ACTEX Learning®

Study Manual for Exam 8

5th Edition

Margaret Tiller Sherwood, FCAS, FSA, MAAA, FCA, CPCU, ARM, ERMP, CERA

A CAS Exam

ACTEX Learning®

Learn Today. Lead Tomorrow.

Actuarial & Financial Risk Resource Materials

Since 1972

Copyright © 2026, ACTEX Learning, a division of ArchiMedia Advantage Inc.

ACTEX Learning® is a registered trademark of ArchiMedia Advantage Inc.

No portion of this ACTEX Study Manual may be
reproduced or transmitted in any part or by any means
without the permission of the publisher.

Who We Are

A Benefit Corporation Experienced at Teaching Actuaries!

Experienced

More than 50 years experience helping students prepare and pass actuarial exams! We are an eLearning technology and education company leveraging experts in the field to constantly update our learning content in a format that works for you.

Trustworthy

ACTEX Learning is a leading US based provider of study materials for actuarial exams. Our authors and content contributors are renowned academics and Actuaries that are proud to have their names on the cover of our manuals and textbooks!

Mission Focused

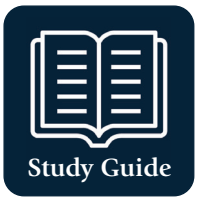
We are a Benefit Corporation focusing on the mission of accessible high quality actuarial education. We're dedicated to empowering actuarial students by offering test prep materials that are not just effective and efficient but also tailored to suit every type of student.

Become an ACTEX Champion

Join our Global ACTEX Champion Program and bring the benefits to your Actuarial Club. To learn more about the program, scan the QR code on the right. If you have any questions or would like to speak to a Champion Coordinator, please do not hesitate to reach out to us at champions@actexlearning.com.

ACTEX Learning

ACTEX Has the Solutions to Help You with Exam Prep



Our study guides offer the most recommended actuarial prep program. Search our interactive manuals for different topics and toggle easily between concepts and study materials.

Available for P, FM, FAM, ALTAM, ASTAM, PA. ATPA, MAS-I, MAS-II, CAS 5, CAS 6 US & CAN, CAS 7, CAS 8, CAS 9

Want to know you're prepared for your exam? Practice efficiently with our robust database of questions and solutions and predict your success through GOAL's innovative scoring system. GOAL also features dedicated instructor support so you can get help where you need it and pass the exam with confidence!

Available for P, FM, FAM, ALTAM, ASTAM, MAS-I, MAS-II, CAS 5, CAS 6 US & CAN

Master key topics and formulas with our flashcards, which allow you to filter by topic. To help you direct your focus, each card is rated to indicate its importance on the exam.

Available for P, FM, FAM, ALTAM, ASTAM, PA. ATPA, MAS-I, MAS-II, CAS 5, CAS 6 US & CAN, CAS 7, CAS 8, CAS 9

Studies have shown video learning can lead to better retention. We offer hours of video instruction to aid you in your studies. They're a great way to deepen your learning on challenging topics and gain a variety of perspectives from our expert instructors.

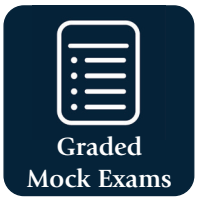
Available for P, FM, FAM, ALTAM, ASTAM, PA. ATPA, MAS-I, MAS-II, CAS 5, CAS 6 US & CAN, CAS 7, CAS 8, CAS 9

ACTEX offers convenient online courses approved for CAS VEE credits. All courses are available on-demand. Students complete the courses at their own pace and take the final exams on the date of their choosing.

Available for Accounting & Finance, Mathematical Statistics, and Economics

Study Materials are Available for the Following:

SOA: P, FM, FAM, ALTAM, ASTAM, SRM, PA, ATPA, CFE, GI, GH, ILA, RET
CAS: MAS-I, MAS-II, CAS 5, CAS 6C, CAS 6US, CAS 7, CAS 8, CAS 9



The ACTEX Graded Mock Exam is a great way to predict your exam outcome! Before you take the official exam - take the new ACTEX Graded Mock Exam and get feedback from an expert. The ACTEX Graded Mock Exam has all the typical elements your SOA exam will have. This can help you evaluate your progress. The questions and format are set up just like the SOA exam.

Available for ALTAM, ASTAM, PA

ACTEX Bootcamps provide a more individualized approach, allow you to ask questions in real time, and boost your last-minute learning. You'll review the harder topics on the exam, as well as common errors and exam strategy. All classes are recorded for future on-demand viewing.

Available for P, FM, FAM, SRM

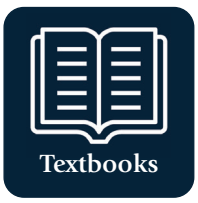
Alongside our P & FM study guide, this course is comparable to a one-semester college class. This course offers SOA Exam practice problems, video solutions, timed practice tests, sample questions, and more. You'll also have 1:1 email support from an instructor for 180 days after purchase.

The Advanced topics in Predictive Analytics video course is designed to help you more easily climb the steep ATPA learning curve. This module-focused video course for Topic 3 in the syllabus, includes videos, end of module assessments and lecture slides. This video course is a deep dive into the three modules. Access to an instructor during the duration of the course as well as participation in a discussion forum.

Available for P, FM, and ATPA

This at-a-glance tool helps you memorize and recall key formulas and information. It covers important formulas needed to prepare your exam. Also, it's an easy-to-print format you can study with, no matter where you are.

Available for P, FM, FAM, ALTAM, ASTAM, PA. ATPA, MAS-I, MAS-II, CAS 5



Looking for Extra Preparation?

Explore our range of textbooks designed to support your studies. From recommended to required readings, ACTEX offers exceptional materials to help you succeed.

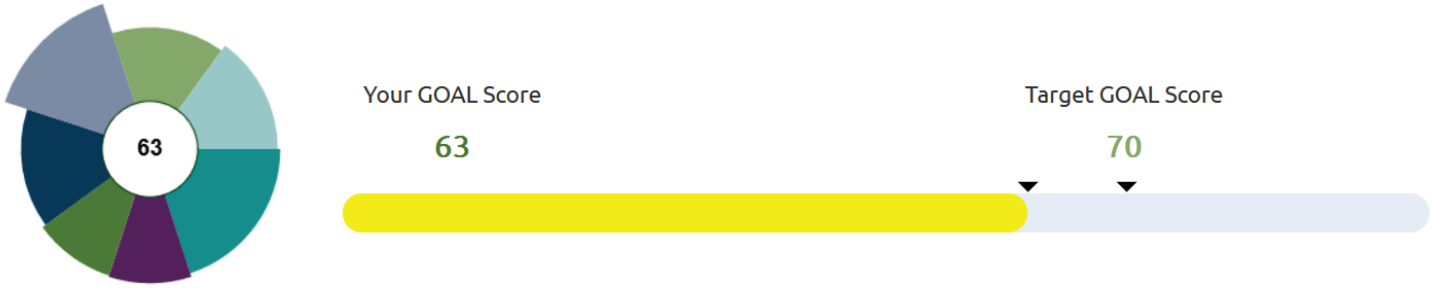
Use GOAL to Practice What You've Learned

- Over 22,000 exam-style problems with detailed solutions
- 3 learning modes (Practice, Quiz, Simulated Exams)
- 3 levels of difficulty (Core, Advanced and Mastery)
- You control your topics and sub-topics
- Dedicated instructor support

GOAL is currently available for the following SOA & CAS Exams:

Exam P 1,050+ Questions	Exam FM 1,500+ Questions	Exam FAM-L 1,300+ Questions	Exam FAM-S 900+ Questions	Exam FAM 2,300+ Questions
Exam ALTAM 1,400+ Questions	Exam ASTAM 1,300+ Questions	Exam SRM 1,150+ Questions	Exam MAS-I 1,050+ Questions	
Exam MAS-II 850+ Questions	Exam CAS 5C 500+ Questions	Exam CAS 6US 550+ Questions	Exam CAS 6CA 650+ Questions	

Use GOAL Score to Gauge Your Exam Readiness



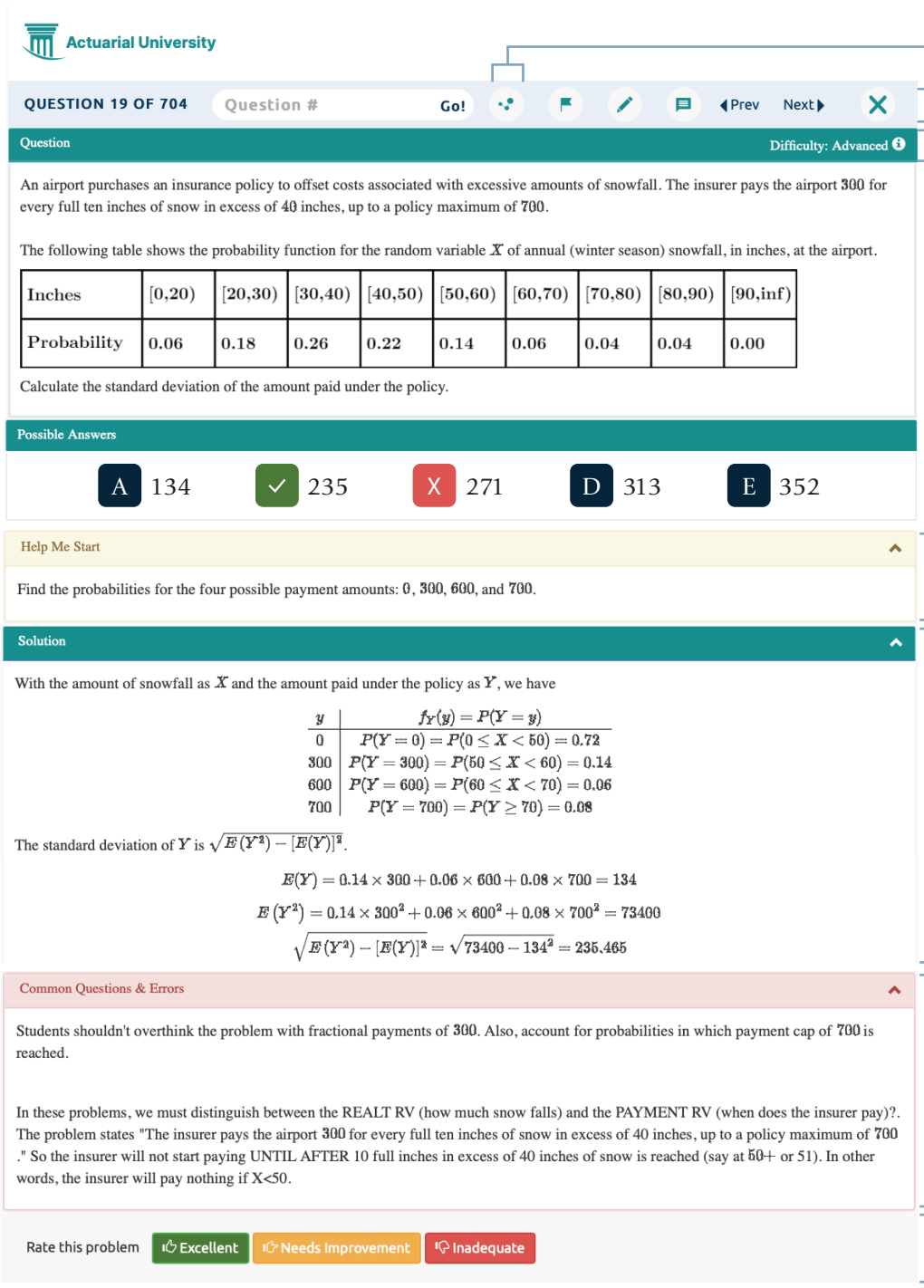
Measure how prepared you are to pass your exam with a tool that suits any study approach. A GOAL Score of 70 or above indicates readiness.

Your score is broken into categories, allowing you to study efficiently by concentrating on problem areas. GOAL Score quantifies your exam readiness by measuring both your performance and the consistency of your performance. Your GOAL Score also analyzes your strengths and weaknesses by category, topic, and level of difficulty.

Scan to Learn More

GOAL Improves Your Studies

How you can prepare for your exam confidently with GOAL custom Practice Sessions, Quizzes, & Simulated Exams:



Actuarial University

QUESTION 19 OF 704 | Question # | Go! | Prev | Next

Question — Difficulty: Advanced

An airport purchases an insurance policy to offset costs associated with excessive amounts of snowfall. The insurer pays the airport 300 for every full ten inches of snow in excess of 40 inches, up to a policy maximum of 700.

The following table shows the probability function for the random variable X of annual (winter season) snowfall, in inches, at the airport.

Inches	[0,20)	[20,30)	[30,40)	[40,50)	[50,60)	[60,70)	[70,80)	[80,90)	[90,inf)
Probability	0.06	0.18	0.26	0.22	0.14	0.06	0.04	0.04	0.00

Calculate the standard deviation of the amount paid under the policy.

Possible Answers

A 134 ✓ 235 X 271 D 313 E 352

Help Me Start

Find the probabilities for the four possible payment amounts: 0, 300, 600, and 700.

Solution

With the amount of snowfall as X and the amount paid under the policy as Y, we have

y	$f_Y(y) = P(Y = y)$
0	$P(Y = 0) = P(0 \le X < 50) = 0.72$
300	$P(Y = 300) = P(50 \le X < 60) = 0.14$
600	$P(Y = 600) = P(60 \le X < 70) = 0.06$
700	$P(Y = 700) = P(Y \ge 70) = 0.08$

The standard deviation of Y is $\sqrt{E(Y^2) - [E(Y)]^2}$.

$$E(Y) = 0.14 \times 300 + 0.06 \times 600 + 0.08 \times 700 = 134$$

$$E(Y^2) = 0.14 \times 300^2 + 0.06 \times 600^2 + 0.08 \times 700^2 = 73400$$

$$\sqrt{E(Y^2) - [E(Y)]^2} = \sqrt{73400 - 134^2} = 235.465$$

Common Questions & Errors

Students shouldn't overthink the problem with fractional payments of 300. Also, account for probabilities in which payment cap of 700 is reached.

In these problems, we must distinguish between the REALT RV (how much snow falls) and the PAYMENT RV (when does the insurer pay)?. The problem states "The insurer pays the airport 300 for every full ten inches of snow in excess of 40 inches, up to a policy maximum of 700 ." So the insurer will not start paying UNTIL AFTER 10 full inches in excess of 40 inches of snow is reached (say at 50+ or 51). In other words, the insurer will pay nothing if X<50.

Rate this problem | Excellent | Needs Improvement | Inadequate

Quickly access the Hub for additional learning.

Flag problems for review, record notes, and get instructor support.

View difficulty level.

Helpful strategies to get you started.

Full solutions with detailed explanations to deepen your understanding.

Commonly encountered errors.

Rate a problem or give feedback.

Thank You for Choosing ACTEX Learning!

We're committed to helping you succeed on your actuarial journey.

For the latest study guides, textbooks, free Formula Sheets, and more resources for SOA, CAS, IFoA, and IAI exams, visit:

ACTEX Learning https://actexlearning.com/

Your destination for comprehensive actuarial exam preparation and professional development.

Looking for additional study material or other actuarial books?

THE ACTUARIAL BOOKSTORE https://www.actuarialbookstore.com/

The #1 online source for actuarial books and study guides.

Scan to Learn More

NOTES

I have been updating this manual since 2014. There have been many syllabus changes since that time, including a major rearrangement of examination topics in the upper exams in 2024. For the current update, I reflected the Fall 2026 syllabus material. This Study Guide is meant to be a supplement to the original material and not a substitute for it. Sections A – Part 1, B, and C are being issued together. Section A – Part 2 will follow.

Beginning with the Fall 2026 syllabus, the NCCI *Experience Rating Plan Manual* and *Retrospective Rating Plan Manual* are no longer on the syllabus, and their chapters have been removed.

Included in this manual are outlines of Bahnemann Chapters 1-4 that are not required (Chapters 5 and 6 are required). The CAS highly recommends that candidates read Bahnemann Chapters 1-4, as candidates will be assumed to be familiar with the material in these chapters.

When readings have been taken off the syllabus or revised, I retained those questions from past exams that I think are relevant to the current readings, making changes to reflect the then-new syllabus material where appropriate. I also created some questions for some of the then-new material. There are no questions for Bahnemann Chapters 1-4 as they are not required reading on the syllabus. There is a section for Integrative Questions applying to multiple readings that appeared on the 2017, 2018, and 2019 exams, sometimes as the first one or two problems on each exam. As a practical matter, I suggest completing all other questions before answering questions that require material from multiple readings, regardless of where questions are placed in the exam.

Questions and parts of some questions have been taken from material copyrighted by the Casualty Actuarial Society. They are reproduced in this study manual with the permission of the CAS solely to aid students studying for CAS exams. Students may also request past exams directly from the CAS or find them on the CAS website. I am very grateful to the CAS for its cooperation and permission to use this material. The CAS is not responsible for the structure or accuracy of this manual. In some cases, questions and answers have been edited or altered to be more accurate, reflect syllabus changes, or provide a better organized manual. Students should keep in mind that there may be more than one correct way to answer a question even if only one is shown.

Effective with the 2020 exams, the Casualty Actuarial Society no longer provides questions and answers for its exams, so the questions and answers from the 2020 and subsequent exams are not included in this update. Exam questions are identified by numbers in parentheses at the end

of each question. Questions have four numbers separated by hyphens. For questions from the exams those numbers represent: the year of the exam, the number of the exam, the number of the question, and the points assigned. Questions I added also have four numbers separated by hyphens and reflect: year I added them, the number of the exam (8), the number of the question I added that year, and the points I assigned. The past exam questions that are retained for which I made significant changes so that they reflect the new syllabus material are designated by: the year of the exam, the number of the exam, the number of the question & MTS, and the points assigned. MC indicates that a multiple-choice question has been converted into a true/false question. I did not change the question label for minor changes to reflect the new syllabus material.

I made a conscientious effort to eliminate mistakes and incorrect answers, but a few may remain. I am grateful to students who previously pointed out errors and encourage those who find others to bring them to my attention. Please send any errors you find to support@actexlearning.com. Also, please check the ACTEX website for corrections subsequent to publication.

Margaret Tiller Sherwood

FCAS, FSA, MAAA, FCA, CPCU, ARM, ERMP, CERA

September 2026

Copyright ©2026 ACTEX Learning®

Contents

NOTES v

A Part 1: Classification Ratemaking 1

ASOP 12: Risk Classification 3

ASOP 25: Credibility Procedures 23

Bailey & Simon: Credibility of Experience 33

Mahler: Credibility and Shifting Risk Parameters 97

Couret & Venter: Multi-Dimensional Credibility 127

GLM: Generalized Linear Models for Insurance Rating 153

Holmes & Casotto: Penalized Regression and Lasso Credibility 223

Part 2: Classification Ratemaking *Coming soon*

T&C - Chalk, Deacon, Guillen, Martinelli, "From GLMs to Comprehensive Insurance Pricing - Techniques and Challenges"

B Excess, Deductible, and Individual Risk Rating 259

Bahnemann Ch. 1: Introduction 261

Bahnemann Ch. 2: Claim Size 273

Bahnemann Ch. 3: Claim Counts 285

Bahnemann Ch. 4: Aggregate Claims 291

Bahnemann Ch. 5: Excess Claims **299**

Bahnemann Ch. 6: Limits and Deductibles **317**

Fisher et al. Ch. 1: Experience Rating **405**

Fisher et al. Ch. 2: Retrospective Rating **495**

Fisher et al. Ch. 3: Aggregate Excess Loss **587**

Fisher et al. Ch. 4: Concluding Remarks **755**

Fisher et al. Case Study **809**

ISO: Commercial General Liability Rating **815**

C Integrative Questions 895

Integrative Questions **897**

Copyright ©2026 ACTEX Learning®

A
Part 1: Classification Ratemaking

ASOP 12: Risk Classification

Actuarial Standards Board,

"Actuarial Standard of Practice No. 12, Risk Classification (for All Practice Areas),"

December 2005, Updated for Deviation Language Effective May 1, 2011

OUTLINE

I. SECTION 1. PURPOSE, SCOPE, CROSS REFERENCES, AND EFFECTIVE DATE

A. Purpose – Provides guidance to actuaries when performing professional services with respect to designing, reviewing, or changing risk classification systems.

B. Scope

1. Applies to all actuaries when performing professional services with respect to designing, reviewing, or changing risk classification systems used in connection with financial or personal security systems regarding the classification of individuals or entities into groups intended to reflect the relative likelihood of expected outcomes.

   a. Expert testimony

   b. Regulatory activities

   c. Legislative activities

   d. Statements concerning public policy

2. Also applies when giving advice with respect to a risk classification system.

3. Risk classification can affect and be affected by many actuarial activities, such as:

   a. Setting rates, contributions, reserves, benefits, dividends, or experience refunds

b. Analysis or projection of quantitative or qualitative experience or results

c. Underwriting actions

d. Development assumptions

4. Standard applies when activities directly or indirectly involve designing, reviewing, or changing a risk classification system.

5. Also applies when performing such activities if those activities directly or indirectly are likely to have a material effect on the intended purpose or expected outcome of the risk classification system.

6. Departures from this standard should be disclosed.

C. Cross References

1. Referenced documents are as amended, restated, or succeeding.

2. If there is a material difference from the originally referenced document, the actuary should consider the guidance in this standard to the extent it is applicable and appropriate.

D. Effective Date – Any professional service commenced on or after May 1, 2006.

II. SECTION 2. DEFINITIONS

A. Advice - An actuary's communication or other work product in oral, written, or electronic form setting forth the actuary's professional opinion or recommendations concerning work that falls within the scope of this standard.

B. Adverse Selection - Actions taken by one party using risk characteristics or other information known to or suspected by that party that cause a financial disadvantage to the financial or personal security system (sometimes referred to as antiselection).

C. Credibility - A measure of the predictive value in a given application that the actuary attaches to a particular body of data (predictive is used here in the statistical sense and not in the sense of predicting the future).

D. Financial or Personal Security System - A private or governmental entity or program that is intended to mitigate the impact of unfavorable outcomes of contingent events. Examples of financial or personal security systems include auto insurance, homeowners insurance, life insurance, and pension plans, where the mitigation primarily takes the form of financial payments; prepaid health plans and continuing care retirement communities, where the mitigation primarily takes the form of direct service to the individual; and other systems, where the mitigation may be a combination of financial payments and direct services.

E. Homogeneity - The degree to which the expected outcomes within a risk class have comparable value.

F. Practical - Realistic in approach, given the purpose, nature, and scope of the assignment and any constraints, including cost and time considerations.

Copyright ©2026 ACTEX Learning®

G. Risk(s) - Individuals or entities covered by financial or personal security systems.

H. Risk Characteristics - Measurable or observable factors or characteristics that are used to assign each risk to one of the risk classes of a risk classification system.

I. Risk Class - A set of risks grouped together under a risk classification system.

J. Risk Classification System - A system used to assign risks to groups based upon the expected cost or benefit of the coverage or services provided.

III. SECTION 3. ANALYSIS OF ISSUES AND RECOMMENDED PRACTICES

A. Introduction

1. Approaches to risk classification can vary significantly.
2. It is appropriate for the actuary to exercise considerable professional judgment.

B. Considerations in the Selection of Risk Characteristics

1. Relationship of Risk Characteristics and Expected Outcomes
   a. The actuary should select risk characteristics that are related to expected outcomes.
   b. A relationship exists if it can be shown that the variation in actual or reasonably anticipated experience correlates to the risk characteristic.
   c. To demonstrate a relationship can use:
      - Analysis of available data
      - Clinical experience
      - Expert opinion
   d. Rates are considered to be **equitable (fair)** if the differences in rates reflect material differences in expected cost for risk characteristics.
   e. The actuary should consider the interdependence of risk characteristics and make appropriate adjustments if their impact on the operation of the risk classification system is expected to be material.
   f. It may be appropriate for the actuary to make inferences without specific demonstration. For example, it might not be necessary to demonstrate that persons with seriously impaired, uncorrected vision would represent higher risks as operators of motor vehicles.
2. Causality – It is not necessary to establish a cause and effect relationship between the risk characteristics and expected outcome.
3. Objectivity – The actuary should select risk characteristics that are capable of being objectively determined.

Copyright ©2026 ACTEX Learning®

4. Practicality – The actuary's selection of a risk characteristic should reflect the tradeoffs between practical and other relevant considerations such as:
   a. Cost, time, and effort needed to evaluate the risk characteristic
   b. The ongoing cost of administration
   c. The acceptability of the usage of the characteristic
   d. Potential usage of different characteristics that would produce equivalent results
5. Applicable Law – The actuary should consider whether compliance with applicable law creates significant limitations on the choice of risk characteristics.
6. Industry Practices – The actuary should consider usual and customary risk classification practices for the type of financial or personal security system under consideration.
7. Business Practices – The actuary should consider limitations created by business practices related to the financial or personal security system as known to the actuary and consider whether such limitations are likely to have a significant impact on the risk classification system.

C. Considerations in Establishing Risk Classes

1. Intended Use
   a. A risk classification system should be appropriate for the intended use.
   b. Different sets of risk classes may be appropriate for different purposes.
2. Actuarial Considerations
   a. Adverse Selection
      - Likely to occur if the variation in expected outcomes within a risk class is too great.
      - To the extent practical, the actuary should establish risk classes such that each has sufficient homogeneity with respect to the expected outcomes to satisfy the purpose for which the risk classification system is intended.
   b. Credibility
      - It is desirable that risk classes be large enough to allow credible statistical inferences regarding expected outcomes.
      - When this is not possible, the actuary should balance considerations of predictability with considerations of homogeneity.
      - The actuary should use professional judgement to achieve this balance.
3. Other Considerations – The actuary should:

a. comply with the applicable law;

b. consider industry practices for that type of financial or personal security system as known to the actuary; and

c. consider limitations created by business practices of the financial or personal security system as known to the actuary.

4. Reasonableness of results – The actuary should consider the reasonableness of results that proceed from the intended use of the risk classes such as:

a. consistency of the patterns of rates;

b. consistency of values; and

c. consistency of factors among risk classes.

D. Testing the Risk Classification System

1. Upon the establishment of the risk classification system and upon subsequent review, the actuary should, if appropriate, test the long-term viability of the financial or personal security system.

2. When performing such tests subsequent to the establishment of the risk classification system, the actuary should evaluate emerging experience and determine whether there is any significant need for change.

3. Effect of Adverse Selection

a. Can potentially threaten the long-term viability of a financial or personal security system.

b. If the effects of adverse selection are expected to be material, the actuary should, when practical, estimate the potential impact and recommend appropriate measures to mitigate the risk.

4. Risk Classes Used for Testing

a. The actuary should consider using a different set of risk classes for testing long-term viability than was used as the basis for determining the assigned values.

b. This is likely to improve the meaningfulness of the tests.

5. Effect of Changes – The actuary should consider testing the effects of changes:

a. if the risk classification system has changed; or

b. business or industry practices have changed.

6. Quantitative Analyses – Depending on the purpose, nature, and scope of the assignment, the actuary should consider performing quantitative analyses of the impact of the following to the extent they are generally known and reasonably available to the actuary:

Copyright ©2026 ACTEX Learning®

a. significant limitations due to compliance with applicable law;

b. significant departures from industry practices;

c. significant limitations created by business practices of the financial or personal security system;

d. any changes in the risk classes or the assigned values based upon the actuary's determination that experience indicates a significant need for a change; and

e. any expected material effects of adverse selection.

E. Reliance on Data or Other Information Supplied by Others – Refer to ASOP No. 23, *Data Quality*.

F. Documentation

1. The actuary should document the assumptions and methodologies used in designing, reviewing, or changing a risk classification system in compliance with the requirements of ASOP No. 41, *Actuarial Communications*.

2. The actuary should also prepare and retain documentation to demonstrate compliance with the disclosure requirements in Section 4.1 of this standard.

IV. SECTION 4. COMMUNICATIONS AND DISCLOSURES

A. Communications and Disclosures (Section 4.1)

1. When issuing actuarial communications under this standard, the actuary should comply with ASOP Nos. 23 and 41.

2. In addition, the actuarial communications should disclose any known significant impact resulting from the following to the extent they are generally known and reasonably available to the actuary:

a. significant limitations due to compliance with applicable law;

b. significant departures from industry practices;

c. significant limitations created by business practices related to the financial or personal security system;

d. a determination by the actuary that experience indicates a significant need or change, such as changes in the risk classes or the assigned values; and

e. expected material effects of adverse selection;

f. the disclosure in ASOP No. 41, section 4.2, if any material assumption or method was prescribed by applicable law (statutes, regulations, and other legally binding authority);

g. the disclosure in ASOP No. 41, section 4.3, if the actuary states reliance on other sources and thereby disclaims responsibility for any material assumption or method selected by a party other than the actuary; and

Copyright ©2026 ACTEX Learning®

h. the disclosure in ASOP No. 41, section 4.4, if, in the actuary's professional judgment, the actuary has otherwise deviated materially from the guidance of this ASOP.

3. The actuarial communications should also disclose any recommendations developed by the actuary to mitigate the potential impact of adverse selection.

Copyright ©2026 ACTEX Learning®

PAST CAS EXAMINATION AND NEW QUESTIONS

1. The Supreme Court's decision in the *Norris* case eliminated the use of sex as a rating variable in pensions. Discuss the potential implications of this decision on automobile insurance classification in the context of the considerations in the selection of risk characteristics discussed in ASOP 12.

   (84–9–9 & MTS–3)

2. A property insurance company is considering adding a new classification rating variable to its homeowners insurance program based on an individual risk's actual loss experience over the past five-year period as follows:

   Class A − no claims Class B − one or two claims Class C − three or more claims

   Considering the considerations in the selection of risk characteristics discussed in ASOP 12, would you recommend the addition of this new classification? Why or why not?

   (96–9–48b & MTS–1.5)

3. As the personal lines actuary for the department of insurance in the state of Crazyfornia, you have been asked by the state's insurance commissioner to comment on Proposition 99.

   Proposition 99 – The ratemaking for personal automobile insurance should be based on a new classification system using the following six criteria:

   a. Insureds are to be classified based on nationality.
   b. Insureds are to be classified based on the ability to pass an annual random drug test.
   c. Insureds are to be classified based on whether they can pass a comprehensive, individually administered eight-hour driving test every year.
   d. Insureds are to be classified based on their weights.
   e. Insureds are to be classified as either good eyesight or bad eyesight. Each eye doctor can have his/her own definition of good/bad eyesight.
   f. Insureds are to be classified as right-handed or left-handed.

   For each criterion, identify which one of the considerations in the selection of risk characteristics discussed in ASOP 12 is violated. You may not use the same consideration for more than two criteria. (97–9–48 & MTS–0.5/0.5/0.5/0.5/0.5/0.5)

Copyright ©2026 ACTEX Learning®

1. ASOP 12 lists the following considerations in the selection of risk characteristics:

   a. There should be a relationship between the risk characteristics and the expected outcome.

   b. The risk characteristics should be objective.

   c. The risk characteristics should reflect the tradeoff between practicality and other considerations.

   d. Risk characteristics should comply with applicable law.

   e. The actuary should consider industry practices in selecting risk characteristics.

   f. The actuary should consider business practices in selecting risk characteristics.

   If the Norris case were applied to automobile insurance, it would violate 1) because the risk classification system would not reflect expected costs as males would be undercharged and females overcharged as one relevant cost-related factor would be disregarded. The resulting risk classification would meet considerations 2), 3), and 4). It would not meet 5) or 6).

2. See #1 for the list of considerations.

   a. The proposed system would not reflect cost differences among risks or distinguish among risks on cost-based factors because past loss experience may not be a good indicator of future loss experience.

   b. The system could be applied objectively.

   c. The new system would entail extra costs without comparable benefits. In addition, public acceptability would be questionable, given the random penalties the system would produce.

   d. Whether the new system complies with the applicable law would have to be determined for each state.

   e. The new system is not current industry practice, which could be an advantage or disadvantage.

   f. The new system is not current business practice and would add expense.

   On balance, I would not recommend the new classification.

3. See #1 for the list of considerations.

   a. Need one of these. It is not objective (2). It does not comply with applicable law (4).

   b. Need one of these. There may not be a relationship between the risk characteristic and the expected outcome (1). There is not practical due to the added expense (3). It may not comply with applicable law; this would have to be determined for each state (4).

   c. It is not practical due to the added expense (3).

Copyright ©2026 ACTEX Learning®

ASOP 25: Credibility Procedures

Actuarial Standards Board,

"Actuarial Standard of Practice No. 25, Credibility Procedures,"

December 2013

OUTLINE

I. SECTION 1 – PURPOSE, SCOPE, CROSS REFERENCES, AND EFFECTIVE DATE

A. Purpose – To provide guidance to actuaries when performing professional services with respect to selecting or development credibility procedures and the application of those procedures to sets of data

B. Scope

1. When the actuary chooses to evaluate the credibility of subject experience, or states in any related actuarial communication that credibility has been evaluated in accordance with this ASOP

2. When the actuary chooses to evaluate the credibility of subject experience, or states in any related actuarial communication that credibility has been evaluated in accordance with this ASOP

3. When the actuary is blending subject experience with any other experience

4. When the actuary represents data being used as statistically or mathematically credible

5. If there is a conflict between ASOP 25 and ASOP 35, *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*, ASOP 35 governs

6. If the actuary departs from guidance in this standard to comply with applicable law (statutes, regulations, and other legally binding authority) or for any other reason, the actuary should see section 4 for disclosure requirements

C. Cross References

1. Referenced documents are as amended, restated, or succeeding.

2. If there is a material difference from the originally referenced document, the actuary should consider the guidance in this standard to the extent it is applicable and appropriate.

D. Effective Date – Any professional services with respect to credibility procedures performed on or after May 1, 2014.

II. SECTION 2. DEFINITIONS

A. Credibility – A measure of the predictive value in a given application that the actuary attaches to a particular set of data (*predictive* is used here in the statistical sense and not in the sense of predicting the future)

B. Credibility Procedure – A process that involves the following:

1. the evaluation of subject experience for potential use in setting assumptions without reference to other data; or

2. the identification of relevant experience and the selection and implementation of a method for blending the relevant experience with the subject experience

C. Full Credibility – The level at which the subject experience is assigned full predictive value, often based on a selected confidence level

D. Relevant Experience – Sets of data, that include data other than the subject experience, that, in the actuary's judgement, are predictive on the parameter under study (including but not limited to loss ratios, claims, mortality, payment patterns, persistency, or expenses). Relevant experience may include subject experience as a subset.

E. Risk Characteristics – Measurable or observable factors or characteristics that are used to assign each risk to one of the risk classes of a risk classification system

F. Risk Classification System – A system used to assign risks to groups based upon the expected cost or benefit of the coverage or services provided

G. Subject Experience – A specific set of data drawn from the experience under consideration for the purpose of predicting the parameter under study

III. ANALYSIS OF ISSUES AND RECOMMENDED PRACTICES

A. Purpose and Use of Credibility Procedures

1. Two purposes

a. To evaluate subject experience for potential use in setting assumptions without reference to other data

b. To improve the estimate of the parameter under study

Copyright ©2026 ACTEX Learning®

2. May be used for tasks such as pricing, ratemaking, prospective experience rating, and reserving

B. Selection or Development of Credibility Procedure

1. Use an appropriate procedure when determining if the subject experience has full credibility or when blending the subject experience with the relevant experience
   a. May be different for different practice areas
   b. May be different for different applications
   c. May need additional review to satisfy applicable law
2. Criteria for a credibility procedure
   a. Whether the procedure is expected to produce reasonable results
   b. Whether the procedure is appropriate for the intended use and purpose
   c. Whether the procedure is practical to implement when taking into consideration both the cost and benefit of employing a procedure
3. Credibility procedures should appropriately consider both the subject experience and the relevant experience
4. The actuary should consider the predictive value of more recent experience as compared to the experience from earlier time periods

C. Selection of Relevant Experience

1. The relevant experience should have characteristics similar to the subject experience, such as
   a. Demographics
   b. Coverages
   c. Frequency
   d. Severity
   e. Other determinable risk characteristics
2. If subject experience is a material part of relevant experience, the actuary should use professional judgement in deciding whether and how to use that relevant experience
3. If no relevant experience is available, the actuary should use professional judgement, considering available subject experience, in setting an estimate of the parameter under study

D. Professional Judgment

1. The actuary should use professional judgment when selecting, developing, or using a credibility procedure

2. In some situations, it may be acceptable to blend the subject experience with the relevant experience based on the actuary assigning full, partial, or zero credibility to the subject experience without using a rigorous mathematical model

E. Homogeneity of Data

1. The actuary should consider the homogeneity of both the subject experience and the relevant experience
2. May be able to enhance the predictive value if can treat segments that are not representative of the whole separately
3. The actuary should consider the balance between the homogeneity of the data and the size of the data sets

IV. COMMUNICATIONS AND DISCLOSURES

A. Disclose the credibility procedures used

B. Disclose any material changes from prior credibility procedures

C. ASOP 41 disclosures

1. If any material assumption or method was prescribed by applicable law
2. If the actuary states reliance on other sources and thereby disclaims responsibility for any material assumption or method selected by a party other than the actuary
3. If, in the actuary's professional judgement, the actuary has otherwise deviated from the guidance in this ASOP

V. CURRENT PRACTICES

A. Classical Credibility Procedures

1. Make assumptions as to the form of the underlying probability distribution
2. Use the probability distribution to measure the volume (such as number of claims or amount of premium) such that the probability that the subject loss experience is within a specified percentage of the expected value (r) is equal to a specified parameter (p), which is the full credibility standard
3. Example – Limited Fluctuation Credibility - Claims follow a Normal distribution with partial credibility assigned to the subject experience is based on the square root of the ratio of actual claims to the full credibility standard

B. Empirical Credibility Procedures – Measure the statistical relationships of the subject experience to its mean and to comparable experience of prior experience periods, without reference to the underlying distribution

C. Bayesian Credibility Procedures

Copyright ©2026 ACTEX Learning®

1. Merges prior distributions representing the statistical information of the relevant experience with the statistical information of the subject experience to produce posterior distributions that reflect both
2. Is a least squares approximation to the mean of the *a posteriori* distribution that would result from a Bayesian analysis
3. Example – Greatest Accuracy Credibility – Linear Bayesian credibility – Bühlmann credibility – Partial credibility is assigned to the subject experience using some form of $n/(n + k)$, where n is the volume of the subject experience and k is a parameter than may be derived from variances in the subject and relevant experience

D. Emerging Practice Involving Statistical Models

1. Use with generalized linear models or other multivariate modeling techniques
   a. Generalized linear mixed models
   b. Hierarchical models
   c. Mixed-effects models
2. Credibility can be estimated based on the statistical significance
   a. Parameter estimates
   b. Model performance on a holdout data set
   c. The consistency of either of these measures over time

E. Credibility Bases – Most common ones are numbers or amounts of

1. Claims
2. Losses
3. Premium
4. Exposures

F. Credibility Procedures for Ratemaking/Pricing

1. Full credibility sometimes is based on the variance of an assumed underlying probability distribution
2. If using an assumed frequency distribution, the actuary usually adjusts the required sample size to recognize variation in claim size or other factors

G. Credibility Procedure for Prospective Experience Rating

1. Assigns credibility to actual experience of a single risk or group of risks (the subject experience)

Copyright ©2026 ACTEX Learning®

2. The subject experience may be subdivided into different components, such as primary and excess loss, with different credibility levels appropriate for each component

Copyright ©2026 ACTEX Learning®

THIS PAGE INTENTIONALLY LEFT BLANK

PAST CAS EXAMINATION AND NEW QUESTIONS

1. a. What are the two purposes of credibility?

   b. What are three tasks they may be used for?

   (25–8–1 MTS–0.5/0.75)

2. What are the three criteria for a credibility procedure?

   (25-8-2 MTS-0.75)

3. Are the following statements true or false? If false, change them to be true.

   a. Credibility procedures should be the same for all applications.

   b. The actuary should consider the predictive value of more recent experience as compared to the experience from earlier time periods.

   c. Subject experience cannot be part of the relevant experience.

   d. The subject experience should always be blended with the relevant experience using a rigorous mathematical model.

   (25-8-3 MTS-0.25/0.25/0.25/0.25)

4. a. List three types of characteristics that should be similar between the subject experience and the relevant experience.

   b. Describe how to enhance the predictive value of the subject experience.

   c. Describe how to enhance the predictive value of the relevant experience.

   d. Describe the trade-off between the homogeneity of the relevant experience data and the size of the data set.

   (25-8-4 MTS-0.75/0.25/0.25/0.25)

5. What are the four most common credibility bases?

   (25-8-5 MTS-1.0)

Copyright ©2026 ACTEX Learning®

1. a. i. To evaluate subject experience for potential use in setting assumptions without reference to other data.

   ii. To improve the estimate of the parameter under study.

   b. Need three of these (there may be others):

      i. Pricing

      ii. Ratemaking

      iii. Prospective experience rating

      iv. Reserving

2. a. Whether the procedure is expected to produce reasonable results.

   b. Whether the procedure is appropriate for the intended use and purpose.

   c. Whether the procedure is practical to implement when taking into consideration both the cost and benefit of employing a procedure.

3. a. False. Credibility procedures may be different for different applications.

   b. True.

   c. False. Subject experience may be a part of relevant experience.

   d. False. The subject experience can be blended with the relevant experience without using a rigorous mathematical model in some situations.

4. a. Need three of these (there may be others):

      i. Demographics

      ii. Coverages

      iii. Frequency

      iv. Severity

   b. Treat the segments that are not representative of the whole separately.

   c. Same answer as b.

   d. Getting a relevant data set that is homogenous may result in a data set that is too small to be 100% credible on its own.

5. a. Claims

   b. Losses

   c. Premium

   d. Exposures

Copyright ©2026 ACTEX Learning®