund (Exams MAS-I, MAS-II, 5 through 9, and SP9)	$100
Change of Exam Center	$60
Online Courses 1/CA1 and 2/CA2: Contact The Institutes for fees that apply.	

†The first exam attempt is included in the $765 Online Course fee.

Exams 1 and 2 Fee Reimbursement Program in the U.S.

The Joint CAS/SOA Committee on Career Encouragement and Actuarial Diversity sponsors a program to reimburse qualified minority candidates for Exam 1 (SOA Exam P) and Exam 2 (SOA Exam FM) fees. Eligible candidates are members of specified groups that are underrepresented in the actuarial profession in the United States, including African-Americans, Hispanics, and Native North Americans who are sitting for actuarial exams. The reimbursement application is available in the Diversity Programs section of the actuarial career website at http://www.BeAnActuary.org.

Fee Discount Program in Qualified Countries

The CAS sponsors a program to provide financial relief to candidates of qualified countries. Eligible candidates must be current full-time residents of a qualified country. Candidates must write their exams in a qualified country. Information, including a list of qualified countries and the application, is available on the Fees Discount Program page of the CAS website.

Computer-Based Testing - Online Courses 1 and 2

The exams for Online Courses 1/CA1 and 2/CA2 are offered by computer-based testing (CBT). Because there are distinctive processes and procedures for CBT, additional information is available on The Institutes

website. The rules and procedures provided on The Institutes website related to Online Courses 1/CA1 and 2/CA2 are part of the CAS examination rules.

Examination Centers

CAS examination centers are listed on the Exam Registration page of the CAS website. Centers are determined by the number of candidates near a center and the availability of proctors. Special examination centers may be arranged at the discretion of the CAS on a case-by-case basis if the request is received by the registration deadline. Candidates will be sent the exact location of their examination center at least two weeks before the examination.

Examinations by computer-based testing - Online Courses 1 and 2 - are administered at established test centers. The Prometric website (http://www.prometric.com/SOA/default.htm) contains a list of the CBT centers.

The CAS will not host exams in any country that has trade sanctions held against it per the U.S. Department of the Treasury.

Change of Center

For Exams MAS, MAS-II, and 5 through 9, any registered candidate who requests a change in examination center must pay a change-of-center fee. No requests will be accepted after the registration deadline. If a request for a change of center occurs, every effort will be made to have the candidate's records and supplies on hand at the appropriate center in time for the examination. If this effort fails, however, the CAS is not responsible. If either a candidate's registration and fees, or request for change of center are received so late that it is not feasible to arrange for the candidate to write the examination, the fees will be refunded in full. The CAS is not responsible for difficulties caused by postal service delays or inadequate postage.

Details for changing a CBT center for the exams for Online Courses 1/CA1 and 2/CA2 are available on The Institutes website (http://www.aicpcu.org/cas.htm).

Languages other than English

Exams MAS-I, MAS-II, and 5 through 9 and Online Courses 1 and 2

Exam questions and instructions will be printed, and exams administered, exclusively in English. Candidates must submit written responses in English; non-English responses will not be graded with the following exception: Should a candidate for an exam jointly sponsored by the Canadian Institute of Actuaries wish to respond to any or all of the constructed-response test items (essay questions) in French, advanced notice must be provided to the CAS Office when applying to write the exam. Provided such advanced notice was received and a suitable translator is available from the Canadian Institute of Actuaries, responses submitted in French will be translated into English by qualified translators and graded exclusively in translation. All translations will be literal translations from French to English. If advanced notice has not been provided, non-English responses will not be graded. If a suitable translator cannot be engaged before the date of the exam, the candidate will be notified. The CAS cannot guarantee the accuracy of any translation. Appeals based upon errors in translation of a candidate's responses will not be considered. Grade reports for exams requiring translation may be delayed.

Special Arrangements for Candidates with a Disability

A candidate with a formally diagnosed disability who needs special testing arrangements must submit a written request for each examination that the candidate intends to write. Documentation of the disability, e.g., physician's statement, diagnostic test results, as well as the need for special arrangements, is required of each candidate. Previous accommodations given to the candidate in an educational program or work setting may be considered.

Requests for special arrangements and supporting documentation must be submitted at the applicant's expense at least two weeks prior to the registration deadline for Exams MAS-I, MAS-II, and 5 through 9; and prior to the first day of the testing window for the exams for Online Courses 1/CA1 and 2/CA2. For Exams MAS-I, MAS-II, and 5 through 9, contact the CAS Examinations Coordinator. For the two online courses, contact The Institutes.

For Exams 1, 2, and 3F, contact the sponsoring organization.

Refunds

Exams 1, 2, and 3F

Contact the sponsoring organization.

Online Courses 1 and 2

The fee for Online Courses 1/CA1 and 2/CA2 includes one attempt at the exam by CBT. No refund for a course is provided once the candidate has accessed the online course. If the candidate decides not to access the online course after payment has been made, the candidate may submit a request for a refund. The request must be submitted to the Customer Success group at The Institutes.

Any candidate who registered for a course exam and subsequently decides not to take the exam may receive a refund for the exam portion of the course fee ($190) only by doing both of the following:

- Cancel the appointment prior to the third day preceding the exam at the test center, and
- Submit a refund request to Customer Success group at The Institutes (CustomerSuccess@TheInstitutes.org) that must arrive prior to the third day preceding the exam.

Exams MAS-I, MAS-II, and 5 through 9

Any candidate who submits an application for Exams MAS-I, MAS-II, or 5 through 9 and subsequently does not write the examination should submit a written request for an examination fee refund. This request must reach the CAS Office by the refund deadline stated in the Examination Schedule of this *Syllabus*. Refund requests may be sent via e-mail to refund@casact.org or by fax to (703) 276-3108. Late requests will not be considered. A $100 administrative fee per examination will be assessed on all refunds. Change-of-center fees, special center fees, and other additional fees will not be refunded in any case. Refunds will be issued one month after the refund deadline. Refunds are issued in the manner that fees were paid, i.e., by credit to a bank card or by check to an individual or company. Fees cannot be transferred from one exam session to another.

B. The Examination

Introduction

The examinations for admission to the Casualty Actuarial Society are designed to establish the qualifications of candidates. The CAS Syllabus & Examination Committee creates exams that follow guidelines developed for and shown in the *Syllabus*. Complete coverage of all readings listed in the *Syllabus* is not practical for every exam every year. The goal is to produce exams that contain representative, high-quality questions that test a candidate's knowledge of topics that are presented in the learning objectives. Thus, the candidate should expect that each exam will cover a large proportion of the learning objectives and associated knowledge statements and syllabus readings, and that all of these will be tested at least once over the course of a few years.

The Syllabus for each examination is defined in the form of Learning Objectives, Knowledge Statements, and Readings. The Learning Objectives present the learning goals for the underlying subjects being tested and set forth, usually in broad terms, what the candidate should be able to do in actual practice. The Knowledge Statements describe the body of knowledge corresponding to the exam subject and are illustrative of the scope of each Learning Objective. The Readings are recommended resources that support the Learning Objectives and may assist candidates to prepare for the examination. The CAS is not responsible for any errors or omissions found in the content of the resources identified in the Readings.

The exam questions will be based on the published learning objectives and supporting knowledge statements. It is intended that the readings, in conjunction with the material as outlined in the next section, will provide sufficient resources to allow the candidate to perform the learning objectives. The exams will test not only a candidate's knowledge of the subject matter, but also a candidate's ability to apply that knowledge.

The Institutes create exams for the online courses that follow the learning objectives contained in the individual courses.

Note: This Syllabus is subject to change in the future.

Order of Examinations and VEE Topics

In the development of the syllabus readings and exam questions, it is generally assumed that candidates for Associateship-level Exams MAS-I, MAS-II, 5, and 6 are familiar with material covered on the preliminary exams; Fellowship-level Exams 7, 8, and 9 generally assume familiarity with material on the Associateship-level exams. There are, however, circumstances when another order might be more appropriate. For example, a candidate may wish to study an exam that is closely related to his or her current work.

VEE topics are not prerequisites to taking actuarial exams and may be fulfilled independently of the exam process, i.e., prior to or concurrent with taking actuarial exams. In some cases, however, understanding the material within a VEE topic may help make the material for an exam easier to understand. For example, VEE-Economics and VEE-Accounting and Finance will help strengthen candidates' understanding of managerial decision-making and completing these topics prior to taking Exam 9 will make material for this exam easier to understand.

Candidates are encouraged to take Online Course 1 and Online Course 2 immediately after they begin their first property-casualty insurance-related employment. For Exams 5 through 9, the general concepts and

knowledge covered on those two Online Courses is often used to establish real-world context for exam questions. Thus, it will be helpful for candidates to take the two Online Courses prior to taking Exams 5 through 9, although detailed knowledge is not assumed except as noted below.

To help candidates decide which exam to take, the following chart indicates which exams assume knowledge of material found on prior exams. While the CAS does not test Learning Objectives and Knowledge Statements directly from other exams, most candidates will find it easiest to study for an exam after studying for all of the exams listed in the "prior knowledge" column.

Exam or VEE Requirement	Assumes Prior Knowledge from the Following Exam(s)
VEE-Accounting and Finance	None
VEE-Economics	None
Online Course 1/CA1	None
Online Course 2/CA2	None
Exam 1	None
Exam 2	Exam 1
Exam 3F	Exams 1 and 2
Exam MAS-I	Exams 1 and 2
Exam MAS-II	Exams 1 and MAS-I
Exam 5	Exams 1 and 2
Exam 6C or 6U	Exams 1 and 5 and Online Course 2
Exam 7	Exams 1, 2, MAS-II, and 5 and VEE-Accounting and Finance
Exam 8	Exams 1, 2, 3F, MAS-I, MAS-II, and 5
Exam 9	Exams 1, 2, 3F, MAS-II, and 5 and VEE-Economics and VEE-Accounting and Finance

Hours of Study

Passing actuarial exams requires many hours of study—more for some people and less for others—but often more than many candidates realize. Putting in enough hours can actually save a candidate time. Suppose, for example, that mastering the syllabus for one exam will take a candidate 400 study hours, and that a candidate only puts in 300 hours and fails the exam the first time. He or she then puts in an additional 300 hours and passes the exam the second time. That candidate will have spent 600 hours, when by studying 400 hours the first time around, he or she would have saved 200 hours, not to mention passing sooner. It is recommended that candidates decide for themselves how many hours they really need to study, and then do that much studying—the first time around.

Requirements for Admission to Examination Center

To be admitted into an examination center, each candidate must present a positive identification with a signature and a photograph (e.g., driver's license, passport, etc.). If a photo ID is not available, the candidate must present two forms of identification with a signature, with at least one form containing a physical description (height, weight, hair color, eye color, etc.). Each candidate will be required to sign in at the examination center. A candidate who does not present positive identification or who refuses will not be permitted to write the examination.

For examinations offered by computer-based testing, each candidate must present a valid government-issued photo identification that includes the candidate's signature (details are available on The Institutes website for exams for the two online courses).

Candidates should arrive at the examination center at least 30 minutes before the scheduled exam time. Candidates may not leave until two hours after the start of the examination. For Exams MAS-I, MAS-II, and 5 through 9, candidates may not leave during the last 15 minutes of the examination.

Conduct of Examinations

The examinations are recorded exclusively in writing (except for exams that are administered by computer-based testing). Except as is noted in the following paragraphs, no books, papers, typewriters, slide rules, laptops, or electronic or mechanical aids for computation of any kind may be brought into the examination room by candidates, nor may any candidate communicate with, or obtain any assistance from, any other candidate during the examination. Candidates must respond to constructed-response test items (essay questions) in English unless advance notice is given (see Languages other than English under Examination Rules—Registration). Examination answer sheets are not returned to candidates.

For Exams MAS-I, MAS-II, and 5 through 9, a candidate wishing to obtain his or her own examination booklet and scrap paper subsequent to the examination must bring a self-addressed stamped envelope to the examination center. (No inter-office mailing is acceptable.) The recommended minimum postage is $2.87 for domestic mail in the U.S.

For Exams MAS-I, MAS-II, and 5 through 9, approximately one week after all exams have been completed, the exam will be posted on the Exams section of the CAS website.

Calculators for Exams MAS-I, MAS-II, and 5 through 9

Electronic calculators will be allowed in the examination room for Exams MAS-I, MAS-II, and 5 through 9. Only the calculators listed below may be brought into the examination room; slide rules, laptops, or other electronic or mechanical aids for computation of any kind may not be brought into the examination room.

Candidates may use the battery- or solar-powered models of the following Texas Instruments calculators:

BA-35	TI-30Xa
BA II Plus	TI-30X II (IIS solar or IIB battery)
BA II Plus Professional	TI-30XS MultiView (or XB battery)

Candidates may use more than one of the approved calculators during the examination. **For those using the BA II Plus, BA II Plus Professional, TI-30X II (IIS solar or IIB battery) or TI-30XS MultiView (or XB battery) models, candidates will be required to show examination proctors that the memory has been cleared prior to the start of the examination. For the BA II Plus and BA II Plus Professional, clearing will reset the calculator to the factory default settings.**

Calculator instructions cannot be brought into the examination room. During the examination, the calculator must be removed from its carrying case so the proctor can confirm it is an approved model. **Any unauthorized calculator brought to the examination center will be confiscated for the duration of the examination. Candidates using a calculator other than the approved models will be subject to examination disqualification and other disciplinary action.**

Candidates may purchase calculators from stores or directly from Texas Instruments: telephone: (800) 842-2737 [1-800-TI-CARES]; website: http://www.ti.com.

It is the candidate's responsibility to see that the calculator used during the examination is in good working order. Spare calculators are no longer being provided to exam centers. Candidates will be expected to provide their own working calculator(s).

Earplugs for Exams MAS-I, MAS-II, and 5 through 9

Simple foam earplugs are allowed and must be checked-in with the supervisor upon entrance to the exam. The ability to hear all verbal instructions, including exam start and stop times is the responsibility of the candidates, regardless of the use of earplugs.

Reading Period for Exams MAS-I, MAS-II, and 5 through 9

Prior to the start of the examinations administered by the CAS, there will be a reading period in which the candidate can silently read the questions and check the examination booklet for missing or defective pages. Writing will NOT be permitted during this time and candidates will not be permitted to hold pens or pencils or be allowed to use calculators. The reading period will be 15 minutes for Exams MAS-I, MAS-II, 5, 6C, 6U, 7, 8, and 9.

Examination Discipline

Candidates must not give or receive assistance of any kind during the examination. Any cheating, attempt to cheat, assisting others to cheat, participating therein, or engaging in improper conduct such as noted in the CAS Examination Discipline Policy is a serious violation and will result in the CAS disqualifying the candidate's exam and additional consequences determined by the vice president-admissions. This may include a temporary or permanent ban from sitting for CAS Examinations. Members of the CAS are also subject to the CAS investigative and discipline process, such as through the Actuarial Board for Counseling and Discipline (ABCD) or the Canadian Institute of Actuaries (CIA), for any violations of the CAS Code of Professional Conduct. Candidates have agreed in their applications for examination to be bound by the rules and regulations governing the examinations.

Examples of improper conduct include but are not limited to:

1. **Improperly obtaining or providing examination questions before the examination or aiding someone else to do so.**
2. Using an unauthorized calculator (as defined in the *Syllabus*) or other mechanical aid that is not permitted.
3. Looking in the examination envelope before the instruction to begin is given.
4. Marking or otherwise writing on the examination booklet or answer sheet before the instruction to begin is given.
5. Making any changes, additions, deletions, or otherwise marking, erasing, or writing on the examination booklet or answer sheet after the time for the examination has expired.
6. Having access to or consulting notes, books **or other unauthorized materials or devices** during the examination.
7. Looking at or copying from another candidate's paper.
8. Enabling another candidate to copy from one's paper.
9. Talking or otherwise communicating with another candidate during the examination.
10. Disturbing other candidates during the examination.
11. **Consulting other persons during the examination**.
12. **Copying questions, answers, or answer choices to take from the examination.**
13. Taking an examination booklet from the examination room.
14. Taking an examination for another candidate.
15. Arranging to have another person take an examination for the candidate.
16. Threatening or physically or verbally abusing a supervisor or proctor responsible for curbing or reporting improper conduct.

17. **Disclosing the contents of an examination to any other person without authorization from CAS**.

18. Presenting false information on an examination application.

19. Failing to remain in the examination room for a minimum of two hours during the examination (for examinations with this requirement).

20. Failing to follow other examination instructions.

21. Accessing or using a communication device (PDA, cell phone, tablet, etc.) during the exam or while at the exam site.

22. **Interfering with the operation of CAS network system, examination platform, or server, including but not limited to accessing or attempting to access examination results through unauthorized means before the official release of results by the CAS.**

23. **Conducting or engaging in any other improper activities that affects the integrity of CAS examinations as determined by CAS.**

The CAS Syllabus & Examination Committee, or its designee, will investigate any irregularity or suspected violation of the rules involving the examination process, and a determination will be made regarding the matter. Where there is a determination to invoke a penalty, the candidate is advised by letter. In the case of a candidate who is a member of the CAS, the candidate's conduct will be reported to the Actuarial Board for Counseling and Discipline (ABCD) or to the Canadian Institute of Actuaries (CIA) if the final penalty invoked is more than disqualification of the examination.

Candidates for the CAS Examinations are expected to follow the rules and procedures included in this *Syllabus*, the Instructions to Candidates printed on their examination booklets, and announcements made by the supervisors at the examination locations. All candidates, on their applications for examinations, are required to read and sign the following statement: "I have read the rules and regulations concerning the examination(s) for which I am applying and agree to be bound by them. I also agree that the results of any examination(s) which I take, and any action taken as a result of my conduct may, at the sole discretion of the Casualty Actuarial Society, be disclosed to any other bona fide actuarial organization that has a legitimate interest in such results and/or actions."

Any dispute or controversy arising under or in connection with the CAS Examination Discipline Policy shall be settled exclusively by arbitration to be held in the Commonwealth of Virginia in accordance with the rules of the American Arbitration Association then in effect. Judgment may be entered on the arbitrator's award in any court having jurisdiction.

The CAS may, at its sole discretion, disclose to any other bona fide actuarial organization having a legitimate interest, information on the identity of candidates determined to have committed a serious examination violation (those for which the penalty is greater than the simple disqualification/nullification of the examination), and the specific penalties imposed on those candidates.

If an actuarial organization with which the CAS has a working relationship (such as the Society of Actuaries) invokes a penalty against a candidate for improper conduct during an examination for which the CAS is not a joint sponsor, the CAS will invoke the same penalty for all CAS-sponsored examinations. If the CAS takes any disciplinary action, it will notify the other actuarial organizations of that action.

These standards may seem stricter than those which candidates are accustomed to in other examination environments. The CAS maintains these strict standards because the examinations are such a significant part of a candidate's career. Therefore, the equitable administration of the examinations and enforcement of the highest standards of conduct cannot be emphasized too strongly.

The CAS Rules of Procedure for Disciplinary Action Involving Candidates is available on the CAS website.

Discipline for Computer-Based Testing

The Policy on Examination Discipline is the same for those taking exams by computer-based testing or in the traditional paper-and-pencil format.

The rules for the CBT administration for Online Courses 1/CA1 and 2/CA2 are available on The Institutes website (http://www.aicpcu.org/). If there is a discrepancy between specific rules for the traditional paper-and-pencil exam administration and computer-based testing administered by The Institutes, the computer-based testing rules will govern.

Multiple-Choice Questions

Exams MAS-I and MAS-II consist entirely of multiple-choice questions; other CAS examinations may have a section of multiple-choice questions. Each multiple-choice problem includes five answer choices identified by the letters A, B, C, D, and E, only one of which is correct. A separate answer sheet provides a row of five ovals for each problem, identified with the letters A, B, C, D, and E, corresponding to the five answer choices. After deciding which answer is correct, candidates should blacken the oval that has the same letter as the appropriate answer. Since the answer sheets are scored by optical scanning equipment, a Number 2 pencil must be used to blacken the ovals. It is important that only one oval be blackened for each question.

Exams for the two online courses will consist entirely of multiple-choice questions. Each multiple-choice problem includes four answer choices identified by the letters A, B, C, and D, only one of which is correct. For exams administered by computer-based testing, candidates should click on the appropriate answer. For all other exams, a separate answer sheet provides a row of four ovals for each problem, identified with the letters A, B, C, and D, corresponding to the four answer choices. After deciding which answer is correct, candidates should blacken the oval that has the same letter as the appropriate answer. Since the answer sheets are scored by optical scanning equipment, a Number 2 pencil must be used to blacken the ovals. It is important that only one oval be blackened for each question.

Guessing Adjustment

For the exams for Online Courses 1/CA1 and 2/CA2, no guessing adjustment are made to candidates' scores. Therefore, candidates will maximize their scores on these examinations by answering every question. On Exams MAS-I, MAS-II, and 5 through 9, multiple-choice questions are scored in such a way that there is no advantage or disadvantage to be anticipated from guessing answers in a purely random fashion as compared with omitting the answers entirely. No additional points will be given for multiple-choice questions left blank, but one-quarter of the point value for each question will be deducted for each incorrect answer.

Constructed-Response Test Items

The admissions process is intended to identify candidates that have demonstrated sufficient mastery of the learning objectives to be admitted as members of the CAS. Examinations that provide a means for better-prepared candidates to demonstrate that mastery are critical to meeting that objective.

Educators often refer to a tool called Bloom's Taxonomy to classify questions into six cognitive levels. Bloom levels range from Level 1, broadly characterized as knowledge, to Level 6, characterized as evaluation. Lower levels of the taxonomy stress recall of facts and an understanding of main ideas; higher levels within the taxonomy stress synthesis, comparison, and subtlety of understanding.

Bloom levels are as follows:

Level 1: Knowledge—tests the ability of the candidate to recall or remember knowledge or facts

Level 2: Comprehension—requires the candidate to demonstrate comprehension of central concepts through explanation of those concepts

Level 3: Application—measures the candidate's ability to apply ideas and concepts to new situations

Level 4: Analysis—requires the candidate to analyze information by separating material into component parts, including identification of facts and development of inferences with respect to a situation

Level 5: Synthesis—tests the ability of a candidate to synthesize, or combine, concepts or ideas and develop and defend the position resulting from that combination

Level 6: Evaluation—requires the candidate to support conclusions by evaluating the validity of ideas and concepts

Generally, questions at higher Bloom levels will have higher associated point values. As a result, examinations with more questions at higher Bloom levels will contain fewer questions, which may result in less syllabus coverage on a particular exam.

Lost Examinations

The CAS—or its designee—is not responsible for lost or destroyed examinations. In the case where an examination is lost or destroyed, the examination fee will be refunded. The CAS and its designees will assume no other obligation and candidates must take the examinations with this knowledge. For Online Courses 1/CA1 and 2/CA2 that are administered by The Institutes, the policy of The Institutes will apply.

C. Grades and Accreditation

CAS Examination Processing

Computer-based tests – Online Courses 1 and 2 – are administered and scored according to computer-based testing methodologies. Although the multiple-choice exams that are administered exclusively by paper-and-pencil – MAS-I and MAS-II – have a process that is similar to the description below, this section and the next, Grading of Examinations: A Timeline, provide details about CAS-specific Exams 5 through 9.

Examination papers where applicable are sent to the CAS Office upon completion of the examination. The CAS Office prepares the examinations for the grading process. The next business day following the administration of all examinations, the examinations will be posted on the Exams page of the CAS website. This is intended to assist candidates and the CAS Syllabus & Examination Committee in determining whether they believe a question is ambiguous or defective.

Grading of Examinations: A Timeline

Week 1

After the examinations are administered, proctors return the exam packages to the CAS Office. Staff members log in each exam. Signatures are verified, and the candidate numbers are checked against the proctor's report. As each envelope is opened, the candidate's number must be checked against the number on the short answer card (both the written number and the coded number) and on all the essay sheets. The short answer cards are prepared for scanning and the essay sheets for all the candidates must be sorted so that individual questions can be copied for the graders.

Week 2

Constructed response (essay) question responses are sent to a vendor to be reproduced. Short answer cards are scanned twice, and output is compared to ensure accuracy. Random checks are made of each series of cards to ensure that the scanner is working properly. When the essay sheet copies are received, copies of candidate responses are sent to the individual graders. Any comments on potentially ambiguous or defective questions are forwarded to the graders, exam part chair, and the general officer of the exam series for review.

Weeks 3 and 4

Committee members review candidate comments about possibly ambiguous or defective questions and decide how they will be handled in the grading process. Discussions on the best course of action are often a very time-consuming part of the grading process.

Copies of responses to each constructed-response test item on the exam are sent to two graders. Some graders are given more than one question to grade. There can be 500 to more than 1,000 answer sheets for each grader to evaluate for a single question. A suggested answer key exists for each question, but alternative solutions may be correct, and the graders must be open to different approaches to a problem. About two-dozen responses are graded and then the results are compared. The grading partners will establish a consistent grading rubric and then evaluate the solution key. Consistency and accuracy are the most important factors in grading the responses. Each grader prepares a computer file with each candidate's number and the score for each question.

Week 5

The part chair holds the grading session with the graders. The first step is running the data through a standard grading program, verifying the data, and noting any significant discrepancies. For each candidate

and each question, the scores of each grading partner must be within a prescribed tolerance. If the scores do not fall within this tolerance, the partners must discuss the candidate's answer sheet and come to a decision on what the point value should be. When all the questions have been reconciled to the required tolerance, the scores are totaled, and a tentative pass score is selected based on the pass mark panel's recommendation, various statistics, and guidelines.

This triggers the second round of reconciliation. Candidates who have scores within a certain number of points from the tentative pass score will have all of their answers reconciled completely. This gives an exact score for any candidate near the passing score. The scores for any candidates who are close to passing will be checked manually as well. The committee members will then look at the statistics one more time and make a final recommendation for the passing score.

Weeks 6 and 7

After the grading session, the part chair will create and submit a report to the general officer of the exam series, the CAS Syllabus & Examination Committee chairperson, and the vice president–admissions. In the report, the part chair recommends a passing score, gives a detailed analysis of the exam, and notes any unusual questions or situations that required special handling. The chairperson and general officer hold a teleconference with the vice president-admissions and a representative from the Canadian Institute of Actuaries (except for Exam 6-US) to discuss all of the exams from the series and to finalize the passing scores.

Week 8

After the vice president–admissions and a representative from the Canadian Institute of Actuaries (except for Exam 6-US) have approved the passing score the data is verified and released to the CAS Office to update each candidate's record. Candidates will be notified by e-mail when their exam results have been uploaded to their profile. Candidates can access their exam results by logging into their My Exams page within their profile on the CAS website.

Determination of the Pass Mark

The goal of the examination system of the CAS is to pass all candidates who have demonstrated adequate knowledge of the syllabus and to fail those candidates who have not. The objective of the examinations is to evaluate candidate performance using criteria for demonstrating adequate knowledge that remain constant throughout the lifetime of the exam series. Pre-set pass marks, e.g., a candidate will pass if he or she answers x percent of the questions correctly, are counter to this philosophy. The examinations are meant to measure the candidate's level of achievement of the required learning objectives and their required level of capability of accomplishing specified learning outcomes.

Multiple-Choice Test Items

As part of the input to the pass mark determination process for the multiple-choice exams that are not offered by computer-based testing, a modified Angoff passing score study is performed where a panel of experts in the subject material is convened to review the examination. This is a common testing and measurement technique. Each expert is asked to review each question in the examination and assess the difficulty of that question. More specifically, they are asked to estimate the likelihood that a candidate with minimum adequate knowledge competency would answer the question correctly. The sum of these probabilities, averaged across the panel of experts, gives a preliminary estimate of the pass mark.

The estimated pass mark resulting from the modified Angoff passing score study is compared to and balanced with the actual performance statistics on the exam in finalizing the pass mark. The effects of any particularly difficult questions are also factored into the determination of the final pass mark.

Computer-based tests are administered and scored according to computer-based testing methodologies.

Constructed-Response Test Items

For CAS examinations consisting in whole or in part of constructed-response test items (written-answer or essay questions), the assessment process is somewhat different. Before the exam is administered, a pass mark panel reviews the exam and assesses it based on how the panelists think a minimally qualified candidate will perform based on a predetermined definition of the minimally qualified candidate. This process follows the same basic technique used for multiple-choice exams as described above. Based on this assessment, an expected pass mark is set.

Following the administration of each exam, responses to each constructed-response test item are graded simultaneously by two graders who must reconcile their grading rubrics and grades. When all responses have been scored, the Examination Part Committee chooses a preliminary pass mark based on the results of the pass mark panel augmented by actual performance of the current candidates versus historical performance of previous candidate cohorts. Candidate papers with scores close to the preliminary pass mark are re-graded to ensure correct and consistent scoring.

The Examination Part Committee then determines the tentative pass mark by again balancing actual performance statistics against minimum adequate knowledge while taking into account other factors such as time pressure situations that may have occurred on some questions. Because the level of difficulty for each examination may vary from year to year, each Examination Part Committee collects extensive data to ascertain the level of difficulty of its examination. The Examination Part Committee compares the performance of the present year's candidates to the performance of candidates from prior years. Appropriate recognition is given to any peculiarities that may appear in connection with the answers to any question on an examination despite all the care taken in setting the examination questions.

With the use of content-based pass marks, fluctuation in the pass rate from session to session is expected. Although the percentage of candidates passing will vary from year to year, those candidates demonstrating the required level of competence with the material will pass.

Final Pass Mark

A recommended pass mark is reached by consultation among the examination part chairperson, the general officer overseeing that examination, and the CAS Syllabus & Examination Committee chairperson. Any significant deviations from the à priori pass mark set by the pass mark panel are explored at this time. The recommended pass mark and explanations for deviations from the à priori pass mark are submitted to the vice president–admissions who approves the final pass mark. As an informational item, the final exam statistics are forwarded to the CAS Executive Council and CAS Board of Directors.

After the pass mark is finalized, each candidate is assigned a score. Scores of 0 to 5 are assigned to candidates who do not pass. On this scale, each interval is 10 percent of the pass mark. For example, a grade of 5 equates to a candidate's score of at least 90 percent, but less than 100 percent, of the pass mark. A grade of 0 means that the candidate's score is less than 50 percent of the pass mark. Candidates at or above the passing mark will receive a score of 6 to 10. Historic passing numeric scores will not be provided.

The CAS releases the pass scores for Exams MAS-I, MAS-II, and 5 through 9 after the appeals deadline for the specific exam session. They are available from the Past Exams and Pass Marks page of the CAS website. The purpose of releasing the pass scores is to help candidates prepare for future exam sittings. The 75th and 95th percentile scores are also released for each exam. These two key statistics indicate the performance level achieved by the better-prepared candidates on the exam. Raw scores are not provided to candidates.

Examination Results

Exams MAS-I, MAS-II, and 5 through 9

Examination results are available approximately eight to nine weeks after the examination date. After exam results are received from the CAS Syllabus & Examination Committee at the CAS Office, candidates will be notified by e-mail that their exam results have been uploaded to their profile. Candidates can only access their exam results by logging into their My Exams page within their profile on the CAS website. Candidates will be apprised of their scores – 0 to 5 for those who did not pass the exam and 6 to 10 for those who passed the exam. Exam results are no longer mailed to candidates.

Candidates for Exams MAS-I, MAS-II, and 5 through 9 who did not pass will automatically be sent an analysis of their examination. The analysis of an examination is computer-generated. Actual points received for multiple-choice questions will be displayed. For constructed-response test items, ranges will be given for the actual score. This information is intended to provide the educational guidance that most candidates desire. The exam analyses will not reflect any changes made resulting from appeals.

To preserve candidate confidentiality, in the event of a lost or misplaced candidate ID number, the candidate ID number will be mailed to the candidate upon request. Under no circumstance will a candidate number be given out over the telephone or by e-mail. Candidates can also verify their candidate number by logging into their profile on the CAS website.

Online Courses 1 and 2

The exams for Online Courses 1 and 2 are offered by computer-based testing. An unofficial pass/fail result will be displayed on the computer screen at the conclusion of the exam. When the official grades have been processed, candidates will receive an e-mail from The Institutes stating that their grades are available. Candidates may then log into their account on The Institutes website (http://www.TheInstitutes.org) to access their grades. The grade report for each candidate will show the candidate's overall score on the exam in ten-point increments (e.g., 60 to 69%, 70 to 79%, and so on). It will similarly show the candidate's performance by assignment using those same ten-point increments. Numeric scores are not released. Once final grades have been released, The Institutes will send a copy of the grades directly to the CAS Office to be added to the candidates' admissions records. **The Institutes sends this information to the CAS several weeks following the closing of the testing window. The CAS will post the list of passing names approximately two weeks later.**

Ambiguous or Defective Questions

For Exams 1, 2, and 3F, the candidate should follow the procedural rules of the sponsoring organizations.

Online Courses 1 and 2

If a candidate believes a question is ambiguous or defective, he or she should bring this to the attention of The Institutes **in writing** within two weeks after the examination was administered. The candidate must submit this correspondence to The Institutes for the two online courses. The correspondence should include detailed reasons why the question is believed to be ambiguous or defective. The Institutes will investigate all questions brought to its attention.

A copy of the correspondence to The Institutes should be sent to the CAS Syllabus & Examination Committee at defective-item@casact.org.

Exams MAS-I, MAS-II, and 5 through 9

The committee compiles and monitors various statistics for the questions it puts on the exams. These statistics often help to uncover potential defects, wording issues, or ambiguities. However, if a candidate believes that a multiple-choice or constructed-response test item is ambiguous or defective, he or she should bring this to the attention of the CAS Syllabus & Examination Committee in writing within two weeks after the examination date. In order to aid the candidate, preliminary answer keys for multiple-choice questions will be available the week following the examinations. The candidate may submit comments to the CAS Office by mail, fax, or e-mail at defective-item@casact.org. The correspondence should include detailed reasons why the question is believed to be ambiguous or defective. The CAS Syllabus & Examination Committee will investigate all questions brought to its attention in writing. To be considered in the grading process, correspondence must reach the CAS Office **within two weeks of the date that the exam was administered**. The decision of the CAS Syllabus & Examination Committee chairperson is final. Items judged to be defective will be identified within the Examiner's Report for Exams 5 through 9 and within the final posted grading key for Exams MAS-I and MAS-II.

Any question found to be defective is carefully examined to determine the most reasonable way to correct the situation. In some cases, the question is discarded, with scores and the determination of the pass mark, as they would have been if the defective question had not been asked. In some cases, more than one answer may be given credit for being correct. In some cases, an exam may be graded both including and excluding the defective question, with two different pass marks considered, with the universe of candidates that would have passed under either of the two versions all considered as passing the exam.

No investigation of ambiguous or defective questions will be considered after these deadlines.

Appeals for Exams MAS-I, MAS-II, and 5 through 9

Multiple-Choice Questions

After grades are released, the only appeal permitted on multiple-choice questions will be to request an administrative check of the candidate's short answer card to verify that the card reader scanned the card correctly and that the output file reflected this data. This request must be made within three weeks after the candidates are notified that their exam results have been uploaded to their profile by mail, fax, or e-mail at appeals@casact.org.

Constructed-Response Test Items

For the constructed-response test items, appeals must reach the CAS Office not later than 2 weeks after the publication of the Examiner's Report for the specific exam. The Examiner's Report will be published to the CAS website as soon as possible after releasing exam results and candidates registered for the respective exam will be alerted by e-mail when this occurs. The candidate may submit his or her appeals to the CAS Office by mail, fax, or e-mail at appeals@casact.org.

If the candidate believes that there is a correct solution that is not contained in the Examiner's Report, the candidate must provide this alternative solution and specific reasoning in support of this claim with their appeal. With this information, the CAS Syllabus & Examination Committee can research the answer properly and reply to the candidate. An example of an invalid appeal would be the following: "I am appealing my score of 5 on Exam 9, please recheck my examination." Another example of an invalid appeal would be: "On question number 2, I believe I should get full credit because I answered the following…" An example of a valid appeal would take the form: "On question 5, a correct answer that does not appear amongst the sample answers in the Examiner's Report is the following…"

The examination part chairperson reviews each valid appeal and makes a recommendation to the CAS Syllabus & Examination Committee chairperson. The examination part chairperson and the CAS Syllabus & Examination Committee chairperson then jointly decide for each valid appeal whether or not the alternative solution provided is indeed a solution that is worthy of credit but was not given credit at the time of grading. Please note that each valid appeal is reviewed and decided upon without reviewing the actual exam paper of the candidate who appealed; candidates should understand this when submitting appeals and ensure the argument in the appeal itself is self-contained, without referencing the candidate's actual exam paper.

Note the Examiner's Reports do not necessarily contain all solutions for which credit was given, e.g., a solution that was rarely used by candidates and considered inferior to other solutions may be awarded credit but excluded from the Examiner's Report to make the document more efficient and effective for candidates using the report to study for future exams. Therefore, an appeal may properly provide a correct alternative answer that was not included in the Examiner's Report but would have received credit in the grading process. Such appeals would not result in any review of exam papers.

In some cases, the Examiner's Report may be adjusted as a result of the appeals process, either to include additional solutions that were identified or additional explanation concerning items that were not awarded credit. Such adjustments are not made for every appeal, however, as the intent of the Examiner's Report is to educate candidates on the most common responses and not on every single response.

In those instances where an appeal identifies a solution that is worthy of credit but that was not awarded credit during the grading process, a subset of exam papers is re-graded. That subset would only include the exam papers of candidates who were close enough to the pass mark such that the points in question for the item appealed can potentially change the grade from fail to pass. Any candidates whose grades change from fail to pass as a result of such appeals would be contacted directly by the CAS Syllabus & Examination Committee chairperson with this information. No points are ever deducted from a candidate's score as a result of an appeal. The CAS does not adjust failing scores for candidates who receive additional credit due to an appeal but for which the additional points did not change their grade from fail to pass.

Responses from the CAS Syllabus & Examination Committee chairperson are e-mailed by the CAS Office to all candidates that submit valid appeals with the decision on each appeal, in terms of whether or not the solution presented was worthy of credit, whether or not credit was given for such a solution during the grading process, and whether or not any papers were re-graded as a result of the appeal. These responses will typically be provided within four to eight weeks from the closing of the appeals window. Note that such responses will not include explanations as to why credit was not awarded for the solution presented, as this is not intended to be an educational exercise. **The decision of the CAS Syllabus & Examination Committee chairperson is final**.

No appeals will be considered after the deadlines.

Confidentiality of Examination Records

The fact that a candidate has passed a particular examination is considered public knowledge. Any further information as to examinations taken by candidates and scores received by candidates is available only to the candidates themselves, to CAS Syllabus & Examination Committee officials if required for committee purposes, and to the CAS Office, unless the candidate requests in writing that such information be provided to someone else. However, if any action is taken against a candidate as a result of his or her conduct (as described in the section on Examination Discipline), the Casualty Actuarial Society, at its sole discretion, may disclose such information to any other bona fide actuarial organization that has a legitimate interest in such results and/or actions. The candidate authorizes and consents to the Society using and disclosing (including, but not limited to, disclosing to the third-party contractors and service-providers of the Society) personally identifiable information about the candidate as necessary and appropriate for the purposes of registering the candidate for the exam, conducting the exam, determining the results of the exam, and communicating with the candidate regarding the results of the exam.

Transition Programs

The CAS generally reviews and makes revisions to the study material on an annual basis. Occasionally, a major topic will be added to or deleted from the syllabus. A major topic is defined as a series of learning objectives comprising a segment of an examination. When a major topic is added, the CAS Syllabus & Examination Committee will determine if a transition program is appropriate. A transition program is generally appropriate when candidates are in a position to lose credit for a segment of an examination.

A transition program usually will provide candidates with at least two opportunities to complete the requirements for that examination. The completion of the requirements will result in the achievement of credit for that entire examination. The failure to fulfill the requirements for that complete examination could result in the expiration of credit for that deleted topic at the end of the transition period. The CAS Board of Directors must approve any transition program.

Current Education Structure

No transition rules are available at this time for the current education structure.

Older Transition Rules Applicable to the Current Education Structure

1. The CAS Board of Directors approved the following transition rules for the education structure that was implemented in January 2018**.**

   To receive credit for the new Exam Modern Actuarial Statistics-I (MAS-I), the candidate must have credit for Exam S–Statistics and Probabilistic Models by January 1, 2018. To receive credit for the new Exam Modern Actuarial Statistics-II (MAS-II), the candidate must have credit for Exam 4–Construction and Evaluation of Actuarial Models by July 1, 2018. If the candidate has not completed Exam S and Exam 4 by these dates, the candidate will need to pass both Exams MAS-I and MAS-II.

Candidate Credit		**Candidate Credit under Examination Structure Implemented in January 2018**		
Exam S by 1/1/2018*	**Exam 4 by 7/1/2018****	**Exam MAS-I**	**Exam MAS-II**	**Action Required to Earn Credit for new Exams MAS-I and MAS-II**
x	x	x	x	Credit granted. No candidate action required.
x		x		Complete Exam 4 examination requirement by 7/1/2018 or pass Exam MAS-II.
	x		x	Pass Exam S before 1/1/2018 or pass Exam MAS-I.
				Candidate must pass both Exam MAS-I and Exam MAS-II.

* Credit for Exam S must be achieved through an examination administered prior to January 1, 2018.

** Credit for Exam 4 must be achieved through an examination administered prior to July 1, 2018 or through course work completed by 12/31/2018 under the CIA's University Accreditation Program. See Waiver of Examinations Rules for the various ways a candidate can be granted a waiver by the CAS for its Exam 4 examination requirement.

The CAS has approved the following transitional waiver policies for examinations sponsored by the Institute and Faculty of Actuaries (United Kingdom), Actuaries Institute (Australia), Actuarial Society of South Africa (ASSA), and the Institute of Actuaries of India. Credit will be granted for examinations passed or waived in accordance with examination equivalencies between the CAS Syllabus and the syllabi of each of the aforementioned actuarial organizations. The CAS will not grant credit for examinations waived on account of academic records achieved in U.S. universities.

- If a candidate has passed all three Exams CT4, CT5, and CT6 or A202, A203, and A204 by 8/31/2016, they will receive credit for CAS Exam S and subsequently CAS Exam MAS-I. See #1 under Older Transition Rules Applicable to the Current Education Structure below for additional details.
- If a candidate has passed both Exams CT4 and CT6 or A202 and A204 by 7/1/2018, they will receive credit for CAS Exam 4 and subsequently CAS Exam MAS-II.

2. The CAS Board of Directors approved the following transition rules for the education structure that was implemented in July 2018**.**

Credit Prior to July 1, 2018	**Credit in Education Structure Implemented in July 2018**
VEE-Corporate Finance	VEE-Accounting and Finance
VEE-Economics	VEE-Economics

3. The CAS Board of Directors approved the following transition rule for the education structure that was implemented in July 2018**.**

Credit Prior to July 1, 2018	**Credit in Education Structure Implemented in July 2018**
Exam 3F - Models for Financial Economics	Exam 3F - Financial Economics

4. The CAS Board of Directors approved the following transition rules for the education structure that was implemented in the Fall of 2015.

   To receive credit for the new Exam S on Statistics and Probabilistic Models during the transition, the candidate must have credit for Exams ST and LC† and the VEE-Applied Statistical Methods educational requirement.

   At the time of transition, if a candidate has credit for either Exam ST or Exam LC, but not both, the candidate will be allowed to take just the exam for which he or she is missing credit in order to obtain partial credit for the new exam. This option will be available for a transition period of two sittings, i.e., Fall 2015 and Spring 2016.

Credit for the VEE-Applied Statistical Methods educational requirement will also be accepted for those candidates who complete it by August 31, 2016. If the candidate has not completed Exam ST, Exam LC, and the VEE-Applied Statistical Methods educational requirement by this date, the candidate will need to pass the full version of Exam S to receive credit.

Candidates with credit for neither Exam ST nor Exam LC on August 31, 2015 will not be permitted to sit for Exam ST or Exam LC during the transition period and will need to pass the full version of Exam S to receive credit.

The following table summarizes the above:

Candidate Credit on August 31, 2015			**Action Required by August 31, 2016 to Earn Credit for new Exam S**
Exam ST	**Exam LC**	**VEE-Applied Statistical Methods**	
x	x	x	Credit granted. No candidate action required.
x	x		Complete VEE-Applied Statistical Methods.
x		x	Pass Exam LC.
x			Pass Exam LC and complete VEE-Applied Statistical Methods.
	x	x	Pass Exam ST.
	x		Pass Exam ST and complete VEE-Applied Statistical Methods.
		x	Candidate must take full version of Exam S.
			Candidate must take full version of Exam S.

[†]The CAS has also granted waivers for Exam LC to candidates who have:

- Passed SOA Exam MLC;
- Passed the Institute and Faculty of Actuaries (U.K.), Actuaries Institute (Australia), or Institute of Actuaries of India Subject CT5; or
- Passed the Actuarial Society of South Africa Course A203; or
- Received a waiver granted by the Canadian Institute of Actuaries University Accreditation Program.

For those candidates who have credit for Exam ST by August 31, 2015, the CAS will continue to grant the above Exam LC waivers through August 31, 2016.

The CAS has approved the following transitional waiver policy for examinations sponsored by the Institute and Faculty of Actuaries (United Kingdom), Actuaries Institute (Australia), Actuarial Society of South Africa (ASSA), and the Institute of Actuaries of India. Credit will be granted for examinations passed or waived in accordance with examination equivalencies between the CAS Syllabus and the syllabi of each of the aforementioned actuarial organizations. The CAS will not grant credit for examinations waived on account of academic records achieved in U.S. universities.

Candidate Credit on August 31, 2015		**Action Required by August 31, 2016 to Earn Credit for new Exam S**
CT5 or A203	**CT4 and CT6 or A202 and A204**	
x	x	Credit granted. No candidate action required.
x		Pass CT4 and CT6 or A202 and A204.
	x	Pass CT5 or A203.
		Candidate must take full version of Exam S.

5. The CAS Board of Directors approved the following transition rules for the education structure that was implemented in January 2014:

Credit in 2013*	**Credit in Education Structure Implemented in 2014**
Exam 3L	Exams LC and ST
SOA Exam MLC	Exams LC and ST

***Note:** Credit for Exam 3L or SOA Exam MLC must have been achieved through an examination administered prior to January 2014.

In addition, the CAS Board of Directors approved the following waiver that will continue beyond January 2014:

Credit	**Credit in Education Structure Implemented in 2014**
SOA Exam MLC	Exam LC

6. The CAS Board of Directors approved the following transition rules for the education structure that was implemented in January 2011:

Credit in 2010	Credit in Education Structure Implemented in 2011
Exam 5	Half of Exam 5 (section on Basic Techniques for Ratemaking)* and Online Course 1
Exam 6	Half of Exam 5 (section on Estimating Claim Liabilities)* and Exam 7 on Estimation of Policy Liabilities, Insurance Company Valuation, and Enterprise Risk Management
Exam 7	Nation-specific Exam 6 on Regulation and Financial Reporting and Online Course 2
Exam 8	Exam 9 on Financial Risk and Rate of Return
Exam 9	Exam 8 on Advanced Ratemaking

***Note:** To receive credit for the new Exam 5 on Basic Techniques for Ratemaking and Estimating Claim Liabilities, the candidate must have credit for both old Exams 5 and 6. At the time of transition, if a candidate has credit for only one of the required exams (either old Exam 5 or Exam 6), the candidate will be allowed to take just the part of the exam for which he or she is missing credit (i.e., either the Basic Techniques for Ratemaking section or the Estimating Claim Liabilities section of the new exam) in order to obtain credit for the new exam. This option will be available for a transition period of two sittings after the official conversion to the new education structure (i.e., May 2011 and May 2012). If the candidate does not have credit for both halves of Exam 5 at the end of the transition period, the candidate would have to pass the full version of Exam 5 to receive credit.

7. The CAS Board of Directors approved the following transition rule for the revision to Exam 3 that was implemented in January 2008:

Credit in 2007	Credit in Education Structure Implemented in 2008
Exam 3	Exams 3F and 3L

8. The CAS Board of Directors approved the following transition rules for the revised education structure that was implemented in January 2005:

Credit in 2004	Credit in Education Structure Implemented in 2005
Exam 1	Exam 1
Exam 2	Exam 2, VEE-Economics, VEE-Corporate Finance
Exam 3	Exam 3 [Exams 3F and 3L]
Exam 4	Exam 4, VEE-Applied Statistical Methods

9. The following rules apply for candidates with unused credit from exams administered prior to 2000:

Pre-2000 Credit	Credit in Education Structure Implemented in 2014
Exam 2 (Probability & Statistics) and Exam 4B (Credibility Theory and Loss Distributions)	Exam ST

Pre-2000 Credit	Credit in Education Structure Implemented in 2011
Exam 3B	Online Course 1

Pre-2000 Credit	Credit in Education Structure Implemented in 2005
Exam 3A	VEE-Applied Statistical Methods
Exam 4A	Exam 2
Exam 4B	Exam 4
Exam 5A	VEE-Economics
Exam 5B	VEE-Corporate Finance

CAS Course on Professionalism

The CAS Course on Professionalism is designed to present candidates with real situations that contain ethical and professional issues for the actuary. Volunteer members of the CAS facilitate small group discussions of actual case studies. Although grades are not given for the course, candidates must actively participate in order to receive credit. Successful completion of this course is required before a candidate can become a member of the Casualty Actuarial Society.

Candidates are urged to register for this course as soon as they are eligible. To be eligible for the CAS Course on Professionalism, the candidate should refer to the CAS website:

- For the US/Canada Course on Professionalism - http://www.casact.org/admissions/index.cfm?fa=cop
- For the Asia Course on Professionalism - http://www.casact.org/admissions/index.cfm?fa=cop-asia

Dates for the course will be posted in the CAS Course on Professionalism page of the CAS website (http://www.casact.org/education/index.cfm?fa=prof). Each course has a limited number of participants; early registration is recommended. Facility information and course times are provided when registration for specific courses is announced.

CAS Membership Requirements

Associateship

Candidates for Associateship in the Casualty Actuarial Society must fulfill the examination requirements by successful completion of, or credit for, Exams 1, 2, 3F, MAS-I, MAS-II, 5, and 6; have credit for Online Courses C1 and C2 (designated CA1 and CA2 by The Institutes); have credit by Validation by Educational Experience (VEE) for the required topics of accounting and finance, and economics; and successful completion of, or credit for, the CAS Course on Professionalism. Exam 6 is nation specific and passage of any one of the CAS-approved nation-specific examinations fulfills the Associateship requirements.

After completing all the prescribed requirements, all prospective Associate members must submit a formal application to the Casualty Actuarial Society. The application form and list of application requirements are available on the CAS website in the Join/Renew section. Candidates must have completed all educational requirements prior to submitting an application for CAS membership.

After all requirements are met and a completed application has been submitted to the CAS, each candidate's application will be reviewed by the CAS staff. Upon approval, the candidate will be admitted as an Associate of the Casualty Actuarial Society (ACAS). Candidates will be notified by letter from the CAS president. Members may indicate their designation as an Associate of the Casualty Actuarial Society by using the initials "ACAS" after their names only after they have received official notification of acceptance as an Associate from the CAS.

Fellowship

In addition to fulfilling all the requirements of Associateship, successful completion of, or credit for, all Fellowship examinations is required to fulfill the requirements for Fellowship and to be designated as a Fellow of the Casualty Actuarial Society (FCAS). Candidates who are admitted to the CAS as Fellows rather than Associates may indicate their designation as a Fellow of the Casualty Actuarial Society by using the initials "FCAS" after their names only after they have **completed the application process as described above under Associateship and have** received official notification of acceptance as a Fellow from the CAS. Associates who complete their Fellowship requirements may use the "FCAS" designation immediately following official notification of successful completion of all the Fellowship requirements as prescribed by the Board of Directors.

CERA Designation Requirements

Candidates for the CERA (Certified Enterprise Risk Analyst) designation must fulfill the educational requirements by successful completion of all CAS Associateship requirements, CAS Exams 7 and 9, the Enterprise Risk Management and Modeling Seminar (specifically designed for the CERA designation), and Exam SP9 of the Institute and Faculty of Actuaries (U.K.).

After completing all the prescribed requirements, all prospective CERA designees must submit a formal application to the Casualty Actuarial Society. The application form will be available in the CERA section of the CAS website (http://www.casact.org/cera/). Candidates must have completed all educational requirements prior to submitting an application for the CERA designation.

After all requirements are met and a completed application has been submitted to the CAS, each candidate is voted on by the CAS Executive Council and then submitted to the international Treaty Board for the CERA Global Credential for approval. Upon approval, the candidate will be granted the CERA designation. CERA designees may indicate their designation by using the initials "CERA" after their names only after they have received official notification from the CAS.

Waiver of Examinations

Basic Education Waiver Policy for Actuarial Examinations

The CAS's **Basic Education Waiver Policy** addresses the extent to which the CAS will grant waivers of its basic education requirements including Exams 1, 2, and 3F; Online Courses 1 and 2; Course on Professionalism; and Validation by Educational Experience requirements, or their equivalents as defined by the Executive Council.

The Board of Directors agrees that an exam waiver should be considered for verified educational accomplishments, e.g., exams or university courses, required by another actuarial organization that substantially meet the learning objectives of a particular CAS exam with reasonably equivalent rigor and level of mastery of the material. The Board agrees that the alternative should not be required to cover every learning objective that is covered in the CAS *Syllabus* for the particular exam in order to consider a waiver and that other learning objectives covered by the alternative may be considered as substitutes.

In addition to actuarial exam requirements, the CAS may grant waivers for other basic education requirements provided that the educational experience is deemed equivalent in subject matter coverage and depth. For example, the CAS may accept a professionalism course offered by another actuarial organization provided that it is deemed equivalent to the CAS Course on Professionalism or the Executive Council provides a supplement to address any significant CAS requirement that may be lacking. Other examples where CAS requirements may be waived include Online Courses or Validation by Educational Experience requirements. In general, the CAS will not grant waivers for its upper-level exams, i.e., Exams 5 through 9.

The CAS will not grant waiver of all or any portion of its examination requirements for work experience or contribution to actuarial literature.

Under this Policy, the granting of waivers by the Executive Council will be based on the recommendation of the vice president-admissions.

Canadian Institute of Actuaries

The CAS recognizes the exam waivers granted by the Canadian Institute of Actuaries University Accreditation Program for CAS Exams 1, 2 and 3F, and under previous education structures for CAS Exam 4 (see below). The CAS will only grant waivers for CIA UAP exam credits that were awarded based on work at universities in Canada. The list of candidates granted waivers by the CIA is provided to the CAS following the end of a semester. The CAS automatically updates its records. No further action is required of candidates.

Note:

- For Exam 1, starting with courses given in summer of 2019, the CIA UAP will recognize courses completed with a minimum grade requirement at many of the 11 accredited universities in Canada.
- Under previous education structures, the CAS recognized the exam waivers for CAS Exams 3L and LC.
- If a candidate has been granted a waiver for CAS Exam 4 under the University Accreditation Program through course work completed by 12/31/2018, then they will receive credit for CAS Exam 4 and subsequently CAS Exam MAS-II.

China Association of Actuaries

The CAS recognizes the preliminary examinations sponsored by the China Association of Actuaries (CAA). **Credit will be granted for examinations passed or waived in accordance with examination equivalencies between the CAS *Syllabus* and the syllabi of the China Association of Actuaries.**

The CAS will not grant credit for examinations waived on account of academic records achieved in U.S. universities, nor for credit granted to candidates not qualifying directly in obtaining membership through the normal qualification/examination process.

Credit will not be given to Fellows of the CAA who have attained their designation through mutual recognition rather than through the organization's standard credentialing process. Fellows by mutual recognition should pursue examination waivers based on their original credentials.

The CAS has approved the following waiver policy:

CAA Exam	Waiver Granted for CAS Exam/Educational Experience
A1	Exam 1
A2	Exam 2
A3	Exam MAS-I
A4	VEE-Economics
A7	VEE-Accounting and Finance

Note: Waivers granted under the previous "cohort" policy will not be revoked.

Institute and Faculty of Actuaries (U.K.), Actuaries Institute (Australia), Actuarial Society of South Africa (ASSA), and Institute of Actuaries of India Examinations

The CAS recognizes some of the examinations sponsored by the Institute and Faculty of Actuaries (United Kingdom), Actuaries Institute (Australia), Actuarial Society of South Africa (ASSA), and the Institute of Actuaries of India. Credit will be granted for examinations passed or waived in accordance with examination equivalencies between the CAS *Syllabus* and the syllabi of each of the aforementioned actuarial organizations.

The CAS will not grant credit for examinations waived on account of academic records achieved in U.S. universities, nor for credit granted to candidates not qualifying directly in obtaining membership through the normal qualification/examination process.

Credit will not be given to Fellows of these actuarial organizations who have attained their designation through mutual recognition rather than through the organization's standard credentialing process. Fellows by mutual recognition should pursue examination waivers based on their original credentials.

The CAS has approved the following waiver policy:

Subject of the Institute and Faculty of Actuaries (U.K.), Actuaries Institute (Australia), and Institute of Actuaries of India	**Subject of the Actuarial Society of South Africa**	**Waiver Granted for CAS Exam/Educational Experience**
CT2	A103	VEE-Accounting and Finance
CT7	A102	VEE-Economics
CT3	A101	Exam 1
CT1	A201	Exam 2
CT8	A205	Exam 3F
CT3, CT4, and CT6 (passed after 9/1/2016)	A101, A202, and A204 (passed after 9/1/2016)	Exam MAS-I

Note: The CAS has approved the following **transitional waiver policies** for examinations sponsored by the Institute and Faculty of Actuaries (United Kingdom), Actuaries Institute (Australia), Actuarial Society of South Africa (ASSA), and the Institute of Actuaries of India. Credit will be granted for examinations passed or waived in accordance with examination equivalencies between the CAS Syllabus and the syllabi of each of the aforementioned actuarial organizations. The CAS will not grant credit for examinations waived on account of academic records achieved in U.S. universities.

- If a candidate has passed all three Exams CT4, CT5, and CT6 or A202, A203, and A204 by 8/31/2016, they will receive credit for CAS Exam S and subsequently CAS Exam MAS-I.
- If a candidate has passed both Exams CT4 and CT6 or A202 and A204 by 7/1/2018, they will receive credit for CAS Exam 4 and subsequently CAS Exam MAS-II.

Society of Actuaries

The CAS recognized the SOA exams listed in the chart below. Candidates who check the "Property and Casualty" field on their preliminary exam application will have the results of their exams automatically updated in the CAS candidate database. Candidates who did not check the "Property and Casualty" field can have their exam results verified and updated in the CAS candidate database by completing the online form.

The CAS recognizes the following exams and the transition rules adopted by the SOA for the changes to their examinations in 2017:

SOA Exam	Waiver Granted for CAS Exam
P (Probability)	1
FM (Financial Mathematics)	2
MFE (Models for Financial Economics)	3F (prior to 7/1/2018)
IFM (Investments and Financial Markets)	3F (after 7/1/2018)
C (Construction of Actuarial Models)	4 (prior to 7/1/2018)

CAS Exam Requirements of SOA Members

An actuary who achieved Fellowship (FSA) or Associateship (ASA) of the SOA by completing the qualification requirements of the SOA, not solely in recognition of membership of another actuarial association, has CAS examination credit for:

Exam 1
Exam 2
Exam 3F
Exam 4 (prior to 7/1/2018)
VEE-Accounting and Finance
VEE-Economics

Therefore, the remaining exams/courses required of an ASA or FSA to achieve ACAS are:

Online Course 1
Online Course 2
Exam MAS-I†
Exam MAS-II††
Exam 5
Exam 6
CAS Course on Professionalism

† If a SOA Member completed SOA Exam MLC and VEE-Applied Statistics prior to 2014, credit for CAS Exam S would be granted under Transition Rules and subsequently Exam MAS-I.
†† If a SOA Member completed SOA Exam C prior to 7/1/2018, they will receive credit for CAS Exam 4 and subsequently Exam MAS-II.

Important Notes:

- The syllabus material covered on CAS Exam 7 is still required in addition to ACAS (with credit for current Exam 6U) to sign a Statement of Actuarial Opinion, NAIC Property and Casualty Annual Statement, in the United States. See https://www.casact.org/press/index.cfm?fa=viewArticle&articleID=4536 for more details.
- At this time, there is no waiver of any other CAS exams based on the SOA's General Insurance (GI) examination process.

Members of Other Actuarial Organizations

For individuals of actuarial organizations that are a member of the International Association of Actuaries (IAA), the CAS will grant waivers for its preliminary examinations/educational requirements as defined by the Executive Council (CAS Exams 1, 2, and 3F, and Validation by Educational Experience requirements) provided that the organization's individual member achieved the highest possible designation in that organization and has been practicing as a professional actuary for at least two years subsequent to obtaining the qualification.

Candidates of Other Actuarial Organizations

Actuarial organizations that are full members of the IAA and have an exam-based admissions requirement may request that the CAS grant waivers to its individual candidates for the CAS preliminary examinations/educational requirements – as a cohort for CAS Exams 1, 2, and 3F, and Validation by Educational Experience requirements – based on credit for their examinations that meet certain IAA requirements. An actuarial organization should contact the CAS Examinations Coordinator for the requirements to obtain this approval. All organization submissions are subject to the approval of the vice president-admissions and Executive Council.

Online Courses and VEE

Online Courses: The CAS will grant a waiver of CAS Online Course 1, Risk Management and Insurance Operations, to those who have the Chartered Property Casualty Underwriter (CPCU) designation.

Validation by Educational Experience: Unlike other CAS admissions requirements, the Validation by Educational Experience (VEE) requirements are generally fulfilled outside an actuarial organization. Candidates requesting waiver of any VEE requirements based on actuarial exams should follow the procedure for requesting a waiver. Most candidates, however, will fulfill the VEE requirements through approved educational experiences and must submit the Application for Validation by Educational Experience Credit. Details are provided in the VEE section of this *Syllabus*.

Waiver Request Process

For a waiver of a CAS admissions requirement that has an approved waiver policy stated above, candidates should present their request to the CAS Examinations Coordinator with appropriate evidence that demonstrates the passing of (or score on) the educational equivalent for which a waiver is requested.

Requests for waivers for CAS admissions requirements for which there currently is no approved waiver policy are considered on a case-by-case basis. Candidates must present their requests to the CAS Examinations

Coordinator and include with their applications documented evidence that demonstrates the asserted equivalence, as well as the appropriate educational policy material of their local actuarial organization or appropriate educational organization. If such material is not included, the CAS Examinations Coordinator will request it from the candidates. The vice president-admissions will review all such requests and, when appropriate, recommend action to the Executive Council.

Please address all waiver requests to: CAS Examinations Coordinator, Casualty Actuarial Society, 4350 N. Fairfax Drive, Suite 250, Arlington, VA 22203, U.S.A.

D. CAS Code of Professional Ethics for Candidates

The purpose of the Casualty Actuarial Society (CAS) Code of Professional Ethics for Candidates (Candidate Code) is to require actuarial candidates to adhere to the high standards of conduct, practice, and qualifications of the actuarial profession, thereby supporting the actuarial profession in fulfilling its responsibility to the public. An actuarial candidate shall comply with the Candidate Code. An actuarial candidate who commits a material violation of the provisions of the Candidate Code shall be subject to the counseling and discipline procedures of the CAS.

"Actuarial candidates" are those persons who have registered for a CAS specific exam but have yet to fulfill all of the requirements for admission into the CAS. In situations where actuarial candidates perform actuarial work, their "principal" is defined as their client or employer. "Actuarial services" are professional services provided to a principal by an individual acting in the capacity of an actuary. Such services include the rendering of advice, recommendations, findings, or opinions based upon actuarial considerations.

Rule 1: An actuarial candidate shall act honestly, with integrity and competence, to uphold the reputation of the actuarial profession.

Rule 2: An actuarial candidate shall not engage in any professional conduct involving dishonesty, fraud, deceit, or misrepresentation or commit any act that reflects adversely on the actuarial profession.

Rule 3: An actuarial candidate shall perform actuarial services with courtesy and professional respect and shall cooperate with others in the principal's interest.

Rule 4: An actuarial candidate shall adhere to the CAS Policy on Examination Discipline.

Rule 5: Actuarial candidates are not authorized to use membership designations of the CAS until they are admitted to membership by the CAS Executive Council.

Rule 6: An actuarial candidate shall not disclose to another party any confidential information unless authorized to do so by the principal or required to do so by law, statute, or regulation. Confidential information includes information of a proprietary nature and information that is legally restricted from circulation.

Rule 7: An actuarial candidate shall respond promptly, truthfully, and fully to any request for information by, and cooperate fully with, appropriate counseling and disciplinary body of the CAS in connection with any disciplinary, counseling or other proceeding of such body relating to the Candidate Code. The actuarial candidate's responsibility to respond shall be subject to applicable restrictions listed in Rule 6 and those imposed by law, statute, or regulation.

(The CAS Board of Directors approved the code above on November 12, 2006, effective with the Spring 2008 exam sitting.)

A copy of the Casualty Actuarial Society Rules of Procedure for Disciplinary Actions Involving Candidates is available in the Exams & Admissions section of the CAS website under "Candidate's Code of Ethics."

STUDY RESOURCES

Study and Exam Techniques

The candidates may want to review various articles on a web page titled Helpful *Future Fellows* Articles in the Study Tips, Tools and Past Pass Marks section of the individual Examination pages under the "Exams and Admissions" section of the CAS website. These articles provide insight into the examination process.

Syllabus Updates

Occasionally, the course of reading for an examination may be changed after publication of the *Syllabus*. Such a change will be announced on the Syllabus Material section of the individual Examination page under the "Exams and Admissions" section of the CAS website.

Study Notes

Official Study Notes are published to help candidates prepare for the examinations. In some instances, Study Notes are the principal materials for study; in others, they are designed to coordinate the subject matter for the candidate or to complement other readings. Study Notes may be downloaded at no charge from the specific exam syllabus web page.

Study Kits for CAS-administered Exams

The Study Kit contains required readings not owned by the CAS but for which the CAS has been granted permission to include in the Study Kit. Study Kits will be available in mid-December for the following April/May examinations and by mid-June for the following October/November examinations. Study Kits may be purchased from the CAS Online Store; there are **NO RETURNS** and **NO REFUNDS**.

Online Publications for CAS-administered Exams

All readings that are denoted as "Online Publications" will be available on a web page titled Complete Online Text References for each examination at no charge.

Online Courses 1/CA1 and 2/CA2

All required educational content for Online Courses 1/CA1 and 2/CA2 is provided in the online courses themselves.

Sample Examination Questions and Past Examinations

Preliminary Exams

Sample examination questions for Exams 1, 2, and 3F may be available from the sponsoring organizations.

CAS-administered Exams

In general, the CAS does not provide sample examination questions for the examinations that it administers. Instead, it provides copies of previously administered exams. In referring to previously administered exams, candidates should keep in mind that the questions were based on the learning objectives in effect for that particular examination and may not reflect the current learning objectives. Candidates may also expect future examinations to vary somewhat as to the proportions of question styles and subjects. New forms of questions may appear from time to time, and the total number of questions may vary from one exam sitting to the next.

CAS-administered exams will be posted in the "Exams" section of the CAS website the day after the given examination has been administered. The Examiner's Report will be posted by the end of July for April/May Examinations and by the end of January for October/November Examinations.

- ***Exams MAS-I and MAS-II***

  Copies of recent past exams for Exams MAS-I and MAS-II are available at no charge in the "Past Exams and Pass Marks" section of the CAS website. Candidates can also look to previously CAS-administered Exams 3L, LC, ST, and S for questions/answers for Learning Objectives that overlap with Exams MAS-I and MAS-II.

  Sample questions/answers for MAS-I and Sample questions/answers for MAS-II along with a Case Study for Exam MAS-II are available on the website in the "Study Tips, Tools, and Past Pass Marks" section of the CAS website.

  Copies of recent past exams including answer keys for Exams 3L, LC, ST, and S are available at no charge in the "Past Exams and Pass Marks" section of the CAS website. While the last exam administration was October 2013 for Exam 3L, May 2016 for Exams LC and ST, and October 2017 for Exam S, copies of past Exams 3L, LC, ST, and S are still provided to assist candidates in preparing for Exam MAS-I and MAS-II.

- ***Exams 5 through 9***

  Copies of recent past exams and the Examiner's Reports for Exams 5 through 9 are available at no charge in the "Past Exams and Pass Marks" section of the CAS website. The Examiner's Report includes narratives for each question describing where points were achieved and where the candidates commonly missed points. The Examiners' Report is an invaluable tool when preparing for an upcoming exam or consequently assessing missed opportunities on a prior exam. All candidates should read the reports from prior versions of the exam for which they are sitting. However, when incorporating the Examiners' Report into your studying routine, it is important to keep in mind what the report is and, most importantly, what it is not. Candidates should review the *Future Fellows* article "Getting the Most out of the Examiners' Report."

E-Mail Study Groups

The CAS has e-mail study groups available on the Online Community for those preparing for CAS examinations. To join a CAS e-mail study group, click on the corresponding community and then "Join" on the right sidebar. Please direct any related questions to Sophie Uy, CAS IT and Online Services Coordinator, at suy@casact.org.

CAS Library

The CAS Library has a limited number of the books available for loan marked with a bold **B** in this *Syllabus*. Candidates registered for CAS Examinations and all members of the CAS have access to the library. The CAS Library is located at the CAS Office in Arlington, Virginia. For those who reside in East Asia, the Casualty Actuarial Society (Hong Kong Office) has CAS Library books available for lending and candidates residing in that area should contact the office in Hong Kong.

Books and manuals may be withdrawn from the library for a period of one month without charge. In general, not more than two references may be in the hands of one borrower at a time.

Requests for library books may be sent via e-mail or in writing to the addresses below. The request must include the borrower's complete name, address, and telephone number as well as the complete title(s) and author(s) of the requested book(s).

For Candidates Outside East Asia:

Casualty Actuarial Society
Attention: Library Service
4350 N. Fairfax Drive, Suite 250
Arlington, Virginia 22203
E-mail: library@casact.org

For Candidates in East Asia:

Joint Actuaries Office - Hong Kong
Casualty Actuarial Society (Hong Kong Office)
Attention: Patricia Kum
2202 Tower Two, Lippo Centre
89 Queensway
Hong Kong
E-mail: hongkonglibrary@casact.org

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Books that are not available through the CAS Library may be obtained by contacting the organizations listed in the "Publishers and Distributors" section at the end of each examination syllabus section.

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2020 EXAMINATION SCHEDULE

Exams for Online Courses 1 and 2 by Computer-Based Testing

	EXAM DATES	DURATION	START TIME	EXAM REFUND DEADLINE
January-March Test Window	Jan. 15 – March 15, 2020	2 Hours	Various	Three business days prior to scheduled exam—fees apply.
April-June Test Window	April 15 – June 30, 2020			
July-September Test Window	July 15 – Sept. 15, 2020			
October-December Test Window	Oct. 15 – Dec. 15, 2020			

October/November 2020 Exam Administration

Exam	EXAM DATES	DURATION	START TIME	REGISTRATION DEADLINE	REFUND DEADLINE*
MAS-I	November 10, 2020	4 Hours	See note below.	August 21, 2020	October 9, 2020
MAS-II	November 13, 2020	4 Hours	See note below.	August 21, 2020	October 9, 2020
Exam 5	**Nov. 19 – Dec. 9, 2020**	4 Hours	**See note below.**	August 21, 2020	**October 20, 2020**
Exams 6-Canada and 6-U.S.	**Nov. 19 – Dec. 9, 2020**				
Exam 7	**Nov. 19 – Dec. 9, 2020**				
Exam 8	**Nov. 19 – Dec. 9, 2020**				
Exam 9	**Nov. 19 – Dec. 9, 2020**				

***Refund deadlines vary by exam. No exceptions will be made.**

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SYLLABUS OF BASIC EDUCATION
2020
Examination Schedule
Revised July 7, 2020

SP9 Exam Administration for CERA Designation

Exam	EXAM DATES	DURATION	START TIME	REGISTRATION DEADLINE	REFUND DEADLINE
October Administration	October 5, 2020	3 Hours	Check Entry Permit	July 24, 2020	July 23, 2020

Important Schedule Notes

- **For Exams MAS-I, MAS-II and 5 through 9, candidates will schedule their individual start time with Pearson VUE test centers.**
- **Exams MAS-I, MAS-II and 5 through 9 will not have a reading period.**
- Waivers for various preliminary exams are accepted from the Actuarial Society of South Africa, the Actuaries Institute (Australia), the Canadian Institute of Actuaries, the China Association of Actuaries, and the Institute and Faculty of Actuaries, and the Society of Actuaries. See the Waivers of Examination page of the CAS website for a complete waiver explanation.
- To meet the CAS requirements for CERA, candidates should submit their registration to the CAS for Institute and Faculty of Actuaries (U.K.) Exam SP9.

COMPUTER-BASED TESTING

The CAS is transitioning to computer-based testing (CBT) and partnering with Pearson VUE Testing Centers to administer the exams. Exams available for computer-based testing:

- MAS-I on November 10, 2020
- MAS-II on November 13, 2020
- Exams 5, 6C, 6U, 7, 8, and 9 on November 19, 2020 through December 9, 2020

EXAMINATION RULES

A. Registration

MAS-I and MAS-II Exam Registration

- Exam registration will open with the CAS on June 1, 2020 and close on August 21, 2020.
- Cancellations must be made prior to October 9, 2020 in order to receive a refund.

Exams 5, 6C, 6U, 7, 8, and 9 Exam Registration

- Exam registration will open with the CAS on June 1, 2020 and close on August 21, 2020.
- Cancellations must be made prior to October 20, 2020 in order to receive a refund.

Exam registration will be a two-step process:

1. Complete an online registration with the CAS and pay the registration fee.
2. Create an account with Pearson VUE and schedule a time and location to take the exam at one of their Pearson VUE Professional Testing Centers.

After you register with the CAS, you will receive an examination Authorization To Test (ATT) email from Pearson VUE within 5 days of registering providing you with your login details and notifying you that you are now eligible to start the scheduling process.

Pearson VUE testing center locations and exam times are available on a first-come, first-served basis.

Exam Scheduling

Included in the Authorization To Test (ATT) email from Pearson VUE, is the link to create a Pearson VUE account and schedule your preferred time and location to sit for the exam. The email will also include the Pearson VUE Customer Service phone number if your preference is to book your preferred time and location over the phone.

Once you schedule your exam, Pearson VUE will send a confirmation email including your exam date, your examination time, the address of the exam center, and directions to the exam center.

The CAS Scheduling Guide provides detailed step by step instructions of the Pearson VUE scheduling process.

Exam Accommodations

If you have a disability and require a specific (non-ESL) accommodation, such as a time extension or a reader/recorder, you will need to obtain prior approval from the CAS before Pearson VUE can complete your booking.

To apply for an accommodation please email bcraver@casact.org.

After the accommodation has been approved by the CAS, you will receive an examination Authorization To Test (ATT) email from Pearson VUE notifying you are now eligible to start the scheduling process. All accommodations must be called into Pearson VUE Customer Service to book your preferred time and location over the phone and ensure your accommodation is recorded in the Pearson VUE system. If you schedule an exam online, the accommodation is not arranged with the testing center.

Exam Day

We ask that you arrive at the test center 30 minutes prior to your scheduled appointment time. This will give you adequate time to complete the necessary sign-in procedures. If you arrive more than 15 minutes late for your appointment, you may be refused admission.

Please be prepared to show one government issued form of identification. The unexpired ID must contain your name exactly as it appears on your exam registration, your photo and signature. Please review the ID policy for acceptable forms of identification.

For security purposes, before you may enter the testing room, you will be required to review the testing center rules, provide your signature, have a digital facial photo taken, and have a palm vein scan. No personal items may be taken into the testing room except a calculator. This includes all bags, books, notes, phones, writing instruments, watches and wallets.

In the testing area, a laminated spiral notebook will be available to you with a fine point felt pen for scratch work. If you need additional notebooks, raise your hand and the proctor will provide you with up to two additional notebooks. Noise cancelling headphones and individually packaged foam earplugs are available at the testing center. The testing center will ask you to empty pockets, check eyeglasses and the memory function of the calculator that is brought into the testing center.

Candidates may bring the following battery or solar-powered models of the following Texas Instruments calculators to the testing center: BA-35, BA II Plus, BA II Plus Professional, TI-30Xa, TI-30X II (IIS solar or IIB battery), TI-30XS MultiView (or XB battery). You may request a calculator at the testing center if you fail to bring one. There is a digital TI-30XS MultiView calculator embedded in the exam for your use during the exam; refer to the demo exam link to view the features and functionality. One calculator is allowed into the testing area. If you choose to bring additional calculators, they can be stored with your personal belongings in a provided locker at the testing center. You are able to take a break to exchange calculators if necessary.

Exam Timing

The scheduled appointment time for the exam is 4.5 hours. Four (4) hours will be used to answer the exam questions presented.

There will be 30 minutes allotted to four parts of the examination for the introduction, agreeing to the CAS Examination Discipline Policy, examination tutorial and post-exam survey. Refer to the demo exam to view the timer location.

There will be a timer warning in the exam at 1 hour, 15 minutes and 5 minutes.

Reschedule Policy

You must contact Pearson VUE or access your online Pearson VUE account to reschedule your exam location a minimum of 48 hours prior to your appointment. You cannot change your exam location less than 48 hours prior to your appointment. Failure to appear for your appointment will result in the forfeiture of your exam fee.

Cancellation Policy

Notify the CAS and cancel your exam with Pearson VUE by logging into your Pearson VUE account or call the Pearson VUE Customer Service number. Failure to appear for your appointment will result in the forfeiture of your exam fee. Please refer to the CAS refund deadline to avoid fees.

Refunds

Any candidate who submits an application for Exams MAS-I, MAS-II, or 5 through 9 and subsequently does not write the examination should submit a written request for an examination fee refund. This request must reach the CAS Office by the refund deadline stated in the Examination Schedule. Refund requests may be sent via e-mail to refund@casact.org or by fax to (703) 276-3108. Late requests will not be considered. A $100 administrative fee per examination will be assessed on all refunds. Refunds are issued in the manner that fees were paid, i.e., by credit to a bank card or by check to an individual or company. Fees cannot be transferred from one exam session to another.

No Show Fee

Candidates are free to reschedule or cancel an exam at a test center up to 48 hours before the scheduled testing time. Candidates who miss their testing time will be considered a no-show and not be issued a refund. Candidates considered no-shows will be charged a $100 fee. Be advised, 48 hours is not 2 business days; it is 48 hours prior to the scheduled exam start time.

Helpful Links

- Pearson/CAS Website
- Pearson VUE Contact Numbers
- Pearson VUE ID Policy
- Pearson VUE Palm Vein Scan
- Pearson VUE Laminated Notebook Video
- Pearson VUE Demo Exam
- What to Expect at a Testing Center Video
- Approved Calculators
- CAS Examination Discipline Policy
- CAS Online Registration
- CAS Scheduling Guide
- MAS-I Sample Exam
- MAS-II Sample Exam
- Written Response (Exams 5-9) Sample Questions
- CBT Tutorial Video

B. The Examination

Requirements for Admission to Examination Center

See material above on Exam Day.

Conduct of Examinations

The CAS is transitioning to computer-based testing (CBT) and partnering with Pearson VUE Testing Centers to administer the exams.

Except as is noted in the rule regarding calculators, no books, papers, typewriters, slide rules, laptops, or electronic or mechanical aids for computation of any kind may be brought into the examination room by candidates, nor may any candidate communicate with, or obtain any assistance from, any other candidate during the examination. Candidates must respond to constructed-response test items (essay questions) in English unless advance notice is given (see Languages other than English under Examination Rules—Registration).

For Exams MAS-I, MAS-II, and 5 through 9, a candidate can no longer obtain his or her own Pearson VUE spreadsheets and laminated spiral notebooks subsequent to the examination.

For Exams MAS-I, MAS-II, and 5 through 9, the exam will no longer be posted on the Exams section of the CAS website.

Calculators for Exams MAS-I, MAS-II, and 5 through 9

The following calculators are permitted: BA II Plus, BA II Plus Professional, TI-30X II (IIS solar or IIB battery) or TI-30XS MultiView (or XB battery) models. Candidates should bring their own approved calculators. You may request a calculator at the testing center if you fail to bring one. There is a digital TI-30XS MultiView calculator embedded in the exam for your use during the exam.

Earplugs for Exams MAS-I, MAS-II, and 5 through 9

Noise cancelling headphones and individually packaged foam earplugs are available at the testing center.

Reading Period for Exams MAS-I, MAS-II, and 5 through 9

Exams MAS-I, MAS-II and 5 through 9, which are offered in the CBT environment, will not have a reading period.

Examination Discipline Policy

Candidates must not give or receive assistance of any kind during or after the examination. Any cheating, attempt to cheat, assisting others to cheat, participating therein, or engaging or appearing to engage in improper conduct such as noted in the CAS Examination Discipline Policy is a serious violation and will result in the CAS disqualifying the candidate's exam and additional consequences determined by the vice president-admissions. This may include a temporary or permanent ban from sitting for CAS Examinations. Members of the CAS are also subject to the CAS investigative and discipline process, such as through the Actuarial Board for Counseling and Discipline (ABCD) or the Canadian Institute of Actuaries (CIA), for any violations of the CAS Code of Professional Conduct. Candidates have agreed in their applications for examination to be bound by the rules and regulations governing the examinations.

Examples of improper conduct include but are not limited to:

1. Improperly obtaining or providing examination questions before or after the examination or aiding someone else to do so.
2. Using an unauthorized calculator (as defined in the Syllabus) or other mechanical aid that is not permitted.
3. Having access to or consulting notes, books or other unauthorized materials or devices during the examination.
4. Talking or otherwise communicating with another candidate during the examination.
5. Disturbing other candidates during the examination.
6. Consulting other persons during the examination.
7. Copying questions, answers, or answer choices to take from the examination.
8. Taking any of the laminated spiral notebooks from the examination room.
9. Arranging to have another person take an examination for the candidate.
10. Threatening or physically or verbally abusing a supervisor or proctor responsible for curbing or reporting improper conduct.
11. Disclosing the contents of an examination to any other person without authorization from the CAS. This includes but is not limited to, discussion on internet forums or social media.
12. Presenting false information on an examination application.
13. Failing to remain in the examination room for a minimum of two hours during the examination (for examinations with this requirement).
14. Failing to follow other examination instructions.
15. Accessing or using a communication device (cell phone, tablet, etc.) during the examination or while at the examination site.
16. Interfering with the operation of CAS network system, examination platform, or server, including but not limited to accessing or attempting to access examination results through unauthorized means before the official release of results by the CAS.
17. Conducting or engaging in any other improper activities that affects the integrity of CAS examinations as determined by CAS.

The CAS Syllabus & Examination Committee, or its designee, will investigate any irregularity or suspected violation of the rules involving the examination process, and a determination will be made regarding the matter. Where there is a determination to

invoke a penalty, the candidate is advised by letter. In the case of a candidate who is a member of the CAS, the candidate's conduct will be reported to the Actuarial Board for Counseling and Discipline (ABCD) or to the Canadian Institute of Actuaries (CIA) if the final penalty invoked is more than disqualification of the examination.

Candidates for the CAS Examinations are expected to follow the rules and procedures included in this Syllabus. All candidates, on their applications for examinations, are required to read and sign the following statement: "I have read the rules and regulations concerning the examination(s) for which I am applying and agree to be bound by them. I also agree that the results of any examination(s) which I take, and any action taken as a result of my conduct may, at the sole discretion of the Casualty Actuarial Society, be disclosed to any other bona fide actuarial organization that has a legitimate interest in such results and/or actions."

Any dispute or controversy arising under or in connection with the CAS Examination Discipline Policy shall be settled exclusively by arbitration to be held in the Commonwealth of Virginia in accordance with the rules of the American Arbitration Association then in effect. Judgment may be entered on the arbitrator's award in any court having jurisdiction.

The CAS may, at its sole discretion, disclose to any other bona fide actuarial organization having a legitimate interest, information on the identity of candidates determined to have committed a serious examination violation (those for which the penalty is greater than the simple disqualification/nullification of the examination), and the specific penalties imposed on those candidates.

If an actuarial organization with which the CAS has a working relationship (such as the Society of Actuaries) invokes a penalty against a candidate for improper conduct during an examination for which the CAS is not a joint sponsor, the CAS will invoke the same penalty for all CAS-sponsored examinations. If the CAS takes any disciplinary action, it will notify the other actuarial organizations of that action.

These standards may seem stricter than those which candidates are accustomed to in other examination environments. The CAS maintains these strict standards because the examinations are such a significant part of a candidate's career. Therefore, the equitable administration of the examinations and enforcement of the highest standards of conduct cannot be emphasized too strongly.

The CAS Rules of Procedure for Disciplinary Action Involving Candidates is available on the CAS website.

Discipline for Online Courses Computer-based Testing

The rules for the CBT administration for Online Courses 1/CA1 and 2/CA2 are available on The Institutes website.

C. Grades and Accreditation

CAS Examination Processing

Starting with the Fall 2020 exam administration, the CAS is transitioning to computer-based testing (CBT) for Exams MAS-I, MAS-II, and 5 through 9. Online Courses 1 and 2 will continue to be administered by The Institutes and scored according to its computer-based testing methodologies.

Upon completion of the examination for Exams MAS-I, MAS-II, and 5 through 9, Pearson VUE sends an electronic file containing the candidate's Pearson VUE spreadsheets to the CAS Office. The files will be provided to the CAS Syllabus & Examination Committee for grading.

In a change from the past, copies of the examinations will NOT be posted on the Exams page of the CAS website.

Grading of Examinations: A Timeline

For Exams 5 through 9, there will be no changes to the way exam questions are graded, except that graders will now be able to consider formulas entered in the Pearson VUE spreadsheets. As has always been the case, candidates are encouraged to show all their work, with partial credit offered for candidates who are able to demonstrate some understanding of the question.

Pearson VUE will not release any exam results. The CAS expects to release exam results in the first quarter of 2021.

Determination of the Pass Mark

Final Pass Mark

A recommended pass mark is reached by consultation among the examination part chairperson, the general officer overseeing that examination, and the CAS Syllabus & Examination Committee chairperson. Any significant deviations from the à priori pass mark set by the pass mark panel are explored at this time. The recommended pass mark and explanations for deviations from the à priori pass mark are submitted to the vice president–admissions who approves the final pass mark. As an informational item, the final exam statistics are forwarded to the CAS Executive Council and CAS Board of Directors.

After the pass mark is finalized, each candidate is assigned a score. Scores of 0 to 5 are assigned to candidates who do not pass. On this scale, each interval is 10 percent of the pass mark. For example, a grade of 5 equates to a candidate's score of at least 90 percent, but less than 100 percent, of the pass mark. A grade of 0 means that the candidate's score is less than 50 percent of the pass mark. Candidates at or above the passing mark will receive a score of 6 to 10. Historic passing numeric scores will not be provided.

Starting with the Fall 2020 exam administration, the CAS will no longer release the pass scores for Exams MAS-I, MAS-II, and 5 through 9. Certain other statistics, such as the percent of candidates that passed the exam, will continue to be published. Pass marks for prior exams are available from the Past Exams and Pass Marks page of the CAS website. Raw scores are not provided to candidates.

Examination Results

Exams MAS-I, MAS-II, and 5 through 9

After exam results are received from the CAS Syllabus & Examination Committee at the CAS Office, candidates will be notified by e-mail that their exam results have been uploaded to their profile. Candidates can only access their exam results by logging into their My Exams page within their profile on the CAS website. Candidates will be apprised of their scores – 0 to 5 for those who did not pass the exam and 6 to 10 for those who passed the exam. Exam results are no longer mailed to candidates.

Candidates for Exams MAS-I, MAS-II, and 5 through 9 who do not pass an exam will continue to have the opportunity to receive feedback on their exam performance, in the form of a new report. Details on the new exam performance report are forthcoming.

To preserve candidate confidentiality, in the event of a lost or misplaced candidate ID number, the candidate ID number will be mailed to the candidate upon request. Under no circumstance will a candidate number be given out over the telephone or by e-mail. Candidates can also verify their candidate number by logging into their profile on the CAS website.

Ambiguous or Defective Questions and Appeals for Exams MAS-I, MAS-II, and 5 through 9

These two processes are no longer applicable for the Fall 2020 administration of CAS examinations. They are replaced by three new processes – Candidate Feedback, Candidate Grievances, and Scoring Verification Request, as described below. An Examiner's Report will no longer be published following the administration of the CAS examinations.

Candidate Feedback, Candidate Grievances, and Scoring Verification Request

Overview

While the past practice of using the published exam and Examiner's Report as the basis for providing feedback on an exam to the CAS will no longer be possible, candidates will continue to have an opportunity to provide feedback on potentially defective questions, including during the examination itself and immediately after submitting their exam. The new process for providing feedback on potentially defective questions is outlined in the new "CAS Candidate Feedback and Grievances" policy. The policy also includes new mechanisms for candidates to express concerns about their exam experience and to request a verification that a candidate's responses were accurately collected.

A synopsis is given below; please see the policy for more details. If there is a discrepancy between the "CAS Candidate Feedback and Grievances" policy and synopsis below, the Policy rules will govern.

Candidate Feedback

Candidate Feedback is a communication that triggers a review but does not require a formal response. Some feedback may be made anonymously, and some would require candidate details. Candidates are reminded to be professional in their feedback.

Candidates are encouraged to use the CAS feedback mechanisms to the fullest. The primary feedback mechanisms are as follows:

1. Flagging items using the ***Flag for Comment*** feature during the examination within the Pearson VUE software. Note: Candidates should minimize the time spent offering feedback in this manner so as to not spend valuable exam time writing highly detailed feedback.

2. Completing the ***Post-exam Questionnaire*** within the Pearson VUE software to provide comments on the exam items and exam administration immediately after the exam.

3. Completing the ***Post-exam CAS Survey*** to provide anonymous comments on the exam experience within two weeks after the exam.

4. ***Emailing the Administrative and Customer Support*** (ACS) department to provide feedback about the exam and the exam experience within one week of the exam if feedback is intended to influence grading

To the extent candidates suspect any items to be defective (such as items testing material not on the syllabus or items that cannot be answered with the information provided), such feedback may be provided through any of the above formats, but we encourage using the Post-exam Questionnaire for this purpose as candidates will have notes available (written on the Pearson notebooks).

Candidate feedback, plus robust item statistics, analysis of candidate responses, and other information, will be used to identify defective items and as input into the scoring and pass mark selection processes. All such inputs will be considered prior to the release of the exam results.

Candidate Grievances

A Candidate Grievance is a submission that requires a formal review and response.

A candidate grievance is a candidate concern unrelated to the content of the exam itself. Candidate grievances trigger a formal review and response by the exam committee. Candidate grievances are accepted on the following grounds and conditions:

Grounds	Conditions
Administration irregularities (noise, technology issues, etc.)	Requests must be received within 5 business days of exam date

Recourse for administration irregularities depends on the severity of the disruption and if the candidate is able to complete the exam. The most common remedy for severe instances is exam rescheduling without fee during the next available exam window.

The grievance review process will occur in a constructive, impartial, and timely manner. A record of the grievance, including any subsequent action(s) taken and decisions made, will be maintained by the CAS. All information pertaining to the grievance will remain confidential.

All grievances must be submitted on the official Grievance form and emailed to Grievance@casact.org. Candidates must provide the following information using the Grievance Form:

- Name and contact information
- Testing center location
- Date and time of exam appointment
- Exam number or name
- Grounds for the grievance
- Rationale or explanation

A CAS representative will acknowledge receipt within three business days. Candidates will be notified of the outcome, or a reason for further delay in the outcome, within 30 days of the submission date.

Scoring Verification Request

A Scoring Verification Request requires a small fee and will initiate a review and a response.

A scoring verification request is a formal candidate request for a verification that the candidate responses were accurately collected. Scoring verification requests trigger a formal review and response by the CAS.

The CAS has an internal quality assurance process to ensure candidate scores are reported correctly. Pearson's scoring methods are highly reliable and accurate. Rarely does a scoring verification on multiple-choice tests or constructed response exams result in a score change.

Candidates can request a scoring verification check to ensure that their scores were transferred and reported correctly. It is important to note that the verification of constructed-response scores does not include re-reading or re-grading candidate responses.

The scoring verification request must be submitted on the Scoring Verification Request Form within ten business days of the release of the exam results, and the completed form must be accompanied by a $50 fee. Candidates for which this fee would be a financial hardship can apply for a waiver using the Scoring Verification Request Fee Waiver Form. The verification fee does not entitle candidates to a copy of the test items, responses, additional grading details, or answer keys.

A CAS representative will acknowledge receipt within three business days. Candidates will be notified of the outcome, or a reason for further delay of the outcome, within 30 days of the submission date. If a score change results, candidates will receive a corrected score report and verification fees will be reimbursed.

STUDY RESOURCES

Sample Examination Questions

Starting with the Fall 2020 exam administration, the CAS will no longer publish the examinations.

All past exams and Examiner's Reports will be available to candidates for study purposes, providing a significant number of problems to work through for existing syllabus material (see Past Examinations below). As new material is added to the syllabus, the CAS will publish sample questions and answers to assist candidates in understanding how the new material may be tested on an exam.

Sample questions for Exams MAS-I, MAS-II, and 5 through 9 are available on the Pearson VUE/CAS website.

Past Examinations

In referring to previously administered exams, candidates should keep in mind that the questions were based on the learning objectives in effect for that particular examination and may not reflect the current learning objectives. Candidates may also expect future examinations to vary somewhat as to the proportions of question styles and subjects. New forms of questions may appear from time to time, and the total number of questions may vary from one exam sitting to the next.

Material for ***examinations administered prior to the Fall 2020*** can be found as follows:

- ***Exams MAS-I and MAS-II***

  Copies of exams administered before Fall 2020 for Exams MAS-I and MAS-II are available at no charge in the "Past Exams and Pass Marks" section of the CAS website. Candidates can also look to previously CAS-administered Exams 3L, LC, ST, and S for questions/answers for Learning Objectives that overlap with Exams MAS-I and MAS-II.

  Sample questions/answers for MAS-I and Sample questions/answers for MAS-II along with a Case Study for Exam MAS-II are available on the website in the "Study Tips, Tools, and Past Pass Marks" section of the CAS website.

  Copies of past exams including answer keys for Exams 3L, LC, ST, and S are available at no charge in the "Past Exams and Pass Marks" section of the CAS website. While the last exam administration was October 2013 for Exam 3L, May 2016 for Exams LC and ST, and October 2017 for Exam S, copies of past Exams 3L, LC, ST, and S are still provided to assist candidates in preparing for Exam MAS-I and MAS-II.

- ***Exams 5 through 9***

  Copies of exams administered before Fall 2020 and the corresponding Examiner's Reports for Exams 5 through 9 are available at no charge in the "Past Exams and Pass Marks" section of the CAS website. The Examiner's Report includes narratives for each question describing where points were achieved and where the candidates commonly missed points.

2020 SYLLABUS UPDATES (as of 09/08/2020)

The following are the changes made to the *Syllabus of Basic Education* after its initial publication.

2020 Spring (April) Examinations

As a result of the coronavirus (COVID-19) outbreak, the CAS has made the difficult decision to cancel the exams originally scheduled to be held in April. Exams 7 and 9, which are normally administered in April, will be administered in October instead.

The changes noted below for the Spring (April) examinations will apply to the Fall (October) examinations except as noted.

Exam 6 Canada — Regulation and Financial Reporting

The edition date of Canadian Institute of Actuaries, "Educational Note: 2019 Guidance to the Appointed Actuary for Property and Casualty Insurers," has been corrected to October 2019.

The effective date of the Office of the Superintendent of Financial Institutions Canada Guideline on "Minimum Capital Test (MCT) for Federally Regulated Property and Casualty Insurance Companies" has changed from 2020 to 2019.

This change, previously announced, will not apply to the Fall examination: Candidates may use either definition of "satisfactory financial condition" and "classification of scenarios" as found in the Consolidated Standards of Practice from the Canadian Institute of Actuaries (CIA CSOP) or in the "Second Revision of Educational Note: Dynamic Capital Adequacy Testing" from Canadian Institute of Actuaries (CIA DCAT).

Exam 7— Estimation of Policy Liabilities, Insurance Company Valuation, and Enterprise Risk Management

Two updates have been made to the syllabus:

- An erratum is included for the "Testing the Assumptions of Age-to-Age Factors" paper by Venter.
- An erratum is included for the "Credible Loss Ratio Claims Reserves: The Benktander, Neuhaus and Mack Methods Revisited" paper by Hürlimann. The erratum replaces the corrected tables previously referred to in the Complete Text References for Exam 7.

2020 Fall (October/November) Examinations

Exam MAS-I — Modern Actuarial Statistics-I

For the November exam administration:

- Candidates may use either the 3rd or the 4th edition of the book *An Introduction to Generalized Linear Models*, written by Dobson and Barnett. The 3rd edition is no longer available.
- Candidates may use either the 11th or the 12th edition of the book *Introduction to Probability Models* by Ross. The 11th edition is no longer available.

Exam 6 Canada — Regulation and Financial Reporting

The Syllabus posted for the Spring (April) 2020 examination will be used for the Fall (October) examination except as noted below.

The following changes **will be made** for the Fall (October) examination:

- Delete the reading - Canadian Institute of Actuaries, "Second Revision of Educational Note: Dynamic Capital Adequacy Testing," November 2017, excluding Appendix A.
- Amend Knowledge Statement C.2.b. from "DCAT" to "FCT."
- Remove the note that candidates may answer based on either DCAT or FCT.

For the reading A.M. Best Company, Inc., *A.M. Best Methodology*, "Understanding BCAR For Canadian Property/Casualty Insurers," candidates may study from either the July 13, 2018 or the July 23, 2020 version.

Exam 6 United States — Regulation and Financial Reporting

The Syllabus posted for the Spring (April) 2020 examination will be used for the Fall (October) examination. The changes announced in the memorandum "Changes for the Spring 2020 CAS *Syllabus of Basic Education*," dated February 25, 2020, **will not be made** at this time.

Waiver of Examinations

The CAS has modified its waiver policy regarding the preliminary examinations sponsored by the China Association of Actuaries (CAA). Credit will be granted for examinations passed or waived in accordance with examination equivalencies between the CAS Syllabus and the syllabi of the China Association of Actuaries. Candidates should review the updated policy at https://www.casact.org/admissions/syllabus/index.cfm?fa=exam_grades#waivers.

Note: *This Syllabus is subject to change in the future.*

The Syllabus for each examination is defined in the form of Learning Objectives, Knowledge Statements, and Readings. The Learning Objectives present the learning goals for the underlying subjects being tested and set forth, usually in broad terms, what the candidate should be able to do in actual practice. The Knowledge Statements describe the body of knowledge corresponding to the exam subject and are illustrative of the scope of each Learning Objective. The Readings are recommended resources that support the Learning Objectives and may assist candidates to prepare for the examination. The CAS is not responsible for any errors or omissions found in the content of the resources identified in the Readings.

The syllabus for this basic education requirement is defined in the form of learning objectives that set forth, usually in broad terms, what the candidate should be able to do in actual practice.

Please check the "*Syllabus* Updates" section of the CAS Web Site for any changes to the *Syllabus*. The options for obtaining credit for this basic education requirement are listed below and in Examination Rules, C. Grades and Accreditation, Waivers of Examinations section of the *Syllabus*.

The purpose of the syllabus is to develop knowledge of the fundamental probability tools for quantitatively assessing risk. The application of these tools to problems encountered in actuarial science is emphasized. A thorough command of the supporting calculus is assumed. Additionally, a very basic knowledge of insurance and risk management is assumed.

A. General Probability

LEARNING OBJECTIVES

1. Use and apply the following concepts in a risk management context:
   - Set functions including set notation and basic elements of probability
   - Mutually exclusive events
   - Addition and multiplication rules
   - Independence of events
   - Combinatorial probability
   - Conditional probability
   - Bayes Theorem / Law of total probability

B. Univariate Probability Distributions

This section includes binomial, negative binomial, geometric, hypergeometric, Poisson, uniform, exponential, gamma, and normal distributions.

LEARNING OBJECTIVES
1. Use and apply the following concepts in a risk management context: • Probability functions and probability density functions • Cumulative distribution functions • Mode, median, percentiles, and moments • Variance and measures of dispersion • Moment generating functions • Transformations

C. Multivariate Probability Distributions

This section includes the bivariate normal distribution.

LEARNING OBJECTIVES
1. Use and apply the following concepts in a risk management context: • Joint probability functions and joint probability density functions • Joint cumulative distribution functions • Central Limit Theorem • Conditional and marginal probability distributions • Moments for joint, conditional, and marginal probability distributions • Joint moment generating functions • Variance and measures of dispersion for conditional and marginal probability distributions • Covariance and correlation coefficients • Transformations and order statistics • Probabilities and moments for linear combinations of independent random variables

Options for Obtaining Exam 1 Credit

The CAS will grant credit for Exam 1 to those who have successfully completed one of the following examinations:

Organization	Examination
Actuarial Society of South Africa	A101, Probability and Mathematical Statistics
Actuaries Institute (Australia)	CT3, Probability and Mathematical Statistics
Canadian Institute of Actuaries (CIA)	University Accreditation Program credit for Probability[1]
China Association of Actuaries	See note below[2]
Institute of Actuaries of India	CT3, Probability and Mathematical Statistics
Institute and Faculty of Actuaries (U.K.)	CT3, Probability and Mathematical Statistics
Society of Actuaries	P, Probability

1. For credit granted through the CIA's University Accreditation Program, the list of candidates granted waivers by the CIA is provided to the CAS following the end of a semester. The CAS automatically updates its records. No further action is required of candidates.

2. The CAS will grant exam waivers based on exams administered by the China Association of Actuaries **as a cohort** for CAS Exams 1, 2, and 3F and Validation by Educational Experience requirements – Accounting and Finance, and Economics. See Waivers of Examination page of the CAS website for a complete waiver explanation.

To obtain credit, candidates should follow the procedures outlined on the Waivers of Examination page of the CAS website.

The syllabus for this basic education requirement is defined in the form of learning objectives that set forth, usually in broad terms, what the candidate should be able to do in actual practice.

Please check the "*Syllabus* Updates" section of the CAS Web Site for any changes to the *Syllabus*. The options for obtaining credit for this basic education requirement are listed below and in Examination Rules, C. Grades and Accreditation, Waivers of Examinations section of the *Syllabus*.

The purpose of the syllabus is to develop knowledge of the fundamental concepts of financial mathematics, and how those concepts are applied in calculating present and accumulated values for various streams of cash flows as a basis for future use in: reserving, valuation, pricing, asset/liability management, investment income, capital budgeting, and valuing contingent cash flows. The candidate will also be introduced to financial instruments, including derivatives, and the concept of no-arbitrage as it relates to financial mathematics.

A basic knowledge of calculus and an introductory knowledge of probability is assumed.

A. Interest Theory

LEARNING OBJECTIVES

1. For time value of money, define and recognize the definitions of the following terms:
   - Interest rate (rate of interest)
   - Simple interest
   - Compound interest
   - Accumulation function
   - Future value
   - Present value/net present value
   - Discount factor
   - Discount rate (rate of discount)
   - Convertible m-thly
   - Nominal rate
   - Effective rate
   - Inflation and real rate of interest
   - Force of interest
   - Equation of value

LEARNING OBJECTIVES
2. For time value of money, the candidate will be able to do the following: • Given any two of interest rate, present value, or future value, calculate the third based on simple or compound interest. • Given any one of the effective interest rate, the nominal interest rate convertible m-thly, the effective discount rate, the nominal discount rate convertible m-thly, or the force of interest, calculate all of the other items. • Write the equation of value given a set of cash flows and an interest rate.
3. For annuities with payments that are not contingent, define and recognize the definitions of the following terms: • Annuity-immediate • Annuity-due • Perpetuity • Payable m-thly, or Payable continuously • Level payment annuity • Arithmetic increasing/decreasing payment annuity • Geometric increasing/decreasing payment annuity • Term of annuity
4. For annuities with payments that are not contingent, the candidate will be able to do the following: • Given an annuity with level payments, immediate (or due), payable m-thly, (or payable continuously), and any three of present value, future value, interest rate, payment, and term calculate the remaining two items. • Given an annuity with non-level payments, immediate (or due), payable m-thly, (or payable continuously), the pattern of payment amounts, and any three of present value, future value, interest rate, payment amounts, and term of annuity calculate the remaining two items.
5. For loans, define and recognize the definitions of the following terms: • Principal • Interest • Term of loan • Outstanding balance • Final payment (drop payment, balloon payment) • Amortization • Sinking fund
6. For loans, the candidate will be able to do the following: • Given any four of term of loan, interest rate, payment amount, payment period, principal, calculate the remaining items. • Calculate the outstanding balance at any point in time. • Calculate the amount of interest and principal repayment in a given payment. • Given the quantities, except one, in a sinking fund arrangement calculate the missing quantity.

LEARNING OBJECTIVES
7. For bonds, define and recognize the definitions of the following terms: • Price • Redemption value • Par Value/Face value • Coupon, Coupon rate • Term of bond • Yield rate • Callable/non-callable • Book value • Accumulation of discount/Amortization of premium
8. For bonds, the candidate will be able to do the following: • Given any four of price, redemption value, yield rate, coupon rate, and term of bond, calculate the remaining item.
9. For general cash flows and portfolios, define and recognize the definitions of the following terms: • Yield rate/rate of return • Dollar-weighted rate of return/Time-weighted rate of return • Current value • Duration (Macaulay, modified and effective) • Convexity • Portfolio and investment year allocation methods • Spot rate • Forward rate • Yield curve • Stock price, stock dividend
10. For general cash flows and portfolios, the candidate will be able to do the following: • Calculate the current value of a set of cash flows. • Calculate the portfolio yield rate. • Calculate the dollar-weighted and time-weighted rate of return. • Calculate the duration and convexity of a set of cash flows. • Calculate either Macaulay or modified duration given the other. • Use duration and convexity to approximate the change in present value due to a change in interest rate. • Calculate the price of a stock using the dividend discount model.
11. For immunization, define and recognize the definitions of the following terms: • Cash-flow matching • Immunization (including full immunization) • Redington immunization

LEARNING OBJECTIVES
12. For immunization, the candidate will be able to do the following: • Construct an investment portfolio to fully immunize a set of liability cash flows. • Construct an investment portfolio to match present value and duration of a set of liability cash flows. • Construct an investment portfolio to exactly match a set of liability cash flows.

B. Financial Economics

LEARNING OBJECTIVES
1. For general derivatives, define and recognize the definitions of the following terms: • Derivative, Underlying asset, Over-the-counter market • Ask price, Bid price, Bid-ask spread • Short selling, Short position, Long position • Stock index • Spot price • Net profit/payoff • Credit risk • Marking-to-market • Margin, Maintenance margin, Margin call
2. For general derivatives, evaluate an investor's margin position based on changes in asset values.
3. For options, define and recognize the definitions of the following terms: • Call option, Put option • Expiration, Expiration date • Strike price/Exercise price • European option, American option, Bermudan option • In-the-money, At-the-money, Out-of-the-money • Covered call, Naked writing • Dividends • Put-call parity
4. For options, evaluate the payoff and profit of basic derivative contracts.

LEARNING OBJECTIVES
5. For hedging and investment strategies, define and recognize the definitions of the following terms: • Hedging, Arbitrage • Diversifiable risk, Nondiversifiable risk • Synthetic forwards • Spreads (including bull, bear, box, and ratio spreads) • Collars (including zero-cost collars), Paylater strategy • Straddles (including strangles, written straddles and butterfly spreads) • Convertible bond, Mandatorily convertible bond
6. For hedging and investment strategies, the candidate will be able to: • Explain how derivative securities can be used as tools to manage financial risk. • Explain the reasons to hedge and not to hedge. • Evaluate the payoff and profit of hedging strategies.
7. For forwards and futures, define and recognize the definitions of the following terms: • Forward contract, Prepaid forward contract • Outright purchase, Fully leveraged purchase • Implied repo rate • Cost of carry • Lease rate • Futures contract
8. For forwards and futures, the candidate will be able to: • Determine forward price from prepaid forward price. • Explain the relationship between forward price and futures price. • Explain the relationship between forward price and future stock price. • Use the concept of no-arbitrage to determine the theoretical value of futures and forwards. • Given any four of call premium, put premium, forward price, strike price and interest rate, calculate the remaining item using the put-call parity formula.
9. For swaps, define and recognize the definitions of the following terms: • Swap, Prepaid swap • Swap term, Swap spread, Notional Amount • Simple commodity swap, Interest rate swap • Deferred swap
10. Use the concept of no-arbitrage to determine the theoretical values of swaps.

Options for Obtaining Exam 2 Credit

The CAS will grant credit for Exam 2 to those who have successfully completed one of the following examinations:

Organization	Examination
Actuarial Society of South Africa	A201, Financial Mathematics
Actuaries Institute (Australia)	CT1, Financial Mathematics
Canadian Institute of Actuaries (CIA)	University Accreditation Program credit for Financial Mathematics[1]
China Association of Actuaries	See note below[2]
Institute of Actuaries of India	CT1, Financial Mathematics
Institute and Faculty of Actuaries (U.K.)	CT1, Financial Mathematics
Society of Actuaries	Exam FM, Financial Mathematics

1. For credit granted through the CIA's University Accreditation Program, the list of candidates granted waivers by the CIA is provided to the CAS following the end of a semester. The CAS automatically updates its records. No further action is required of candidates.

2. The CAS will grant exam waivers based on exams administered by the China Association of Actuaries **as a cohort** for CAS Exams 1, 2, and 3F and Validation by Educational Experience requirements – Accounting and Finance, and Economics. See Waivers of Examination page of the CAS website for a complete waiver explanation.

To obtain credit otherwise, candidates should follow the procedures outlined on the Waivers of Examination page of the CAS website.

The syllabus for this basic education requirement is defined in the form of learning objectives that set forth, usually in broad terms, what the candidate should be able to do in actual practice.

Please check the "*Syllabus* Updates" section of the CAS Web Site for any changes to the *Syllabus*. The options for obtaining credit for this basic education requirement are listed below and in Examination Rules, C. Grades and Accreditation, Waivers of Examinations section of the *Syllabus*.

The purpose of the syllabus is to develop the candidate's knowledge of investment and financial markets. A thorough knowledge of calculus, probability, and interest theory is assumed.

A. Investment Markets

LEARNING OBJECTIVES
1. Understand mean-variance portfolio theory and use it to calculate risk-return relationships for assets and portfolios.
2. Understand asset-pricing models, including the capital asset pricing model, and factor models.
3. Understand the different levels of market efficiency, and how behavioral finance explains market anomalies and inefficiencies.

B. Corporate Finance

LEARNING OBJECTIVES
1. Calculate and interpret different measures of investment risk, and understand their application in project analysis and capital budgeting.
2. Explain the key elements of capital structure considerations.

C. Financial Derivatives: Forwards and Futures

LEARNING OBJECTIVES
1. Understand the characteristics of forwards, and calculate prices, payoffs, and profits.
2. Understand the characteristics of futures and how they differ from forwards, including margins and marking-to-market.

D. Financial Derivatives: Options

LEARNING OBJECTIVES
1. Understand the characteristics and cash flows of financial options.
2. Calculate the value of European and American options using the binomial model.
3. Calculate the value of European options using the Black-Scholes option-pricing model
4. Identify the situations where the values of European and American options are the same.
5. Interpret the option Greeks (i.e., option price partial derivatives).
6. Explain and demonstrate how to control risk using the method of delta-hedging.
7. Explain the cash flow characteristics of exotic options.
8. Explain the properties of a lognormal distribution and explain the Black-Scholes formula as an expected value for a lognormal distribution.

Options for Obtaining Exam 3F Credit

The CAS will grant credit for basic education requirement for Exam 3F to those who have successfully completed one of the following examinations:

Organization	Examination
Actuarial Society of South Africa	A205, Financial Economics
Actuaries Institute (Australia)	CT8, Financial Economics
Canadian Institute of Actuaries	University Accreditation Program credit for Models for Financial Economics[1]
China Association of Actuaries	See note below[2]
Institute of Actuaries of India	CT8, Financial Economics
Institute and Faculty of Actuaries (U.K.)	CT8, Financial Economics
Society of Actuaries	IFM, Investment and Financial Markets

1. For credit granted through the CIA's University Accreditation Program, the list of candidates granted waivers by the CIA is provided to the CAS following the end of a semester. The CAS automatically updates its records. No further action is required of candidates.

2. The CAS will grant exam waivers based on exams administered by the China Association of Actuaries **as a cohort** for CAS Exams 1, 2, and 3F and Validation by Educational Experience requirements – Accounting and Finance, and Economics. See Waivers of Examination page of the CAS website for a complete waiver explanation.

To obtain credit otherwise, candidates should follow the procedures outlined on the Waivers of Examination page of the CAS website.

The syllabus for this four-hour exam is defined in the form of learning objectives, knowledge statements, and readings.

LEARNING OBJECTIVES set forth, usually in broad terms, what the candidate should be able to do in actual practice. Included in these learning objectives are certain methodologies that may not be possible to perform on an examination, such as complex simulations, but that the candidate would still be expected to explain conceptually in the context of an examination.

KNOWLEDGE STATEMENTS identify some of the key terms, concepts, and methods that are associated with each learning objective. These knowledge statements are not intended to represent an exhaustive list of topics that may be tested, but they are illustrative of the scope of each learning objective.

READINGS support the learning objectives. It is intended that the readings, in conjunction with the material on earlier examinations, provide sufficient resources to allow the candidate to perform the learning objectives. Some readings are cited for more than one learning objective. The CAS Syllabus & Examination Committee emphasizes that candidates are expected to use the readings cited in this *Syllabus* as their primary study materials.

Thus, the learning objectives, knowledge statements, and readings complement each other. The learning objectives define the behaviors, the knowledge statements illustrate more fully the intended scope of the learning objectives, and the readings provide the source material to achieve the learning objectives. Learning objectives should not be seen as independent units, but as building blocks for the understanding and integration of important competencies that the candidate will be able to demonstrate.

Note that the range of weights shown should be viewed as a guideline only. There is no intent that they be strictly adhered to on any given examination—the actual weight may fall outside the published range on any particular examination.

The overall section weights should be viewed as having more significance than the weights for the individual learning objectives. Over a number of years of examinations, absent changes, it is likely that the average of the weights for each individual overall section will be in the vicinity of the guideline weight. For the weights of individual learning objectives, such convergence is less likely. On a given examination, in which it is very possible that not every individual learning objective will be tested, there will be more divergence of guideline weights and actual weights. Questions on a given learning objective may be drawn from any of the listed readings, or a combination of the readings. There may be no questions from one or more readings on a particular exam.

After each set of learning objectives, the readings are listed in abbreviated form. Complete text references are provided at the end of this exam syllabus.

Items marked with a bold **OP** (Online Publication) are available at no charge and may be downloaded from the CAS website.

Please check the "*Syllabus* Updates" section of the CAS Web Site for any changes to the *Syllabus*.

A. Basic Techniques for Ratemaking

Range of weight for Section A: 45-55 percent

This section introduces the general principles of ratemaking as well as specific details regarding data requirements, calculations, key assumptions, and implementation-related issues. Candidates require a thorough understanding of basic ratemaking so that they will be able to analyze data, select appropriate techniques, and develop solutions to problems. This section addresses the advantages and disadvantages of the various ratemaking techniques as they are applied to specific situations and different lines of business. Classification of insureds for the purpose of risk stratification and other important ratemaking topics, such as coinsurance and catastrophe provisions, are also examined in this section.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Describe, analyze, or design the information requirements for ratemaking related to exposures and demonstrate the use of exposures in ratemaking. Range of weight: 2-6 percent	a. Definition of exposure base b. Characteristics of exposure bases c. Selection of exposure base d. Organization of data: calendar year, policy year, accident year e. Written exposure versus earned exposure versus in-force exposure f. Role of exposures in the ratemaking process g. Influence of changes in exposures
READINGS	
• Werner & Modlin, Chapters 1, 3-4	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
2. Describe, analyze, or design the information requirements for ratemaking related to premiums and demonstrate the use of premiums in ratemaking. Range of weight: 5-9 percent	a. Organization of data: calendar year, policy year, accident year b. Written premium versus earned premium versus in-force premium c. Relationship between earned premium and earned exposure d. Policy terms e. Effect of law changes f. Effect of rate changes g. Determinations of and application of premium trend h. Adjustment for coverage and benefit level changes i. Distributional shifts j. Parallelogram method k. Extension of exposures
READINGS	
• ASOP 13 • Werner & Modlin, Chapters 1, 3, 5, and Appendices A-D	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
3. Describe, analyze, or design the information requirements for ratemaking related to loss and loss adjustment expenses and demonstrate the use of loss and loss adjustment expenses in ratemaking. Range of weight: 8-14 percent	a. Organization of the data: calendar year, policy year, accident year, report year b. Policy provisions c. Occurrence coverage d. Claims-made coverage: • Report lag • Coverage triggers • Principles of claims-made policies • Retroactive date • Tail coverage e. Reported losses versus paid losses f. Claim counts g. Loss adjustment expense (allocated and unallocated expenses) h. Loss development i. Frequency trend j. Severity trend k. Pure premium trend l. Approaches to determining trend (e.g., exponential and linear analyses) m. Relationship between trend and loss development n. Effect of law changes o. Effect of changes in mix of business p. Adjustment for coverage and benefit level changes q. Credibility criteria and formulae r. Large loss adjustment s. Reinsurance recoveries t. Reinsurance costs u. Catastrophe adjustment

READINGS

- ASOP 13
- Werner & Modlin, Chapters 1, 3, 6, 12, 16, and Appendices A-D

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
4. Calculate the underwriting expense provisions underlying the overall rate level indication. Range of weight: 0-5 percent	a. Expense categories (e.g., commission, general, other acquisition, taxes, licenses, and fees) b. Sources of data and selection criteria c. Profit and contingency provisions d. Net cost of reinsurance e. Cost of capital f. Fixed expenses and variable expenses g. Differences in procedures for loss adjustment expenses versus underwriting expenses h. Permissible loss ratio
READINGS	
• Werner & Modlin, Chapters 1, 7, and Appendices A-D	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
5. Calculate the overall rate level indication using the pure premium and loss ratio methods and argue the merits of each. Range of weight: 3-6 percent	a. Statement of Principles, CAS b. Assumptions of each method c. Mechanics associated with each method (including organization of the data) d. When each method works and when it does not
READINGS	
• CAS Ratemaking Principles • Werner & Modlin, Chapters 1, 8, and Appendices A-D	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
6. Describe, analyze, and validate the considerations beyond the calculated cost-based estimate of the rate when selecting a final rate change to implement. Range of weight: 0-5 percent	a. Calculated cost-based rate b. Regulatory constraints c. Operational constraints d. Marketing constraints: • Competitive comparisons • Close ratios • Retention ratios • Growth • Distributional analysis • Policyholder dislocation analysis e. Lifetime value analysis f. Optimized pricing g. Underwriting cycles
READINGS	
• Werner & Modlin, Chapter 13	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
7. Explain the purpose for segregating data into homogeneous groups and summarize the considerations for determining such groups. Range of weight: 0-5 percent	a. Risk Classification Standard of Practice b. Criteria for selection of classification grouping c. Credibility d. Adverse Selection e. Practicality
READINGS	
• ASOP 12 • Werner & Modlin, Chapter 9	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
8. Develop rating differentials for classification and territory and relativities for deductibles and increased limits. Range of weight: 10-14 percent	a. Formulae and process for each rating differential or relativity b. Credibility and complements of credibility c. Off balance d. Capping of change e. Loss elimination f. Basic limits versus total limits g. Layers of loss h. Expense adjustments i. Shortcomings of Univariate Methods j. Benefits of Multivariate Methods k. Generalized Linear Models: • Output • Diagnostics, including Standard Errors, Deviance Tests, Chi-Square Test, and Consistency Test • Model Validation
READINGS	
• Werner & Modlin, Chapters 9-12, 15 and Appendices E-F	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
9. Assess the considerations for implementing rates to achieve an organization's goals. Range of weight: 0-3 percent	a. Rating algorithms b. Rating variables and differentials c. Fixed expenses, if applicable d. Expense fee calculation e. Calculation of final rates f. Minimum premiums g. Non-pricing solutions
READINGS	
• Werner & Modlin, Chapter 14	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
10. Calculate premium for policies with coinsurance provisions. Range of weight: 0-5 percent	a. Definition of coinsurance b. Insurance to value c. Common policy provisions d. Layers of loss e. Coverage issues f. Guaranteed replacement cost g. Formulae for coinsurance
READINGS	
• Werner & Modlin, Chapter 11	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
11. Perform basic individual risk rating calculations. Range of weight: 0-5 percent	a. Purpose of individual risk rating b. Schedule rating c. Manual rating d. Retrospective rating e. Experience modification f. Composite loss-rated risks g. Experience period h. Credibility i. Layers of loss j. Large dollar deductibles
READINGS	
• Werner & Modlin, Chapter 15	

B. Estimating Claim Liabilities

Range of weight for Section B: 45-55 percent

This section explores basic techniques that actuaries use to estimate unpaid claims for both insurance entities and also for non-insurance entities that retain risk. The CAS Principles and the American Academy of Actuaries' Standards of Practice related to the estimation of unpaid claims are also examined in this section.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Describe, analyze, and validate the information requirements for estimating unpaid claims. Range of weight: 2-6 percent	a. Types of data and their sources b. Role of homogeneity and credibility of data in the process of estimating unpaid claims c. Fundamentals of different types of insurance (e.g., long tail versus short tail lines of business, low frequency versus high frequency lines) d. Organization of data: calendar year, accident year, policy year, underwriting year, report year e. Insurer's environment f. Importance of accurate estimates of unpaid claims
READINGS	
• Friedland, Chapters 1, 3, and 4 • CAS Unpaid Claims Principles • ASOP 43	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
2. Build and analyze claim development triangles. Range of weight: 2-6 percent	a. Purposes of the development triangle b. Development triangle as a diagnostic tool c. Examples and uses of diagnostic development triangles: • Claim and claim count • Ratio of premium to claims • Average values triangles • Ratios of claims and counts
READINGS	
• Friedland, Chapters 5-6	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
3. Construct and appraise unpaid claims estimates using each of the following estimation techniques: • Development technique, including case outstanding technique • Expected claim technique • Bornhuetter-Ferguson technique • Cape Cod technique • Frequency-Severity techniques • Benktander technique Range of weight: 14-20 percent	a. Standards of Practice, ASOP 43 b. Statement of Principles, CAS c. The claim process d. Assumptions of each estimation technique e. Mechanics associated with each technique (including organization of the data) f. Reporting and payment patterns g. When each technique works and when each does not h. Key terms: case outstanding, paid claims, reported claims, incurred but not reported, ultimate claims, claims related expenses, reported and closed claim counts, claim counts closed with no payment, insurance recoverables, exposures, experience period, maturity or age, and components of unpaid claim estimates

READINGS

- Friedland, Chapters 1-12, and 15
- CAS Unpaid Claims Principles
- ASOP 43

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
4. Assess the influence of operating changes on the estimation of unpaid claims. Range of weight: 0-5 percent	a. How internal operating changes affect estimates of unpaid claims: • Claims processing • Underwriting and policy provisions • Marketing • Coding of claim counts and/or claim related expenses • Treatment of recoveries such as policyholder deductibles and salvage and subrogation • Reinsurance

READINGS

- Friedland, Part 3 (Chapters 6-15)

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
5. Adjust data and/or estimation techniques for changes in the: • Internal environment (e.g., claims processes that result in shift in the adequacy of case outstanding or shift in settlement rates, change in mix of business, change in rate level) • External environment (e.g., inflationary or legal environment) Range of weight: 5-9 percent	a. Effect on estimation techniques due to change in: rate levels, claim ratio, mix of business b. Use of trend factors and tort reform factors in estimation techniques c. Identification of changes in case outstanding adequacy d. Adjustment for changes in case outstanding adequacy e. Identification of changes in rate of claims settlement f. Adjustment for changes in rate of claims settlement g. Berquist-Sherman techniques h. Adjustment for large losses
READINGS	
• Friedland, Chapters 7-14	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
6. Estimate recoveries. Range of weight: 0-5 percent	a. Salvage and subrogation b. Reinsurance c. Key assumptions of estimation techniques
READINGS	
• Friedland, Chapter 14	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
7. Estimate unpaid claim adjustment expenses. Range of weight: 2-7 percent	a. Organization of the data b. Estimation of unpaid ALAE c. Estimation of unpaid ULAE d. Key assumptions of estimation techniques e. Strengths and weaknesses of the estimation techniques for claim related expenses
READINGS	
• Friedland, Chapters 1, 3, 16, and 17	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
8. Appraise and validate the results of the estimation process for adequacy and reasonableness. Range of weight: 4-8 percent	a. Components of evaluation: • Multiple methods • Explanation of differences • Test statistics (e.g., claim ratios, severities, pure premiums, frequencies, indicated unpaid claims) b. Monitoring and interim valuations
READINGS	
• Friedland, Chapter 15	

Complete Text References for Exam 5

Text references are alphabetized by the citation column.

Citation	Abbreviation	Learning Objective	Source
Actuarial Standards Board of the American Academy of Actuaries, "Actuarial Standard of Practice No. 12, Risk Classification (for All Practice Areas)," revised in 2005, updated for deviation language in 2011.	ASOP 12	A7	**OP**
Actuarial Standards Board of the American Academy of Actuaries, "Actuarial Standard of Practice No. 13, Trending Procedures in Property/Casualty Insurance," revised in 2009, updated for deviation language in 2011.	ASOP 13	A2, A3	**OP**
Actuarial Standards Board of the American Academy of Actuaries, "Actuarial Standard of Practice No. 43, Property/Casualty Unpaid Claim Estimates," adopted in 2007, updated for deviation language in 2011.	ASOP 43	B1, B3	**OP**
Friedland, J.F., *Estimating Unpaid Claims Using Basic Techniques*, Casualty Actuarial Society, Third Version, July 2010. The Appendices are excluded.	Friedland	B1-B8	**OP**
Statement of Principles Regarding Property and Casualty Insurance Ratemaking, Casualty Actuarial Society, May 1988.	CAS Ratemaking Principles	A5	**OP**
Statement of Principles Regarding Property and Casualty Unpaid Claims Estimates, Casualty Actuarial Society, adopted November 2014, released May 2015.	CAS Unpaid Claims Principles	B1, B3	**OP**
Werner, G, and Modlin, C., *Basic Ratemaking*, Casualty Actuarial Society, Fifth Edition, May 2016. The Appendices are an integral part of the textbook and will be used for creating questions. Chapter 2 is excluded.	Werner & Modlin	A1-A11	**OP**

Source Key

B	Book—may be purchased from the publisher or bookstore or borrowed from the CAS Library.
NEW	Indicates new or updated material.
OP	All text references marked as Online Publications will be available on a web page titled Complete Online Text References.
SK	Material included in the 2020 Study Kit.
SKU	Material included in both the 2020 CAS Study Kit and the 2020 Update to the 2019 Study Kit.

Items printed in **red** indicate an update, clarification, or change.

Publishers and Distributors

Contact information is furnished for those who wish to purchase the text references cited for this exam. Publishers and distributors are independent and listed for the convenience of candidates; inclusion does not constitute endorsement by the CAS.

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Actuarial Bookstore, P.O. Box 69, Greenland, NH 03840; telephone: (800) 582-9672 (U.S. only) or (603) 430-1252; fax: (603) 430-1258; website: www.actuarialbookstore.com.
Actuarial Standards Board, American Academy of Actuaries, 475 N. Martingale Road, Suite 600, Schaumburg, IL 60173; telephone: (847) 706-3513; fax: (847) 706-3599; website: www.actuarialstandardsboard.org.
Casualty Actuarial Society, 4350 N. Fairfax Drive, Suite 250, Arlington, VA 22203; telephone: (703) 276-3100; fax: (703) 276-3108; e-mail: office@casact.org; website: www.casact.org.

The Actuarial Institute of Chinese Taipei (AICT) uses the Casualty Actuarial Society examinations for its property-casualty actuaries. The CAS Board of Directors approved specific AICT exams (i.e., current AICT Exam 6GA3 on Actuarial Standard of Practice and Accounting and Exam 6GB3 on Insurance Regulations and Discipline) as fulfilling the nation-specific requirement for CAS membership effective January 1, 2010.

In the 2011 transition to a revised basic education structure, learning objectives from the 2010 nation-specific exams were mapped to both the new Exam 6 on Regulation and Financial Reporting and new Online Course 2 on Insurance Accounting, Coverage Analysis, Insurance Law, and Insurance Regulation. Because the AICT continues to cover material from both new Exam 6 and new Online Course 2, candidates who have passed both AICT Exams 6GA3 and 6GB3 will be granted credit for both CAS Exam 6-Taiepi and Online Course 2.

For details on the administration of the AICT examinations, please contact:

Actuarial Institute of Chinese Taipei
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- Exam information: www.airc.org.tw/exam/202
- Past exam linage: www.airc.org.tw/exam/download

Website in English:
- Exam information: en.airc.org.tw
- Past exam linage: en.airc.org.tw/exam/download

Applying for CAS Exam Credit

If a candidate has passed both parts of the AICT nation-specific exam (current AICT Exams 6GA3 and 6GB3) after January 1, 2010, then the candidate may apply for exam credit with the CAS. To receive credit for CAS Exam 6-Taipei and Online Course 2, the candidate should submit a written request to the Actuaries' Resource Center (arc@casact.org). The request must include the candidate's full legal name, contact information (including mailing address and telephone number), date of birth, and the administration (month/year of exam) that each of the AICT nation-specific exam parts was passed. The Actuaries' Resource Center will verify the exam information with the AICT and then update the candidate's record to reflect the credit as appropriate.

The syllabus for this four-hour exam is defined in the form of learning objectives, knowledge statements, and readings.

LEARNING OBJECTIVES set forth, usually in broad terms, what the candidate should be able to do in actual practice. Included in these learning objectives are certain methodologies that may not be possible to perform on an examination, such as complex simulations, but that the candidate would still be expected to explain conceptually in the context of an examination.

KNOWLEDGE STATEMENTS identify some of the key terms, concepts, and methods that are associated with each learning objective. These knowledge statements are not intended to represent an exhaustive list of topics that may be tested, but they are illustrative of the scope of each learning objective.

READINGS support the learning objectives. It is intended that the readings, in conjunction with the material on earlier examinations, provide sufficient resources to allow the candidate to perform the learning objectives. Some readings are cited for more than one learning objective. The CAS Syllabus & Examination Committee emphasizes that candidates are expected to use the readings cited in this *Syllabus* as their primary study materials.

Thus, the learning objectives, knowledge statements, and readings complement each other. The learning objectives define the behaviors, the knowledge statements illustrate more fully the intended scope of the learning objectives, and the readings provide the source material to achieve the learning objectives. Learning objectives should not be seen as independent units, but as building blocks for the understanding and integration of important competencies that the candidate will be able to demonstrate.

Note that the range of weights shown should be viewed as a guideline only. There is no intent that they be strictly adhered to on any given examination—the actual weight may fall outside the published range on any particular examination.

The overall section weights should be viewed as having more significance than the weights for the individual learning objectives. Over a number of years of examinations, absent changes, it is likely that the average of the weights for each individual overall section will be in the vicinity of the guideline weight. For the weights of individual learning objectives, such convergence is less likely. On a given examination, in which it is very possible that not every individual learning objective will be tested, there will be more divergence of guideline weights and actual weights. Questions on a given learning objective may be drawn from any of the listed readings, or a combination of the readings. There may be no questions from one or more readings on a particular exam.

After each set of learning objectives, the readings are listed in abbreviated form. Complete text references are provided at the end of this exam syllabus.

Items marked with a bold **SK** or **SKU** constitute the Spring 2020 Exam 6-Canada Study Kit that may be purchased from the CAS Online Store. The Spring 2020 Update to the Fall 2019 Study Kit includes only the new items marked with a bold **SKU**; the Update may be purchased from the CAS Online Store. **Candidates should use the Spring 2020 SK and/or SKU for the Fall 2020 examination.**

Items marked with a bold **OP** (Online Publication) are available at no charge and may be downloaded from the CAS website.

Please check the "*Syllabus* Updates" section of the CAS Web Site for any changes to the *Syllabus*.

The inherent nature of the material addressed in this nation-specific exam makes it subject to continual development and change. It is expected that the candidates will respond to exam questions based on the current syllabus presented below. Recognizing the changing nature of law, regulation, and financial reporting requirements, however, the CAS Syllabus & Examination Committee will strive to acknowledge candidates who also respond with the current state in their solutions to examination questions.

In addition, this exam assumes that the candidate has completed Online Course 2. Online Course 2 contains fundamental background material for both Section A (Regulation of Insurance and Canadian Insurance Law) and Section C (Financial Reporting and Solvency).

CHANGES FROM THE SPRING 2020 SYLLABUS:

To assist candidates in finding the differences from the Spring 2020 syllabus, the changes are summarized below:

- Delete the reading - Canadian Institute of Actuaries, "Second Revision of Educational Note: Dynamic Capital Adequacy Testing," November 2017, excluding Appendix A.
- Amend Knowledge Statement C.2.b from "DCAT" to "FCT."
- Remove the note that candidates may answer based on either DCAT or FCT.

In addition, material deleted from the Spring 2020 syllabus are shown as inline deletions.

Items printed in **red** indicate an update, clarification, or change from the Spring 2020 Syllabus.

A. Regulation of Insurance and Canadian Insurance Law

Range of weight for Section A: 15-20 percent

Candidates should understand the role of the insurance business as a supplier of a vital service. Because of the essential and highly technical nature of insurance, a system of regulatory controls has been established requiring insurers to demonstrate that they are providing fair and reliable services in accordance with the statutes and regulations of each jurisdiction.

The material in this section encompasses Canadian insurance legislation and regulations including their historical development. Judicial decisions affect insurance regulation and insurance benefits to the extent they interpret the law and thereby modify regulatory behavior. Candidates are presented with a number of Canadian cases that have contributed to the development of legal precedents in the area of insurance.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Describe the historical development of insurance legislation and regulations, including the division of responsibility between federal and provincial/state regulators. Range of weight: 2-6 percent	a. British North America Act b. Privy Council c. Federal and provincial regulation of insurance d. Office of the Superintendent of Financial Institutions e. Foreign and provincial insurance companies f. Nature of Canadian insurance regulations
READINGS	
• Baer and Rendall • KPMG PACICC • McDonald	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
2. Discuss the current state of insurance regulation in Canada. Range of weight: 5-8 percent	a. Motor vehicle injury compensation systems b. Rate regulation in Canada and its effects c. Legislative/Regulatory requirements with respect to Automobile Insurance in Ontario (mandatory insurance coverages, claims settlement practices, underwriting practices, rates, and risk classification) d. Required and prohibited elements of a rate and risk classification system in Ontario Automobile Insurance e. Situations where a certificate of the actuary is required f. Key elements of actuarial analysis required by insurance regulations in Ontario Automobile Insurance g. Elements of actuarial analysis that an actuary must certify (certificate of the actuary) h. Use of credit scoring in ratemaking and underwriting practices i. Market conduct j. Solvency

READINGS

- AAA Credit Scores
- Alberta TNC
- CIA CSOP (Ratemaking, Section 2600)
- EY
- FSCO Coverages
- FSCO Private Auto
- FSCO Reg. 664
- FSCO UBI
- IBC Code of Conduct
- KPMG PACICC
- KPMG Regulatory Oversight
- Marshall
- OSFI Supervisory Framework

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
3. Discuss the issues, outcome, rationale and implications of landmark decisions for the insurance industry. Range of weight: 5-8 percent	a. Specific landmark court decisions cited in the Readings section
READINGS	
• Baer and Rendall • Davidson • Landmark Legal • McDonald	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
4. Describe the litigation environment with respect to insurance. Range of weight: 2-6 percent	a. Trends in tort litigation, including tort reform and class action suits b. Mass torts (e.g., asbestos); examples of the impact of latent liability can have on P&C insurance companies c. Types of litigation costs d. Canadian litigation system vs. other systems
READINGS	
• ATRA • EY • Harris	

B. Government and Industry Insurance Programs

Range of weight for Section B: 15-20 percent

This section focuses on the identification of major Canadian insurance programs administered by government agencies and insurance industry organizations. The candidates are expected to have an understanding of the objectives, operations, and effectiveness of the following insurance programs:

- Agricultural Insurance
- Employment insurance
- Flood insurance
- Guaranty funds including the Canadian Property and Casualty Insurance Compensation Corporation ("PACICC")
- Health care insurance
- Residual personal insurance markets, e.g., auto, property
- Terrorism Risk Insurance
- Workers compensation insurance

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Describe the origin and purpose of specific government and insurance industry programs. Range of weight: 5-7 percent	a. Reason for inception b. Major historical developments c. Philosophy of program
2. Describe the operations and risk transfer process for each government and insurance industry program listed in the introduction to Section B and their interactions with the voluntary private insurance sector.	a. Funding mechanisms and sources of funding b. Allocation/assignment of exposures and associated costs c. Automobile residual market participation ratios d. Eligibility provisions e. Claim settlement and insurance coverage provisions f. Welfare (subsidization) versus insurance principles g. Private response to gap in government program h. Government response to gap in private program
Range of weight: 5-7 percent	

3. Evaluate the effectiveness of a government and insurance industry program (actual, as listed in the introduction to Section B, or hypothetical). Range of weight: 5-7 percent	a. How to measure performance of programs: • Solvency • Efficiencies • Stability • Viability and long term prospects b. How well program meets its purpose c. Effect of external factors (e.g., economic conditions, weather, regulation, etc.)

READINGS

- Agricultural Programs
- CIP Terrorism
- Dibra and Leadbetter
- Dutil
- EY
- Government Insurers Study Note
- IBC Flood
- Morneau Shepell
- PACICC

C. Financial Reporting and Solvency

Range of weight for Section C: 50-55 percent

This section addresses financial reporting and solvency issues. The intent is to address Canadian and global issues related to the reporting of financial results for property and casualty insurers. The core of the syllabus focuses on Canadian issues with an overview of relevant differences in other countries.

Candidates should have detailed knowledge of the contents, purposes, and recent changes in the Canadian Annual Return, including recent guidelines issued by the Office of the Superintendent of Financial Institutions (OSFI) and the provincial regulatory authorities. Specifically, candidates are expected to be knowledgeable of the sections of the Canadian Annual Return related to financial statements (such as the balance sheet and income statement), capital statements, insurance, and reinsurance.

This section is complemented by readings on solvency monitoring systems such as the Minimum Capital Test (MCT), Dynamic Capital Adequacy Testing (DCAT), and ORSA.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Describe the elements and prepare the schedules of the Canadian Annual Return using standards that are current or which have been announced to become effective. Range of weight: 25-30 percent	a. Financial statements prepared in accordance with IFRS • Financial position • Net income • Comprehensive Income • Changes in equity • OSFI annual return • Notes to financial statements b. Valuation of policy liabilities in accordance with accepted actuarial practice in Canada • Claim liabilities • Premium liabilities c. Reinsurance accounting issues • Risk transfer • Effect of different types of reinsurance on financial statements. • Commutation d. Calculation of excess (deficiency) ratio of net claim liabilities e. Calculation of Earthquake Reserves

READINGS

- Blanchard and Klann
- CCIR Instructions
- CAS Financial Reporting
- CIA CSOP
- CIA Discounting
- CIA Duration
- CIA IFRS 17
- CIA Materiality
- CIA MfAD
- CIA Premium Liabilities
- CIA Reinsurance Treatment
- CIA Runoff
- CIA Subsequent Events
- CIA Taxes
- CIA Valuation
- Freihaut and Vendetti
- IAA Risk
- OSFI Annual Return I
- OSFI Annual Return II
- OSFI Earthquake
- OSFI Memorandum

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
2. Evaluate the financial health of an insurance entity based on various solvency frameworks. Range of weight: 25-30 percent	a. MCT b. **FCT** c. Stress testing d. Internal target capital ratios e. MSA ratios f. Key financial measures used by rating agencies g. Rules-based and principles-based solvency regulation (ORSA, MCT, and Solvency II) h. A.M. Best rating system

READINGS

- AM Best Understanding BCAR
- AM Best Catastrophe
- CIA CSOP
- CIA Valuation
- Feldblum
- IFOA
- MSA
- OSFI Annual Return I
- OSFI Annual Return II
- OSFI Corporate Governance
- OSFI MCT
- OSFI Stress Testing
- OSFI Target Capital
- OSFI ORSA

D. Professional Responsibilities of the Actuary in Financial Reporting

Range of weight for Section D: 10-15 percent

This section focuses on the professional responsibilities of the appointed actuary related to the reporting of financial results by property and casualty insurers in Canada. The candidate will be required to understand the various statutory requirements of the appointed actuary under the Insurance Companies Act and the provincial insurance acts related to financial reporting and general corporate governance.

The material in this section encompasses sections of federal and provincial insurance laws and regulations, regulatory guidelines, and professional standards of practice and educational notes issued by the Canadian Institute of Actuaries that are related to the financial reporting of general insurers.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Explain the responsibilities of an actuary as defined by standards of practice, regulators, and insurance laws for financial reporting. Range of weight: 10-15 percent	a. Statutory Actuarial Opinion b. Contents of Statutory Reports of the Actuary c. Standards of Practice d. Educational Notes e. Insurance Companies Act f. Actuary and auditor relationship g. Regulatory requirements

READINGS

- CIA CSOP
- CIA Discounting
- CIA Duration
- CIA IFRS 17
- CIA Materiality
- CIA MfAD
- CIA Models
- CIA Runoff
- CIA Subsequent Events
- CIA Taxes
- CIA Valuation
- IAA Risk
- ICA
- KPMG PACICC
- OSFI AA
- OSFI Earthquake
- OSFI Memorandum

Complete Text References for Exam 6-Canada

Text references are alphabetized by the citation column.

Citation	Abbreviation	Learning Objective	Source
Alberta Treasury Board and Finance, "Alberta Standard Automobile Insurance Policy Form – Transportation Network S.P.F. No. 9," June 28, 2016, pp. 1-4.	Alberta TNC	A2	**OP**
A.M. Best Company, Inc., *A.M. Best Methodology*, "Understanding BCAR For Canadian Property/Casualty Insurers," **July 23, 2020**, pp. 1-9 (up to Section C), 21-29 (B5 Reserve Risk and B6 Premiums Risk), 30-31 (B8 Catastrophe Risk) only. **Candidates may also study from the previous July 13, 2018, version of the paper.** **Links to both versions are provided in the Complete Online Text References for Exam 6C on the CAS website.**	AM Best Understanding BCAR	C2	**OP**
A.M. Best Company, Inc., *A.M. Best Methodology*, "Catastrophe Analysis in A.M. Best Ratings," October 13, 2017.	AM Best Catastrophe	C2	**OP**
American Academy of Actuaries, "NAIC Public Hearing on Credit-Based Insurance Scores," April 30, 2009.	AAA Credit Scores	A2	**OP**
"ATRA Tort Reform Record," CAS Study Note, December 19, 2012.	ATRA	A4	**SK**
Baer, M.G. and Rendall, J.A., *Cases on the Canadian Law of Insurance*, Sixth Edition, Carswell, 2000, pp. 67-91, 93-100, 302-304, 518-529, 821-827, and 829-831. Candidates are responsible for the following cases: *Glenn v. Scottish Union and National Insurance Company Ltd.* (Chapter 1); *Fletcher v. MPIC* (Chapter 8); *and Dillon v. Guardian Insurance* (Chapter 11).	Baer and Rendall	A1, A3	**SK**
Blanchard, R.S. and Klann, J., "Basic Reinsurance Accounting—Selected Topics," CAS Study Note, October 2012.	Blanchard and Klann	C1	**OP**
Canadian Council of Insurance Regulators, *Annual Statement Instructions P&C-1*, 2019, Sections I, III, IV, V, and VI. Candidates will be responsible for detailed instructions for the pages listed in OSFI Annual Return I and OSFI Annual Return II. NOTE: Please use the 2019 edition that has been archived on the CAS Web Site with permission for educational purposes.	CCIR Instructions	C1	**OP NEW**
Canadian Institute of Actuaries, Consolidated Standards of Practice, 1240, 1400, 1510, 1520, 1600, 1700, 2100, 2200, 2400, 2500, and 2600, January 1, 2020.	CIA CSOP	A2, C1, C2, D1	**OP NEW**

Citation	Abbreviation	Learning Objective	Source
Canadian Institute of Actuaries, "Draft Educational Note: Comparison of IFRS 17 to Current CIA Standards of Practice," September 2018, excluding Sections 4.2, 4.3, 5.3, 7.3, 8.1.2, 8.3.1, 8.3.2, and Appendix E. Candidates will not be tested on issues related solely to life assurance.	CIA IFRS 17	C1, D1	**OP**
Canadian Institute of Actuaries, "Educational Note: 2019 Guidance to the Appointed Actuary for Property and Casualty Insurers," October 2019.	CIA Valuation	C1, C2, D1	**OP NEW**
Canadian Institute of Actuaries, "Educational Note: Consideration of Future Income Taxes in the Valuation of Policy Liabilities," July 2005.	CIA Taxes	C1, D1	**OP**
Canadian Institute of Actuaries, "Educational Note: Discounting and Cash Flow Considerations for P&C Insurers," May 2016. Candidates are responsible for the Excel illustrations attached to the Educational Note.	CIA Discounting	C1, D1	**OP**
Canadian Institute of Actuaries, "Educational Note: Duration Considerations for P&C Insurers," March 2017. Candidates are responsible for the Excel illustrations attached to the Educational Note.	CIA Duration	C1, D1	**OP**
Canadian Institute of Actuaries, "Educational Note: Evaluation of the Runoff of P&C Claim Liabilities when the Liabilities are Discounted in Accordance with Accepted Actuarial Practice," June 2011.	CIA Runoff	C1, D1	**OP**
Canadian Institute of Actuaries, "Educational Note: Margins for Adverse Deviations for Property-Casualty Insurance," December 2009, Sections 1 to 5 and 11 only.	CIA MfAD	C1, D1	**OP**
Canadian Institute of Actuaries," Educational Note: Premium Liabilities," July 2016. Candidates are responsible for the Excel illustrations attached to the Educational Note.	CIA Premium Liabilities	C1	**OP**
Canadian Institute of Actuaries, "Educational Note: Subsequent Events," October 2015, excluding Appendix B.	CIA Subsequent Events	C1, D1	**OP**
Canadian Institute of Actuaries, "Report: Materiality," October 2007. Candidates are not responsible for material in the Appendix.	CIA Materiality	C1, D1	**OP**
Canadian Institute of Actuaries, "Report of the CIA Task Force on the Appropriate Treatment of Reinsurance," October 2007. Candidates will be responsible for the following sections: Key Principles of Risk Transfer (pp. 11-12), Qualitative Assessment (pp. 13), Limitations of Risk Transfer (pp. 15-18) and Other Issues (pp. 18-23).	CIA Reinsurance Treatment	C1	**OP**

Citation	Abbreviation	Learning Objective	Source
Canadian Institute of Actuaries, "Use of Models Educational Note," January 2017.	CIA Models	D1	**OP**
Chevalier, Sarah, "Agricultural Risk Management Programs in Canada," October 2014. Note that the table on page 6 is for reference only.	Agricultural Programs	B1-B3	**SK**
Davidson, J., "The Cap on Non Pecuniary General Damages: Where is it Going and How Does it Affect Litigation?"	Davidson	A3	**OP**
Dibra, S. and Leadbetter, D., "Why insurers fail: The dynamics of property and casualty insurance insolvency in Canada," Property and Casualty Insurance Compensation Corporation, 2007, excluding pp. 9-13, 33-40.	Dibra and Leadbetter	B1-B3	**OP**
Dutil, R., "Facility Association," CAS Study Note, May 2008.	Dutil	B1-B3	**OP**
EY, "ICBC Affordable and effective auto insurance – A new road forward for British Columbia," July 2017, Sections 1-4.	EY	A2, A4, B1-B3	**OP**
Feldblum, S., "Rating Agencies," CAS Study Note, October 3, 2011, pp. 1-7 and 14-19, including Appendix A. Candidates are not responsible for Section 4, Appendices B-D, formulæ, and the endnotes.	Feldblum	C2	**OP**
Financial Services Commission of Ontario, "Private Passenger Automobile Filing Guidelines–Major," October 2016, pp. 1-5 (excluding filing format), 11-21 (starting from Section 3), and Appendix B2.	FSCO Private Auto	A2	**OP**
Financial Services Commission of Ontario, "Regulation 664 of the Revised Regulations of Ontario 1990 Automobile Insurance made under the Ontario Insurance Act," amended version as of 4th July 2016.	FSCO Reg. 664	A2	**OP**
Financial Services Commission of Ontario, "Usage-Based Automobile Insurance Pricing in Ontario," Bulletin A-16/16, December 5, 2016.	FSCO UBI	A2	**OP**
Financial Services Commission of Ontario, "What do the coverages mean?," October 2014.	FSCO Coverages	A2	**OP**
Freihaut, D. and Vendetti, P., "Common Pitfalls and Practical Considerations in Risk Transfer Analysis," Casualty Actuarial Society *E-Forum*, Spring 2009. Appendices A and B are for information only and will not be directly tested.	Freihaut and Vendetti	C1	**OP**
Germani, W., et al., "Government Insurers Study Note," CAS Study Note, April 2017, pp. 1-5, excluding Crop Insurance.	Government Insurers Study Note	B1-B3	**OP**

Citation	Abbreviation	Learning Objective	Source
Harris, C., "Tort Reform Tension," Canadian Underwriter.ca, August 2005.	Harris	A4	**OP**
Institute & Faculty of Actuaries General Insurance Reserving Oversight Committee's Working Party on Solvency II Technical Provisions, "Solvency II Technical Provisions for General Insurers," Institute and Faculty of Actuaries, August 2013, Sections 6.4 and 6.5.	IFOA	C2	**OP**
Insurance Bureau of Canada, "Code of Conduct for Insurers' use of Credit Information (CODE)."	IBC Code of Conduct	A2	**OP**
Insurance Bureau of Canada, "The financial management of flood risk," 2015.	IBC Flood	B1-B3	**OP**
"Insurance Companies Act," Chapter 47, Sections 165(1), 165(2), 203, 331(1), 331(2), 331(4), 346, 357-370, 464, 465, 476-478, 517, 581, 625-632, 641, 664, 665, 667(1), 667(2), and 674 (updated to 12th December 2017).	ICA	D1	**SK**
Insurance Institute of Canada, *Advantage Monthly*, "Terrorism Risk and Insurance," February 2017.	CIP Terrorism	B1-B3	**OP**
International Actuarial Association, "Risk Adjustments for Insurance Contracts," May 2018, Overview and Chapter 1 only.	IAA Risk	C1, D1	**SK**
KPMG, "Property and Casualty Insurance Compensation Corporation (PACICC), The Actuaries' role in safeguarding the solvency of P&C insurers," March 2015, Parts 1, 2, 5 and 7 (pp. 43-47 only).	KPMG PACICC	A1, A2, D1	**OP**
KPMG, "Research Report – Best Practices for Actuarial Involvement in the Regulatory Oversight of Property and Casualty Insurance Rates," December 2012, pp. 21-31.	KPMG Regulatory Oversight	A2	**SK**
"Landmark Legal Insurance Cases in Canada" which covers the following cases: *Whiten v. Pilot Insurance Co.*; *Somersall v. Friedman*; *Somersall v. Scottish and York*; *Sansalone v. Wawanesa Mutual Insurance Co.*; *Nichols v. American Home Assurance Co.*; *Amos v. Insurance Corporation of British Columbia*; *KP Pacific Holdings Ltd. v. Guardian Insurance Co. of Canada*; *Alie v. Bertrand & Frere Construction Company Limited*; *Resurface Corp. v. Hanke*; *Morrow v. Zhang* (Sections I, II, III, IV, VI (E), VII, VIII, and IX.); *PIPEDA Report of Findings #2012-005*; *Kusnierz v. Economical Mutual Insurance Company; Aviva Canada Inc. v. Pastore*; *Belanger v. Sudbury*; and *Precision Plating Ltd. v. Axa Pacific Insurance Co.*	Landmark Legal	A3	**SK**
Marshall, D., "Fair Benefits Fairly Delivered," April 2017, pp. 8-12.	Marshall	A2	**OP**

<table>
<tr><th>Citation</th><th>Abbreviation</th><th>Learning Objective</th><th>Source</th></tr>
<tr><td>McDonald, B.R., Life Insurance Laws of Canada (Common Law Provinces), Life Underwriters Association of Canada, 1995, pp. A1-1, A2-1 to A2-9, B1-1 to B1-2, B2-1 to B2-3, and B4-1 to B4-3. Candidates are responsible for all cases cited in this text.</td><td>McDonald</td><td>A1, A3</td><td>SK</td></tr>
<tr><td>Morneau Shepell Handbook of Canadian Pension and Benefit Plans, 16th edition, LexisNexis Canada, 2016, Chapters 17-19. Candidates will not be responsible for specific values and figures included in the text.</td><td>Morneau Shepell</td><td>B1-B3</td><td>SK</td></tr>
<tr><td>MSA Research, Inc., “MSA Report on Property & Casualty, Canada, 2019,” Section 3, pp. 1-10.</td><td>MSA</td><td>C2</td><td>SKU</td></tr>
<tr><td>Odomirok, K.C., et al., Financial Reporting Through the Lens of a Property/ Casualty Actuary, Casualty Actuarial Society, 2014, Edition 4, Chapters 1-5, 25, 27, and 28.</td><td>CAS Financial Reporting</td><td>C1</td><td>OP</td></tr>
<tr><td>Office of the Superintendent of Financial Institutions Canada, “Corporate Governance Guideline,” September 2018, Section V and Annex B only.</td><td>OSFI Corporate Governance</td><td>C2</td><td>OP</td></tr>
<tr><td>Office of the Superintendent of Financial Institutions Canada, “Earthquake Exposure Sound Practices Guideline” Guideline B-9, February 2013.</td><td>OSFI Earthquake</td><td>C1, D1</td><td>OP</td></tr>
<tr><td>Office of the Superintendent of Financial Institutions Canada, Guideline E-15, “Appointed Actuary: Legal Requirements, Qualifications, and Peer Review,” September 2012.</td><td>OSFI AA</td><td>D1</td><td>OP</td></tr>
<tr><td>Office of the Superintendent of Financial Institutions Canada Guideline E-18, “Stress Testing,” December 2009.</td><td>OSFI Stress Testing</td><td>C2</td><td>OP</td></tr>
<tr><td>Office of the Superintendent of Financial Institutions Canada Guideline, “Minimum Capital Test (MCT) for Federally Regulated Property and Casualty Insurance Companies, Effective January 1, 2019.” Candidates are <u>not</u> responsible for the following sections:
<table>
<tr><td>1.2.2.</td><td>2.1.1.1.
2.1.2.
2.1.3.
App. 2-A</td><td>3</td><td>4.6.</td><td>5.1.1.5.
5.1.1.6.
5.2.2.
5.3.4.1.
5.3.4.2.</td><td>6.1.1.
6.2.1.
6.2.2.
6.2.3.
6.3.</td></tr>
</table>
Candidates are <u>not</u> responsible for risk factors relating to insurance, market, or credit risk.</td><td>OSFI MCT</td><td>C2</td><td>OP</td></tr>
<tr><td>Office of the Superintendent of Financial Institutions Canada Guideline, “Regulatory Capital and Internal Capital Targets,” December 2017.</td><td>OSFI Target Capital</td><td>C2</td><td>OP</td></tr>
</table>

Citation	Abbreviation	Learning Objective	Source
Office of the Superintendent of Financial Institutions Canada, "Memorandum for the Appointed Actuary's Report on Property and Casualty Insurance Business," 2019.	OSFI Memorandum	C1, D1	**OP NEW**
Office of the Superintendent of Financial Institutions Canada, "Own Risk and Solvency Assessment," December 2017.	OSFI ORSA	C2	**OP**
Office of the Superintendent of Financial Institutions Canada, "Supervisory Framework," December 2010.	OSFI Supervisory Framework	A2	**OP**
Office of the Superintendent of Financial Institutions Canada, Quarterly Sample Return, 2020, Approved by the Canadian Council of Insurance Regulators – P&C-1Q, pp. 20.10, 20.20, 20.30, 20.42, 20.45, 20.54, 30.61, 30.62, 30.64, 30.66, 30.71, 30.73, 30.75, 30.77, 30.79, 40.07, 60.30, 70.60, 70.61, and 80.10. NOTE: Please use the 2020 edition that has been archived on the CAS Web Site for educational purposes. Candidates may wish to review illustrations of sample Annual Return schedules (please use the link provided on the CAS Web Site). These illustrations are for information only and will not be directly tested.	OSFI Annual Return I	C1, C2	**OP NEW**
Office of the Superintendent of Financial Institutions Canada, Annual Supplement, 2019, Approved by the Canadian Council of Insurance Regulators – P&C-1A, pp. 10.60, 60.40, and 60.41. NOTE: Please use the 2019 edition that has been archived on the CAS Web Site for educational purposes. Candidates may wish to review illustrations of sample Annual Return schedules (please use the link provided on the CAS Web Site). These illustrations are for information only and will not be directly tested.	OSFI Annual Return II	C1, C2	**OP NEW**
Property and Casualty Insurance Compensation Corporation, "Guide to Compensation Plan for Property and Casualty Insurers," May 2010.	PACICC	B1-B3	**OP**

Source Key

B	Book—may be purchased from the publisher or bookstore or borrowed from the CAS Library.
NEW	Indicates new or updated material.
OP	All text references marked as Online Publications will be available on a web page titled Complete Online Text References.
SK	Material included in the Spring 2020 Study Kit. **Candidates should use the Spring 2020 SK for the Fall 2020 examination.**
SKU	Material included in both the Spring 2020 CAS Study Kit and the Spring 2020 Update to the Fall 2019 Study Kit. **Candidates should use the Spring 2020 SKU for the Fall 2020 examination.**

Items printed in **red** indicate an update, clarification, or change.

Publishers and Distributors

Contact information is furnished for those who wish to purchase the text references cited for this exam. Publishers and distributors are independent and listed for the convenience of candidates; inclusion does not constitute endorsement by the CAS.

ACTEX Learning (Mad River Books), 4 Bridge Street, P.O. Box 715, New Hartford, CT 06057; telephone: (800) 282-2839 or (860) 379-5470; fax: (860) 738-3152; e-mail: support@actexmadriver.com; website: www.actexmadriver.com.
Actuarial Bookstore, P.O. Box 69, Greenland, NH 03840; telephone: (800) 582-9672 (U.S. only) or (603) 430-1252; fax: (603) 430-1258; website: www.actuarialbookstore.com.
A.M. Best Company, Inc. Ambest Road, Oldwick, New Jersey, 00858 U.S.A; Website: www.ambest.com
American Academy of Actuaries, 1100 Seventeenth Street NW, Seventh Floor, Washington, DC 20036; telephone: (202) 223-8196; website: www.actuary.org.
American Institute for Chartered Property Casualty Underwriters, Order Department, P.O. Box 3016, 720 Providence Road, Malvern, PA 19355-0716; telephone: (610) 644-2100; fax: (610) 640-9576.
Baer, M.G.; and Rendall, J.A., *Cases on the Canadian Law of Insurance*, Fifth Edition, 1995, Carswell, Attention: Customer and Order Services, One Corporate Plaza, 2075 Kennedy Road, Scarborough, Ontario M1T 3V4, Canada; telephone: (416) 609-3800 or (800) 387-5164; fax: (416) 298-5082; website: www.carswell.com.
Canadian Institute of Actuaries, Secretariat, Suite 820, 360 Albert Street, Ottawa, Ontario K1R 7X7, Canada; telephone: (613) 236-8196; fax: (613) 233-4552; website: www.actuaries.ca.
Casualty Actuarial Society, 4350 N. Fairfax Drive, Suite 250, Arlington, VA 22203; telephone: (703) 276-3100; fax: (703) 276-3108; e-mail: office@casact.org; website: www.casact.org.

Facility Association, 151 Yonge Street, 18th Floor, Toronto, Ontario M5C 2W7, Canada; telephone: (416) 863-1750 or (800) 268-9572; fax: (416) 868-0894.
Financial Institutions Act, "Insurance Companies Act," Chapter 47, The Federal Publication, 388 King Street West, Toronto, Ontario M5V 1K2, Canada; telephone: (416) 860-1611.
Financial Services Regulatory Authority of Ontario, 5160 Yonge Street, P.O. Box 85, North York, Ontario M2N 6L9, Canada; telephone: (416) 250-7250; fax: (416) 590-7070; website: www.fsrao.ca.
Insurance Bureau of Canada, 240 Duncan Mill Road, Suite 700, Toronto, Ontario M3B 1Z4, Canada; telephone: (416) 445-5912; fax: (416) 445-2183.
Insurance Institute of Canada, 18 King Street East, 6th Floor, Toronto, ON M5C 1C4, Canada; telephone: (416) 362-8586; fax: (416) 362-1126; website: https://www.insuranceinstitute.ca.
International Actuarial Association, 99 Metcalfe Street, Suite 1203, Ottawa, Ontario, Canada K1P 6L7; telephone: (613) 236-0886; fax: (613) 236-1386; website: https://www.actuaries.org/iaa.
Morneau Shepell Handbook of Canadian Pension and Benefit Plans, Sixteenth Edition, 2016, LexisNexis Canada, 111 Gordon Baker Road, Suite 900, Toronto, Ontario M2H 3R1, Canada; telephone: (800) 668-6481.
Office of the Superintendent of Financial Institutions Canada, 255 Albert Street, Ottawa, Ontario K1A 0H2 Canada; telephone: (613) 990-7788; fax: (613) 952-8219; website: www.osfi-bsif.gc.ca.

The syllabus for this four-hour exam is defined in the form of learning objectives, knowledge statements, and readings.

LEARNING OBJECTIVES set forth, usually in broad terms, what the candidate should be able to do in actual practice. Included in these learning objectives are certain methodologies that may not be possible to perform on an examination, such as complex simulations, but that the candidate would still be expected to explain conceptually in the context of an examination.

KNOWLEDGE STATEMENTS identify some of the key terms, concepts, and methods that are associated with each learning objective. These knowledge statements are not intended to represent an exhaustive list of topics that may be tested, but they are illustrative of the scope of each learning objective.

READINGS support the learning objectives. It is intended that the readings, in conjunction with the material on earlier examinations, provide sufficient resources to allow the candidate to perform the learning objectives. Some readings are cited for more than one learning objective. The CAS Syllabus & Examination Committee emphasizes that candidates are expected to use the readings cited in this *Syllabus* as their primary study materials.

Thus, the learning objectives, knowledge statements, and readings complement each other. The learning objectives define the behaviors, the knowledge statements illustrate more fully the intended scope of the learning objectives, and the readings provide the source material to achieve the learning objectives. Learning objectives should not be seen as independent units, but as building blocks for the understanding and integration of important competencies that the candidate will be able to demonstrate.

Note that the range of weights shown should be viewed as a guideline only. There is no intent that they be strictly adhered to on any given examination—the actual weight may fall outside the published range on any particular examination.

The overall section weights should be viewed as having more significance than the weights for the individual learning objectives. Over a number of years of examinations, absent changes, it is likely that the average of the weights for each individual overall section will be in the vicinity of the guideline weight. For the weights of individual learning objectives, such convergence is less likely. On a given examination, in which it is very possible that not every individual learning objective will be tested, there will be more divergence of guideline weights and actual weights. Questions on a given learning objective may be drawn from any of the listed readings, or a combination of the readings. There may be no questions from one or more readings on a particular exam.

After each set of learning objectives, the readings are listed in abbreviated form. Complete text references are provided at the end of this exam syllabus.

Items marked with a bold **SK** or **SKU** constitute the Fall 2019-Spring 2020 Exam 6-US Study Kit that may be purchased from the CAS Online Store. The 2019 Update to the Fall 2018-Spring 2019 Study Kit includes only the new items marked with a bold **SKU**; the Update may be purchased from the CAS Online Store. **Candidates should use the Fall 2019-Spring 2020 SK and/or SKU for the Fall 2020 examination.**

Items marked with a bold **OP** (Online Publication) are available at no charge and may be downloaded from the CAS website.

Please check the "*Syllabus* Updates" section of the CAS Web Site for any changes to the *Syllabus*.

Section A of this examination covers insurance regulation with regards to property-casualty coverages, ratemaking, pricing, and solvency, and U.S. tort law as it affects the property-casualty business. Section B covers markets, coverages, and private and governmental programs for the property-casualty business in the United States. Section C covers the aspects of statutory, Generally Accepted Accounting Principles (GAAP), and International Financial Reporting Standards (IFRS) insurance accounting and taxation as these affect reserving and statutory reporting in the United States. Section D covers the professional responsibilities of the appointed actuary according to the Property and Casualty Annual Statement Instructions issued by the National Association of Insurance Commissioners (NAIC). Section E presents the general concepts of reinsurance accounting to the candidate.

The inherent nature of the material addressed in this nation-specific exam makes it subject to continual development and change. It is expected that the candidates will respond to exam questions based on the current syllabus presented below. Recognizing the changing nature of law, regulation, and financial reporting requirements, however, the CAS Syllabus & Examination Committee will strive to acknowledge candidates who also respond with the current state in their solutions to examination questions.

In addition, this exam assumes that the candidate has completed Online Course 2. Online Course 2 contains fundamental background material for Section A (Regulation of Insurance and United States Insurance Law), Section C (Financial Reporting and Taxation), and Section E (Reinsurance Accounting Principles).

A. Regulation of Insurance and United States Insurance Law

Range of weight for Section A: 15-20 percent

Candidates should understand that insurers are regulated by various governmental agencies because insurance is a valuable public service. An understanding of the dual U.S. state and federal regulatory system is required, along with the various state systems of regulation. The major areas of regulation for rate, contract terms, and solvency should be understood, as should the role of antitrust law as it pertains to insurance regulation.

Regulation as it affects insurance ratemaking in the U.S. is covered. Regulatory and political aspects of risk classification are also covered. Some learning objectives extend the topic to regulation and governmental actions designed to enhance the availability of insurance.

This section also covers the regulation for solvency in the U.S., including financial ratios tested by the National Association of Insurance Commissioners, Insurance Regulatory Information System (IRIS) tests and guaranty fund mechanisms set up by the various states. Also covered are risk-based capital calculations from the statutory blank and how they are used to monitor solvency.

U.S. tort law, while not a strictly actuarial subject, affects many areas of an actuary's work. The judicial role in the development of tort law is also covered.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Describe the historic development and the current state of insurance regulation. Range of weight: 3-7 percent	a. Basis of insurance regulation b. Functions of NAIC c. Antitrust provisions d. Rate regulation
READINGS	
• Kucera • McCarty • NAIC Price • NAIC Solvency Regulatory Framework • NAIC Telematics • Porter 1	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
2. Discuss the historic development of solvency regulation; describe current programs used to monitor solvency. Range of weight: 3-7 percent	a. Solvency, including RBC, insolvency, insurance department examination, and NAIC regulatory tests such as IRIS b. Receivership

READINGS

- CAS Financial Reporting
- NAIC IRIS
- NAIC Solvency Regulatory Framework
- Porter 1
- Porter 2
- Vaughn

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
3. Describe current regulation addressing specialized insurance topics. Range of weight: 0-5 percent	a. Surplus Lines Companies b. Risk Retention Groups and Purchasing Groups c. Captives d. Admitted vs. Non-admitted Companies e. Rating Agencies

READINGS

- Baribeau
- Dearie
- Feldblum (Rating Agencies)
- GAO Report
- NAIC Solvency Regulatory Framework
- Porter 1

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
4. Discuss the issues, outcome, rationale, and implications of landmark decisions and antitrust laws for the insurance industry including the division of responsibility between federal and state regulators. Range of weight: 3-7 percent	a. Federal and State Antitrust Laws (e.g. Sherman Antitrust) b. McCarran-Ferguson c. Southeastern Underwriters d. Dodd-Frank Act e. Gramm Leach Bliley Act f. Paul vs. Virginia

READINGS

- Baribeau
- Dearie
- NAIC Solvency Regulatory Framework
- Porter 1
- Vaughn

B. Government and Industry Insurance Programs

Range of weight for Section B: 10-15 percent

This section focuses on the identification of major United States insurance programs administered by government agencies and insurance industry organizations. The candidates are expected to have an understanding of the objectives, operations, and effectiveness of the following insurance programs:

- Automobile Plans, e.g., MD Fund
- Crop Insurance
- Flood insurance
- Government Backstops, e.g., TRIA and Florida Hurricane Catastrophe Fund
- Guaranty funds
- Residual markets, e.g., auto, workers compensation, property
- Workers compensation, including its interaction with Medicare

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Describe the origin and purpose of government and industry insurance programs. Range of weight: 3-7 percent	a. Reason for inception b. Major historical development c. Philosophy of program
2. Describe the operations and risk transfer process for government/industry programs and their interaction with voluntary private insurance sector. Range of weight: 3-7 percent	a. Funding mechanisms/sources b. Allocation/assignment of exposures and associated costs c. Claim settlement and insurance coverage provisions d. Welfare (subsidization) versus insurance principles
3. Evaluate the effectiveness of a government/industry program. Range of weight: 3-7 percent	a. Solvency b. Efficiencies c. Stability d. Viability/longer term prospects e. How well program meets its purpose

READINGS

- Cook
- Government Insurers Study Note
- Horn & Webel
- Porter 2
- Webel 1
- Webel 2

C. Financial Reporting and Taxation

Range of weight for Section C: 35-55 percent

This section addresses financial reporting, solvency, and taxation issues. Candidates should have detailed knowledge of the contents, purposes, and recent changes in the NAIC Annual Statement and the Insurance Expense Exhibits. Knowledge of federal income tax treatment, including loss reserve discounting, is expected.

Candidates may find it valuable to review an actual insurer's Annual Statement to gain a more complete understanding of the key schedules, particularly the Notes to Financial Statements and General Interrogatories Sections. A candidate may review the Annual Statement of the company for which the candidate works or the Annual Statement of a publicly held company. There are links to publicly available Annual Statements of a few U.S. insurers in the citation for the NAIC Annual Statement Examples in the Complete Text References section below. Candidates are not responsible for the details of the companies' Annual Statement.

Candidates should understand the details of, and the reasons for, the differences between Generally Accepted Accounting Principles (GAAP), Statutory Accounting Principles (SAP), and International Financial Reporting Standards (IFRS).

This section is complemented by readings on solvency monitoring systems such as Risk Based Capital (RBC) and the IRIS ratios.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Describe the elements of the Annual Statement. Complete specific schedules and exhibits and use them to evaluate the financial health of an insurance entity. Range of weight: 20-25 percent	a. Balance sheet b. Income statement c. Change in surplus d. Schedule P e. Insurance Expense Exhibit f. Notes to financial statements g. Reinsurance accounting including Schedule F h. Underwriting and Investment Exhibit i. Exhibit of Premiums and Losses (Statutory Page 14)

READINGS

- 2018 IEE
- CAS Financial Reporting
- Feldblum (Surplus)
- NAIC Annual Statement
- NAIC Annual Statement Examples
- NAIC SSAP 5R, 9, 53, 55, 62R, and 65

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
2. Using RBC formulas and IRIS ratios, evaluate an insurer's financial health. Range of weight: 10-15 percent	a. RBC formula b. Components of RBC c. IRIS ratios d. Interaction of RBC and IRIS Ratios
READINGS	
• CAS Financial Reporting • NAIC IRIS	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
3. Differentiate between various accounting reporting principles and standards. Range of weight: 5-10 percent	a. U.S. Statutory Accounting Principles b. Generally Accepted Accounting Principles (SEC Filers) c. Adjustments to go from SAP to GAAP d. Fair Value of claims liabilities, including Risk Margins e. International Financial Reporting Standards f. Solvency II
READINGS	
• CAS Financial Reporting • NAIC APPM, Preamble • NAIC Solvency Regulatory Framework	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
4. Discuss and calculate specific elements of income tax and evaluate their implications for a property/casualty insurer. Range of weight: 0-5 percent	a. Discounting b. Elements of income tax calculation c. Statutory book income versus taxable income d. Alternative minimum tax e. Investment income
READINGS	
• CAS Financial Reporting	

D. Professional Responsibilities of the Actuary in Financial Reporting

Range of weight for Section D: 15-20 percent

This section focuses on the professional responsibilities of the appointed actuary related to the reporting of financial results by property/casualty insurance companies in the United States of America. The identification of the appointed actuary is described in the Property and Casualty Annual Statement Instructions issued by the NAIC.

The candidate will be required to understand the various statutory requirements of the appointed actuary, and the appropriate professional standards and educational notes issued by the American Academy of Actuaries that are related to the financial reporting of property and casualty insurance companies.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Explain the responsibilities of an actuary as defined by standards of practice, regulators, and insurance laws for financial reporting. Range of weight: 15-20 percent	a. Statutory Prescribed Statement of Actuarial Opinion b. Standards of Practice c. Actuarial Report d. Actuary and auditor relationship e. Materiality f. Actuarial Opinion Summary

READINGS

- AAA Materiality
- ASOPs 20, 36, 41, and 43
- CAS Financial Reporting
- COPLFR P&C Practice Note

E. Reinsurance Accounting Principles

Range of weight for Section E: 5-10 percent

This section presents the general concepts of reinsurance accounting to the candidate. The candidate should become familiar with reinsurance accounting terminology and practice.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Describe reinsurance accounting terminology and practice, and evaluate considerations such as risk transfer testing and commutations. Range of weight: 5-10 percent	a. Identification and evaluation of insurance and financing components of the contracts b. Determination whether the contract qualifies for insurance accounting treatment or deposit accounting treatment (i.e., passes risk transfer), and understand impact on financial statements c. Commutations—definition, motivations of parties, and accounting and tax treatment

READINGS

- ASC 944-020-15
- Blanchard and Klann
- Freihaut & Vendetti
- Klann
- NAIC SSAP 62R

Complete Text References for Exam 6-US

Text references are alphabetized by the citation column.

Citation	Abbreviation	Learning Objective	Source
2018 Insurance Expense Exhibit.	2018 IEE	C1	**B NEW**
Actuarial Standards Board of the American Academy of Actuaries, "Actuarial Standard of Practice, No. 20, Discounting of Property/Casualty Unpaid Claim Estimates," September 2011.	ASOP 20	D1	**OP**
Actuarial Standards Board of the American Academy of Actuaries, "Actuarial Standard of Practice No. 36, Statements of Actuarial Opinion Regarding Property/Casualty Loss and Loss Adjustment Expense Reserves," December 2010, updated for deviation language in May 2011.	ASOP 36	D1	**OP**
Actuarial Standards Board of the American Academy of Actuaries, "Actuarial Standard of Practice No. 41, Actuarial Communications," December 2010.	ASOP 41	D1	**OP**
Actuarial Standards Board of the American Academy of Actuaries, "Actuarial Standard of Practice No. 43, Property/Casualty Unpaid Claim Estimates," June 2007, updated for deviation language in May 2011.	ASOP 43	D1	**OP**
American Academy of Actuaries, Task Force on Materiality, "Materiality, Concepts on Professionalism," Discussion Paper, Professionalism Series, 2006, No. 8, June 2006.	AAA Materiality	D1	**OP**
Baribeau, A.G., "Demystifying the Regulatory Web," Actuarial Review, March/April 2016.	Baribeau	A3-A4	**OP**
Blanchard, R.S.; and Klann, J., "Basic Reinsurance Accounting–Selected Topics," CAS Study Note, October 2012.	Blanchard and Klann	E1	**OP**
Committee on Property and Liability Financial Reporting, American Academy of Actuaries, "A Public Policy Practice Note, Statements of Actuarial Opinion on Property & Casualty Loss Reserves, 2018." Exclude Appendix I.1.3 NAIC Title SAO Instructions and Appendix IV. SSAPs. Note that SSAP 5R, 9, 53, 55, 62R, and 65 found in Appendix IV are readings for Learning Objectives C1 and E1 for this exam.	COPLFR P&C Practice Note	D1	**OP NEW**
Cook, Mary Ann, ed., *Personal Insurance,* (Second Edition), The Institutes, 2013, pp. 2.13-2.15 and 7.32-7.36.	Cook	B1-B3	**SK**

Citation	Abbreviation	Learning Objective	Source
Dearie, J. P., editor, "2018 Excess and Surplus Lines Laws in the United States," Locke Lord LLP, pp. ii-iv (stop at Calculation of Surplus Lines Taxes Under NRRA) and pp. 1.1-1.5 excluding the sections on: • NAIC Approval, pp. 1.1-1.2; • Industrial Insurance, pp. 1.3-1.4; and • Ocean Marine and Transportation Insurance, p. 1.4.	Dearie	A3, A4	**SKU NEW**
Feldblum, S., "Rating Agencies," CAS Study Note, October 3, 2011, pp. 1-7 and 14-15 (stop at Best's Capital Adequacy Ratio) and Appendix A. Candidates are not responsible for Section 4, Section 5 beginning at Best's Capital Adequacy Ratio on p. 15, Appendices B-D, and the endnotes.	Feldblum (Rating Agencies)	A3	**OP**
Feldblum, S., "Statutory Surplus: Computation, Pricing and Valuation," CAS Study Note, June 2003, including errata. Candidates are not responsible for the endnotes.	Feldblum (Surplus)	C1	**OP**
Financial Accounting Standards Board, Accounting Standards Codification 944, "Financial Guarantee Insurance Contracts," 2011, Section 15, Scope and Scope Exceptions, paragraphs 15-1 to 15-2; 15-5 to 15-7; 15-34 to 15-35; 15-41 to 15-44; and 15-49 to 15-54. Candidates are not responsible for material relating to long-duration contracts and/or life insurance.	ASC 944-020-15	E1	**SK**
Freihaut, D.; and Vendetti, P., "Common Pitfalls and Practical Considerations in Risk Transfer Analysis," Casualty Actuarial Society *E-Forum*, Spring 2009. Appendices A and B are for information only and will not be directly tested.	Freihaut & Vendetti	E1	**OP**
"GAO Report to Congressional Requesters, Risk Retention Groups, Clarifications Could Facilitate States' Implementation of the Liability Risk Retention Act," United States Government Accountability Office, GAO-12-16, December 2011, pp. 5-7 and 34-38.	GAO Report	A3	**OP**
Germani, W., et al., "Government Insurers Study Note," CAS Study Note, April 2017, pp. 1-16.	Government Insurers Study Note	B1-B3	**OP**
Horn, D. and Webel, B., "Private Flood Insurance and the National Flood Insurance Program" July 31, 2018, Congressional Research Service R45242, pp. 1-19.	Horn & Webel	B1-B3	**OP NEW**

Citation	Abbreviation	Learning Objective	Source
Karapiperis, Dimitri; Birnbaum, Birny; Brandenberg, Aaron; Castagna, Sandra; Greenberg, Allen; Harbage, Robin; and Obersteadt, Anne, *Usage-Based Insurance and Vehicle Telematics: Insurance Market and Regulatory Implications,* National Association of Insurance Commissioners, CIPR Study, March 2015, pp. 1-16 (excluding section on Tower Watson's DriveAbility) and 42-60.	NAIC Telematics	A1	**OP**
Klann, J., "Reinsurance Commutation," 2013.	Klann	E1	**OP**
Kucera, J., "NAIC Public Hearing on Credit-Based Insurance Scores," American Academy of Actuaries, April 30, 2009.	Kucera	A1	**OP**
McCarty, K.M., "Testimony of Kevin M. McCarty, Florida Insurance Commissioner, Florida Office of Insurance Regulation and Representing the National Association of Insurance Commissioners, Regarding: 'The Impact of Credit-Based Insurance Scoring on the Availability and Affordability of Insurance,' May 21, 2008," Subcommittee on Oversight and Investigations of the House Committee on Financial Services, excluding Appendices 1 and 2.	McCarty	A1	**OP**
National Association of Insurance Commissioners, *Accounting Practices and Procedures Manual*, 2018, Preamble.	NAIC APPM, Preamble	C3	**SKU NEW**
National Association of Insurance Commissioners, *Accounting Practices and Procedures Manual*, 2018, Statement of Statutory Accounting Principles 5R, "Liabilities, Contingencies and Impairment of Assets," paragraphs 1-12, 26-29, and 33-34. This material is available in Appendix IV of the COPLFR P&C Practice Note.	NAIC SSAP 5R	C1	**OP NEW** **See COPLFR Practice Note**
National Association of Insurance Commissioners, *Accounting Practices and Procedures Manual*, 2018, Statement of Statutory Accounting Principles 9, "Subsequent Events," paragraphs 1-8. This material is available in Appendix IV of the COPLFR P&C Practice Note.	NAIC SSAP 9	C1	**OP NEW** **See COPLFR Practice Note**
National Association of Insurance Commissioners, *Accounting Practices and Procedures Manual*, 2018, Statement of Statutory Accounting Principles 53, "Property Casualty Contracts—Premiums," paragraphs 1-18. This material is available in Appendix IV of the COPLFR P&C Practice Note.	NAIC SSAP 53	C1	**OP NEW** **See COPLFR Practice Note**

Citation	Abbreviation	Learning Objective	Source
National Association of Insurance Commissioners, *Accounting Practices and Procedures Manual*, 2018, Statement of Statutory Accounting Principles 55, "Unpaid Claims, Losses and Loss Adjustment Expenses," paragraphs 1-6 and 10-17. This material is available in Appendix IV of the COPLFR P&C Practice Note.	NAIC SSAP 55	C1	**OP** **NEW** **See COPLFR Practice Note**
National Association of Insurance Commissioners, *Accounting Practices and Procedures Manual*, 2018, Statement of Statutory Accounting Principles 62R, "Property and Casualty Reinsurance," paragraphs 1-90. This material is available in Appendix IV of the COPLFR P&C Practice Note.	NAIC SSAP 62R	C1, E1	**OP** **NEW** **See COPLFR Practice Note**
National Association of Insurance Commissioners, *Accounting Practices and Procedures Manual*, 2018, Statement of Statutory Accounting Principles 65, "Property and Casualty Contracts," paragraphs 1-46. This material is available in Appendix IV of COPLFR P&C Practice Note.	NAIC SSAP 65	C1	**OP** **NEW** **See COPLFR Practice Note**
National Association of Insurance Commissioners, "NAIC Insurance Regulatory Information System (IRIS) Ratios Manual," 2018, Section II, Property/Casualty Ratios, pp. 5-26.	NAIC IRIS	A2, C2	**OP** **NEW**
National Association of Insurance Commissioners, *Official 2018 NAIC Annual Statement Blanks, Property and Casualty*, (both individual and consolidated basis), pp. 2-13, Notes to the Financial Statement p. 14 (refer to the Odomirok paper for the Notes to cover); Schedules D (pp. SI03 through SI09), F (pp. 20-29), H (pp. 30-32), and P (pp. 33-93). Candidates will be expected to have knowledge of other sections of the annual statement that are discussed in other Syllabus readings. Candidates are not responsible for page numbers. [The "Notes to the Financial Statement" are cited for reference only. Candidates are responsible for the Notes as described in the Odomirok reading where the Notes are referenced by title. If the 2018 Annual Statement and the study materials differ, candidates may base their answers on either.]	NAIC Annual Statement	C1	**B** **NEW**

Citation	Abbreviation	Learning Objective	Source
National Association of Insurance Commissioners Official Annual Statement Examples: The following companies post their annual statements online. Candidates may use these (or their own company's statements) as illustrations to better understand the annual statement but are not responsible for any company-specific data: (1) Travelers and (2) the Liberty Mutual Group.	NAIC Annual Statement Examples	C1	**OP NEW**
National Association of Insurance Commissioners, Casualty Actuarial and Statistical Task Force, *Price Optimization White Paper,* November 2015, pp. 1-16.	NAIC Price	A1	**OP**
NAIC White Paper, "The U.S. National State-Based System of Insurance Regulation and the Solvency Modernization Initiative," 2013. Candidates are **not** responsible for the following: • Section 2: paragraphs 15-18, 26-28, 32-34, 41-42, Appendix 1, and Appendix 2; • Section 3: paragraphs 9, 13-15, 23-32, and 38-39; • Section 4; and • Section 5: paragraphs 9, 20-29, 30-45, and 61-86.	NAIC Solvency Regulatory Framework	A1-A4, C3	**OP**
Odomirok, K.C., et al., *Financial Reporting Through the Lens of a Property/ Casualty Actuary*, Casualty Actuarial Society, 2014, Edition 4, excluding Part VII [Canadian Introduction and Canadian Chapters 27-29 (pp. 335-362)] and Appendix II. Including Errata.	CAS Financial Reporting	A2, C1-C4, D1	**OP**
Porter, K., *Insurance Regulation*, Insurance Institute of America, 2008, Chapters 2 (exclude pp. 2.19-2.29), 3 (exclude pp. 3.21 starting at Other Interest Groups -3.25), 4 (exclude pp. 4.16-4.23), 5 (exclude pp. 5.12-5.22), 6 (pp. 6.11-6.17), 8 (pp. 8.3-8.6 and 8.12-8.15), and 12 (exclude pp. 12.12-12.17).	Porter 1	A1-A4	**B**
Porter, K., *Insurance Regulation*, Insurance Institute of America, 2008, Chapter 12 (pp. 12.12-12.17).	Porter 2	A2, B1-B3	**B**
Vaughn, T., "The Economic Crisis and Lessons from (and for) U.S. Insurance Regulation," Journal of Insurance Regulation, Fall 2009, pp. 3-16.	Vaughn	A2, A4	**OP NEW**
Webel, B., "Terrorism Risk Insurance: Issue Analysis and Overview of Current Program," Congressional Research Service, July 23, 2014, pp. 5-11.	Webel 1	B1-B3	**OP**
Webel, B., "Terrorism Risk Insurance Legislation the 114th Congress: Issue Summary and Side-by-Side Analysis," Congressional Research Service, January 20, 2015, Summary page and pp. 1-3.	Webel 2	B1-B3	**OP**

Source Key

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American Institute for Chartered Property Casualty Underwriters, Order Department, P.O. Box 3016, 720 Providence Road, Malvern, PA 19355-0716; telephone: (610) 644-2100; fax: (610) 640-9576.
Association Form of the Annual Statement Blanks, Bowne Insurance Services, 1717 Arch Street, 31st Floor, Philadelphia, PA 19103; telephone: (215) 988-5690 or (800) 234-6859.
Casualty Actuarial Society, 4350 N. Fairfax Drive, Suite 250, Arlington, VA 22203; telephone: (703) 276-3100; fax: (703) 276-3108; e-mail: office@casact.org; website: www.casact.org.

Insurance Expense Exhibit, Bowne Insurance Services, 1717 Arch Street, 31st Floor, Philadelphia, PA 19103; telephone: (215) 988-5690 or (800) 223-3103.
Insurance Institute of America, 720 Providence Road, Malvern, PA 19355-0770; telephone: (610) 644-2100.
Journal of Insurance Regulation, National Association of Insurance Commissioners, 120 W. 12th Street, #1100, Kansas City, MO 64105; telephone: (816) 842-3600.
NAIC Annual Statement Blanks, Property and Casualty may be obtained from Bowne Insurance Services, 1717 Arch Street, 31st Floor, Philadelphia, PA 19103; telephone: (215) 988-5690 or (800) 223-3103.
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A. Estimation of Policy Liabilities

Range of weight for Section A: 65-75 percent

This section focuses on advanced techniques that the actuary may need to estimate reserves for unpaid claims. The candidate is expected to be well versed in the basic Principles and Standards of Practice for unpaid claim estimation. This section addresses how actuarial concepts are adapted to evaluate liabilities arising in complex risk transfer agreements common in excess insurance and reinsurance contracts. Emphasis is placed on developing ranges around a best estimate.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Calculate unpaid claim estimates using credibility models. Range of weight: 10-14 percent	a. Application of credibility b. Mechanics of the methods (including loss ratio based payout factors) c. Strengths and weaknesses d. Testing results for reasonableness
READINGS	
• Brosius • Hürlimann • Mack (2000)	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
2. Estimate parameters and unpaid claims using claims development models related to loss reserving methods such as: • Chain ladder • Cape Cod • Chain ladder plus calendar-year effects • Bornhuetter-Ferguson 3. Calculate the moments and percentiles of unpaid claim distributions implied by the models. Range of weight for Learning Objectives A.2 and A.3 collectively: 16-18 percent	a. Key assumptions of the models and testing of assumptions b. Original Mack chain ladder assumptions c. Relationship of variance assumptions to methods of calculating development factors d. Row-factor, column-factor, and combined row-times column-factor models e. Calendar-year effects in development factor models and in row-column factor models f. Effect of trends and their interrelationship (e.g., calendar year, accident year, and development year trends) g. Testing for and eliminating insignificant parameters h. Testing whether the methods work and how well the models fit (including both one-tail and two-tail tests) i. Moments of the chain ladder unpaid claim estimate when factors are calculated based on different variance assumptions j. Simulation of parameter percentiles and unpaid claims percentiles when models assume a distribution of residuals fit by MLE

READINGS

- Clark
- Mack (1994)
- Venter Factors

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
4. Estimate unpaid claims for various layers of claims. Range of weight: 5-7 percent	a. Methods for estimating unpaid claims in a deductible layer, excess of a threshold, and excess of a retention but bounded by a limit b. Interrelationships between parameters and development patterns for forecasting deductible, unlimited excess, layer excess and total claims
READINGS	
• Sahasrabuddhe • Siewert	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
5. Describe the various sources of risk and uncertainty that are associated with the determination of reserves. Calculate risk margins that consider these sources of risk and uncertainty.	a. Systemic risks and independent risks b. Limitations of quantitative risk assessment c. Risk correlations d. Testing and evaluation of risk models
6. Calculate the mean and prediction error of a reserve given an underlying statistical model.	a. Distributions and distribution-free models b. Comparison of Chain Ladder stochastic models
7. Derive predictive distributions using bootstrapping, simulation techniques, and generalized linear models.	a. Comparison of methods b. Simulation using bootstrapping c. Simulation from parameters d. Bayesian methods e. Generalized linear models
8. Identify data issues and related model adjustments for reserving models. 9. Test assumptions underlying reserve models. 10. Develop a distribution of reserves using weights and multiple stochastic models. Range of weight for Learning Objectives A.5 through A.10 collectively: 22-24 percent	a. Bayesian methods b. Adjustments to various reserving techniques c. Comparison of ODP Bootstrap and GLM Bootstrap models

READINGS

- Marshall et al.
- Shapland
- Taylor
- Verrall
- Meyers (2015)

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
11. Compare and contrast reinsurance and primary reserving procedures. 12. Adjust primary methods and data to be used for reinsurance reserving. 13. Calculate ceded loss reserves using appropriate methods. Range of weight for Learning Objectives A.11 through A.13 collectively: 6-9 percent	a. Reinsurance and primary reserving methods b. Effect on assumptions from differences in information available to reinsurers c. Stanard-Buhlmann (Cape Cod) method d. Underlying business characteristics of reinsurance contracts, e.g., concentration of exposures e. Data structures, e.g., Ground up versus Excess loss, Accident Year versus Treaty Year
READINGS	
• Patrik	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
14. Forecast Premium Reserves. Range of weight: 4-5 percent	a. Reserves for retrospective premiums
READINGS	
• Teng and Perkins	

B. Insurance Company Valuation

Range of weight for Section B: 8-12 percent

This section focuses on methods used to determine the theoretical value of equity securities and extending the methodology to value property and casualty insurance companies. The candidate is expected to be proficient with the basic tools and techniques commonly used in the financial analysis of corporations as described in the knowledge requirements set forth for VEE–Accounting and Finance (previously VEE-Corporate Finance).

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Calculate the effect of loss and expense reserve requirements and regulatory or rating agency capital requirements on the free cash flow to equity for a P&C insurer.	a. Calculate the effect of loss and expense reserve requirements and regulatory or rating agency capital requirements on the free cash flow to equity for a P&C insurer.
2. Value the equity of a P&C insurer based on its expected future dividends, its free cash flow to equity, or its expected abnormal earnings	a. Dividend Discount Model (DDM) b. Free cash flow to equity for a P&C insurer c. Discounted Cash Flow (DCF) Valuation using free cash flow to equity (FCFE), including effect of alternative methods of estimating terminal values and reasons why this method is preferred over the free cash flow to the firm (FCFF) method for P&C insurers d. Abnormal Earnings (AE) Valuation, including effect of alternative methods of estimating terminal values e. Option Pricing
3. Value the equity of a firm using comparative or relative valuation methods based on multiples of selected financial variables obtained from either peer companies or from underlying fundamentals. Range of weight for Learning Objectives B.1 through B.3 collectively: 8-12 percent	a. Comparative valuation ratios including price-earnings, price-sales, price-book, price-cash flow b. Relationship between the dividend discount model and the price-earnings (P-E) ratio c. Relationship between the abnormal earnings valuation model and the price-book value (P-BV) ratio
READINGS	
• Goldfarb	

C. Enterprise Risk Management

Range of weight for Section C: 15-25 percent

This section introduces the candidate to the concepts and basic techniques of Enterprise Risk Management (ERM). ERM seeks to integrate the entire landscape of risk that confronts a business. Topics include value of risk management and basic modeling concepts.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Demonstrate how insurance and financial risk can be analyzed quantitatively.	a. Definition of ERM and key elements of consideration b. ERM process and risk management c. ERM risk models evaluation d. Sources of risks and modeling of dependencies e. ERM in setting capital requirements
2. Describe the rationale for, methods for, and effect of managing insurance and financial risks.	a. IRM and other capital adequacy models b. An asset-liability modeling approach c. Reinsurance and Risk optimization
3. Demonstrate the properties of various risk measures and their limitations. 4. Describe how risk measures and risk modeling, including allocation, can affect strategic management.	a. VaR, TVaR, and XTVaR b. Expected policyholder deficit c. Probability transforms d. Generalized moments
5. Describe the use of enterprise-wide risk modeling and aggregation techniques. 6. Evaluate and select appropriate models to handle diverse risks, including stochastic approaches. Range of weight for Learning Objectives C.1 through C.6 collectively: 13-17 percent	a. Incorporating the use of correlation b. Evaluation and selection of appropriate copulas as part of the process of modeling multi-variate risks c. Tail dependence and tail correlations d. Low frequency/high severity events e. Parameter, projection, estimation, and model risk
READINGS	
• Brehm et al., Chapter 1, Chapter 2 (Sections 2.1-2.5), Chapter 3 (Sections 3.1-3.3)	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
7. Describe operational risk and demonstrate possible mitigation and quantification methodology.	a. Types of operational risk b. Key risk indicators and operational risk modeling c. Types of strategic risks d. Examples of strategic risks e. Scenario planning
8. Describe approaches to modeling the underwriting cycle. Range of weight for Learning Objectives C.7 and C.8 collectively: 4-6 percent	a. Definition, characteristics, and drivers of the underwriting cycle b. Soft, behavioral, and technical modeling approaches c. Modeling components: supply and demand, capital flows
READINGS	
• Brehm et al., Chapter 4 and Chapter 5, Section 5.4	

Complete Text References for Exam 7

Text references are alphabetized by the citation column.

Citation	Abbreviation	Learning Objective	Source
Brehm, P.; Gluck, S.; Kreps, R.; Major, J.; Mango, D.; Shaw, R.; Venter, G.; White, S.; and Witcraft, S., Guy Carpenter, "Enterprise Risk Analysis for Property & Liability Insurance Companies," Chapter 1, 2 (excluding Section 2.6), 3 (excluding Section 3.4), 4, and 5 (Section 5.4 only).	Brehm et al.	C1-C8	**SK**
Brosius, E., "Loss Development Using Credibility," CAS Study Note, March 1993.	Brosius	A1	**OP**
Clark, D.R., "LDF Curve Fitting and Stochastic Reserving: A Maximum Likelihood Approach," Casualty Actuarial Society *Forum*, Fall 2003.	Clark	A2-A3	**OP**
Goldfarb, R., "P&C Insurance Company Valuation," CAS Study Note, October 2010.	Goldfarb	B1-B3	**OP**
Hürlimann, W., "Credible Loss Ratio Claims Reserves: The Benktander, Neuhaus and Mack Methods Revisited," *ASTIN Bulletin* 39(1), 2009, pp. 81-99. **Including errata.** Candidates are not responsible for mathematical proofs.	Hürlimann	A1	**OP** **Errata is NEW**
Mack, T., "Measuring the Variability of Chain Ladder Reserve Estimates," Casualty Actuarial Society *Forum*, Spring 1994.	Mack (1994)	A2-A3	**OP**
Mack, T., "Credible Claims Reserve: The Benktander Method," *ASTIN Bulletin*, 2000, pp. 333-337.	Mack (2000)	A1	**OP**
Marshall, K.; Collings, S.; Hodson, M.; and O'Dowd, C., "A Framework for Assessing Risk Margins," Institute of Actuaries of Australia 16th General Insurance Seminar, 9-12 November 2008, Coolum, Australia.	Marshall et al.	A5-A10	**OP**
Meyers, G., "Stochastic Loss Reserving Using Bayesian MCMC Models," CAS Monograph #1.	Meyers (2015)	A5-A10	**OP**
Patrik, G.S., "Reinsurance," *Foundations of Casualty Actuarial Sci*ence, Fourth Edition, Casualty Actuarial Society, 2001, Chapter 7, pp. 434-464 (section on Reinsurance Loss Reserving).	Patrik	A11-A13	**OP**
Sahasrabuddhe, R., "Claims Development by Layer: The Relationship between Claims Development Patterns, Trend and Claim Size Models," Casualty Actuarial Society *E-Forum*, Fall 2010, Volume 1 (revised January 2, 2013). Including errata.	Sahasrabuddhe	A4	**OP**

Citation	Abbreviation	Learning Objective	Source
Shapland, M., "Using the ODP Bootstrap Model: A Practitioner's Guide," CAS Monograph #4. Supplementary modeling files linked on pages 61-62 will aid in understanding of the method's application.	Shapland	A5-A10	**OP**
Siewert, J.J., "A Model for Reserving Workers Compensation High Deductibles," Casualty Actuarial Society *Forum*, Summer 1996, pp. 217-244.	Siewert	A4	**OP**
Taylor, G. and McGuire G., "Stochastic Loss Reserving Using Generalized Linear Models," CAS Monograph #3, Chapters 1-3. Including errata.	Taylor	A5-A10	**OP** **Errata is NEW**
Teng, M.T.S. and Perkins, M.E., "Estimating the Premium Asset on Retrospectively Rated Policies," *PCAS* LXXXIII, 1996, pp. 611-647, excluding Section 5. Including discussion of paper: Feldblum, S., *PCAS* LXXXV, 1998, pp. 274-315, Sections 1 and 2 only. Candidates will not be held responsible for specific Annual Statement notation but will be responsible for concepts presented.	Teng and Perkins	A14	**OP**
Venter, G.G., "Testing the Assumptions of Age-to-Age Factors," *PCAS* LXXXV, 1998, pp. 807-847. **Including errata.**	Venter Factors	A2-A3	**OP** **Errata is NEW**
Verrall, R.J., "Obtaining Predictive Distributions for Reserves Which Incorporate Expert Opinion," Variance, Vol. 1, Issue 1, 2007, Casualty Actuarial Society. Including errata.	Verrall	A5-A10	**OP**

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Candidates for Exam 8 are expected to have already acquired considerable technical knowledge and practical experience in insurance ratemaking. Therefore, this examination will assume a working knowledge of basic ratemaking and will deal with advanced topics. To some degree, the examination will deal with the types of practical problems that a fully qualified actuary, working in ratemaking, should be able to solve. The ability to apply ratemaking knowledge and experience may be tested through questions dealing with problems for which there are no generally recognized solutions. The readings for Exam 8 should be studied for illustration of basic principles and theories, as well as for insight into advanced ratemaking problems and their solutions.

A. Classification Ratemaking

Range of weight for Section A: 20-35 percent

In this exam, classification ratemaking and rate filings, which were introduced earlier in the syllabus, are treated in greater depth. The material in this section provides tools that enable the practitioner to go beyond mechanical construction to the comparison and evaluation of alternative classification schemes.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Identify and evaluate possible rate classes. Range of weight: 5-10 percent	a. Characteristics of appropriate classifications b. Sampling techniques c. Credibility considerations d. Statistical significance e. Cluster analysis
READINGS	
• ASOP 12 • Bailey & Simon • Mahler • Robertson	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
2. Measure statistical significance of possible classes and estimate the loss costs of rating classes. Range of weight: 5-10 percent	a. Multidimensional relativities b. Credibility techniques c. Quintiles Test d. Holdout sample
READINGS	
• Bailey & Simon • Couret & Venter	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
3. Design and build generalized linear models (GLMs) for classification ratemaking.	a. Components of a GLM formula b. Data considerations c. Distribution selection d. Transformation of variables e. Variable interactions
4. Assess model fit and interpret model results Range of weight for Learning Objectives A.3 through A.4 collectively: 10-15 percent	a. Measures of fit: Log-likelihood, Deviance, etc. b. Comparing competing models c. Assessing fit with plots d. Measuring Lift
READINGS	
• GLM	

B. Excess, Deductible, and Individual Risk Rating

Range of weight for Section B: 45-65 percent

One of the important functions performed by an actuary is rating individual risks. Prior to Exam 8, most of the readings addressed group or classification risk rating. This section is intended to prepare candidates to design and manage excess, deductible, and individual risk rating systems.

The readings range from those that discuss the theoretical foundation of excess, deductible, and individual risk rating, to those that discuss the application of specific rating plans. Candidates are expected to apply these concepts in a creative and problem-solving manner.

The first subsection covers pricing for layers of loss including excess and deductible business while the following subsections cover individual risk rating consisting of:

- Experience rating, in which prior individual risk experience is used to adjust rates prospectively.
- Retrospective and loss sensitive rating, in which the insured will pay an amount (in premium or retained loss) that depends on the experience after the policy has been written.

Candidates are also expected to be knowledgeable in the application of individual risk rating plans currently in use. Excerpts from the NCCI *Experience Rating Plan Manual for Workers Compensation and Employers Liability Insurance*, NCCI *Retrospective Rating Plan Manual for Workers Compensation and Employers Liability Insurance*, and ISO *Commercial General Liability Experience and Schedule Rating Plan* will be provided with the examination. Candidates are not required to memorize the details but will be expected to be able to use the details of these plans during the examination. Since the necessary excerpts will be included with the examination, candidates will not be allowed to bring copies of the documents into the examination room.

Excess and Deductible Rating

Excess and deductible rating allows the insured to retain the risk of loss and loss expenses up to limits selected in advance.

This section builds on the material covered in the basic ratemaking section of Exam 5. Candidates should have a general knowledge and understanding of excess coverages and the problems inherent in pricing these coverages for different lines of business.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Apply frequency and severity distributions to determine expected losses by layer of insurance. Range of weight: 6-9 percent	a. Severity distributions and their uses, including increased limits factors (ILFs) and loss elimination ratios (LERs) b. Properties of ILFs and LERs c. Interaction among inflation, changes in layer, and losses d. Methods of estimating frequency and severity distributions from losses
READINGS	
• Bahnemann • Fisher et al. & Case Study	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
2. Estimate aggregate loss distributions. Range of weight: 7-10 percent	a. Techniques to estimate aggregate loss distributions directly from aggregate data (e.g., Table M, Table L) b. Construction of an aggregate loss distribution from frequency and severity distributions
READINGS	
• Bahnemann • Fisher et al. & Case Study	

Experience Rating

The primary goal of experience rating is the adjustment of an individual risk's rate to reflect the extent to which that risk's own experience identifies it as being different from other risks in the same class. The readings begin with principles and concepts, and then move to a discussion of plans in current use.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
3. Adjust class rates based on individual risk experience and exposure. Range of weight: 8-11 percent	a. Actuarial principles and concepts underlying the development of experience rating plans b. Methods to apply credibility concepts to an insured's experience (e.g., maximum single loss) c. Current NCCI and ISO experience rating plans d. Schedule rating and its interaction with experience rating
READINGS	
• Fisher et al. & Case Study • ISO • NCCI 1	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
4. Assess effectiveness of experience rating plans. Range of weight: 6-9 percent	a. Relationship between Modifications and Loss Ratios b. Evaluation techniques, e.g., quintile test c. Over-/Under- corrections
READINGS	
• Fisher et al. & Case Study	

Retrospective and Loss Sensitive Rating

Retrospective rating allows adjustment of individual risk premium after policy expiration in response to actual loss and expenses associated with the policy. The retrospective rating plans currently in use adjust the premium up or down within limits selected in advance.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
5. Construct a loss sensitive rating plan (LSRP). Range of weight: 8-11 percent	a. Actuarial principles and concepts underlying the construction of a retrospective rating plan (e.g., construction of table of insurance charges) b. NCCI retrospective rating plans
READINGS	
• Fisher et al. & Case Study • NCCI Circular	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
6. Analyze the elements of a LSRP. Range of weight: 7-10 percent	a. Influence of the parameters and other elements of the plan on the final price and potential cost of product b. Influence of the parameters and other elements of the plan on cost and cash flow to insured c. Criteria for selecting among various LSRPs
READINGS	
• Fisher et al. & Case Study	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
7. Calculate the cost of the layer of risk given the loss cost. Range of weight: 3-5 percent	a. Impact of policy provisions on expected losses b. Variability of expenses by layer and policy provisions
READINGS	
• Bahnemann • Fisher et al. & Case Study	

C. Catastrophic and Reinsurance Pricing

Range of weight for Section C: 15-20 percent

Catastrophe Ratemaking

This subsection introduces candidates to the methods used to model losses due to catastrophic events for the purpose of generating a catastrophe risk load and to manage the total exposure from catastrophic events within an insurance portfolio.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Describe the components and structure of catastrophe models.	a. Hazard, exposure, vulnerability and loss modules b. Exceedance Probability Curve c. Simulation and modeling techniques
2. Explain the use of catastrophe models in insurance ratemaking and portfolio management. Range of weight for Learning Objectives C.1 and C.2 collectively: 4-6 percent	a. Insurability of catastrophe risks b. Sources and nature of uncertainty in catastrophe modeling c. Use of catastrophe models in insurance ratemaking d. Use of catastrophe models in portfolio management
READINGS	
• Grossi & Kunreuther and including errata for Section 2.4	

Reinsurance Ratemaking

This subsection introduces candidates to current and historical methods used to price reinsurance. The candidates will be familiar with many of these methods from the materials on primary insurance ratemaking; the emphasis here is on the application of these methods in pricing reinsurance contracts.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
3. Determine the price of various types of reinsurance contracts.	a. Types of contracts, including excess of loss, quota share, surplus share, treaty, aggregate excess of loss, and facultative b. Common methods for pricing reinsurance, including burning cost, exposure rating and experience rating c. Reinsurance loss development and trend d. Use of increased limit factors in reinsurance pricing e. Evaluation of aggregate distribution models f. Prospective and retrospective pricing in reinsurance
4. Determine the effect of common contract provision on the price of reinsurance contracts.	a. Pricing for reinstatements, loss corridors, clash, profit and sliding scale commissions, and other common provisions in reinsurance contracts
5. Specify, fit, and use loss distribution based exposure curves. Range of weight for Learning Objectives C.3 through C.5 collectively: 11-14 percent	a. Define an exposure curve b. Limited and unlimited distributions c. Expected value and total loss probability d. Use of MBBEFD class distributions as exposure curves
READINGS	
• Clark • Bernegger	

Complete Text References for Exam 8

Text references are alphabetized by the citation column.

Citation	Abbreviation	Learning Objective	Source
Actuarial Standards Board of the American Academy of Actuaries, "Actuarial Standard of Practice No. 12, Risk Classification (for all Practice Areas)," December 2005, updated for deviation language in May 2011.	ASOP 12	A1	**OP**
Bahnemann, D., "Distributions for Actuaries," CAS Monograph #2, Chapters 5 and 6. It is highly recommended that candidates should read the entire monograph, as the material in Chapters 1-4 will be assumed to be familiar to candidates.	Bahnemann	B1-B2, B7	**OP**
Bailey, R. A. and Simon, L. J., "An Actuarial Note on the Credibility of Experience of a Single Private Passenger Car," *PCAS* XLVI, 1959, pp. 159-164. Including discussion of paper: Hazam, W. J., *PCAS* XLVII, 1960, pp. 150-152.	Bailey & Simon	A1-A2	**OP**
Bernegger, S., "Swiss Re Exposure Curves and the MBBEFD Distribution Class," ASTIN Bulletin, Vol. 27, No. 1, May 1997, pp. 99-111.	Bernegger	C3, C5	**OP**
Clark, D. R., "Basics of Reinsurance Pricing," CAS Study Note, Revised 2014. Candidates are not responsible for Section 6 of the paper.	Clark	C3-C4	**OP**
Couret, J. and Venter, G., "Using Multi-Dimensional Credibility to Estimate Class Frequency Vectors in Workers Compensation," ASTIN Bulletin, Vol. 38, No. 1, May 2008, pp. 72-85.	Couret & Venter	A2	**OP**
Fisher, G., et al., "Individual Risk Rating Study Note," CAS Study Note, Version 3, October 2019. Candidates are also responsible for the case study presented in an Excel file, which can be downloaded here.	Fisher et al. & Case Study	B1-B7	**OP** **NEW**
Goldburd, M., et al., "Generalized Linear Models for Insurance Rating," CAS Monograph #5, 2nd edition, Chapters 1-9.	GLM	A3-A4	**OP** **NEW**
Grossi, P. and Kunreuther, H., Editors, *Catastrophe Modeling: A New Approach to Managing Risk*, 2005, Springer, Chapters 2-6 (excluding references at the end of each chapter) and including errata for Section 2.4, updated May 2016.	Grossi & Kunreuther	C1-C2	**B** **Errata is OP**

Citation	Abbreviation	Learning Objective	Source
Insurance Services Office, Inc., *Commercial General Liability Experience and Schedule Rating Plan*, 07/14/2014. Excerpts from the ISO Commercial General Liability Experience and Schedule Rating Plan will be provided with the exam. Candidates are not required to memorize the details but will be expected to be able to use them on the exam. Portions of this manual will be provided with the examination booklet to the extent needed to answer questions on the exam. Candidates should not rely on having the complete manual available during the exam administration.	ISO	B3	**SK**
Mahler, H. C., "An Example of Credibility and Shifting Risk Parameters," *PCAS* LXXVII, 1990, pp. 225-282. Candidates will not be tested on the Appendices.	Mahler	A1	**OP**
National Council on Compensation Insurance, *Experience Rating Plan Manual for Workers Compensation and Employers Liability Insurance*. Candidates are responsible for only the excerpted material included in the Study Kit. Candidates are not required to memorize the details but will be expected to be able to use them on the examination. Portions of this manual will be provided with the examination booklet to the extent needed to answer questions on the exam. Candidates should not rely on having the complete manual available during the exam administration.	NCCI 1	B3	**SK**
National Council on Compensation Insurance, Circular CIF-2018-28, 06/21/2018, selected pages as included in the Study Kit. Candidates are responsible for only the excerpted material included in the Study Kit. Candidates are not required to memorize the details but will be expected to be able to use them on the examination. Portions of this circular will be provided with the examination booklet to the extent needed to answer questions on the exam. Candidates should not rely on having the complete circular available during the exam administration.	NCCI Circular	B5	**SKU NEW**
Robertson, J.P., "NCCI's 2007 Hazard Group Mapping," *Variance*, Vol. 3, Issue 2, 2009, Casualty Actuarial Society, pp. 194-213.	Robertson	A1	**OP**

Source Key

B	Book—may be purchased from the publisher or bookstore or borrowed from the CAS Library.
NEW	Indicates new or updated material.
OP	All text references marked as Online Publications will be available on a web page titled Complete Online Text References.
SK	Material included in the 2020 Study Kit.
SKU	Material included in both the 2020 CAS Study Kit and the 2020 Update to the 2019 Study Kit.

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American Academy of Actuaries, 1100 Seventeenth Street NW, Seventh Floor, Washington, DC 20036; telephone: (202) 223-8196; website: www.actuary.org.
Casualty Actuarial Society, 4350 N. Fairfax Drive, Suite 250, Arlington, VA 22203; telephone: (703) 276-3100; fax: (703) 276-3108; e-mail: office@casact.org; website: www.casact.org.
Insurance Services Office, Inc., 545 Washington Boulevard, Jersey City, NJ 07310-1686; telephone: (800) 888-4476.
National Council on Compensation Insurance, 901 Peninsula Corporate Circle, Boca Raton, FL 33487; telephone: (800) NCCI-123.

The syllabus for this four-hour exam is defined in the form of learning objectives, knowledge statements, and readings.

LEARNING OBJECTIVES set forth, usually in broad terms, what the candidate should be able to do in actual practice. Included in these learning objectives are certain methodologies that may not be possible to perform on an examination, such as complex simulations, but that the candidate would still be expected to explain conceptually in the context of an examination.

KNOWLEDGE STATEMENTS identify some of the key terms, concepts, and methods that are associated with each learning objective. These knowledge statements are not intended to represent an exhaustive list of topics that may be tested, but they are illustrative of the scope of each learning objective.

READINGS support the learning objectives. It is intended that the readings, in conjunction with the material on earlier examinations, provide sufficient resources to allow the candidate to perform the learning objectives. Some readings are cited for more than one learning objective. The CAS Syllabus & Examination Committee emphasizes that candidates are expected to use the readings cited in this *Syllabus* as their primary study materials.

Thus, the learning objectives, knowledge statements, and readings complement each other. The learning objectives define the behaviors, the knowledge statements illustrate more fully the intended scope of the learning objectives, and the readings provide the source material to achieve the learning objectives. Learning objectives should not be seen as independent units, but as building blocks for the understanding and integration of important competencies that the candidate will be able to demonstrate.

Note that the range of weights shown should be viewed as a guideline only. There is no intent that they be strictly adhered to on any given examination—the actual weight may fall outside the published range on any particular examination.

The overall section weights should be viewed as having more significance than the weights for the individual learning objectives. Over a number of years of examinations, absent changes, it is likely that the average of the weights for each individual overall section will be in the vicinity of the guideline weight. For the weights of individual learning objectives, such convergence is less likely. On a given examination, in which it is very possible that not every individual learning objective will be tested, there will be more divergence of guideline weights and actual weights. Questions on a given learning objective may be drawn from any of the listed readings, or a combination of the readings. There may be no questions from one or more readings on a particular exam.

After each set of learning objectives, the readings are listed in abbreviated form. Complete text references are provided at the end of this exam syllabus.

Items marked with a bold **SK** or **SKU** constitute the 2020 Exam 9 Study Kit that may be purchased from the CAS Online Store. The 2020 Update to the 2019 Study Kit includes only the new items marked with a bold **SKU**; the Update may be purchased from the CAS Online Store. Items marked with a bold **OP** (Online Publication) are available at no charge and may be downloaded from the CAS website.

Please check the "*Syllabus* Updates" section of the CAS Web Site for any changes to the *Syllabus*.

Exam 9 focuses on a broad array of finance, investment, and financial risk management topics. This examination assumes a working knowledge of basic ratemaking, finance, probability and statistical modeling, liability and reserve risk, and insurance underwriting. The ability to apply this knowledge and experience may be tested through questions dealing with problems for which there are no generally recognized solutions.

Texts for this Exam

There is one main text for this exam: *Investments* (10th or 11th Edition) by Bodie, Kane, and Marcus. The *Investment*s text contains references to various websites. Candidates are not responsible for the identity of the websites or the actual content of the websites except to the extent that the content is reproduced in the text. Candidates are also not responsible for any aspect of the Excel applications or the boxes entitled "E-Investments" that are usually placed at or towards the end of a chapter.

While, in general, it is suggested that the candidate cover the learning objectives in the order listed, some references to later chapters in texts may occur before references to earlier chapters. In these cases, the candidate may need to review the earlier chapters first and then return to the learning objectives that reference the later chapters.

For the Financial Risk and Rate of Return exam, the appendices are part of the material covered unless specifically excluded.

There are various numeric tables scattered throughout the readings, illustrating actual observations or hypothetical examples. Candidates are not responsible for the actual numeric values.

Background in Financial Markets and Instruments

Candidates may find it helpful to review Chapters 1-5 of the *Investments* text for background in financial markets and instruments.

A. Portfolio Theory and Equilibrium in Capital Markets

Range of weight for Section A: 20-30 percent

The portfolio theory portion of this section discusses the relationship between the risk and return for different combinations of risky and risk-free investments and discusses the effect of diversification on this relationship. Candidates are introduced to the manner in which investors might select a particular portfolio, from those available, that best suits their individual preferences for risk and return. In the portion of this section on equilibrium in capital markets, various equilibrium models are presented, including the Capital Asset Pricing Model (CAPM) and Arbitrage Pricing Theory (APT). The concept of market efficiency is presented to help candidates understand the factors that move market prices towards and away from the theoretical prices presented in these models.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Explain key concepts of risk: • Appetite • Tolerance • Aversion • Measurement • Portfolio construction • Strategies for monitoring Range of weight: 0-5 percent	a. Utility functions, utility scores, and utility maximization b. Risk aversion c. Mean-variance criterion d. Capital allocation line e. Complete portfolio f. Reward to volatility ratio (Sharpe ratio) g. Passive versus active strategies: costs of active strategy and free-rider benefit
READINGS	
• BKM, Chapter 6	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
2. Calculate the expected value, variance, and covariance of returns of asset portfolios in a multi-dimensional setting. Range of weight: 0-5 percent	a. Expected return and standard deviation for portfolios of risky and risk-free assets b. Optimal risky portfolio c. Optimal complete portfolio
3. Describe the Markowitz Portfolio Selection Model. Range of weight: 0-5 percent	a. Minimum variance frontier b. Efficient frontier of risky assets c. Optimal capital allocation line d. Separation property e. Asset allocation versus security selection
4. Explain and demonstrate effects of various diversification strategies. Range of weight: 0-5 percent	a. Systematic risk b. Risk pooling c. Risk sharing d. Insurance principle
READINGS	
• BKM, Chapter 7	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
5. Explain and use the single factor models and compare/contrast the process of portfolio construction with the full covariance (Markowitz) model. Range of weight: 0-5 percent	a. Markowitz model b. Single factor model c. Single index model d. Systematic risk e. Alpha, Beta estimating and forecasting f. Covariance and correlation estimates for single index model g. Risk premiums due to market and non-market factors h. Parameter estimation risk i. Macroeconomic factors
READINGS	
• BKM, Chapter 8	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
6. Explain the assumptions and construction of CAPM and use CAPM to calculate expected returns for risky securities. Range of weight: 3-7 percent	a. CAPM assumptions b. Market price of risk c. Capital market line d. Security market line
7. Compare/contrast CAPM and single index model and explain the assumptions that are modified under various extensions of CAPM. Range of weight: 0-5 percent	a. CAPM b. Single index model c. Expected versus actual returns d. Market portfolio versus market index e. Extensions of CAPM • Zero Beta CAPM • CAPM with non-traded assets and labor income • ICAPM • CAPM with liquidity adjustments
READINGS	
• BKM, Chapter 9	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
8. Use APT to determine the expected return for a security and compare/contrast with CAPM and factor models. Range of weight: 0-5 percent	a. Arbitrage and the Law of One Price b. APT and its comparison to CAPM c. Factor betas d. Factor portfolios and factor risk premiums e. Fama and French's 3 Factor Model f. Alternative factors in multifactor models
READINGS	
• BKM, Chapter 10	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
9. Explain market efficiency and its implications for portfolio management, and describe the various tests and studies of market efficiency. Range of weight: 0-5 percent	a. Efficient market hypothesis b. Random walk c. Technical analysis d. Fundamental analysis e. Passive investment strategy f. Portfolio management
READINGS	
• BKM, Chapter 11	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
10. Explain the influence of behavioral finance in understanding certain aspects of market efficiency. Range of weight: 0-5 percent	a. Information processing errors b. Behavioral biases c. Limits to arbitrage d. Violations of Law of One Price e. Behavioral critique f. Technical analysis
READINGS	
• BKM, Chapter 12	

B. Asset-Liability Management

Range of weight for Section B: 10-20 percent

This section exposes the candidate to factors that influence the price sensitivity of fixed income securities and presents various ways in which a portfolio manager might manage the interest rate and cash flow risk in a portfolio of these instruments. The same concepts are also applied to the interest rate risk associated with a firm's liabilities and the interest rate risk associated with a firm's total market value, inclusive of their franchise value.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Explain the different Term Structure Theories Range of weight: 0-5 percent	a. Expectations hypothesis b. Liquidity preference theory c. Forward rates versus expected short rates and spot rates
2. Determine U.S. Treasury zero rates at different maturities. Range of weight: 3-7 percent	a. Determining zero rates from coupon bonds using both annual and semi-annual compounding b. Determining forward rates from spot rates (zero rates) c. Spot rates d. Short rates e. Forward Contracts f. Treasury Inflation Protected Securities (TIPS)
READINGS	
• BKM, Chapters 14, 15 and 16	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
3. Utilize various strategies to manage interest rate risk and cash flow risk in a bond portfolio. Range of weight: 3-7 percent	a. Duration (Macaulay, modified, and effective) b. Convexity c. The effect of interest changes on bond prices d. Immunization e. Cash flow matching and dedication f. Rebalancing g. Use of interest rate swaps, mortgage-backed securities, and other derivative securities to alter the interest rate risk for a bond portfolio h. Currency swaps
READINGS	
• BKM, Chapters 16 and 23 (Sections 23.3 and 23.4)	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
4. Quantify franchise value, evaluate the impact of interest rate sensitivity, and demonstrate how interest rate sensitivity of the franchise value can be managed. Range of weight: 0-5 percent	a. Total economic value b. Franchise value—magnitude and exposure to interest rate risk (duration) c. Pricing strategy d. Advantages of managing the interest rate sensitivity of the firm's total economic value through pricing strategy
READINGS	
• Panning	

C. Financial Risk Management

Range of weight for Section C: 25-35 percent

This section addresses financial risks as well as risks related to the insurance industry from the financial economics perspective. The concepts and techniques presented in this section are important components in the field of enterprise risk management.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Estimate the credit risk due to default and default correlation associated with fixed income securities. Range of weight: 0-5 percent	a. Default risk b. Bond safety determinants c. Expected loss from default d. Yield spread
2. Describe the credit risk in derivatives transactions and various mechanisms to manage the risk. Range of weight: 0-5 percent	a. Counterparty default risk b. Collateralization
READINGS	
• BKM, Chapter 14	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
3. Describe the reasons for the development of credit derivatives market, the valuation of credit derivative contracts, and the complexity of trading credit risks. Range of weight: 0-5 percent	a. Credit default swaps (CDS) b. Types of Active Bond Portfolio management swaps c. Collateralized debt obligations (CDOs) and related structured financial instruments d. The role credit derivative contracts played in the 2008 financial crisis
READINGS	
• BKM, Chapters 14 and 16 • Coval, Jurek, and Stafford	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
4. Discuss the development and the complexity of financial engineering products such as mortgage-backed securities and other forms of securitization. Range of weight: 0-5 percent	a. Effect of securitization on sources of funds for mortgage holders and on interest rate risk retained by the mortgage originators b. Mortgage pass-throughs and the effect of mortgage prepayment on cash flows to investors c. Collateralized mortgage obligations (CMOs) and the effect of prepayments on cash flows to investors in particular tranches d. Market liquidity and premium spreads e. Lessons from the recent subprime crisis
5. Describe the market for securitizing catastrophe risk in the insurance industry and explain the reasons for its growth. Range of weight: 0-5 percent	a. Products on the market: • Risk-linked securities • CAT bonds • Sidecars • Cat-E-puts • Catastrophe risk swaps • Industry loss warranties b. Factors influencing interest in insurance securitization in relation to traditional reinsurance c. Factors impeding the growth of the market: • Regulatory • Accounting • Tax • Rating issues
READINGS	
• BKM, Chapter 16 (Section 16.2) • Coval, Jurek, and Stafford • Cummins CAT Bond	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
6. Describe various risk measures and the need for practicing sound financial risk management. Range of weight: 3-7 percent	a. Capital structure and risk taking incentives b. Regulation and rating agency c. Value at risk (VaR) d. Risk-based capital e. Expected policyholder deficit (EPD) f. Capital associated with a constant EPD ratio g. Risk-adjusted return on capital (RAROC), including alternative measures of income and alternative measures of risk-adjusted capital h. Economic value added (EVA) i. Percentile layer of capital j. Lessons from past failures due to poor financial risk management

READINGS

- Bodoff
- Butsic
- Cummins Capital
- Goldfarb

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
7. Describe the concept of economic capital (or risk capital) in the insurance industry and various methods of allocating the risk capital to business units or lines of business. Range of weight: 3-7 percent	a. Financial and insurance risks b. Economic capital or risk capital c. Risk aggregation d. Strengths and weaknesses of the various allocation methods using risk measures such as: • Percentile (VaR) • Conditional tail expectation (CTE) • EPD Ratio • Merton-Perold method • Insolvency Put/EPD ratio risk measure • Myers-Read method • Co-Measures • Co-CTE • Percentile Layer of Capital
8. Apply the RAROC framework to risk management in the insurance industry. Range of weight: 0-5 percent	a. Economic profit as income measure b. Cost of capital c. RAROC d. Additional risk margin in price e. Multi-period capital commitment
9. Assess the performance of business units and set prices for insurance policies on a risk-adjusted basis. Range of weight: 0-5 percent	a. Economic profit as income measure b. Cost of capital c. RAROC d. Additional risk margin in price e. Multi-period capital commitment
READINGS	
• Bodoff • Cummins Capital • Goldfarb	

D. Rate of Return, Risk Loads, and Contingency Provision

Range of weight for Section D: 25-35 percent

This section explores the relationship between insurance concepts (such as underwriting profits, premium-to-surplus ratios, and investment income) and financial concepts (such as interest rates, inflation rates, cost of capital, and risk premiums). The readings build on a background of finance as related to the insurance business, and deal with specific techniques used by actuaries to develop an appropriate profit loading in insurance prices.

Because insurance claims are fortuitous, the expected profit loaded in rates may not be realized. Some models discuss insured events that are predictable in time and amount while other models consider when insured events are uncertain, particularly where capacity is limited and/or sufficient diversification of exposure is impossible.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Evaluate the internal rate of return framework. Range of weight: 3-7 percent	a. Inter-relationship between the product market and financial market b. IRR Model calculations c. Decision rule of the IRR model d. Distinction between equity flows and all other cash flows e. Impact of surplus allocation and timing on equity flows f. Methods of allocating surplus and impact on IRR g. Potential pitfalls in IRR analysis
READINGS	
• Feldblum Financial	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
2. Evaluate the components of total return to stockholders and how leverage can be used to maximize shareholder value. Range of weight: 0-5 percent	a. Relationship between profitability measures from investors' perspective, society's perspective, and regulators' perspective b. Insurance leverage and reserve capital c. Influence of leverage on stockholders' equity d. Optimal capital structure e. Dynamic relationship among formula variables
READINGS	
• Ferrari	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
3. Assess insurance profitability. Range of weight: 0-5 percent	a. Policyholder versus investor perspectives b. Return on equity versus return on sales c. Methods to determine benchmark rate of return
READINGS	
• McClenahan	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
4. Describe the underwriting profit provision. Range of weight: 0-5 percent	a. Evolution of the profit provision b. Policyholder versus stockholder return c. Types of underwriting profit
5. Calculate and compare the provision for underwriting profit in property and casualty insurance rates Range of weight: 3-7 percent	a. Calendar Year Investment Offset procedure b. Present Value Offset procedure c. Calendar Year Return on Equity and Growth Model d. Present Value of Income over Present Value of Equity method e. Present Value Return on Cash Flow method f. Risk-Adjusted Discounted Cash Flow method g. Internal Rate of Return on Equity Flows method
READINGS	
• Robbin IRR • Robbin UW	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
6. Use Riskiness Leverage models to determine risk loads. Range of weight: 3-7 percent	a. Relationship of capital needs and risk loads b. Forms of riskiness leverage models c. Representation of various risk attitudes with riskiness leverage models d. Properties of riskiness leverage models e. Evaluation of reinsurance purchases with riskiness leverage models from the cedant perspective
READINGS	
• Kreps Ratios	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
7. Calculate and compare the risk loads for property catastrophe insurance. Range of weight: 3-7 percent	a. Order dependency b. Marginal Surplus method c. Marginal Variance method d. Sub-additive and super-additive properties e. Renewal additivity f. Shapley Value method g. Covariance Share method
READINGS	
• Mango	

Complete Text References for Exam 9

Text references are alphabetized by the citation column.

Citation	Abbreviation	Learning Objective	Source
Bodie, Z.; Kane, A.; and Marcus, A.J., *Investments*, 10th or 11th Edition, McGraw-Hill/Irwin, 2014. Chapter or section citations are listed under the appropriate learning objective. Candidates may use either the 10th or 11th edition of the book.	BKM	A1-A10, B1-B3, C1-C5	**B**
Bodoff, N.M., "Capital Allocation by Percentile Layer," Casualty Actuarial Society *Forum*, Winter 2008.	Bodoff	C6-C9	**OP**
Butsic, R.P., "Solvency Measurement for Property-Liability Risk-Based Capital Applications," *The Journal of Risk and Insurance*, American Risk and Insurance Association, Inc., December 1994, Vol. 61, No. 4, pp. 656-690.	Butsic	C6	**SK**
Coval, J.; Jurek, J.; and Stafford, E., "The Economics of Structured Finance," *The Journal of Economic Perspectives*, American Economic Association, Winter 2009, Vol. 23, No. 1.	Coval, Jurek, and Stafford	C3-C5	**SK**
Cummins, J. D., "Allocation of Capital in the Insurance Industry," *Risk Management and Insurance Review*, American Risk and Insurance Association, Inc., Spring 2000, Vol. 3, No. 1, pp. 7-27.	Cummins Capital	C6-C9	**SK**
Cummins, J. D., "CAT Bond and Other Risk-Linked Securities: State of the Market and Recent Developments," *Risk Management and Insurance Review*, American Risk and Insurance Association, Inc., 2008, Vol. 11, No. 1, pp. 23-47.	Cummins CAT Bond	C4-C5	**SK**
Feldblum, S., "Pricing Insurance Policies: The Internal Rate of Return Model," CAS Study Note, May 1992. Only Sections 1, 3, and 6 will be directly tested, but the other sections may provide useful background.	Feldblum Financial	D1	**OP**
Ferrari, J.R., "The Relationship of Underwriting, Investment, Leverage, and Exposure to Total Return on Owners' Equity," *PCAS* LV, 1968, pp. 295-302. Includes discussion: Balcarek, R.J., *PCAS* LVI, 1969, pp. 58-60.	Ferrari	D2	**OP**
Goldfarb, R. "Risk-Adjusted Performance Measurement for P&C Insurers," CAS Study Note, October 2010.	Goldfarb	C6-C9	**OP**
Kreps, R.E., "Riskiness Leverage Models," *PCAS* XCII, 2005, pp. 31-60. For candidates attempting to replicate the exhibits in this paper, a spreadsheet developed by the author can be downloaded **here**.	Kreps Ratios	D6	**OP**

Citation	Abbreviation	Learning Objective	Source
Mango, D.F, "An Application of Game Theory: Property Catastrophe Risk Load," *PCAS* LXXXV, 1998, pp. 157-186.	Mango	D7	**OP**
McClenahan, C.L., "Insurance Profitability," *Actuarial Considerations Regarding Risk and Return in Property-Casualty Insurance Pricing*, Casualty Actuarial Society, 1999, Chapter 8.	McClenahan	D3	**OP**
Panning, W.H., "Managing Interest Rate Risk: ALM, Franchise Value, and Strategy," Willis Re Working Paper, July 2006.	Panning	B4	**OP**
Robbin, Ira, "IRR, ROE, and PVI/PVE," Casualty Actuarial Society *Forum*, Winter 2007. Excluding Sections 6 and 7.	Robbin IRR	D4-D5	**OP**
Robbin, Ira, "The Underwriting Profit Provision," CAS Study Note, as updated in 1992. Excluding Sections V, VI, and IX and related exhibits.	Robbin UW	D4-D5	**OP**

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American Risk and Insurance Association, 716 Providence Road, P.O. Box 3028, Malvern, PA 19355; telephone: (610) 640-1997; fax: (610) 725-1007; website: aria@cpcuiia.org.
Casualty Actuarial Society, 4350 N. Fairfax Drive, Suite 250, Arlington, VA 22203; telephone: (703) 276-3100; fax: (703) 276-3108; e-mail: office@casact.org; website: www.casact.org.
American Economic Association, 2014 Broadway, Suite 305, Nashville, TN 37203, telephone: (615) 322-2595; fax: (615) 343-7590; website: http://www.aeaweb.org/jep/index.php.
McGraw-Hill/Irwin, 860 Taylor Station Road, Blacklick, OH 43004; telephone: (800) 262-4729.

The syllabus for this four-hour exam is defined in the form of learning objectives, knowledge statements, and readings.

LEARNING OBJECTIVES set forth, usually in broad terms, what the candidate should be able to do in actual practice. Included in these learning objectives are certain methodologies that may not be possible to perform on an examination, such as calculating the Hat Matrix for a complex Generalized Linear Model, but that the candidate would still be expected to explain conceptually in the context of an examination.

KNOWLEDGE STATEMENTS identify some of the key terms, concepts, and methods that are associated with each learning objective. These knowledge statements are not intended to represent an exhaustive list of topics that may be tested, but they are illustrative of the scope of each learning objective.

READINGS support the learning objectives. It is intended that the readings, in conjunction with the material on earlier examinations, provide sufficient resources to allow the candidate to perform the learning objectives. Some readings are cited for more than one learning objective. The CAS Syllabus & Examination Committee emphasizes that candidates are expected to use the readings cited in this *Syllabus* as their primary study materials.

Thus, the learning objectives, knowledge statements, and readings complement each other. The learning objectives define the behaviors, the knowledge statements illustrate more fully the intended scope of the learning objectives, and the readings provide the source material to achieve the learning objectives. Learning objectives should not be seen as independent units, but as building blocks for the understanding and integration of important competencies that the candidate will be able to demonstrate.

Note that the range of weights shown should be viewed as a guideline only. There is no intent that they be strictly adhered to on any given examination—the actual weight may fall outside the published range on any particular examination.

The overall section weights should be viewed as having more significance than the weights for the individual learning objectives. Over a number of years of examinations, absent changes, it is likely that the average of the weights for each individual overall section will be in the vicinity of the guideline weight. For the weights of individual learning objectives, such convergence is less likely. On a given examination, in which it is very possible that not every individual learning objective will be tested, there will be more divergence of guideline weights and actual weights. Questions on a given learning objective may be drawn from any of the listed readings, or a combination of the readings. There may be no questions from one or more readings on a particular exam.

After each set of learning objectives, the readings are listed in abbreviated form. Complete text references are provided at the end of this exam syllabus.

Items marked with a bold **OP** (Online Publication) are available at no charge and may be downloaded from the CAS website.

Please check the "*Syllabus* Updates" section of the CAS Web Site for any changes to the *Syllabus*.

A thorough knowledge of calculus and probability is assumed, as is familiarity with discounting cash flows.

Given the material covered on Section C, we assume that the candidate has knowledge of Linear Algebra concepts at the level commonly assumed as a prerequisite to taking an undergraduate level course in regression analysis. The insurance terminology used in questions for Exam MAS-I will not assume prior knowledge of either reserving or ratemaking actuarial practice, but we may include problems with insurance terms consistent with those stated in the Knowledge Statements for section B.3. The Probability Models section (Section A) covers Stochastic Processes, Markov Chains and Survival Models along with a simplified version of Life Contingencies. Survival models are covered in depth as part of probability modeling in generic terms. Markov Chains provide the means to model how an entity can move through different states. Life Contingencies problems can be viewed as discounted cash flow problems that include the effect of probability of payment and are covered through a Study Note linking the generic survival model concepts to a subset of life actuarial concepts to illustrate how to calculate annuities or single premium insurance amounts.

In general, the material covered under the Statistics section (Section B) covers topics that would be commonly found in a second semester course of a two semester Probability & Statistics sequence at the undergraduate level. Coverage of the topics listed under the Statistics section will vary by college and the candidate may need to supplement that course work with additional reading and problem-solving work from the suggested textbooks listed at the end of Section B.

Extended Linear Models including Generalized Linear Models, a predictive modeling technique commonly used to construct classification plans, are covered in Section C. The ordinary least squares model is covered as one member of the exponential family under the Extended Linear Models section. Many textbooks covering this topic, including the textbook on the syllabus, use statistical software to illustrate the concepts covered in examples, since using a calculator to solve a realistic problem is impractical. While we are not testing a candidate's ability to write R code, some of the examples in the textbooks cited in the Readings require using R code to work the examples. Those candidates that work through the examples or exercises will understand the material better than those who do not.

The Time Series section (Section D) covers an introduction to modeling activity over time like financial results or stock prices using the Auto Regressive Integrated Moving Average (ARIMA) where activity in a given time period may be linked to activity in subsequent time periods. That connection between adjacent time periods violates one of the assumptions behind the Extended Linear Model techniques, but the ARIMA approach incorporates that linkage as an aid in predicting future results. The Time Series section also covers the application of regression models to time series analysis.

A variety of tables will be provided to the candidate with the examination booklet. The tables include values for the illustrative life tables, standard normal distribution, abridged inventories of discrete and continuous probability distributions, Chi-square Distribution, t-Distribution, and F-Distribution. Since they will be included with the examination, candidates will not be allowed to bring copies of the tables into the examination room.

A guessing adjustment will be used in grading this exam. Details are provided under "Guessing Adjustment" in the "Examination Rules-The Examination" section of the *Syllabus of Basic Education*.

A. Probability Models (Stochastic Processes and Survival Models)

Range of weight for Section A: 20-35 percent

Candidates should be able to solve problems using stochastic processes. They should be able to determine the probabilities and distributions associated with these processes. Specifically, candidates should be able to use a Poisson process in these applications. Survival models are simply an extension of the stochastic process probability models where one is estimating the future lifetime of an entity given assumptions on the distribution function used to describe the likelihood of survival. Markov Chains are a useful tool to model movement between states in a given process and underlie modern Bayesian MCMC models. A short section on computer simulation is included, since in some cases a closed form solution to a problem involving random variables is not possible and simulation provides a means to arrive at a solution. The Study Note will re-cast the generic survival model learning objectives to link those concepts to life actuarial symbols to help ensure P&C actuaries can communicate with life actuaries on basic concepts, but we should recognize that many disciplines like engineering or computer science incorporate survival models in their work. Life Contingencies problems can be viewed as discounted cash flow problems that can be set up and solved using Markov Chain concepts or simply viewed as three matrices in a spreadsheet indicating payment amount, likelihood of payment, and discount effect by time period as illustrated by Learning Objective A.7.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Understand and apply the properties of Poisson processes: • For increments in the homogeneous case • For interval times in the homogeneous case • For increments in the non-homogeneous case • Resulting from special types of events in the Poisson process • Resulting from sums of independent Poisson processes Range of weight: 0-5 percent	a. Poisson process b. Non-homogeneous Poisson process c. Memoryless property of Exponential and Poisson d. Relationship between Exponential and Gamma e. Relationship between Exponential and Poisson

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
2. For any Poisson process and the inter-arrival and waiting distributions associated with the Poisson process, calculate: • Expected values • Variances • Probabilities Range of weight: 0-5 percent	a. Probability calculations for Poisson process b. Conditional distribution of arrival times c. Splitting grouped Poisson rate to subsets of population using probability distribution d. Conditional distribution of events by category within a group within a certain time period
READINGS	
• Daniel • Ross, Sections 5.3, 5.4.1	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
3. For a compound Poisson process, calculate moments associated with the value of the process at a given time. Range of weight: 0-5 percent	a. Compound Poisson process mean and variance b. Normal approximation and hypothesis testing
READINGS	
• Daniel • Ross, Sections 5.4.2	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
4. Apply the Poisson process concepts to calculate the hazard function and related survival model concepts. • Relationship between hazard rate, probability density function and cumulative distribution function • Effect of memoryless nature of Poisson distribution on survival time estimation Range of weight: 2-8 percent	a. Failure time random variables b. Cumulative distribution functions c. Survival functions d. Probability density functions e. Hazard functions and relationship to Exponential distribution f. Relationships between failure time random variables in the functions above g. Greedy algorithms
READINGS	
• Ross, Section **5.2.1-5.2.4**	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
5. Given the joint distribution of more than one source of failure in a system (or life) and using Poisson Process assumptions: • Calculate probabilities and moments associated with functions of these random variables' variances. • Understand difference between a series system (joint life) and parallel system (last survivor) when calculating expected time to failure or probability of failure by a certain time. • Understand the effect of multiple sources of failure (multiple decrement) on expected system time to failure (expected lifetime). Range of weight: 2-8 percent	a. Joint distribution of failure times b. Probabilities and moments c. Time until failure of the system (life) d. Time until failure of the system (life) from a specific cause e. Time until failure of the system (life) for parallel or series systems with multiple components f. Paths that lead to parallel or series system failure for systems with multiple components g. Relationship between failure time and minimal path and minimal cut sets h. Bridge system and defining path to failure i. Random graphs and defining path to failure j. Effect of multiple sources of failure (multiple decrements) on failure time calculations (competing risk) k. Non-uniform probability of component failure (multiple decrement) l. Method of inclusion and exclusion as applied to failure time estimates m. Expected system lifetime as function of component lifetime and properties of expected lifetime estimates n. Linkage between reliability function for a system and future expected lifetime
READINGS	
• Ross, Sections 9.1-9.6	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
6. For discrete Markov Chains under both homogeneous and non-homogenous states: • Definition of a Markov Chain • Chapman-Kolmogorov Equations for n-step transition calculations • Accessible states • Ergodic Markov Chains and limiting probabilities Range of weight: 2-8 percent	a. Random Walk b. Classification of states and classes of states (absorbing, accessible, transition, irreducible, and recurrent) c. Transition step probabilities d. Stationary probabilities e. Recurrent vs. transient states f. Gamblers ruin problem g. Branching processes h. Homogeneous transition probabilities i. Memoryless property of Markov Chains j. Limiting probabilities
READINGS	
• Ross, Sections 4.1-4.8	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
7. Solve Life Contingency problems using a life table in a spreadsheet as the combined result of discount, probability of payment and amount of payment vectors. Understand the linkage between the life table and the corresponding probability models. • Calculate annuities for discrete time. • Calculate life insurance single net premiums (or property/casualty pure premiums) for discrete time. • Solve for net level premiums (not including fractional lives). Range of weight: 2-5 percent	a. Discounted cash flow b. Relationship between annuity values and insurance premiums c. Life table linkage to probability models d. Equivalence property
READINGS	
• Struppeck	

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
8. The candidate should be familiar with basic computer simulation methods. • Understand the basic framework of Monte Carlo Simulation. • Understand the mechanics of generating uniform random numbers. • Generate random numbers from a variety of distributions using the inversion method. • Be able to explain when and how to use the Acceptance-Rejection method. Range of weight: 2-5 percent	a. Random Number Generation b. Uniform Random Numbers c. Inversion Method d. Acceptance-Rejection Method
READINGS	
• Ross, Sections 11.1, 11.2.1, and 11.2.2	

B. Statistics

Range of weight for Section B: 15-30 percent

Candidates should have a thorough understanding of the concepts typically covered in the 2nd semester of a two semester undergraduate sequence in Probability and Statistics. The specific topics to be tested are described below. Mastering the concepts listed under Section B is necessary to understand the concepts behind the Generalized Linear Models presented under Section C.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Perform point estimation of statistical parameters using Maximum likelihood estimation ("MLE"). Apply criteria to the estimates such as: • Consistency • Unbiasedness • Sufficiency • Efficiency • Minimum variance • Mean square error Calculate parameter estimates using methods other than maximum likelihood.	a. Equations for MLE of mean, variance from a sample b. Estimation of mean and variance based on sample c. General equations for MLE of parameters d. Recognition of consistency property of estimators and alternative measures of consistency e. Application of criteria for measurement when estimating parameters through minimization of variance, mean square error f. Definition of statistical bias and recognition of estimators that are unbiased or biased g. Application of Rao-Cramer Lower Bound and Efficiency h. Relationship between Sufficiency and Minimum Variance i. Develop and estimate a sufficient statistic for a distribution j. Factorization Criterion for sufficiency k. Application of Rao-Cramer Lower Bound and Fisher Information l. Application of MVUE for the exponential class of distributions m. Linkage between Score Function, Fisher Information and maximum likelihood n. Method of Moments o. Percentile Matching p. Kernel Density Estimation q. Maximum Likelihood with Censoring & Truncation

LEARNING OBJECTIVES Range of weight: 5-15 percent	KNOWLEDGE STATEMENTS
2. Test statistical hypotheses including Type I and Type II errors using: • Neyman-Pearson theorem • Likelihood ratio tests • First principles Apply Neyman-Pearson theorem to construct likelihood ratio equation. Use critical values from a sampling distribution to test means and variances. Range of weight: 5-15 percent	a. Presentation of fundamental inequalities based on general assumptions and normal assumptions b. Definition of Type I and Type II errors c. Significance levels d. One-sided versus two-sided tests e. Estimation of sample sizes under normality to control for Type I and Type II errors f. Determination of critical regions g. Definition and measurement of likelihood ratio tests h. Determining parameters and testing using tabular values i. Recognizing when to apply likelihood ratio tests versus chi-square or other goodness of fit tests j. Apply paired t-test to two samples k. Test for difference in variance under Normal distribution between two samples through application of F-test l. Test of significance of means from two samples under Normal distribution assumption in both large and small sample cases m. Test for significance of difference in proportions between two samples under Binomial distribution assumption in both large and small sample case n. Application of contingency tables to test independence between effects o. Asymptotic relationship between likelihood ratio tests and the Chi-Square distribution p. Application of Neyman-Pearson theorem to Uniformly Most Powerful hypothesis tests q. Equivalence between critical regions and confidence intervals r. Kolmogorov –Smirnov test

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
3. For the Exponential, Gamma, Weibull, Pareto, Lognormal, Beta, and mixtures thereof: • Identify the applications to Insurance claim modeling in which each distribution is used and reasons why. • Transformation of distributions Range of weight: 2-5 percent	a. Frequency, severity, and aggregate loss b. Common continuous distributions for modeling claim severity c. Mixing distributions d. Tail properties of claim severity e. Effects of coverage modifications including, for example: limits, deductibles, loss elimination ratios and effects of inflation
4. Calculate Order Statistics of a sample for a given distribution Range of weight: 0-5 percent	a. General Form for distribution of nth largest element of a set b. Application to a given distributional form

READINGS

There are many good introductory statistics textbooks that do an excellent job of covering the material on Section B. In the interest of clarity for the candidates though we have selected two. One should note that the Tse textbook is also used as a reference on Exam MAS-II.

- Hogg, McKean, and Craig
- Tse

For a mapping of the sections of these texts to the learning objectives, candidates should refer to the "Knowledge Statement Mapping for Exam MAS-I" document posted on the CAS website under the Syllabus Material section for this exam.

For those candidates who would like to work additional problems or see additional examples to illustrate the concepts in Section B, a couple of sources are listed below that are from the Schaum's Outline series. We are not expanding the range of material covered and only mention these additional sources as a study aid.

- Schiller, Spiegel, and Srinivasan: Chapters 4-9
- Spiegel and Stephens: Chapters 8-12

C. Extended Linear Models

Range of weight for Section C: 30-50 percent

This section covers the Extended Linear Model Family and treats Ordinary Least Squares as one type of a Linear Model that may be used when the dependent variable follows the Normal distribution and the observations are independent and identically distributed with constant variance. There is a range of models shown in this section with varying degrees of depth of coverage in the readings. The most commonly used form of the Linear Model for insurance modeling work today is the Generalized Linear Model. Generalized Additive Models are an extension of Generalized Linear Models in which the explanatory variables in the linear equation contain functions, which are in turn modeled when running the software. The models presented in this section all assume that the underlying data consists of independent and identically distributed observations from a member of the exponential distribution family. Also, we assume there is a formula describing the behavior of the dependent variable can be described as a linear process of the dependent variables after applying a link function and that the variance is a function of the mean. There are linear models in which those assumptions are violated, but that is a topic for Exam MAS-II. The specific topics to be tested are described below

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Understand the assumptions behind different forms of the Extended Linear Model and be able to select the appropriate model from list below: • Ordinary Least Squares • Generalized Linear Model • ANOVA • Generalized Additive Models • Local Regression • Lasso • Ridge Regression • Partial Least Squares • Principle Component Analysis (PCA) Regression Range of weight: 5-15 percent	a. Understand the relationship between mean and variance by model family member for the exponential distribution b. Understand how to select the appropriate distribution function for the dependent variable and the implication for the appropriate model form c. Link Functions (Identity, Log, Logit, Power, Inverse) d. Characteristics of Exponential Family (Binomial, Normal, Exponential, Gamma, Poisson, Inverse Gaussian, Negative Binomial, and Tweedie) e. Canonical Forms of link function and effect of non-canonical link function on bias f. Penalized Regression as implemented using the Lasso or Ridge Regression g. Understand concept of models within models for Generalized Additive Models h. Understand dimension reduction using Partial Least Squares or PCA Regression

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
2. Evaluate models developed using Extended Linear Model approach. Range of weight: 5-15 percent	a. Raw and studentized Residuals b. R-Squared statistic c. Cook's Distance and outliers d. Influential points e. Leverage f. Akaike Information Criterion (AIC) and BIC penalized log likelihood measures g. Standardized/Studentized Residuals h. Deviance, Deviance Residuals and relationship to likelihood i. Pearson Residuals vs. Deviance Residuals j. Scatter, QQ and Box Plots k. Type III Sequential Chi-Square test l. T-test and Wald test for significance of regression coefficients m. Prediction intervals for response variable n. Mean square error and standard error o. Calculation and validity of F test to compare two models (under OLS) p. Cross Validation q. Test vs. Train Error r. Bootstrapping to test model validity s. Prediction vs. Forecast Error t. Overfitting u. Bias-Variance Tradeoff v. Evaluate collinearity using variance inflation factor[1] w. Evaluate appropriateness of underlying assumptions including: • Homoscedasticity • Autocorrelation of residuals

[1] See Readings for a definition of variance inflation factor (VIF).

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
3. Understand the algorithms behind the numerical solutions for the different forms of the Extended Linear Model family to enable interpretation of output from the statistical software employed in modeling and to make appropriate modeling choices when selecting modeling options. Range of weight: 5-15 percent	a. Maximum Likelihood and Ordinary Least Squares b. Fisher Scoring (iterative weighted least squares as implemented using the Information and Score functions covered in Section B.1) c. Quasi-Likelihood and relationship to maximum likelihood d. Collinearity (Aliasing) and model stability e. Hat matrix f. Design matrix g. Fitting adjoining, overlapping observations in groups for Local Regression h. Supervised vs. Unsupervised learning methods i. Modeling functions within functions for Generalized Additive Models j. Penalty function in Penalized regression models (Lasso and Ridge Regression) k. Partial Least Squares Supervised learning vs. PCA Regression Unsupervised learning

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
4. Understand and be able to select the appropriate model structure for an Extended Linear Model given the behavior of the data set to be modeled. Range of weight: 5-15 percent	a. Predictor variables b. Response variables c. Regression through the origin d. Transformation of variables e. Categorical vs. continuous explanatory variables f. Interaction terms g. Significance and model comparison statistics h. Residuals and model parameter selection i. Piecewise Linear and Smoothing Splines j. Smoothing parameter for splines k. Basis Functions l. Knot Selection for Splines m. Weighting function for local regression n. Selection of functions within functions for Generalized Additive Models o. Selection of appropriate tuning factor for Lasso or Ridge Regression p. Select either Lasso or Ridge Regression depending on desired effect from penalized regression q. Curse of High Dimensionality r. Forward or backward or best subset selection

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS

READINGS

- **Dobson and Barnett, Chapters 1-9, excluding 6.3.3, 6.7, 6.8, & 7.9 in the 4th edition only**
- Hogg, McKean, and Craig, Sections 4.4 (only the sections related to QQ and Box Plots), 6.3 through 6.5, 7.5, and 9.1 through 9.6
- James et al., Chapters 1, 2 (excluding Section 2.2.3), 3 (Sections 3.1 through 3.3, and 3.6 labs on Sections 3.1 through 3.3), 4 (Sections 4.1 through 4.4; the Linear Discrimination Analysis portion of Section 4.4 will not be tested), 5, 6, and 7
- Larsen

For a mapping of the sections of these texts to the learning objectives, candidates should refer to the "Knowledge Statement Mapping for Exam MAS-I" document posted on the CAS website under the Syllabus Material section for this exam.

The definition of variance inflation factor (VIF), as referenced in Knowledge Statement C.2.v, varies across the syllabus readings. Candidates should familiarize themselves with the widely accepted VIF formula found on p.102 of James et al. and **p. 101 (3rd edition) or p. 119 (4th edition) of Dobson**. The VIF formula on p. 101 of James et al. will not be used on the exam.

Exam questions from this section may contain parameter tables and diagnostic tables or plots of the type shown in the texts. Candidates should understand how to interpret these tables. Candidates who become familiar with a statistical language capable of generating this type of output, such as R, will have an easier time understanding and applying the concepts covered in the syllabus material. In particular, candidates that work the lab exercises at the end of the chapters in the James, Gareth, et al. textbook will have a better grasp of the material than that obtained by simply reading the textbook. However, for exam questions from this section, candidates will not be asked to write or interpret R code.

Candidates are encouraged to seek out examples of GLM problems to enhance their understanding of GLM concepts. Sources for such examples will be posted on the CAS website under the Study Tips, Tools, and Past Pass Marks section for this exam. Candidates will not be tested on concepts that are outside of the scope of the required reading that may appear in those examples. The examples are furnished so that candidates might reinforce concepts covered in the Dobson and Barnett textbook.

For those candidates who would like to work additional problems or see additional examples to illustrate the concepts in Section C, a couple of sources are listed below that are from the Schaum's Outline series. We are not expanding the range of material covered and only mention these additional sources as a study aid.

- Salvatore and Reagle: Chapters 6-9
- Schiller, Spiegel, and Srinivasan: Chapters 8 and 9
- Spiegel and Stephens: Chapters 13 and 16

D. Time Series with Constant Variance

Range of weight for Section D: 10-20 percent

This section will cover basic applications of the Auto Regressive Integrated Moving Average time series model. The specific topics to be tested are described below.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Use time series to model trends. • Estimation, data analysis, and forecasting • Forecast errors and confidence intervals Range of weight: 2-8 percent	a. Mean-reverting time series b. Elimination of trends using differencing c. Relationship between seasonality and autocorrelation
2. Model relationships of current and past values of a statistic / metric. • Estimation, data analysis, and forecasting • Forecast errors and confidence intervals Range of weight: 2-8 percent	a. Calculation and use of lag k autocorrelation statistic and cross correlation statistics in determining model structure b. Stationary series c. Autoregressive models of order 1, AR(1) d. Autoregressive integrated moving average models (ARIMA) • AR(p) models • Moving average models (MA) • Autoregressive moving average models (ARMA) • ARIMA model vs. ARMA model e. Invertible time series and relationship between AR and MA models f. Converting between AR and MA models g. Interpretation of auto-correlation function as aid to model selection (AR vs. MA and number of lags to include in model) h. Relationship between time series input and item modeled for AR vs. MA
3. Understand forecasts produced by ARIMA. Range of weight: 2-5 percent	a. Forecast using ARIMA models b. One step ahead prediction vs. many step ahead projection c. Change in variance in prediction by AR vs. MA model

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
4. Time Series with Regression Range of weight: 2-5 percent	a. Deterministic vs. Stochastic Trend b. Serial correlation in regression error results c. Correction in regression via Generalized Least Squares d. Transformation of data using natural logarithms for regression modeling e. Forecast error correction under natural logarithm transformation

READINGS

- Cowpertwait, Chapters 1-5 (excluding Sections 3.3 and 3.4), 6, 7 (Sections 7.1, 7.2 and 7.3)

Exam questions from this section may contain snippets of simple R code and illustrative output of the type shown in the text. Candidates should understand the general functionality of the R commands listed in the "Summary of commands used in examples" sections at the end of Chapters 1-5 and 6. Candidates will not be asked to write R code, nor will they be required to interpret complex applications or complete R programs.

Complete Text References for Exam MAS-I

Text references are alphabetized by the citation column.

Citation	Abbreviation	Learning Objective	Source
Cowpertwait, P. and Metcalfe, A., *Introductory Time Series with R*, Springer, 2009.	Cowpertwait	D1-D4	**B**
Daniel, J.W., "Poisson processes (and mixture distributions)," CAS Study Note, June 2008.	Daniel	A1-A3	**OP**
Dobson, A and Barnett, A, *An Introduction to Generalized Linear Models*, 3rd Edition **or 4th Edition**, Chapman and Hall/CRC Press, 2008/**2018**. **Note: Candidates may use either the 3rd or 4th edition for the November 2020 exam administration**.	Dobson & Barnett	C1-C4	**B** **4th Edition is NEW**
Hogg, R.V.; McKean, J.W.; and Craig, A.T., *Introduction to Mathematical Statistics*, 7th Edition, Prentice Hall, 2013.	Hogg, McKean, and Craig	B1-B4, C1-C4	**B**
James, G., et al., *An Introduction to Statistical Learning, with Application in R*, 1st ed. 2013, Corr. 8th printing, Springer, 2017. Note: Although page iv of the text identifies it as the corrected 8th printing, the publisher refers to it as the corrected 7th printing. Candidates should use the version found in the Complete Online Text References web page for this exam.	James et al.	C1-C4	**OP**
Larsen, M., "Generalized Linear Models," CAS Study Note, December 2015, revised June 2016.	Larsen	C1-C4	**OP**
Ross, S. M., *Introduction to Probability Models*, 11th Edition **or 12th Edition,** Academic Press (an imprint of Elsevier, Inc.), 2014/ **2019**. **Note: Candidates may use either the 11th or 12th edition for the November 2020 exam administration.**	Ross	A1-A6, A8	**B** **12th Edition is NEW**
Struppeck, T., "Life Contingencies," CAS Study Note, October 2014, revised September 2015.	Struppeck	A7	**OP**
Tse, Y., *Nonlife Actuarial Models, Theory Methods and Evaluation*, Cambridge University Press, 2009.	Tse	B1-B3	**B**

Additional Study Aids

Citation	Abbreviation	Learning Objective	Source
Salvatore, D. and Reagle, D., *Schaum's Outline of Statistics and Econometrics*, McGraw-Hill, 2nd Edition, paperback, January 27, 2011, Chapters 6-9.	Salvatore	C1-C4	**BO**
Schiller, J.; Spiegel, M.; and Srinivasan, R., *Schaum's Outlines of Probability and Statistics*: 897 Solved Problems + 20 Videos, McGraw-Hill, 4th Edition, Chapters 4-9.	Schiller	B1-B3, C1-C4	**BO**
Spiegel, M. and Stephens, L., *Schaum's Outline of Statistics*, McGraw-Hill, 5th Edition, Chapters 8-13 and 16.	Spiegel	B1-B3, C1-C4	**BO**

Source Key

B	Book—may be purchased from the publisher or bookstore or borrowed from the CAS Library.
BO	Book (Optional)—may be purchased from the publisher or bookstore.
NEW	Indicates new or updated material.
OP	All text references marked as Online Publications will be available on a web page titled Complete Online Text References.
SK	Material included in the 2020 Study Kit.
SKU	Material included in both the 2020 CAS Study Kit and the 2020 Update to the 2019 Study Kit.

Items printed in **red** indicate an update, clarification, or change.

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Contact information is furnished for those who wish to purchase the text references cited for this exam. Publishers and distributors are independent and listed for the convenience of candidates; inclusion does not constitute endorsement by the CAS.

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ACTEX Learning (Mad River Books), 4 Bridge Street, P.O. Box 715, New Hartford, CT 06057; telephone: (800) 282-2839 or (860) 379-5470; fax: (860) 738-3152; e-mail: support@actexmadriver.com; website: www.actexmadriver.com.
Actuarial Bookstore, P.O. Box 69, Greenland, NH 03840; telephone: (800) 582-9672 (U.S. only) or (603) 430-1252; fax: (603) 430-1258; website: www.actuarialbookstore.com.
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CRC Press, Taylor & Francis Group, 6000 Broken Sound Parkway NW, Suite 300, Boca Raton, FL 33487-2742; website: http://www.crcpress.com.
McGraw-Hill/Irwin, 860 Taylor Station Road, Blacklick, OH 43004; telephone: (800) 262-4729.
Prentice Hall, Inc., 200 Old Tappan Road, Old Tappan, NJ 07675; telephone: (800) 282-0693; website: www.pearsonhighered.com
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2020 SYLLABUS OF BASIC EDUCATION				
KNOWLEDGE STATEMENT MAPPING FOR EXAM MAS-I				
SECTION B				
			Hogg,	
			McKean	
			& Craig	Tse
Learning				
Objective	Knowledge Statement		Section	Section
B.1	a.	Equations for MLE of mean, variance from a sample	Section 6.1	
B.1	b.	Estimation of mean and variance based on sample	Section 2.8	
B.1	c.	General equations for MLE of parameters	Section 4.1, 6.1	
B.1	d.	Recognition of consistency property of estimators and alternative measures of consistency	Section 5.1	Section 10.1
B.1	e.	Application of criteria for measurement when estimating parameters through minimization of variance, mean square error	Section 7.1	Section 10.1
B.1	f.	Definition of statistical bias and recognition of estimators that are unbiased or biased	Section 4.1	Section 10.1
B.1	g.	Application of Rao-Cramer Lower Bound and Efficiency	Section 6.2	
B.1	h.	Relationship between Sufficiency and Minimum Variance	Section 7.3, 7.4	
B.1	i.	Develop and estimate a sufficient statistic for a distribution	Section 7.2	
B.1	j.	Factorization Criterion for sufficiency	Section 7.2	
B.1	k.	Application of Rao-Cramer Lower Bound and Fisher Information	Section 6.2, 6.4	
B.1	l.	Application of MVUE for the exponential class of distributions	Section 7.5, 7.6	
B.1	m.	Linkage between Score Function, Fisher Information and maximum likelihood	Section 6.2	
B.1	n.	Method of Moments		Section 12.1
B.1	o.	Percentile Matching		Section 12.1
B.1	p.	Kernel Density Estimation		Section 11.1.2
B.1	q.	Maximum Likelihood with Censoring & Truncation		Section 10.2, 12.3
B.2	a.	Presentation of fundamental inequalities based on general assumptions and normal assumptions	Section 4.5	
B.2	b.	Definition of Type I and Type II errors	Section 4.5, 8.1	
B.2	c.	Significance levels	Section 4.5, 8.1	
B.2	d.	One-sided versus two-sided tests	Section 4.6, 6.2	
B.2	e.	Estimation of sample sizes under normality to control for Type I and Type II errors	Section 4.5, 4.6	
B.2	f.	Determination of critical regions	Section 4.5	
B.2	g.	Definition and measurement of likelihood ratio tests	Section 6.3, 8.1, 8.2 , 8.3	
B.2	h.	Determining parameters and testing using tabular values	Section 4.5, 4.6	
B.2	i.	Recognizing when to apply likelihood ratio tests versus chi-square or other goodness of fit tests	Section 4.7, 6.3, 8.1-8.3	
B.2	j.	Apply paired t-test to two samples	Section 4.5, 4.6	
B.2	k.	Test for difference in variance under Normal distribution between two samples through application of F-test	Section 8.3	
B.2	l.	Test of significance of means from two samples under Normal distribution assumption in both large and small sample cases	Section 4.5, 4.6, 5.3	
B.2	m.	Test for significance of difference in proportions between two samples under Binomial distribution assumption in both large and small sample case	Section 4.5, 4.6, 5.3	
B.2	n.	Application of contingency tables to test independence between effects	Section 4.7	
B.2	o.	Asymptotic relationship between likelihood ratio tests and the Chi-Square distribution	Section 6.3, 6.5	
B.2	p.	Application of Neyman-Pearson Theorem to Uniformly Most Powerful hypothesis tests	Section 6.4, 8.1	
B.2	q.	Equivalence between critical regions and confidence intervals	Section 4.5	
B.2	r.	Kolmogorov -Smirnov Test		Section 13.2.1
B.3	a.	Frequency, severity, and aggregate loss		Section 1.1
B.3	b.	Common continuous distributions for modeling claim severity		Section 2.2
B.3	c.	Mixing distributions	Section 2.2, 2.7, 3.7	Section 2.3
B.3	d.	Tail properties of claim severity	Section 3.7	Section 2.4
B.3	e.	Effects of coverage modifications including, for example: limits, deductibles, loss elimination ratios and effects of inflation	Section 1.7.1	Section 2.5
B.4	a.	General form for distribution of nth largest element of a set	Section 4.4	
B.4	b.	Application to a given distributional form	Section 4.4	

2020 SYLLABUS OF BASIC EDUCATION						
KNOWLEDGE STATEMENT MAPPING FOR EXAM MAS-I						
SECTION C						
				Hogg,		
			Dobson &	McKean		
			Barnett	& Craig	James et al.	Larsen
Learning						
Objective		Knowledge Statement	Chapter	Section	Section	
C1.	a.	Understand the relationship between mean and variance by model family member for the exponential distribution	Chapter 3	Section 7.5		x
C1.	b.	Understand how to select the appropriate distribution function for the dependent variable and the implication for the appropriate model form	Chapters 2 & 3			
C1.	c.	Link Functions (Identity, Log, Logit, Power, Inverse)	Chapter 3	Section 7.5		x
C1.	d.	Characteristics of Exponential Family (Binomial, Normal, Exponential, Gamma, Poisson, Inverse Gaussian, Negative Binomial, and Tweedie)	Chapter 3	Section 7.5		x
C1.	e.	Canonical Forms of link function and effect of non-canonical link function on bias	Chapter 3			
C1.	f.	Penalized Regression as implemented using the Lasso or Ridge Regression			Section 6.2	
C1.	g.	Understand concept of models within models for Generalized Additive Models			Section 7.7	
C1.	h.	Understand dimension reduction using Partial Least Squares or PCA Regression			Section 6.3, 6.4	
C2.	a.	Raw and studentized Residuals	Chapter 2, Section 6.2 , Section 7.6		Section 3.1, 3.2, 3.3	
C2.	b.	R-Squared statistic	Section 6.3		Section 3.1	
C2.	c.	Cook's Distance and outliers	Section 6.2		Section 3.3	
C2.	d.	Influential points	Section 6.2		Section 3.3	
C2.	e.	Leverage	Section 6.2		Section 3.3	
C2.	f.	Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) penalized log likelihood measures	Section 7.5		Section 6.1	x
C2.	g.	Standardized/Studentized Residuals	Section 6.2		Section 3.3	
C2.	h.	Deviance, Deviance Residuals and relationship to likelihood	Sections 5.6, 7.4, & 7.5		Section 6.1	
C2.	i.	Pearson Residuals vs. Deviance Residuals	Section 7.6			
C2.	j.	Scatter, QQ and Box Plots	Chapter 2	Section 4.4	Chapter 1	x
C2.	k.	Type III Sequential Chi-Square test	Section 7.4	Section 6.5		
C2.	l.	T-test and Wald test for significance of regression coefficients	Section 5.4 & 5.7	Section 9.6 & 6.3	Section 3.1	
C2.	m.	Prediction intervals for response variable			Section 3.2	
C2.	n.	Mean square error and standard error	Section 6.3		Section 2.2, 3.1-3.2	
C2.	o.	Calculation and validity of F test to compare two models (under OLS)	Section 5.7	Sections 9.1 - 9.5	Section 3.2	
C2.	p.	Cross Validation			Section 5.1	
C2.	q.	Test vs. Train Error			Section 2.2	
C2.	r.	Bootstrapping to test model validity			Section 5.2	
C2.	s.	Prediction vs. Forecast Error			Section 3.2	
C2.	t.	Overfitting			Section 2.2	
C2.	u.	Bias- Variance Tradeoff			Section 2.2	
C2.	v.	Evaluate collinearity using variance inflation factor	Section 6.3		Section 3.3	
C2.	w.	Evaluate appropriateness of underlying assumptions including:	Section 2.3		Section 3.3	
		Homoscedasticity				
		Autocorrelation of residuals				
C3.	a.	Maximum Likelihood & Ordinary Least Squares	Chapter 4	Section 9.6	Section 4.3	
C3.	b.	Fisher Scoring (iterative weighted least squares)	Chapter 4			
C3.	c.	Quasi-Likelihood and relationship to maximum likelihood	Section 7.7			x
C3.	d.	Collinearity (Aliasing) and model stability	Section 6.3		Section 3.3	
C3.	e.	Hat matrix	Section 5.6 & 6.2			
C3.	f.	Design matrix	Section 2.4		Chapter 1	
C3.	g.	Fitting adjoining, overlapping observations in groups for Local Regression			Section 7.6	
C3.	h.	Supervised vs. Unsupervised learning methods			Section 2.1	
C3.	i.	Modeling functions within functions for Generalized Additive Models			Section 7.7	
C3.	j.	Penalty function in Penalized regression models (Lasso and Ridge Regression)			Section 6.2	
C3.	k.	Partial Least Squares Supervised learning vs. PCA Regression Unsupervised learning			Section 6.3	

2020 SYLLABUS OF BASIC EDUCATION						
KNOWLEDGE STATEMENT MAPPING FOR EXAM MAS-I						
SECTION C						
					Hogg,	
			Dobson &	McKean		
			Barnett	& Craig	James et al.	Larsen
Learning						
Objective	Knowledge Statement		Chapter	Section	Section	
C4.	a.	Predictor variables	Chapter 1		Section 2.1	
C4.	b.	Response variables	Chapter 1		Section 2.1	
C4.	c.	Regression through the origin				x
C4.	d.	Transformation of variables	Section 6.6 & 9.2		Section 3.3, Chapter 7	
C4.	e.	Categorical vs. continuous explanatory variables	Chapter 1 & Section 6.5		Section 3.3	
C4.	f.	Interaction terms	Section 6.4 & 6.6		Section 3.3	
C4.	g.	Significance and model comparison statistics	Chapters 5, 6, 7,8 &9		Section3.2	
C4.	h.	Residuals and model parameter selection	Section 2.3			
C4.	i.	Piecewise Linear and Smoothing Splines			Section 7.4, 7.5	
C4.	j.	Smoothing parameter for splines			Section 7.5	
C4.	k.	Basis Functions			Section 7.3	
C4.	l.	Knot Selection for Splines			Section 7.4	
C4.	m.	Weighting function for local regression			Section 7.6	
C4.	n.	Selection of functions within functions for Generalized Additive Models			Section 7.7	
C4.	o.	Selection of appropriate tuning factor for Lasso or Ridge Regression			Section 6.2	
C4.	p.	Select either Lasso or Ridge Regression depending on desired effect from penalized regression			Section 6.2	
C4.	q.	Curse of High Dimensionality			Section 6.4	
C4.	r.	Forward or backward or best subset selection			Section 6.1	

The syllabus for this four-hour exam is defined in the form of learning objectives, knowledge statements, and readings.

LEARNING OBJECTIVES set forth, usually in broad terms, what the candidate should be able to do in actual practice. Included in these learning objectives are certain methodologies that may not be possible to perform on an examination, such as applying the Metropolis-Hastings algorithm or building a decision tree, but that the candidate would still be expected to explain conceptually in the context of an examination.

KNOWLEDGE STATEMENTS identify some of the key terms, concepts, and methods that are associated with each learning objective. These knowledge statements are not intended to represent an exhaustive list of topics that may be tested, but they are illustrative of the scope of each learning objective.

READINGS support the learning objectives. It is intended that the readings, in conjunction with the material on earlier examinations, provide sufficient resources to allow the candidate to perform the learning objectives. Some readings are cited for more than one learning objective. The CAS Syllabus & Examination Committee emphasizes that candidates are expected to use the readings cited in this *Syllabus* as their primary study materials.

Thus, the learning objectives, knowledge statements, and readings complement each other. The learning objectives define the behaviors, the knowledge statements illustrate more fully the intended scope of the learning objectives, and the readings provide the source material to achieve the learning objectives. Learning objectives should not be seen as independent units, but as building blocks for the understanding and integration of important competencies that the candidate will be able to demonstrate.

Note that the range of weights shown should be viewed as a guideline only. There is no intent that they be strictly adhered to on any given examination—the actual weight may fall outside the published range on any particular examination.

The overall section weights should be viewed as having more significance than the weights for the individual learning objectives. Over a number of years of examinations, absent changes, it is likely that the average of the weights for each individual overall section will be in the vicinity of the guideline weights. For the weights of individual learning objectives, such convergence is less likely. On a given examination, in which it is very possible that not every individual learning objective will be tested, there will be more divergence of guideline weights and actual weights. Questions on a given learning objective may be drawn from any of the listed readings, or a combination of the readings. There may be no questions from one or more readings on a particular exam.

After each set of learning objectives, the readings are listed in abbreviated form. Complete text references are provided at the end of this exam syllabus.

Items marked with a bold **OP** (Online Publication) are available at no charge and may be downloaded from the CAS website.

Please check the "*Syllabus* Update" section of the CAS Web Site for any changes to the *Syllabus*.

A thorough knowledge of calculus and probability is assumed. Given the material covered on this exam, we assume that the candidate has knowledge of linear algebra concepts at the level commonly assumed as a prerequisite to taking an undergraduate level course in regression analysis. Candidates are expected to have mastered the concepts in Exam MAS-I. For those candidates who have obtained a waiver for Exam MAS-I through the transition rule that granted credit for Exam MAS-I by having credit for Exam S - Statistics and Probabilistic Models or through examinations administered by the Institute and Faculty of Actuaries (United Kingdom), Actuaries Institute (Australia), Actuarial Society of South Africa (ASSA), or the Institute of Actuaries of India, it is recommended to review and master the concepts in the paper "Generalized Linear Models" by Larsen[1] and the following Sections in *An Introduction to Statistical Learning, with Applications in R*: 2.1.4, 2.2.1, 2.2.2, 5.1, and 5.2. See Waivers of Examination page of the CAS website for a complete waiver explanation. While some problems may have an insurance or risk management theme, no prior knowledge of insurance terminology is expected.

A variety of tables along with standard notation for the mixed models will be provided to the candidate with the examination booklet. The tables include values for the standard normal distribution, abridged inventories of discrete and continuous probability distributions, Chi-square Distribution, t-Distribution, and F-Distribution. Since they will be included with the examination, candidates will not be allowed to bring copies of the tables into the examination room.

A guessing adjustment will be used in grading this exam. Details are provided under "Guessing Adjustment" in the "Examination Rules-The Examination" section of the *Syllabus of Basic Education*.

[1] See Syllabus for Exam MAS-I for complete text reference.

A. Introduction to Credibility

Range of weight for Section A: 5-15 percent

Advances in statistical computing tools have now made it practical to include a form of credibility weighting when building regression type models. For example, what the statisticians call shrinkage in a Linear Mixed Effect Model is a form of least squares credibility weighting. These advanced techniques are covered extensively in Sections B and C. However, candidates should be familiar with the topics listed below as they can serve as a good introduction to those techniques and are still very much in practice today. Specifically, candidates should be familiar with limited fluctuation credibility and be able to calculate estimates using Bayesian credibility procedures. They should also be fluent with Bayesian and Bühlmann (least squares credibility) procedures both for discrete and continuous models.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Understand the basic framework of credibility and be familiar with limited fluctuation credibility, including partial and full credibility 2. Understand the basic framework of Bühlmann credibility 3. Calculate different variance components for Bühlmann credibility 4. Calculate Bühlmann and Bühlmann-Straub credibility factor and estimates for frequency, severity, and aggregate loss 5. Understand the basic framework of Bayesian credibility 6. Calculate Bayes estimate/Bayesian premium 7. Bayesian versus Bühlmann credibility for conjugate distributions 8. Calculate credibility estimates using the Nonparametric empirical Bayes Method Range of weight for Learning Objectives A.1 through A.8 collectively: 5-15 percent	a. Limited fluctuation credibility, Partial and Full Credibility b. Conjugate priors, Poisson/Gamma, Binomial/Beta, Normal/Normal c. Bühlmann Credibility Continuous d. Bühlmann Credibility Discrete e. Bayesian Analysis Discrete f. Bayesian Analysis Continuous g. Nonparametric Empirical Bayes
READINGS	
• Tse, Chapters 6.1-6.3, 7.1-7.4, 8.1-8.2, and 9.1-9.2	

B. Linear Mixed Models

Range of weight for Section B: 15-35 percent

This section covers linear models that use a form of credibility weighting for a designated subset of variables in the model called random effects. The candidates will be expected to understand the concepts of shrinkage for Linear Mixed Models as well as how to accommodate models with correlated observations or models where the variance is not assumed to be constant for each observation or a function of the mean. Mixed Models include both Gaussian (Linear Mixed Models) and non-Gaussian (Generalized Linear Mixed Models or Non-Linear Mixed Models) models. This section will only cover Linear Mixed Models. The candidate is expected to understand the linkage between shrinkage and credibility weighting, how to select the appropriate model to induce credibility weighting at the appropriate level when setting up the model structure, and how to account for correlation in the residuals.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Understand the assumptions behind Linear Mixed Models and use that understanding to evaluate how to set up a Linear Mixed Effect Model design to best accomplish the goals of the modeling exercise	a. Characteristics of random and fixed effects explanatory variables for Linear Mixed Models • How to identify a random effect variable • Interaction between fixed and random effect variables when calculating standard error of estimate b. Implications of correlation matrix choice by model form for Linear Mixed Models • Independence assumption for observations • Repeated Measures/Longitudinal Studies • Correlation forms for random vs. fixed effect variables • Hierarchal model structure implementation of treatment and design structure • Explicitly model variance as a function of an explanatory variable

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
2. Understand the algorithms behind the numerical solutions for the Linear Mixed Model to enable interpretation of output from the statistical software employed in modeling to make appropriate choices when evaluating modeling options	a. Restricted Maximum Likelihood b. Choice between Restricted Maximum Likelihood and Maximum Likelihood c. Estimable vs. predictable functions d. Best Linear Unbiased Predictor and interaction with fixed effects variables e. Shrinkage of Best Linear Unbiased Predictors f. Newton-Raphson vs. Fisher scoring vs. EM algorithm g. Bias in variance estimates of fixed effects h. Credibility adjusted degrees of freedom (Saitherwaite/Kenward Rodgers adjustments) i. Conditional vs. population estimate
3. Understand and be able to select the appropriate model structure and variable selection for a Linear Mixed Model given the behavior of the data set to be modeled by interpreting the model diagnostics and or summary statistics on the variables available in the model along with any graphs depicting how the dependent variable behaves as a function of possible explanatory variables Range of weight for Learning Objectives B.1 through B.3 collectively: 15-35 percent	a. Units of replication b. Randomized block designs c. Implication of random effects for model prediction d. Interaction terms for fixed effects vs. random effect variables e. Model selection when covariance structure changes f. Covariance structure g. Selection of fixed vs. random effect class for mixed effect explanatory variables h. Explicitly model variance i. Marginal Model and Implied Marginal Model j. Residual graphs evaluating normality and constant variable assumptions k. Hypothesis tests for fixed and random effects l. Intraclass correlation coefficient m. Know when nested model comparisons are appropriate n. Application of AIC & BIC relative measures of goodness of fit o. Application of Scatter Plots and Box Plots as an aid to model design

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS

READINGS

- West, Chapters 1, 2 (excluding 2.9.6), 3-8, and Appendix B, Additional Notes on Shrinkage (http://www-personal.umich.edu/~bwest/shrinkage.doc)

Chapters 1 and 2 contain an introduction to the modeling concepts underlying Linear Mixed Effect model. Chapters 3 through 8 contain examples that illustrate how to build a Linear Mixed Effect model to accommodate different circumstances. The chapters covering the examples include code from different software packages including SAS, R, SPSS, and HLM. Candidates should focus on understanding the design choices made in modeling, the output from those packages, and how that output was interpreted. Comments on how to make design choices and/or the type of hypothesis test to be employed at a given point in the modeling process expand on the introduction to modeling concepts covered in Chapters 1 and 2 and are a vital part of the reading from West.

The matrix notations employed in the readings for specifying linear model forms will be adopted for exam question from this section and will be provided in the Exam MAS-II Tables supplementary packet that accompanies the examination booklet. Additionally, the format for model output will match that as provided by R software.

Similarly, exam questions from this section may contain parameter tables and diagnostic tables or plots of the type shown in the text. Candidates should understand how to interpret these tables. Candidates who become familiar with a statistical language capable of generating this type of output, such as R, will have an easier time understanding and applying the concepts covered in the syllabus material. In particular, candidates that work with the R code examples in the West textbook, along with the datasets provided, will have a better grasp of the material than that obtained by simply reading the textbook. However, for exam questions from this Section, candidates will not be explicitly tested on software code.

The book's website has made available the datasets and code introduced in the chapters. It can be found at http://www-personal.umich.edu/~bwest/almmussp.html.

C. Bayesian Analysis and Markov Chain Monte Carlo

Range of weight for Section C: 40-60 percent

This section covers current techniques in use to apply Bayesian statistics to modeling problems where conjugate prior distributions may not be the best choice. The candidate is expected to be able to apply Bayesian techniques, to understand a model, and to evaluate the resulting goodness of fit by interpreting the diagnostics that are described below. The candidate is also expected to understand why the Bayesian approach is different than the classical (frequentist) procedures.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Understand basis and basics of Bayesian analysis and incorporate that understanding when interpreting model results • Difference between Bayesian and classical (frequentist) procedures • How probability is used as a measure of uncertainty • Components of a Bayesian model • Use of simulation to create predictive distributions • Summarizing posterior distributions	a. Bayes' rule b. Subjectivity c. Likelihood d. Prior distribution e. Posterior distribution f. Posterior predictive distribution g. Credible, confidence, highest posterior density, and prediction intervals
2. Evaluate the different options available when creating and using Bayesian models for a given modeling assignment. Understand how to set up a Bayesian MCMC model and evaluate how a given set of design choices affects the results of a model • Recognize benefits and limitations of different kinds and parameterizations of priors • Calculating posterior and posterior predictive distributions for single and multi-parameter models • Linear Regression • Mixture models • Hierarchical models	a. Conjugacy b. Proper and improper priors c. Informative, non-informative, and regularizing priors d. Hyperpriors e. Exchangeability f. Transformations of parameters g. Sampling from posterior distribution h. Regularization i. Pooling and shrinkage j. Varying effects of intercepts and slopes k. Gaussian Process Regression for continuous varying effects

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
3. Understand Bayesian computation, how Markov Chain Monte Carlo methods are used, and how to evaluate model performance. Interpret and calculate diagnostics of simulation performance to evaluate when a given modeling approach should be used. • Simulation and sampling • Conditional sampling • Convergence assessment • Efficient samplers • Hamiltonian Monte Carlo	a. Shortcomings of grid and quadratic approximation b. Markov chains c. Gibbs sampler d. Metropolis and Metropolis-Hastings algorithms e. Warm-up / Burn-in f. Convergence in parameter estimate measurement g. Trace plot h. Acceptance rate i. Within-sequence correlation j. Thinning k. Effective number of samples l. Potential scale reduction (R-Hat or Gelman-Rubin statistic) m. Advantage of Hamiltonian Monte Carlo
4. Understand how to apply model checking, evaluation, comparison, and expansion techniques as an aid to interpreting and evaluating model diagnostics • Know how to check model fit to data • Understand limitations of various tests • Understand and calculate measures of model predictive accuracy • Understand and calculate information criteria, their uses and limitations (e.g. bias, dependence on prior, etc.) • Compare models via predictive performance measures • Understand how models can be expanded and what further checks may be needed Range of weight for Learning Objectives C.1 through C.4 collectively: 40-60 percent	a. Sensitivity analysis b. External validation c. Posterior predictive checking d. Predictor residual plots e. Counterfactual plots f. Marginal vs population average posterior predictions g. Log predictive density h. Out-of-sample predictive accuracy i. Information criteria measures (AIC, DIC, WAIC) j. Effective number of parameters k. Cross-validation (LOO-CV) l. Model averaging

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS

READINGS

- Ford
- McElreath, Chapters 2, 3, 4, 5, 6, 8, 9.2, 10, 11, 12, and 13

While candidates will not be explicitly tested on software code, they are encouraged to work the exercises in the material to get hands-on, practical experience building and interpreting Bayesian models.

For instruction on how to obtain the required software and configure the computing environment to run the examples in McElreath, candidates can read the 'Front Matter' section of the text and visit the author's website at http://xcelab.net/rm/software/.

For a copy of the R programs in the Ford study note, candidates can find them under mcmc_algorithms.R at https://github.com/pford221/mcmc_algorithms/.

D. Statistical Learning

Range of weight for Section D: 10-20 percent

This section introduces candidates to a sample of foundational statistical learning techniques. Both supervised and unsupervised techniques are detailed in the readings and candidates should be able to distinguish between them. The supervised learning techniques are non-parametric in nature, meaning the model cannot easily be described in an equation form — they tend to model flexible, non-linear hypotheses well. The unsupervised learning techniques are useful for reducing the dimensions of the data to aid in the profiling of the data or to facilitate more efficient learning from the data. Candidates are expected to understand the mechanics of these algorithms and recognize their inherent strengths and weaknesses so as to be able to select the most appropriate procedure for the learning task at hand.

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
1. Understand the computations behind K-nearest neighbors (KNN) and be able to explain how it works in practice and its relationship with Bayes classifier.	a. Classification versus regression for supervised learning b. Bayes classifier c. KNN decision boundary versus Bayes decision boundary
2. Understand the computations involved in building decision trees, the purpose of tree pruning, and how extensions such as bagging, random forest, and boosting can improve the prediction accuracy of tree-based methods.	a. Recursive binary splitting for decision trees b. Pruning for decision trees c. Comparison of decision trees versus linear models d. Advantages and disadvantages of decision trees e. Bagging and OOB Error f. Similarity and differences between bagging and random forest g. Sequential learning via boosting h. Gini/entropy application for splitting
3. Understand the purpose of, and the computations behind principle components analysis (PCA) and be able to interpret related software outputs.	a. Loading vector and scores for principle component b. Effect of scaling on PCA c. Proportion of variance explained by PCA and scree plots d. Combining many dimensions (variables) into fewer e. Compare purpose of PCA to K-means
4. Be familiar with purpose of, and the computations behind clustering procedures and be able to interpret related software outputs.	a. K–means clustering algorithm b. Agglomerative hierarchical clustering algorithm c. Dendrogram d. Dissimilarity measure

LEARNING OBJECTIVES	KNOWLEDGE STATEMENTS
Range of weight for Learning Objectives D.1 through D.4 collectively: 10-20 percent	

READINGS

- James et al., Chapters 1 (Background reading only), 2.2.3, 8, and 10. Exam questions will not be sourced directly from Chapter 1.

Programming labs found in sections 2.3, 8.3, and 10.4 demonstrate the implementation of topics covered in the sections above with R, but no new concepts are introduced here. These labs show how to load and work with datasets made available in the ISLR package in R. For information on how to install and load R packages, please refer to section 3.6.1. Examination questions will not explicitly test software code, but careful review of these sections will greatly help the candidates understand and apply these concepts.

Complete Text References for Exam MAS-II

Text references are alphabetized by the citation column.

Citation	Abbreviation	Learning Objective	Source
Ford, P., "MCMC Algorithms," CAS Study Note, Version 0.7, November 2019.	Ford	C3	**OP NEW**
James, G., et al., *An Introduction to Statistical Learning, with Application in R*, 1st ed. 2013, Corr. 8th printing, Springer, 2017. Note: Although page iv of the text identifies it as the corrected 8th printing, the publisher refers to it as the corrected 7th printing. Candidates should use the version found in the Complete Online Text References web page for this exam.	James et al.	D1-D4	**OP**
McElreath, R., *Statistical Rethinking: A Bayesian Course with Examples in R and Stan*, CRC Press, 2016.	McElreath	C1-C4	**B**
Tse, Y., *Nonlife Actuarial Models, Theory Methods and Evaluation*, Cambridge University Press, 2009.	Tse	A1-A8	**B**
West, B. T.; Welsh, K. B.; and Galecki, A. T., *Linear Mixed Models: A Practical Guide Using Statistical Software*, 2nd Edition, CRC Press, 2015.	West	B1-B3	**B**

Source Key

B	Book—may be purchased from the publisher or bookstore or borrowed from the CAS Library.
NEW	Indicates new or updated material.
OP	All text references marked as Online Publications will be available on a web page titled Complete Online Text References.
SK	Material included in the 2020 Study Kit.
SKU	Material included in both the 2020 CAS Study Kit and the 2020 Update to the 2019 Study Kit.

Items printed in **red** indicate an update, clarification, or change.

Publishers and Distributors

Contact information is furnished for those who wish to purchase the text references cited for this exam. Publishers and distributors are independent and listed for the convenience of candidates; inclusion does not constitute endorsement by the CAS.

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SYLLABUS OF BASIC EDUCATION
2020
Risk Management and Insurance Operations
CAS Online Course 1

Notice about the 3rd Edition

3rd Edition: The first exam offering on this content was April 15, 2019.

Risk Management and Insurance Operations is called Online Course 1 by the CAS and CA1, 3rd Edition, by The Institutes. Prometric lists this course as CAS1 on its Web site under The Institutes.

Online Course 1/CA1 prepares CAS candidates for a two-hour, seventy-five-point multiple-choice examination. The online course and exam were developed collaboratively with The Institutes. The online course is available through the Casualty Actuarial Society Online Courses Web Page on The Institutes' Web Site. Similarly, the exam is administered by The Institutes at Prometric test centers during four, two-month testing windows annually.

The CAS will grant a waiver of CAS Online Course 1 to those who have the Chartered Property Casualty Underwriter (CPCU) designation.

The study material for CAS Course 1/CA1 is contained in the online course access. The fee for access to the online course includes one attempt at passing the exam. Candidates are required to purchase the online course to obtain access to the exam. Exam retakes may be purchased separately if needed.

Purchasing the course requires that candidates declare the testing window in which they are planning to take the exam. To register for the exam, a candidate must:

- Call The Institutes at (800) 644-2101 or (610) 644-2100, extension 6000, to register for the exam itself. This will place the candidate on an eligibility list for Prometric.
- Then make an appointment with Prometric for a specific date and time during the testing window. Early registration for the exam is strongly encouraged as seats fill quickly. There is a $115 fee for changing testing windows.
- Schedule your appointment when you know you will be ready to sit for the exam. Effective January 1, 2012, Prometric will charge a $50 fee to candidates who reschedule their appointments between 3 to 12 business days of a test date. Changes to the appointment date/time are not permitted within 3 business days of the appointment.

Questions or concerns regarding CAS Online Course 1/CA1 should be directed to The Institutes' Customer Success group at (800) 644-2101 or (610) 644-2100, extension 6000, or CustomerSuccess@TheInstitutes.org.

Assignment 1: Introduction to Risk Management

MODULE TITLE	LEARNING OBJECTIVES
Understanding and Quantifying Risk	Describe each of the following in the context of risk: • Uncertainty • Possibility • Possibility compared with probability
Classifications of Risk	Explain how the following classifications of risk apply and how they help in risk management: • Pure and speculative risk • Subjective and objective risk • Diversifiable and nondiversifiable risk • Quadrants of risk (hazard, operational, financial, and strategic)
Financial Consequences of Risk	Describe the three financial consequences of risk.
Basic Purpose and Scope of Risk Management	Describe the basic purpose and scope of risk management in terms of the following: • How risk management is practiced by individuals and organizations • The basic distinction between traditional risk management and enterprise-wide risk management
Loss Exposures	Describe the following elements of property, liability, personnel, and net income loss exposures: • Assets exposed to loss • Causes of loss, including associated hazards • Financial consequences of loss
Risk Management Benefits	Describe the benefits of risk management and how it reduces the financial consequences of risk for individuals, organizations, and society.
Risk Management Program Goals	Summarize pre-loss and post-loss risk management program goals and the conflicts that can arise as they are implemented.
The Risk Management Process	Describe each of the steps in the risk management process

Assignment 2: Risk Control

MODULE TITLE	LEARNING OBJECTIVES
Risk Control Techniques	Describe the six categories of risk control techniques in terms of the following: • Whether each reduces loss frequency, reduces loss severity, or makes losses more predictable • How each can be used to address a particular loss exposure • How they differ from one another
Risk Control Goals	Explain how an organization can use risk control techniques and measures to achieve the following risk control goals: • Implement effective and efficient risk control measures • Comply with legal requirements • Promote life safety • Ensure business continuity
Selection of Risk Control Techniques	Explain how risk control techniques can be applied to property, liability, personnel, and net income loss exposures.
Business Continuity Management	Describe business continuity management in terms of its scope, the process used to implement it, and the contents of a typical business continuity plan.

Assignment 3: Risk Financing

MODULE TITLE	LEARNING OBJECTIVES
Risk Financing Goals	Explain how individuals or organizations can achieve their overall and risk management goals by fulfilling the following risk financing goals: • Pay for losses • Manage the cost of risk • Manage cash flow variability • Maintain an appropriate level of liquidity • Comply with legal requirements
Retention and Transfer	Describe the following aspects of retention and transfer: • Retention funding measures • Limitations on risk transfer measures • The advantages of both retention and transfer
Selecting Appropriate Risk Financing Measures	Explain how the following can affect the selection of the appropriate risk financing measure: • Ability of a risk financing measure to meet risk financing goals • Loss exposure characteristics • Characteristics specific to an individual or organization
Risk Financing Measures	Explain how an organization meets its risk financing goals by using the following risk financing measures: • Guaranteed cost insurance • Self-insurance • Large deductible plans • Captives • Finite risk plans • Pools • Retrospective rating plans • Hold-harmless agreements • Capital market solutions

Assignment 4: Enterprise-Wide Risk Management

MODULE TITLE	LEARNING OBJECTIVES
Traditional Risk Management Versus ERM	Contrast traditional risk management and ERM.
Improving Strategic Decision Making With ERM	Explain how an organization can improve its strategic decision-making by incorporating enterprise-wide risk management (ERM).
ERM in Approaching Business Uncertainties	Explain why ERM is an effective approach to use to face business uncertainties.
Major Risk Management Frameworks and Standards	Summarize the main risk management frameworks and standards.

Assignment 5: Insurance as a Risk Management Technique

MODULE TITLE	LEARNING OBJECTIVES
How Insurance Reduces Risk	Explain how insurance reduces risk through pooling.
Benefits of Insurance	Explain how insurance benefits individuals, organizations, and society.
Characteristics of an Ideally Insurable Loss Exposure	Explain why each of the six characteristics of an ideally insurable loss exposure is important to the insurance mechanism.
Insurability of Commercial Loss Exposures	Explain how the six characteristics of an ideally insurable loss exposure apply to commercial loss exposures.
Insurability of Personal Loss Exposures	Explain how the six characteristics of an ideally insurable loss exposure apply to personal loss exposures.
Government Insurance Programs	Explain how state and federal governments are involved in the insurance market and the rationale for, and level of, their involvement.

Assignment 6: Overview of Insurance Operations

MODULE TITLE	LEARNING OBJECTIVES
Insurer Goals and the Constraints on Achieving Them	Categorize the internal and external constraints that impede insurers from achieving their major goals.
Classifications of Insurers	Explain how insurers have organized to provide property-casualty insurance.
Measuring Insurer Performance	Describe the measurements used to evaluate how successful an insurer is at meeting its established goals.
Functional View of Insurance	Describe the core and supporting functions performed by insurers.
The Digitization of Insurance	Explain how expanding data sources, the blockchain, and advanced analytics can transform Insurance operations.

Assignment 7: Insurance Marketing and Distribution

MODULE TITLE	LEARNING OBJECTIVES
Property-Casualty Insurance Marketplace	Describe the following attributes of the competitive property-casualty insurance marketplace: distinguishing characteristics of insurance customers, insurer marketing differentiations, and unique factors in the insurance marketplace.
Unique Factors In the Property-Casualty Insurer Marketplace	Explain how unique economic factors shape the insurance marketplace.
Insurer Marketing Activities	Explain how typical insurer marketing activities are performed and why they are performed.
Insurance Distributions Systems and Channels	Distinguish among the main types of insurance distribution systems and channels.
Functions of Insurance Producers	Describe the functions performed by insurance producers.
Selecting Insurance Marketing Distribution Systems and Channels	Describe the key factors an insurer should evaluate during the distribution-system and distribution-channel selection process.

Assignment 8: The Underwriting Function

MODULE TITLE	LEARNING OBJECTIVES
Purpose of Underwriting	Describe the purpose of underwriting.
Underwriting Activities	Describe the underwriting activities typically performed by line and staff underwriters.
Underwriting Authority	Describe the importance of compliance with underwriting authority in individual account selection.
Constraints in Establishing Underwriting Policy	Describe the constraining factors considered in the establishment of underwriting policy.
Implementing Underwriting Policy	Describe the purposes that underwriting guidelines and underwriting audits serve.
Steps in the Underwriting Process	Summarize the steps in the underwriting process and the purpose of each.
Measuring Underwriting Results	Explain how an insurer's underwriting results are measured and how financial measures can be distorted.

Assignment 9: Underwriting Property and Liability Insurance

MODULE TITLE	LEARNING OBJECTIVES
Underwriting Property Insurance Using the COPE Model	Describe in detail each of the COPE factors used to evaluate property loss exposures.
Property Policy Provision Underwriting Considerations	Explain how insurable interest, policy provisions for valuing losses, and insurance to value affect a loss payment amount under property insurance.
Measures of Potential Loss Severity	Explain how underwriters use policy amount, amount subject, normal loss expectancy (NLE), probable maximum loss (PML), and maximum foreseeable loss (MFL) to measure potential loss severity.
Underwriting Business Income and Extra Expense Coverage	Describe the underwriting considerations for business income and extra expense coverage.
Underwriting Commercial Crime Insurance	Describe the underwriting considerations and risk control techniques associated with employee dishonesty and crimes committed by others.

MODULE TITLE	LEARNING OBJECTIVES
Underwriting Commercial General Liability Insurance	Describe the loss exposures and the underwriting considerations for commercial general liability insurance.
Underwriting Personal and Commercial Auto Insurance	Describe the underwriting considerations for personal and commercial auto insurance.

Assignment 10: Risk Control and Premium Auditing

MODULE TITLE	LEARNING OBJECTIVES
Insurer Risk Control Goals	Describe the goals of insurer risk control activities.
Risk Control Services Provided by Insurers	Describe the risk control services provided by insurers.
Cooperation Between Risk Control and Other Insurer Functions	Explain how risk control cooperates with other insurer functions.
Reasons for Premium Auditing	Explain why premium audits are conducted.
Premium Auditing Process	Describe the premium auditing process.
Importance of Accurate Premium Audits	Explain why premium audits must be accurate.
Premium Auditing Contributions	Explain how premium auditing contributes to other insurer functions.

Assignment 11: The Claim Function

MODULE TITLE	LEARNING OBJECTIVES
Overview of the Claim Function	Explain how an Insurer's claim function achieves its primary goals, provides valuable information to other departments, and interacts effectively with outside contacts.
Claim Department Structure, Personnel, and Performance	Explain how Claims Department results can be optimized by: • Department structure • The types and functions of claims personnel • Claim performance measures

MODULE TITLE	LEARNING OBJECTIVES
Measures Used to Ensure Regulatory Compliance	Explain how the following measures are used to ensure regulatory compliance: • Claim guidelines, policies, and procedures • Controls • Supervisor and manager reviews • Claim audits
The Claims Handling Process	Describe the activities in the claims handling process.
Framework for Coverage Analysis	Describe the framework for coverage analysis and the information obtained by following it.
Applying the Claims Handling Process and the Framework for Coverage Analysis	Given a claim resolution scenario, demonstrate how a claim representative handles the claim and analyzes coverage.

Assignment 12: Adjusting Property and Liability Claims

MODULE TITLE	LEARNING OBJECTIVES
Property Claim Handling Process	Explain how and why the activities in the framework for handling property claims are accomplished.
Handling Specific Types of Property Claims	Describe the challenges of handling the following types of property claims: • Residential dwelling claims • Residential personal property claims • Commercial structure claims • Business income claims • Merchandise claims • Transportation and bailment claims • Catastrophe claims
Liability Claim Handling Process	Explain how and why the activities in the framework for handling a liability claim are accomplished.

MODULE TITLE	LEARNING OBJECTIVES
Handling Specific Types of Liability Claims	Describe the challenges of handling each of the following types of claims: • Auto bodily injury liability claims • Auto property damage claims • Premises liability claims • Operations liability claims • Products liability claims • Workers compensation claims • Professional liability claims

Assignment 13: Reinsurance Principles and Concepts

MODULE TITLE	LEARNING OBJECTIVES
Reinsurance and Its Functions	Describe principal functions of reinsurance.
Reinsurance Sources	Describe the three sources of reinsurance.
Reinsurance Transactions	Contrast treaty reinsurance and facultative reinsurance.
Types of Pro Rata Reinsurance	Given a case, determine the amount of loss that would be payable under a pro rata reinsurance contract.
Types of Excess of Loss Reinsurance	Given a case, determine the amount of loss that would be payable under an excess of loss reinsurance contract.
Alternatives to Traditional Reinsurance	Explain how finite risk reinsurance and capital market-based methods are used as alternatives to traditional reinsurance.

Assignment 14: Insurer Strategic Management

MODULE TITLE	LEARNING OBJECTIVES
Strategic Management Process	Summarize the stages in the strategic management process.
The Five Forces and SWOT Methods of Analyzing the Environment	Explain how the Five Forces and SWOT methods can be used to analyze the environment in which an insurer operates.
Determining Strategy at Different Organizational Levels	Explain how strategies are developed at the corporate, business, functional, and operational levels.
Strategic Management Case Study	Given information about an insurer's business strategies, conduct a SWOT analysis to evaluate its strategy.

Assignment 15: The Underwriting Cycle

MODULE TITLE	LEARNING OBJECTIVES
The Insurance Underwriting Cycle	Describe the phases of the insurance underwriting cycle and the strategies normally used by insurers and producers during each phase.
Financial Factors Influencing the Underwriting Cycle	Explain how the following financial factors influence underwriting cycles • Investment income • Capacity • Return on equity • Cash flow
Effects of Supply and Demand on the Underwriting Cycle	Explain how the theory of demand and supply applies to insurance and the underwriting cycle.

Assignment 16: Actuarial Data Management

MODULE TITLE	LEARNING OBJECTIVES
Data Quality	Summarize: • The concepts of data quality and information quality • The impact of data quality on the actuarial work product
Principles of Data Quality	Given a principle of data quality, provide an example that illustrates the principle.
Data Quality—ASOP No. 23	Given a concept from the Actuarial Standard of Practice No. 23, provide an example of its application or use.
Life Cycle for Insurance Data	For each step in the life cycle for insurance data, describe the purpose, the responsible parties, and errors typically encountered.
Metadata	Summarize metadata including: • How metadata are defined • The actuary's role in creating and sharing metadata • How metadata are shared across an organization • The data collected under different statistical plans
The Need for Aggregate Insurance Statistical Data	Explain the regulatory and business needs for statistical data.
Types of Statistical Plans	Summarize the relationship of Statistical Plans to insurance rating elements and the two basic types of Statistical Plans: • Summary-based Statistical Plans • Transaction-based Statistical Plans
Insurance Data Elements: Date Fields and Amount Fields in Statistical Plans	Describe the functions of the date field and amount field data elements in a statistical plan.
Insurance Data Elements: Classification or Rating Variable Fields and Exposure Data Elements	Describe the following statistical plan data elements by line of business: • Classification and Rating Elements • Exposure

MODULE TITLE	LEARNING OBJECTIVES
Techniques and Applications to Improve Information Quality	Summarize the following data quality analysis concepts: • Exploratory data analysis • Data cubes • Identifying missing data • Descriptive statistics • Box and whisker plots
Auditing Data and the Actuary's Responsibility in Assessing Data Reasonability	Explain the following: • The purpose and steps of data auditing • An actuary's responsibility in assessing data reasonability

Study Materials for CAS Online Course 1

The online course itself contains learning objectives and all the educational material to meet these objectives and successfully complete the exam. The course fee includes one attempt at the exam.

The following printed materials are supplemental and may also be purchased from The Institutes, but are not required:

- **Textbook** contains material that is identical to the online course—only in a hardcopy format.
- **Review Notes** is a condensed version of the textbook.
- **Course Guide** contains sample questions and answers.
- **Flashcards** contain key words and phrases.

The materials described above may be purchased individually or in various package combinations.

Questions about potentially defective questions or material should be directed to The Institutes' Customer Success group at (800) 644-2101 or (610) 644-2100, extension 6000, or CustomerSuccess@TheInstitutes.org.

Publisher and Distributor

CAS Online Course 1/CA1 is available through The Institutes.

The Institutes, 720 Providence Road, Suite 100, Malvern, PA 19355-3433; telephone: (800) 644-2101 or (610) 644-2100 extension 6000; e-mail: CustomerSuccess@TheInstitutes.org; website for CAS Online Courses: www.aicpcu.org/cas.htm.

Exam Results

Candidates taking this computer-based test will receive unofficial pass/fail results at the conclusion of their exam. The unofficial pass/fail result will be displayed on the computer screen at the conclusion of the exam. In most test centers, a printed copy of the candidate's unofficial pass/fail result will be available upon completion of the computer-based test from the proctor in the administrative area outside the testing room. The candidate, however, should carefully read the result that is displayed on the computer screen at the conclusion of the exam.

When the official grades have been processed, candidates will receive an e-mail from The Institutes stating that their grades are available. Candidates may then log into their account on The Institutes Website (www.TheInstitutes.org) to access their grades. The grade report for each candidate will show the candidate's overall score on the exam in ten-point increments (e.g., 60 to 69%, 70 to 79%, and so on). It will similarly show the candidate's performance by assignment using those same ten-point increments.

Notice about the 4th Edition

4th Edition: The first exam offering on this content was April 15, 2019.

Insurance Accounting, Coverage Analysis, Insurance Law, and Insurance Regulation is called Online Course 2 by the CAS and CA2, 4th Edition, by The Institutes. Prometric lists this course as CAS2 on its website under The Institutes.

Online Course 2/CA2 prepares CAS candidates for a two-hour, seventy-five-point, multiple-choice examination. The online course and exam were developed collaboratively with The Institutes. The online course is available through the Casualty Actuarial Society Online Courses Web Page on The Institutes' website. Similarly, the exam is administered by The Institutes at Prometric test centers during four, two-month testing windows annually.

The study material for CAS Course 2/CA2 is contained in the online course access. The fee for access to the online course includes one attempt at passing the exam. Candidates are required to purchase the online course to obtain access to the exam. Exam retakes may be purchased separately if needed.

Purchasing the course requires that candidates declare the testing window in which they are planning to take the exam. To register for the exam, a candidate must:

- Call The Institutes at (800) 644-2101 or (610) 644-2100, extension 6000, to register for the exam itself. This will place the candidate on an eligibility list for Prometric.
- Then make an appointment with Prometric for a specific date and time during the testing window. Early registration for the exam is strongly encouraged as seats fill quickly. There is a $115 fee for changing testing windows.
- Schedule your appointment when you know you will be ready to sit for the exam. Effective January 1, 2012, Prometric will charge a $50 fee to candidates who reschedule their appointments between 3 to 12 business days of a test date. Changes to the appointment date/time are not permitted within 3 business days of the appointment.

Questions or concerns regarding CAS Online Course 2/CA2 should be directed to The Institutes' Customer Success group at (800) 644-2101 or (610) 644-2100, extension 6000, or CustomerSuccess@TheInstitutes.org.

Assignment 1: Introductory Insurance Accounting

MODULE TITLE	LEARNING OBJECTIVES
Qualitative Accounting Information Criteria	Explain the following qualitative accounting information criteria: • Understandability • Relevance • Reliability • Comparability and consistency • Lack of bias • Cost-benefit effectiveness
Types of Accounting Frameworks	Describe the frameworks and the intended users and focus of each of the following sets of accounting frameworks: • Generally Accepted Accounting Principles (GAAP) accounting • Regulatory/supervisory accounting • Tax accounting • Management accounting
Accounting Frameworks and Rule Hierarchies	Explain the concept of a rule hierarchy and the sources of the following accounting frameworks: • Generally Accepted Accounting Principles (GAAP) • Regulatory/supervisory accounting • Tax accounting
Selected Accounting Concepts	Summarize the following accounting concepts: • Fair value versus historical cost • Recognition versus measurement • Deferral-matching versus asset-liability • Impairment • Revenue recognition • Reporting segment • Liquidation versus going concern • Change in accounting principle versus change in accounting estimate • Principle-based versus rule-based

MODULE TITLE	LEARNING OBJECTIVES
Fundamentals of Insurer Financial Statements	Describe the purpose and primary components of these key schedules of an insurer's financial statements: • Balance sheet • Income statement • Cash flow statement • Notes and disclosures
Premium Accounting—Revenue Recognition	Explain how and when insurers recognize premium revenue in their financial statements under deferral-matching and asset-liability approaches.
Premium Accounting—Types of Written Premium	Distinguish between the various types of written premium and policy transactions that may not be classified as premium.
Other Premium Accounting Issues	Summarize the implications of these premium accounting issues: • Financing—premiums versus service charges • Earning premium before it is written • Extended reporting endorsements (definite versus indefinite periods) • Reinsurance lags • Large deductible credits
Unearned Premium	Summarize the purpose of unearned premium and these issues associated with how premiums are earned over time: • Pro rata and non-pro rata approaches to earning premium • Multiyear policies • Liability adequacy test and the premium deficiency reserve
The Relationship Between Loss Reserves and the Unearned Premium Reserve	Explain the relationship between loss reserves and the unearned premium reserve.

MODULE TITLE	LEARNING OBJECTIVES
Loss and Loss Adjustment Expense Accounting	Describe the following issues related to loss and loss adjustment expense (LAE) accounting: • Loss accounts • Loss cycle • Paid loss versus cash payment • Recoverable amounts • Accounting for discounted reserves • Self-insurer issues
Reinsurance Accounting Basics	Explain the accounting and financial reporting considerations, including how values in insurers' financial reports are influenced by lags in the reporting of reinsurance transactions and bordereau reporting, for these types of reinsurance: • Assumed reinsurance • Ceded reinsurance • Commutations • Prospective versus retroactive reinsurance
Deposit Accounting	Explain the conditions under which an accounting framework may require deposit accounting for an insurance contract, and the operation of three general forms of deposit accounting rules.

Assignment 2: Insurance Policy Analysis

MODULE TITLE	LEARNING OBJECTIVES
Distinguishing Characteristics of Insurance Policies	Describe the following characteristics of insurance policies, including common exceptions to these characteristics. • Indemnity • Utmost good faith • Fortuitous losses • Contract of adhesion • Exchange of unequal amounts • Conditional • Nontransferable

MODULE TITLE	LEARNING OBJECTIVES
Structure of Insurance Policies	Describe these approaches to insurance policy structure and how they can affect policy analysis: • Self-contained and modular policies • Preprinted and manuscript policies • Standard and nonstandard forms • Endorsements and other related documents
Types of Policy Provisions	Describe the purpose(s) and characteristics of each of these types of policy provisions in a property-casualty insurance policy: • Declarations • Definitions • Insuring agreements • Exclusions • Conditions • Miscellaneous provisions
Policy Analysis	Describe the primary methods of insurance policy analysis.

Assignment 3: Common Policy Concepts

MODULE TITLE	LEARNING OBJECTIVES
Insurable Interest	Given a case, evaluate one or more entities' insurable interests.
Insurance to Value	Explain why insurance to value is important to property insurers, how insurers encourage insurance to value, and what insureds can do to address the problems associated with maintaining insurance to value.
Property Valuation Methods	Explain how property is valued under each of the following valuation methods in property insurance policies: • Actual cash value • Replacement cost • Agreed value • Functional valuation

MODULE TITLE	LEARNING OBJECTIVES
Valuation of Liability Claims	Explain how the amount payable for a claim covered under a liability insurance policy is determined.
Reasons for Property Insurance Deductibles	Explain how deductibles in property insurance benefit the insured.
Liability Deductibles and Self-Insured Retentions	Explain when and why deductibles and self-insured retentions are appropriate for use in liability insurance.
Other Sources Of Recovery	Describe the multiple sources of recovery that may be available to an insurance policyholder for a covered loss.

Assignment 4: Personal Auto Policy: Liability, Medical Payments, and Uninsured Motorist Coverage

MODULE TITLE	LEARNING OBJECTIVES
Overview of the Personal Auto Policy	Summarize the sections of the Personal Auto Policy.
Declarations	Identify the types of information typically contained on the declarations page of a personal auto policy.
Definitions	Define the words and phrases included in the definitions section of the Personal Auto Policy.
Part A - Liability Coverage	Summarize each of the provisions in Part A - Liability Coverage of the Personal Auto Policy.
Part A - Liability Coverage Case Study	Given a case describing an auto liability claim, determine whether Part A - Liability Coverage of the Personal Auto Policy would cover the claim and, if so, the amount the insurer would pay for the claim.
Part B - Medical Payments Coverage	Summarize each of the provisions in Part B - Medical Payments Coverage of the Personal Auto Policy.
Part B - Medical Payments Coverage Case Study	Given a case describing an auto medical payments claim, determine whether Part B - Medical Payments Coverage of the Personal Auto Policy would cover the claim and, if so, the amount the insurer would pay for the claim.

MODULE TITLE	LEARNING OBJECTIVES
Part C - Uninsured Motorists Coverage	Summarize each of the provisions in Part C - Uninsured Motorists Coverage of the Personal Auto Policy.
UM/UIM Endorsements and State Variations	Describe underinsured motorists coverage in terms of: • Its purpose • The ways in which it can vary by state
Part C - Uninsured Motorists Coverage Case	Given a case describing an uninsured motorists claim, determine whether Part C - Uninsured Motorists Coverage of the Personal Auto Policy would cover the claim and, if so, the amount the insurer would pay for the claim.

Assignment 5: Personal Auto Policy: Physical Damage, Duties After an Accident, Endorsements, General Provisions

MODULE TITLE	LEARNING OBJECTIVES
Part D - Damage to Your Auto Coverage	Summarize each of the provisions in Part D - Damage to Your Auto of the Personal Auto Policy.
Part D - Damage to Your Auto Coverage Case	Given a case describing an auto physical damage claim, determine whether Part D - Coverage for Damage to Your Auto of the Personal Auto Policy would cover the claim and, if so, the amount the insurer would pay for the claim.
Part E - Duties After an Accident or Loss	Identify the insured's duties following an auto accident or loss (Part E) covered by the Personal Auto Policy.
Part F - General Provisions	Summarize each of the general provisions in Part F of the Personal Auto Policy.
Common Endorsements to the Personal Auto Policy	Identify the Personal Auto Policy endorsements that are used to handle common auto loss exposures.
Personal Auto Endorsements for Transportation Network Exposures	Describe the Personal Auto Endorsements that are used to handle exposures related to transportation network companies.
Personal Auto Coverage Case Study	Given a case describing an auto claim, determine whether the Personal Auto Policy would cover the claim and, if so, the amount the insurer would pay for the claim.

Assignment 6: Homeowners Property Coverage

MODULE TITLE	LEARNING OBJECTIVES
ISO Homeowners Program	Describe how individuals and families can use the ISO Homeowners insurance program to address their personal risk management needs.
Homeowners Program Structure	Summarize these aspects of the 2011 Homeowners Program: • Structure of the Homeowners Policy (HO-3) • Key changes in the ISO 2011 Program Revision • Factors important to rating homeowners insurance
HO-3 Section I - Property Coverages	Determine whether the 2011 HO-3 policy provisions in the following Section I - Property Coverages provide coverage for a given loss or loss exposure: • Coverage A - Dwelling • Coverage B - Other Structures • Coverage C - Personal Property • Coverage D - Loss of Use • Additional Coverages
HO-3 Section I - Perils Insured Against and Exclusions	Summarize each of the 2011 HO-3 policy provisions: • Perils Insured Against • Exclusions
HO-3 Section I - Conditions	Summarize each of the 2011 HO-3 policy provisions in Section I - Conditions.
2011 HO-3 Section I - Property Coverage Case Study	Given a scenario describing a homeowners property claim, determine whether the 2011 HO-3 Policy Section I - Property Coverages would cover the claim, and if so, the amount the insurer would pay for the claim.

Assignment 7: Homeowners Liability, Conditions, Coverage Forms, and Endorsements

MODULE TITLE	LEARNING OBJECTIVES
HO-3 Section II - Liability Coverages	Determine whether the 2011 HO-3 Policy provisions in the following Section II - Liability Coverages provide coverage for a given loss or loss exposure: • Coverage E - Personal Liability • Coverage F - Medical Payments to Others • Additional Coverages
HO-3 Section II - Exclusions	Determine whether one or more exclusions preclude the coverage provided by Section II of the 2011 HO-3 - Special Edition policy provisions in Section II - Exclusions.
HO-3 Section II - Conditions	Summarize each of these 2011 HO-3 Special Edition policy provisions: • Conditions applicable to Section II • Conditions applicable to Sections I and II
Determining Whether HO-3 Section II - Liability Coverages Covers a Claim	Given a case describing a homeowners liability claim, determine whether the Homeowners Section II - Liability Coverages would cover the claim and, if so, the amount the insurer would pay for the claim.
Coverage Variations in ISO Homeowners Forms	Compare the coverage provided by each of the following 2011 Homeowners policies to the coverage provided by the 2011 HO-3 policy: • HO-2 Broad Form • HO-5 Comprehensive Form • HO-4 Contents Broad Form • HO-6 Unit-Owners Form • HO-8 Modified Coverage Form
Commonly Used Endorsements that Modify the 2011 ISO Homeowners Policies	Summarize the coverages provided by various 2011 ISO Homeowners policy endorsements.
HO-3 Coverage Case	Given a case describing a homeowners claim, determine whether a 2011 HO-3 Policy that may include one or more endorsements would cover the claim, and, if so, the amount the insurer would pay for the claim.

Assignment 8: Life Insurance, Annuities and Health Insurance

MODULE TITLE	LEARNING OBJECTIVES
Premature Death Loss Exposures	Describe the financial impact of the premature death personal loss exposure on the following types of family structures: • Singles without children • Single-parent families • Two-income families • Traditional families • Blended families • Sandwiched families
Types of Life Insurance	Summarize the various types of life insurance.
Sources of Life Insurance	Summarize the distinguishing characteristics of life insurance provided by each of the following sources: individual life insurance, group life insurance, and government-provided life insurance.
Common Life Insurance Contractual Provisions and Riders	Summarize the common life insurance contractual provisions and riders.
Individual Annuities	Summarize the various types of individual annuities.
Disability and Health-Related Personal Loss Exposures	Describe the financial impact of disability and other health-related personal loss exposures on individuals and families.
Disability Income Insurance	Summarize the distinguishing characteristics of each of the following types of disability income insurance: • Individual disability income insurance • Group disability income insurance • Social Security disability income program
Health Insurance Plans	Describe the characteristics of the following nongovernment programs for providing healthcare benefits: • Traditional health insurance plans • Managed-care plans • Consumer-directed health plans

Assignment 9: Commercial Property Insurance, Part I

MODULE TITLE	LEARNING OBJECTIVES
Overview of the Commercial Property Insurance	Describe commercial property insurance in terms of these elements: • The major categories of loss exposures that can be covered • The components of a commercial property coverage part
BPP Covered Property	Determine whether a described item of property qualifies as Covered Property under one or more of these categories in the Building and Personal Property Coverage Form: • Building • Your Business Personal Property • Personal Property of Others
BPP Additional Coverages and Coverage Extensions	Determine which of the additional coverages and coverage extensions of the Building and Personal Property Coverage Form apply to a described loss.
Causes of Loss—Basic Form and Broad Form	Determine whether the cause of a described loss is a covered cause of loss under either the Causes of Loss—Basic Form or the Causes of Loss—Broad Form.
Cause of Loss—Special Form	Determine whether the cause of a described loss is a Covered Cause of Loss under the Causes of Loss—Special Form.
BPP Limits of Insurance and Deductibles	Apply the Limits of Insurance and Deductible provisions of the Building and Personal Property Coverage Form to a described loss.

Assignment 10: Commercial Property Insurance, Part II

MODULE TITLE	LEARNING OBJECTIVES
BPP Loss Conditions and Additional Conditions	Explain how each of the Loss Conditions and Additional Conditions affects coverage under the Building and Personal Property Coverage Form.
BPP: Optional Coverages	Explain how each of the following optional coverages described in the BPP modifies the basic coverage of the BPP: • Agreed Value • Inflation Guard • Replacement Cost • Extension of Replacement Cost to Personal Property of Others
Commercial Property Conditions	Summarize each of the Commercial Property Conditions.
Common Policy Conditions	Explain how each of the conditions contained in the Common Policy Conditions affects coverage under a commercial property coverage part.
Commercial Property Endorsements	Explain how each of these documents modifies the Building and Personal Property Coverage Form: • Ordinance or Law Coverage endorsement • Spoilage Coverage endorsement • Flood Coverage endorsement • Earthquake and Volcanic Eruption Coverage endorsement • Peak Season Limit of Insurance endorsement • Value Reporting Form
Factors Affecting Commercial Property Premiums	Identify the factors that affect commercial property insurance premiums
Determining Whether the BPP Covers a Loss	Given a case, determine whether, and for what amount, a described loss would be covered by a commercial property coverage part that includes the Building and Personal Property Coverage Form and any of the three causes of loss forms.

Assignment 11: Commercial General Liability Insurance, Part I

MODULE TITLE	LEARNING OBJECTIVES
Overview of Commercial General Liability Insurance	Describe commercial general liability insurance in terms of these elements: • The types of losses that can be covered by general liability insurance • The components of a commercial general liability coverage part
CGL Coverage A - Insuring Agreement	Determine whether a described claim meets the conditions imposed by the Coverage A insuring agreement of the Commercial General Liability Coverage Form (occurrence version).
CGL Coverage A - Exclusions	Determine whether any of the exclusions applicable to Coverage A of the Commercial General Liability Coverage Form eliminate coverage for a described claim.
CGL Coverage B - Personal and Advertising Injury Liability	Determine whether a described claim meets the conditions imposed by the Coverage B insuring agreement of the Commercial General Liability Coverage Form and whether any of the Coverage B exclusions eliminate coverage for the claim.
CGL Coverage C - Medical Payments	Determine whether a described claim meets the conditions imposed by the Coverage C insuring agreement of the Commercial General Liability Coverage Form, and whether any of the Coverage C exclusions eliminate coverage for the claim.
CGL Supplementary Payments	Summarize the supplementary payments of the Commercial General Liability Coverage Form.

Assignment 12: Commercial General Liability Insurance, Part II

MODULE TITLE	LEARNING OBJECTIVES
CGL Who Is an Insured Provisions	Determine whether a described person organization is an insured under the Commercial General Liability Coverage Form.
CGL Limits of Insurance	Explain how the following limits of insurance in the CGL Coverage Form are applied: • Each occurrence limit • Personal and advertising injury limit • Damage to premises rented to you limit • Medical expense limit • General aggregate limit • Products-completed operations aggregate limit
CGL Conditions	Apply the Commercial General Liability Conditions to claims or other interactions between the insurer and the insured.
Rating CGL Coverage	Explain how the premium for CGL coverage is determined.
Determining Whether the CGL Covers a Claim Case	Given a case, determine whether, and for what amount, the Commercial General Liability Coverage Form (occurrence version) covers a described claim.

Assignment 13: Specialty Coverages

MODULE TITLE	LEARNING OBJECTIVES
Commercial Excess and Umbrella Liability Insurance	Describe commercial excess liability insurance and commercial umbrella liability insurance in terms of these characteristics: • The three basic types of commercial excess liability insurance • The provisions commonly found in commercial umbrella liability policies that distinguish them from other types of commercial liability policies
Professional Liability and Management Liability Insurance	Describe professional liability insurance and management liability insurance in terms of these aspects: • How they differ from each other • How they differ from commercial general liability policies • The common types of professional and management liability policies
Environmental Insurance	Describe the purpose and characteristics of each of these types of environmental insurance policies: • Site-specific environmental impairment liability (EIL) policies • Underground storage tank compliance policies • Remediation stop-loss policies • Contractors pollution liability policies • Environmental professional errors and omissions liability policies
Aircraft Insurance	Describe aircraft insurance in terms of these characteristics: • The purposes-of-use categories that insurers used to classify aircraft • The coverages that can be included in an aircraft policy
Cyber Risk Insurance	Describe the types of losses that can be covered by each of the insuring agreements generally available in cyber risk insurance policies.

MODULE TITLE	LEARNING OBJECTIVES
Insuring Foreign Operations	Explain how an organization domiciled in the United States can insure foreign loss exposures that would not be covered under standard property and liability insurance policies.
Terrorism Endorsements for Commercial Property and Liability Forms	Summarize the purpose and provisions of the terrorism endorsements developed by Insurance Services Office, Inc., and the National Council on Compensation Insurance, Inc.
Types of Surety Bonds	Summarize the guarantee provided by the particular types of surety bonds within the following bond classifications: • Contract bonds • License and permit bonds • Public official bonds • Court bonds • Miscellaneous bonds

Assignment 14: Insurance Law, Part I

MODULE TITLE	LEARNING OBJECTIVES
Tort Law	Explain these concepts: • Tort as distinguished from other offenses • Classifications of tort • Application of laws in tort cases
Negligence	Describe negligence claims in terms of: • The elements of negligence • The required proof of negligence
Defenses Against Negligence Claims	Describe these defenses against negligence claims: Comparative negligence, releases and exculpatory clauses, immunity, statutes of limitations and repose, tortfeasor's capacity.
Liability of Landowners or Occupiers of Land	Explain how negligence applies to landowners or occupiers of land.

MODULE TITLE	LEARNING OBJECTIVES
Intentional Torts Part 1 of 2	Describe these intentional torts, the circumstances under which they can occur, and common defenses to them: • Battery • Assault • False imprisonment and false arrest • Intentional infliction of emotional distress • Defamation (libel and slander) • Invasion of the right of privacy
Intentional Torts Part 2 of 2	Describe these intentional torts, the circumstances under which they can occur, and common defenses to them: • Fraud • Bad faith, or outrage • Interference with relationships between others • Misuse of legal process • Trespass • Nuisance • Conversion
Liability in Extraordinary Circumstances	Explain how liability attaches as a result of the unique circumstances presented by the following: • Ultrahazardous activities • Ownership and/or possession of animals • Escape of toxic substances

Assignment 15: Insurance Law, Part II

MODULE TITLE	LEARNING OBJECTIVES
Products Liability	Describe these causes of action for products liability and the possible defenses to them: • Misrepresentation • Breach of warranty • Strict liability and negligence
Professional Liability	Describe professional and directors and officers liability.
Damages in Tort Suits	Describe the types of damages a court can award a plaintiff for a tort claim.

MODULE TITLE	LEARNING OBJECTIVES
Equitable Remedies	Explain these equitable remedies: • Specific performance • Injunction
Factors Affecting Amounts and Payment of Damages	Summarize these legal concepts related to negligence damages and remedies: • *Restitutio in integrum* • Mitigation of damages • Aggravated damages • Structured settlements and judgments
Liability Concepts Affecting Tort Claims	Explain how any of these concepts can affect a tort claim: • Joint tortfeasor's liability • Expanded liability concepts • Vicarious liability • Good Samaritan issues • Class actions
Trends in Tort Litigation	Summarize these trends in tort litigation: • Class action litigation • Litigation funding • Punitive damages • Tort reform

Assignment 16: Insurance Regulation

MODULE TITLE	LEARNING OBJECTIVES
Economic Impact of the Insurance Industry	Explain the economic impact of the insurance industry.
The Objectives of Insurance Regulation	Describe the objectives of insurance regulation.
The Sources of Insurance Regulation	Describe the three sources from which insurance regulatory powers originate: • Legislation • Judicial review • Administrative agencies
The Structure of Insurance Regulations	Describe the structure of insurance regulations.

MODULE TITLE	LEARNING OBJECTIVES
Elements of Rate Regulation and Ratemaking	Describe the following elements of rate regulation and ratemaking: • Purpose and unique qualities of the insurance industry • Actuarial ratemaking principles and considerations in rate regulation • Insurance advisory organizations
Types of Rate Regulations	Compare the following types of rate regulation: • Prior approval • File and use • Use and file • Open competition • Flex rating • Government-mandated rates
Effects of Rate Regulation on Insurers	Summarize the effects of rate regulation on these aspects of insurance: • Resources required for complying with rate regulations • The underwriting cycle • Insurers' decision making regarding where to operate

Study Materials for CAS Online Course 2

The online course itself contains learning objectives and all the educational material to meet these objectives and successfully complete the exam. The course fee includes one attempt at the exam.

The following printed materials are supplemental and may also be purchased from The Institutes, but are not required:

- **Textbook** contains material that is identical to the online course—only in a hardcopy format.
- **Review Notes** is a condensed version of the textbook.
- **Course Guide** contains sample questions and answers.
- **Flashcards** contain key words and phrases.

The materials described above may be purchased individually or in various package combinations.

Questions about potentially defective questions or material should be directed to The Institutes' Customer Success group at (800) 644-2101 or (610) 644-2100, extension 6000, or CustomerSuccess@TheInstitutes.org.

Publisher and Distributor

CAS Online Course 2/CA2 is available through The Institutes.

The Institutes, 720 Providence Road, Suite 100, Malvern, PA 19355-3433; telephone: (800) 644-2101 or (610) 644-2100 extension 6000; e-mail: CustomerSuccess@TheInstitutes.org; website for CAS Online Courses: www.aicpcu.org/cas.htm.

Exam Results

Candidates taking this computer-based test will receive unofficial pass/fail results at the conclusion of their exam. The unofficial pass/fail result will be displayed on the computer screen at the conclusion of the exam. In most test centers, a printed copy of the candidate's unofficial pass/fail result will be available upon completion of the computer-based test from the proctor in the administrative area outside the testing room. The candidate, however, should carefully read the result that is displayed on the computer screen at the conclusion of the exam.

When the official grades have been processed, candidates will receive an e-mail from The Institutes stating that their grades are available. Candidates may then log into their account on The Institutes Website (www.TheInstitutes.org) to access their grades. The grade report for each candidate will show the candidate's overall score on the exam in ten-point increments (e.g., 60 to 69%, 70 to 79%, and so on). It will similarly show the candidate's performance by assignment using those same ten-point increments.

VALIDATION BY EDUCATIONAL EXPERIENCE

2020 REQUIREMENTS

INTRODUCTION

As part of basic education, the CAS requires Validation by Educational Experience (VEE) topics. Validation of these topics is required in addition to the preliminary education exams listed below. The CAS, in conjunction with the Canadian Institute of Actuaries and the Society of Actuaries, has implemented VEE requirements for the following topics:

VEE-Accounting and Finance

VEE-Economics

The preliminary education exams are:

- Exam 1 – Probability
- Exam 2 – Financial Mathematics
- Exam 3F – Financial Economics

In addition to the preliminary education requirements listed above (i.e., VEE requirements and various exams), Exams MAS-I, MAS-II, 5, and 6 (6C, 6U or 6T), Online Courses 1 and 2, and the CAS Course on Professionalism are required for Associateship. The syllabi for the examinations are provided in the Materials for Study for Examination section of this Syllabus. Details about the process for obtaining credit for the VEE topics are provided below. VEE topics are not prerequisites for the preliminary examinations and may be fulfilled independently of the preliminary exam process.

VEE PROCESS–HOW TO GET VEE CREDIT

Validation by Educational Experience can be accomplished in any of the following ways:

1. **College Course(s)**
   Complete one or more courses offered by a college or university and approved by the CAS, CIA, and SOA. Candidates must receive a grade of B- or better in each course. If the institution does not use letter grading, an appropriate translation will be determined. A directory of approved courses is available from the VEE Information section of the CAS Web Site.

2. **Standardized Examinations and Other Educational Experiences**
   Achieve a pre-set score on a standardized examination or other educational experience as approved by the CAS, CIA, and SOA. A list of approved standardized exams and other educational experiences is available from the VEE Information section of the CAS Web Site.

Step 1: Approval of Courses/Experiences

The VEE Administration Committee (VEEAC) will determine which college courses, standardized exams, and other educational experiences are appropriate for VEE credit. Before a candidate may submit an application to receive individual credit for a VEE topic, the course or educational experience itself must first be approved and listed on either the Directory of Approved VEE Courses/Experiences or the Standardized Exams and Other Educational Experiences list. Each list identifies the educational institution, the approved courses/experiences by VEE topic, a unique approval code for each course/experience, and the years for which the courses/experiences are approved.

If a VEE Course/Experience does not appear on either list, approval must be requested by completing an official VEE course/experience approval application form and submitting it along with the required documentation. The application form is available in the Exam Applications and Order Forms section. The VEEAC will review the course/experience.

The guidelines that the VEEAC will use to determine whether specific courses or educational experiences are appropriate to fulfill the VEE requirements are provided in the next three sections of this Syllabus.

Step 2: Approval of Individual VEE Credits for Candidates

Candidates who have credit for at least two actuarial examinations may submit an application for their own VEE credits. In addition to the application, candidates will be required to arrange for an official transcript to be submitted to the VEE administrator. The Application for Validation by Educational Experience Credit includes specific directions. Only courses/experiences that are listed in the online Directory of Approved VEE Courses/Experiences or the Standardized Exams and Other Educational Experiences list may be used for VEE credit. If a course/experience is not on the approved list, the candidate may submit the course for approval according to the procedures described in Step 1 above.

Candidates may combine two approved courses/experiences to complete a VEE topic requirement. For example, an approved microeconomics course from a university may be combined with an approved macroeconomics course from another school or provider. In these cases, candidates should include approval codes from both approved courses on their individual VEE credit application form. Corporate finance courses, however, must be completed in the combinations shown in the directory. No alternate combinations will be accepted without an additional course approval application process.

Note: Candidates may not submit VEE credit applications for partial credit (e.g., a microeconomics course may not be submitted alone but must be accompanied on the same application by an approved macroeconomics course). Candidates may not submit for VEE credit for a topic until they have completed all requirements for that topic. Specific questions may be sent to vee@soa.org.

Once a candidate's application and documentation of the required grade on an approved course/experience have been validated, credit for the specific VEE topic will be granted. The candidate will be sent a written response to each application.

VEE-ACCOUNTING and FINANCE

The following guidelines for the Validation by Educational Experience (VEE) requirement for Accounting and Finance will be used by the VEE Administration Committee to determine whether specific courses or educational experiences are appropriate to fulfill the VEE requirements. Details about submitting a course for approval as well as obtaining individual VEE credit are provided at the beginning of this section on VEE. The Directory of Approved VEE Courses/Experiences and the Standardized Exams and Other Educational Experiences are available in the VEE Information section of the CAS Web Site.

While this material may be entirely covered in a course or courses that cover both topics, it is more likely that separate courses will be used for accounting and for finance. If distinct courses are used, the application should indicate which are for the accounting topic and which are for the finance topic. The typical finance program covers the topics below in one semester with an introductory course. Should the topics be split across two semesters or courses, both will be required. Most of the topics listed below should be covered:

Accounting

- Describe the basic principles of personal and corporate taxation and the taxation of investments held by institutions.
- Explain why companies are required to produce annual reports and accounts.
- Explain fundamental accounting concepts and terms and describe the main sources of accounting regulation.
- Explain the purpose and interactions between the income statement, balance sheet, and cash flow statements.
- Explain the value of reporting on environmental, social and economic sustainability and other alternatives to traditional financial reporting and describe possible contents of such reports.
- Explain the basic structure of company and group accounts.
- Explain the purpose of the main components of company accounts and interpret them.
- Construct simple statements of financial position and profit or loss.
- Calculate and interpret financial and accounting ratios.

Finance

- Explain the characteristics of various forms of equity capital from the point of view of the issuer and the investor.
- Explain the characteristics of various forms of long-term debt capital from the point of view of the issuer and the investor.
- Explain the characteristics of various forms of short- and medium-term financing from the point of view of the issuer and the investor.
- Calculate weighted-average cost of capital.
- Explain the main methods of capital budgeting.
- Calculate a project's investment return.

VEE–ECONOMICS

The following guidelines for the Validation by Educational Experience (VEE) requirement for Economics will be used by the VEE Administration Committee to determine whether specific courses or educational experiences are appropriate to fulfill the VEE requirements. Details about submitting a course for approval as well as obtaining individual VEE credit are provided at the beginning of this section on VEE. The Directory of Approved VEE Courses/Experiences and the Standardized Exams and Other Educational Experiences are available in the VEE Information section of the CAS Web Site.

Typically, the VEE requirement for economics will be met if a candidate has completed two economics courses, one course covering microeconomics and the other covering macroeconomics. If distinct courses are used, the application should indicate which are for the microeconomics topic and which are for the macroeconomics topic. Most of the topics listed below should be covered:

Microeconomics

- Explain the concept of utility and how rational utility maximizing agencies make consumption choices.
- Explain the elasticity of supply and demand and the effects on a market of the different levels of elasticity.
- Explain the interaction between supply and demand and the way in which equilibrium market prices are achieved.

- Explain various pricing strategies that can be used by firms.
- Explain the core economic concepts involved in choices made by businesses with respect to short-run and long-run investment and production choices.
- Explain competitive markets and how they operate.
- Explain profitability in markets with imperfect competition.

Macroeconomics

- Explain basic macroeconomic measures (e.g., GDP) used to compare the economies of countries.
- Describe the structure of public finances for an industrialized country.
- Explain the effect of fiscal and monetary policy on the economy, including the effect on financial markets.
- Explain the role of international trade, exchange rates and the balance of payments in the economy.
- Explain the effect of savings and consumption rates on the economy.
- Explain the major factors affecting the level of interest rates, the rate of inflation, the exchange rate, the level of employment and the rate of growth for an industrialized country.
- Describe the function of money in the economy.
- Explain the relationship between money and interest rates.
- Explain how macroeconomic policies affect business