



ACTUARIAL STANDARDS BOARD

• FOURTH EXPOSURE DRAFT •

**Proposed
Actuarial Standard
of Practice**

Modeling

**Comment Deadline:
May 15, 2019**

**Developed by the
Modeling Task Force of the
General Committee of the
Actuarial Standards Board**

**Approved for Exposure by the
Actuarial Standards Board**

December 2018

FOURTH EXPOSURE DRAFT—December 2018

TABLE OF CONTENTS

Transmittal Memorandum	iv
STANDARD OF PRACTICE	
Section 1. Purpose, Scope, Cross References, and Effective Date	1
1.1 Purpose	1
1.2 Scope	1
1.3 Cross References	2
1.4 Effective Date	2
Section 2. Definitions	2
2.1 Assumption	2
2.2 Data	2
2.3 Governance and Controls	2
2.4 Input	2
2.5 Intended Purpose	2
2.6 Intended User	2
2.7 Model	2
2.8 Model Risk	3
2.9 Model Run	3
2.10 Output	3
2.11 Overfitting	3
2.12 Parameter	3
Section 3. Analysis of Issues and Recommended Practices	3
3.1 Model Meeting the Intended Purpose	3
3.1.1 Designing, Developing, or Modifying the Model	3
3.1.2 Selecting, Using, Reviewing, or Evaluating the Model	3
3.1.3 Understanding the Model	4
3.1.4 Model Structure	4
3.1.5 Data	4
3.1.6 Assumptions and Parameters Used As Input	5
3.2 Reliance on Data or Other Information Supplied by Others	6
3.3 Reliance on Models Developed by Others	6
3.4 Reliance on Experts	6
3.5 Mitigation of Model Risk	7
3.5.1 Model Testing	7
3.5.2 Model Validation	8
3.5.3 Review by Another Professional	8
3.5.4 Reasonable Governance and Controls	8
3.5.5 Mitigating Misuse and Misinterpretation	8
3.6 Documentation	8

FOURTH EXPOSURE DRAFT—December 2018

Section 4. Communications and Disclosures	9
4.1 Required Disclosures in an Actuarial Report	9
4.2 Additional Disclosures in an Actuarial Report	9
4.3 Confidential Information	9

APPENDIXES

Appendix 1—Background and Current Practices	10
Appendix 2—Comments on the Third Exposure Draft and Responses	12

FOURTH EXPOSURE DRAFT—December 2018

December 2018

TO: Members of Actuarial Organizations Governed by the Standards of Practice of the Actuarial Standards Board and Other Persons Interested in Modeling

FROM: Actuarial Standards Board (ASB)

SUBJ: Proposed Actuarial Standard of Practice (ASOP) on Modeling

This document contains the exposure draft of a proposed actuarial standard of practice, *Modeling*. Please review this exposure draft and give the ASB the benefit of your comments and suggestions. Each written comment letter or email received by the comment deadline will receive appropriate consideration by the drafting committee and the ASB.

The ASB accepts comments by either electronic or conventional mail. The preferred form is e-mail, as it eases the task of grouping comments by section. However, please feel free to use either form. If you wish to use e-mail, please send a message to **comments@actuary.org**. You may include your comments either in the body of the message or as an attachment prepared in any commonly used word processing format. **Please do not embed your comments in the exposure draft and do not password protect any attachments. If the attachment is in the form of a PDF, please do not “copy protect” the PDF.** Include the phrase “ASB COMMENTS” in the subject line of your message. Please note: Any message not containing this exact phrase in the subject line will be deleted by our system’s spam filter. Also, please indicate in the body of the e-mail if your comments are being submitted on your own behalf or on behalf of a company or organization.

If you wish to use conventional mail, please send comments to the following address:

Modeling (Fourth Exposure)
Actuarial Standards Board
1850 M Street, NW, Suite 300
Washington, DC 20036

The ASB posts all signed comments received to its website to encourage transparency and dialogue. Comments received after the deadline may not be considered. Anonymous comments will not be considered by the ASB nor posted to the website. Comments will be posted in the order that they are received. All posted comments will be available to the general public on the ASB website. The ASB disclaims any responsibility for the content of the comments, which are solely the responsibility of those who submit them.

For more information on the exposure process, please see the ASB Procedures Manual.

Deadline for receipt of responses in the ASB office: **May 15, 2019**

FOURTH EXPOSURE DRAFT—December 2018

History of the Standard

The ASB first began work on a standard for modeling in the late 1990s. Motivated primarily to address the role catastrophe modeling of earthquakes and hurricanes played in casualty ratemaking, this work was focused on the use of specialized models where actuaries would have to rely on a model that was developed by professionals other than actuaries. As a result of this work, ASOP No. 38, *Using Models Outside the Actuary's Area of Expertise*, was approved by the ASB in June of 2000 with the scope of the standard limited to the Property/Casualty area of practice. Historically, ASOP No. 38 had been the only ASOP that specifically addressed modeling.

Recently, the number and importance of modeling applications in actuarial science has increased, with the results of actuarial models often entering financial statements directly. Recognizing this trend, the ASB asked the Life Committee in 2010 to begin work on an ASOP focused on modeling. The Life Committee formed a task force to address this issue and, in February of 2012, a discussion draft titled *Modeling in Life Insurance and Annuities* was released and nineteen comment letters were received. The transmittal letter also mentioned that the scope might be expanded to all practice areas and asked for comments on this idea.

Based upon the feedback received, and numerous other discussions on the topic of modeling, in December of 2012 the ASB created two multi-disciplinary task forces under the direction of the General Committee: i) a general Modeling Task Force, charged with developing an ASOP to address modeling applications in all practice areas, and ii) a Catastrophe Modeling Task Force to consider expanding ASOP No. 38 to all practice areas while focusing exclusively on using catastrophe models. The membership of these task forces has experience in all actuarial practice areas, including enterprise risk management.

As the guidance in this proposed modeling ASOP and in the working draft of ASOP No. 38, currently titled *Catastrophe Modeling (for All Practice Areas)*, is intended to be coordinated, the ASB plans to issue final versions of both ASOPs to be effective concurrently. To facilitate review of this proposed modeling ASOP, a link to the current working draft of ASOP No. 38 is provided [here](#) for your information. The working draft of ASOP No. 38 is not being exposed for comment at this time but does reflect guidance that the ASB and General Committee believe works in concert with the guidance in this fourth exposure draft of this proposed modeling ASOP.

First Exposure Draft

The first exposure draft, titled *Modeling*, was released in June 2013 with a comment deadline of September 30, 2013. Forty-eight comment letters were received and considered in making changes that were reflected in the second exposure draft.

FOURTH EXPOSURE DRAFT—December 2018

Second Exposure Draft

A second exposure draft, titled *Modeling*, was released in November 2014 with a comment deadline of March 1, 2015. Thirty-seven comment letters were received and considered in making changes that were reflected in the third exposure draft.

Third Exposure Draft

A third exposure draft, titled *Modeling*, was released in June 2016 with a comment deadline of October 31, 2016. Twenty-eight comment letters were received and considered in making changes that were reflected in this fourth exposure draft. For a summary of issues contained in these comment letters, please see appendix 2.

Notable Changes from the Third Exposure Draft

Changes made to the fourth exposure draft include the following:

1. clearer accommodation of other forms of modeling (such as predictive and statistical modeling) different from those of financial projection modeling, such as the clarification of the applicability of section 3.1.6;
2. a revision of section 1.2., Scope, as follows:
 - removed the concept of “simple models” from the scope since the definition of “simple models” was not helpful;
 - reorganized scope around the role of the actuary; and
 - incorporated portions of prior sections 3.1 and 3.8 into section 1.2;
3. addition of new section 3.1.6(f), Reasonable Model in the Aggregate, and related disclosure in section 4.1(d);
4. inclusion of new section 3.4, Reliance on Experts; and
5. elimination of the Presentation of Results section (section 3.6 in the third exposure draft) and revisions to section 4.

Request for Comments

The ASB appreciates comments and suggestions on all areas of this proposed standard.

Please provide comments that are succinct, identifying particular sections in the exposure draft for which specific alternative wording is suggested, including the rationale for each suggestion.

The ASB voted in December 2018 to approve this exposure draft.

FOURTH EXPOSURE DRAFT—December 2018

Modeling Task Force

Dale S. Hagstrom, Chairperson

Maryellen J. Coggins	Stephen Mildenhall
Julie H. Fried	Judy K. Stromback
Kenneth R. Kasner	

General Committee of the ASB

Margaret Tiller Sherwood, Chairperson

Shawna S. Ackerman	Susan E. Pantely
Ralph S. Blanchard III	Judy K. Stromback
Andrew M. Erman	Hal Tepfer
Dale S. Hagstrom	Christian J. Wolfe

Actuarial Standards Board

Beth E. Fitzgerald, Chairperson

Christopher S. Carlson	Darrell D. Knapp
Maryellen J. Coggins	Cande J. Olsen
Robert M. Damler	Kathleen A. Riley
Mita D. Drazilov	Barbara L. Snyder

The Actuarial Standards Board (ASB) sets standards for appropriate actuarial practice in the United States through the development and promulgation of Actuarial Standards of Practice (ASOPs). These ASOPs describe the procedures an actuary should follow when performing actuarial services and identify what the actuary should disclose when communicating the results of those services.

PROPOSED ACTUARIAL STANDARD OF PRACTICE

MODELING

STANDARD OF PRACTICE

Section 1. Purpose, Scope, Cross References, and Effective Date

- 1.1 Purpose—This actuarial standard of practice (ASOP or standard) provides guidance to actuaries when performing actuarial services with respect to designing, developing, selecting, modifying, using, reviewing, or evaluating **models**.
- 1.2 Scope—This standard applies to actuaries in any practice area when performing actuarial services with respect to designing, developing, selecting, modifying, or using all types of **models**. For example, an actuary using a **model** developed by others in which the actuary is responsible for the **model output** is subject to this standard.

If the actuary's actuarial services involve reviewing or evaluating **models**, the reviewing or evaluating actuary should be reasonably satisfied that the actuarial services were performed in accordance with this standard. The reviewing or evaluating actuary should use the guidance in this standard to the extent practicable within the scope of the actuary's assignment.

The guidance in this ASOP applies when, in the actuary's professional judgment, **intended users** of the **model** rely on the **output** of the **model**, and their use of the **output** of the **model** has a material effect for the **intended user**. This judgment should be made within the context of the use of the **model output** and the needs of the **intended user**, based on facts known by the actuary at the time the actuarial services are performed. For example, actuarial services performed in relation to pension plan contribution and cost projection **models**, insurance pricing (including predictive) or reserving **models**, and insurance company financial planning **models** may require application of the guidance in this ASOP. In assessing materiality, the actuary should be guided by ASOP No. 1, *Introductory Actuarial Standard of Practice*, section 2.6.

The guidance in this ASOP does not apply to actuaries when performing services with respect to individual pension benefit calculations, as described in section 1.2 of ASOP No. 4, *Measuring Pension Obligations and Determining Pension Plan Costs or Contributions*.

The actuary should understand the extent of the actuary's responsibilities. The actuary's responsibilities may extend to performing actuarial services related to an entire **model** or to a small portion of a **model**. This standard only applies to the extent of the actuary's responsibility.

FOURTH EXPOSURE DRAFT—December 2018

Other ASOPs provide specific requirements for actuarial services that involve **models**. If the actuary determines that such specific guidance from an applicable ASOP conflicts with the guidance of this ASOP, the guidance of such other ASOPs will govern.

If the actuary departs from the guidance set forth in this ASOP in order to comply with applicable law (statutes, regulations, and other legally binding authority), or for any other reason, the actuary should refer to section 4. If a conflict exists between this standard and applicable law, the actuary should comply with applicable law.

- 1.3 Cross References—When this ASOP refers to the provisions of other documents, the reference includes the referenced documents as they may be amended or restated in the future, and any successor to them, by whatever name called. If any amended or restated document differs materially from the originally referenced document, the actuary should consider the guidance in this ASOP to the extent it is applicable and appropriate.
- 1.4 Effective Date—This ASOP is effective for work performed on or after nine months after adoption by the Actuarial Standards Board.

Section 2. Definitions

The terms below are defined for use in this actuarial standard of practice.

- 2.1 Assumption—A type of **input** to a **model** that represents expectations, represents possibilities based on professional judgment, or may be prescribed by law or by others.
- 2.2 Data—Facts or information that are either direct **input** to a **model** or inform the selection of **input**. **Data** may be collected from sources such as records, experience, experiments, surveys, observations, or **output** from other **models**.
- 2.3 Governance and Controls—The application of a set of procedures and an organizational structure designed so that **intended users** can place their confidence in the **output** of the **model**.
- 2.4 Input—Information used in a **model** to produce **output**.
- 2.5 Intended Purpose—The goal or question, whether generalized or specific, addressed by the **model** within the context of the assignment.
- 2.6 Intended User—Any person whom the actuary identifies as able to rely on the actuarial findings.
- 2.7 Model—A simplified representation of relationships among real world variables, entities, or events using statistical, financial, economic, mathematical, or scientific concepts and equations. A **model** consists of three components: an information **input** component,

FOURTH EXPOSURE DRAFT—December 2018

which delivers **assumptions**, **data**, and sometimes **parameters** to the **model**; a processing component, which transforms **input** into **output**; and a results component, which translates the **output** into useful business information. **Models** are used to help explain a system, to study the effects of different parts of a system, to predict the behavior of a system, or to derive estimates and guide decisions.

- 2.8 Model Risk—The risk of adverse consequences resulting from reliance on a **model** that does not adequately represent that which is being modeled or that is misused or misinterpreted.
- 2.9 Model Run—The process of transforming a particular selection of **input** to a particular set of **output** in a **model**. A **model run** could include the whole transformation process or part of the process, as applicable.
- 2.10 Output—The results of a **model** including point estimates, likely or possible ranges, **parameters** (as **input** for other **models**), or qualitative criteria on which decisions could be made.
- 2.11 Overfitting—A situation where a **model** fits sample **data** so closely that prediction accuracy decreases when the **model** is applied to different (for example, out-of-sample) **data**.
- 2.12 Parameter—A type of statistical, financial, economic, mathematical, scientific, or contractual **input** to certain types of **models**. Examples of **parameters** include expected values in probability distributions, coefficients of formula variables, and benefit plan or policy provisions. Some types of **models**, such as predictive or statistical **models**, produce estimates of **parameters**, which may be used as **input** to other **models**.

Section 3. Analysis of Issues and Recommended Practices

- 3.1 Model Meeting the Intended Purpose—The actuary should understand the **model's intended purpose**.
 - 3.1.1 Designing, Developing, or Modifying the Model—When the actuary designs, develops, or modifies the **model**, the actuary should confirm that the capability of the **model** is consistent with the **intended purpose**. Items the actuary should consider, if applicable, include but are not limited to the level of detail built into a **model**, the dependencies recognized, and the **model's** ability to identify possible volatility around expected values.
 - 3.1.2 Selecting, Using, Reviewing, or Evaluating the Model—When selecting, reviewing, or evaluating the **model**, the actuary should confirm the **model** reasonably meets the **intended purpose**. When using the **model**, the actuary should make reasonable efforts to ensure that any revisions to the **input** and

FOURTH EXPOSURE DRAFT—December 2018

formulas, documentation, **governance and controls**, validation, and presentation of **output** are consistent with the **intended purpose**.

- 3.1.3 Understanding the Model—When expressing an opinion on or communicating results of the **model**, the actuary should understand the following:
- a. important aspects of the **model** being used, including but not limited to, basic operations, important dependencies, and major sensitivities;
 - b. known weaknesses in **assumptions** and **parameters** used as **input**, known weaknesses in methods or other known limitations of the **model** that have material implications; and
 - c. any limitation of **data** or information, time constraints, or other practical considerations that could materially impact the **model's** ability to meet its **intended purpose**.
- 3.1.4 Model Structure—The actuary should assess whether the structure of the **model** (including judgments reflected in the **model**) is appropriate for the **intended purpose**. The actuary should consider the following, as applicable, for a particular **model**:
- a. which provisions and risks specific to a business segment, contract, or plan, if any, or interactions more broadly, are material and appropriate to reflect in the **model**;
 - b. whether the form of the **model** is appropriate, such as a projection **model** (deterministic or stochastic), statistical **model**, or predictive **model**;
 - c. whether the use of the **model** dictates a particular level of detail, for example, whether grouping **inputs** will produce reasonable **output** or whether a certain level of detail in the **output** is needed to meet the **intended purpose**;
 - d. whether the **model** is **overfitting** the **data**; and
 - e. whether the **model** appropriately represents options, if any, that could be reasonably expected to have a material effect on the **output** of the **model**. Examples include call options on fixed income assets, policyholder surrender options, and early retirement options.
- 3.1.5 Data—The actuary should use, or confirm use of, **data** appropriate for the **model's intended purpose** and should refer to ASOP No. 23, *Data Quality*, when selecting, reviewing, or evaluating **data** used in the **model**, either directly or as the basis for deriving, estimating, or testing **assumptions** and **parameters** used as

FOURTH EXPOSURE DRAFT—December 2018

input to the **model**.

- 3.1.6 Assumptions and Parameters Used As Input—For **models** that use **assumptions** and **parameters** as **input**, the actuary should use, or confirm use of, **assumptions** and **parameters** that are appropriate in light of the **model’s intended purpose**. The following guidance applies only for **models** that use **assumptions** and **parameters** as **input**:
- a. Setting Assumptions and Parameters—When setting **assumptions** and **parameters**, the actuary should consider using the following:
 1. actual experience adjusted to current conditions where applicable, to the extent it is available, relevant, and sufficiently reliable;
 2. other relevant and sufficiently reliable experience, such as industry experience that is properly modified to reflect the circumstances being modeled, if actual experience is not available or relevant, or is not sufficiently reliable;
 3. future expectations, estimates inherent in market **data** when available and appropriate, or a combination of both; or
 4. other relevant sources of information.
 - b. Margins—If appropriate, the actuary may consider adjusting an **assumption** or **parameter** to include margins. If the actuary considers inclusion of margins within a **model**, the actuary should consider the potential impact to the **model output** to ensure it has the intended impact in the aggregate. If the actuary does decide to use margins to adjust an **assumption** or **parameter**, the actuary should select margins that are reasonable in light of relevant, available experience, given the **model’s intended purpose**.
 - c. Range of Assumptions and Parameters—The actuary may consider using a range of **assumptions** and **parameters** and, if so, whether the number of **model runs** analyzed reflects a set of conditions consistent with the **intended purpose**.
 - d. Consistency—Where appropriate, the actuary should use, or confirm use of, **assumptions** and **parameters** for the **model** that are reasonably consistent with one another for a given **model run**.

If the actuary is aware of any material inconsistencies among **assumptions** and **parameters** used by the actuary in the **model**, the actuary should disclose the inconsistencies and any known reasons for the inconsistencies in accordance with section 4.1(c). In the case of **assumptions** and

FOURTH EXPOSURE DRAFT—December 2018

parameters prescribed by applicable law, the actuary's disclosure may be limited to identifying the possibility of an inconsistency with other **assumptions** and **parameters**.

- e. Appropriateness of Input in Current Model Run—Where practical and appropriate, the actuary reusing an existing **model** should evaluate whether the **input** is still appropriate for use in the current **model run**. For example, **models** used in financial reporting may offer opportunities to compare **assumptions** and **parameters** to emerging experience in the aggregate.
- f. Reasonable Model in the Aggregate—The actuary should assess whether the **assumptions** and **parameters** are reasonable in the aggregate. While **assumptions** and **parameters** might appear to be reasonable individually, conservatism or optimism in multiple **assumptions** and **parameters** may result in a set of **assumptions** and **parameters** that produces unreasonable **output**.

3.2 Reliance on Data or Other Information Supplied by Others—When relying on **data** or other information supplied by others, the actuary should refer to ASOP No. 23 and ASOP No. 41, *Actuarial Communications*, for guidance.

3.3 Reliance on Models Developed by Others—If the actuary relies on a **model** designed, developed, or modified by others, such as a vendor or colleague, and the actuary has a limited ability to obtain information about the **model** or to understand the underlying workings of the **model**, the actuary should disclose the extent of any such reliance. In addition, the actuary should make a reasonable attempt to have a basic understanding of the **model**, including the following, as appropriate:

- a. the designer's or developer's original **intended purpose** for the **model**;
- b. the general operation of the **model**;
- c. major sensitivities and dependencies within the **model**; and
- d. key strengths and limitations of the **model**.

When relying on **models** developed by others, the actuary should make practical efforts to comply with other applicable sections of this standard.

3.4 Reliance on Experts—The actuary may rely on experts in the fields of knowledge used in the development of the **model**. In determining the appropriate level of reliance, the actuary may consider the following:

- a. whether the individual or individuals upon whom the actuary is relying are

FOURTH EXPOSURE DRAFT—December 2018

experts in the applicable field;

- b. the extent to which the **model** has been reviewed or validated by experts in the applicable field, including any known significant differences of opinion among experts concerning aspects of the **model** that could be material to the actuary's use of the **model**;
- c. whether there are industry or regulatory standards that apply to the **model** or to the testing or validation of the **model**, and whether the **model** has been certified as having met such standards; and
- d. whether the science underlying the expertise is likely to produce useful **models** for the **intended purpose**.

The actuary should disclose the extent of any such reliance.

3.5 Mitigation of Model Risk—The actuary should evaluate **model risk** and, if appropriate, take reasonable steps to mitigate **model risk**. The type and degree of **model risk** mitigation that is reasonable and appropriate may depend on the following:

- a. the **model's intended purpose**;
- b. the nature and complexity of the **model**;
- c. the operating environment and **governance and controls** related to the **model**;
- d. whether there have been any changes to the **model** or the **model** environment; and
- e. the balance between the cost of the mitigation efforts and the reduction in potential **model risk**.

3.5.1 Model Testing—For a **model run** or set of **model runs** generated at one time or over time that is to be relied upon by the **intended user**, the actuary should perform sufficient testing to ensure that the **model** reasonably represents that which is intended to be modeled. **Model** testing may include the following:

- a. reconciling relevant **input** values to the relevant system, study, or other source of information, addressing and documenting the differences appearing in the reconciliation, if material;
- b. checking formulas, logic, and table references; and

FOURTH EXPOSURE DRAFT—December 2018

- c. reconciling the **output** of a **model run** to prior **model runs**, given any changes in **assumptions** and **parameters** used as **input, data**, formulas, or other aspects of the **model** since the prior **model run**.
- 3.5.2. **Model Validation**—The actuary should take appropriate steps to validate that the **model output** reasonably represents that which is being modeled. Depending on the **intended purpose, model** validation may include the following:
- a. testing, where applicable, preliminary **model output** against historical actual results to verify that modeled **output** would bear a reasonable relationship to actual results over a given time period if **input** to the **model** were set to be consistent with the conditions prevailing during such period;
 - b. performing statistical or analytical tests on **model output** to assess their reasonableness;
 - c. running tests of variations on key **assumptions** and **parameters** used as **input** to test that changes in the **output** are consistent with the changes in those **assumptions** and **parameters**; and
 - d. comparing **model output** to those of an alternative **model(s)**, where appropriate.
- 3.5.3 **Review by Another Professional**—The actuary may consider obtaining a review by a second, qualified professional, depending upon the nature and complexity of the **model**.
- 3.5.4 **Reasonable Governance and Controls**—The actuary should use, or, if appropriate, may rely on others to use, reasonable **governance and controls** to mitigate **model risk**.
- 3.5.5 **Mitigating Misuse and Misinterpretation**—The actuary should refer to the guidance in ASOP No. 41, in particular sections 3.4.1 and 3.7, to mitigate possible misuse and misinterpretation of the **model**.
- 3.6 **Documentation**—The actuary should consider preparing and retaining documentation to support compliance with the requirements of section 3 and the disclosure requirements of section 4. The actuary should consider preparing such documentation in a form such that another actuary qualified in the same practice area could assess the reasonableness of the actuary’s work or could assume the assignment if necessary. The degree of such documentation should be based on the professional judgment of the actuary, and may vary with the complexity and purpose of the actuarial services. In addition, the actuary should refer to ASOP No. 41, section 3.8, for guidance related to the retention of file material other than that which is to be disclosed under section 4.

FOURTH EXPOSURE DRAFT—December 2018

Section 4. Communications and Disclosures

- 4.1 Required Disclosures in an Actuarial Report—When issuing an actuarial report under this standard, the actuary should refer to ASOP Nos. 23 and 41. In addition, the actuary should disclose the following in such actuarial reports:
- a. the **intended purpose** of the **model**, as discussed in section 3.1;
 - b. material limitations that result from the items discussed in section 3.1.3;
 - c. material inconsistencies, if any, among **assumptions** and **parameters**, and any known reasons for such inconsistencies, as discussed in section 3.1.6(d);
 - d. unreasonable **output** resulting from the aggregation of **assumptions** and **parameters** used as **input**, if any, as discussed in section 3.1.6(f);
 - e. extent of reliance on **models** developed by others, if any, as discussed in section 3.3; and
 - f. extent of reliance on experts, if any, as discussed in section 3.4.
- 4.2 Additional Disclosures in an Actuarial Report—The actuary should include the following, as applicable, in an actuarial report:
- a. the disclosure in ASOP No. 41, section 4.2, if any material **assumption**, **parameter**, or method was prescribed by applicable law;
 - b. 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**, **parameter**, or method selected by a party other than the actuary; and
 - c. 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.
- 4.3 Confidential Information—Nothing in this ASOP is intended to require the actuary to disclose confidential information.

Appendix 1

Background and Current Practices

Note: This appendix is provided for informational purposes but is not part of the standard of practice.

Background

Models are used to help explain a system, to study the effects of different components, and to derive estimates and guide decisions. Models have always played a fundamental role in actuarial work, with every discipline relying on a broad range of modeling applications, ranging from simple spreadsheets to complex capital models. The number and importance of modeling applications in actuarial science have continued to increase, with the results of actuarial models frequently entering financial statements directly.

Actuaries often develop and use models when analyzing uncertain outcomes. Even a model that is prudently developed and carefully used does not eliminate inherent uncertainty and variability, and actual experience may differ, sometimes significantly, from the estimates derived from the model results. A model is only an approximation of reality, not the reality itself, and the differences between the model and actual experience, by themselves, do not indicate a flawed model or noncompliance with standards.

This standard covers a wide range of models, ranging from projection models to statistical models and predictive models. These models have different purposes. Some models evolve through a life cycle consisting of: (1) a specification phase, (2) an implementation phase, and (3) a production phase, which consists of one or more model runs. Other models evolve through a life cycle consisting of the following: (1) a specification phase, (2) a possibly iterative, parameter estimation phase fitting one or more model structures, and (3) an output evaluation, validation, and selection phase. For other models, other combinations of functionally similar phases may exist.

When a model will be used repeatedly, it is common that the model will be subject to appropriate governance and controls. Examples of model governance and controls include the following:

- limitations on access to use and modify the model (that is, restricting access to model input, model code and calculations, and model output);
- confirmation that model output is reproducible upon rerun (if the model allows for such reproducibility);
- implementing a model change management process;
- specification, documentation, and programming standards for the implementation;

FOURTH EXPOSURE DRAFT—December 2018

- procedures for secure back-up of the media storing the implementation and data;
- appropriate staff training or cross-training for continuity of use and mitigation of key-person risk;
- plans for periodic consideration of the organization's continued ability to access and maintain the model, including data, software, staff, hardware, and vendor relationships;
- plans for periodic updating of model input; and
- plans for periodic review of the assumptions, parameters, functionality, and methodology.

The actuary designing or developing a model often considers whether the model can be easily updated for anticipated changes in data, parameters, or assumptions.

Current Practices

The use of margins in model assumptions may differ by practice area. In some practice areas, the ideal model would use only assumptions without margins. In other practice areas, the current practice is to use assumptions that may include margins. Possible reasons for using margins include adding an element of conservatism or adjusting for the cost of bearing risk. The size of the margins may be driven by future unpredictability, experience data that are not fully reliable, or both.

FOURTH EXPOSURE DRAFT—December 2018

Appendix 2

Comments on the Third Exposure Draft and Responses

The third exposure draft titled *Modeling* was approved by the ASB in June 2016 with a comment deadline of October 31, 2016. Twenty-eight comment letters were received, some of which were submitted on behalf of multiple commentators, such as by firms or committees. For purposes of this appendix, the term “commentator” may refer to more than one person associated with a particular comment letter. The Task Force and General Committee carefully considered all comments received, and the ASB reviewed (and modified, where appropriate) the changes proposed by the General Committee.

Summarized below are the significant issues and questions contained in the comment letters and the responses to each. Minor wording or punctuation changes that are suggested but not significant are not reflected in the appendix, although they may have been adopted.

The term “reviewers” includes the Task Force, General Committee, and the ASB. Unless otherwise noted, the section numbers and titles used below refer to those in the third exposure draft, which are then cross referenced with those in the fourth exposure draft.

TRANSMITTAL MEMORANDUM QUESTIONS	
Question 1: Does the proposed standard provide sufficient and appropriate guidance to actuaries working with models? If not, what suggestions do you recommend for improving the guidance?	
Comment	Several commentators agreed the proposed standard provides sufficient and appropriate guidance to actuaries working with models but would be enhanced by other suggestions listed in the specific comment sections.
Comment	Two commentators felt the ASOP was not sufficient, in particular, for property/casualty actuaries working with ratemaking models including predictive models.
Response	The reviewers made changes throughout the ASOP to address these concerns. In addition, the reviewers added a subject matter expert and revised the considerations and guidance to better cover statistical modeling and predictive modeling.
Comment	One commentator stated the guidance in section 3 should be differentiated by role and should address the situation in which one project includes multiple embedded models.
Response	The reviewers have clarified the guidance regarding the actuary’s role and responsibilities.
Question 2: Does the proposed standard provide sufficient and appropriate guidance to actuaries working with all types of models, including financial projection models, predictive models, and statistical models?	
Comment	Several commentators agreed the proposed standard provides sufficient and appropriate guidance to actuaries working with financial projection models.
Comment	Several commentators felt the proposed standard did not provide sufficient guidance for actuaries working with predictive models.
Response	The reviewers note a predictive modeling expert was added to the task force to improve the guidance for actuaries working with predictive models and made changes throughout the ASOP to improve guidance.

FOURTH EXPOSURE DRAFT—December 2018

Question 3: The scope of the proposed ASOP excludes “simple” models, which are defined in section 2.13. Is this definition appropriate and sufficiently clear?	
Comment	Some commentators believed the definition of “simple” models was appropriate and sufficiently clear.
Response	The reviewers appreciate the affirmation. However, based on the comments received, the reviewers believe that the concept of a “simple model” was not helpful and therefore deleted it.
Comment	One commentator stated the components and phases of the life cycle may not be present or distinguishable in some simple models, which may cause some simple models to not satisfy the “model” definition of the standard.
Response	Based on the comments received, the reviewers believe that the concept of a “simple model” was not helpful and therefore deleted it.
Comment	Some commentators believe the definition needs to be more specific, and suggested that examples of types of models that would fall under the definition would be helpful.
Response	Based on the comments received, the reviewers believe that the concept of a “simple model” was not helpful and therefore deleted it.
Comment	One commentator believed the standard should not relieve an actuary of the duty and responsibility to be thorough for simple models, and should require the actuary to perform sufficient due diligence, review and documentation for all models whether simple or not.
Response	Based on the comments received, the reviewers believe that the concept of a “simple model” was not helpful and therefore deleted it.
Question 4: Section 3.2 requires the actuary to make practical efforts to comply with applicable sections of this standard with respect to models designed or built by someone else, such as a vendor or a colleague, when the actuary has a limited ability to obtain information about the model or to understand the underlying workings of the model. Is this guidance appropriate and clear?	
Comment	Overall, commentators agreed that the guidance was appropriate.
Comment	One commentator sought additional guidance as to what should be done if the actuary is unable to come to a reasonable understanding of the model.
Response	The reviewers made no change in response to this comment.
Comment	One commentator requested examples illustrating the practical efforts an actuary should make to comply with other applicable sections of the standard.
Response	The reviewers believe the guidance is sufficiently clear without the addition of such illustrative examples.
Question 5: Does any guidance in this exposure draft conflict with the guidance in the proposed working draft of ASOP No. 38, Catastrophe Modeling (for All Practice Areas)?	
Comment	Two commentators believe there are some slight differences in definitions between the exposure draft and the proposed working draft of ASOP No. 38, <i>Catastrophe Modeling (for All Practice Areas)</i> .
Response	The reviewers agree and note that the definitions in the draft ASOP No. 38 will be reviewed before the final issuance of that ASOP.
Comment	Two commentators noted there are certain situations in which it is not clear as to which ASOP applies.
Response	The reviewers believe it is sufficiently clear that this ASOP applies to actuaries working with all models including catastrophe models, whereas the draft ASOP No. 38 applies to actuaries working only with catastrophe models. The relationship of this ASOP to other ASOPs is discussed in section 1.2, Scope.

FOURTH EXPOSURE DRAFT—December 2018

GENERAL COMMENTS	
Comment	One commentator felt the terms “output” and “results” were used interchangeably and suggested using one term throughout the ASOP.
Response	The reviewers agree and made the change to use “output” throughout the ASOP when referring to output directly from a model.
Comment	One commentator suggested requiring disclosure of the model validation performed.
Response	The reviewers disagree and made no change in response to this comment.
Comment	Several commentators stated the guidance as written did not apply well to a broad family of statistical models.
Response	The reviewers added a subject matter expert and revised the considerations and guidance to better cover statistical modeling and predictive modeling.
Comment	One commentator sought clarity about the steps required for a simple model.
Response	Based on the comments received, the reviewers believe that the concept of a “simple model” was not helpful and therefore deleted it.
Comment	One commentator was concerned about the application of section 3.2 in two circumstances: when a different team produced data for input to the current model, and when two different actuaries took responsibility for different aspects of an actuarial opinion.
Response	The reviewers believe that current sections 3.2, 3.3, and 3.4 appropriately address these situations and made no change in response to this comment.
Comment	One commentator noted there should be greater clarification on the actuarial role in sections such as 3.4.6 and 3.4.7.
Response	The reviewers agree and added the words “or confirm use of” in current sections 3.1.5 and 3.1.6.
Comment	One commentator suggested the standard should have an explicit statement that the ASOP is not intended to require the disclosure of confidential information, as exists in ASOP Nos. 4, <i>Measuring Pension Obligations and Determining Pension Plan Costs or Contributions</i> ; 27, <i>Selection of Economic Assumptions for Measuring Pension Obligations</i> ; and 35, <i>Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations</i> .
Response	The reviewers agree and note current section 4.3 addresses this concern.
Comment	One commentator suggested standards should acknowledge that actuaries need to be aware of all laws and regulations that could take precedence.
Response	The reviewers note that the discussion of actuaries’ compliance with laws and regulations is addressed by the introductory section of the <i>Code of Professional Conduct</i> (Code) as follows: “An Actuary must be familiar with, and keep current with, not only the Code, but also applicable Law and rules of professional conduct for the jurisdictions in which the Actuary renders Actuarial Services. An Actuary is responsible for securing translations of such Laws or rules of conduct as may be necessary.” Therefore, the reviewers made no change.
Comment	One commentator commended the specific mention of different phases of a model because risk mitigation needs to consider all such phases.
Response	The reviewers appreciate the comment and note that the descriptive information is now in appendix 1.

FOURTH EXPOSURE DRAFT—December 2018

SECTION 1. PURPOSE, SCOPE, CROSS REFERENCES, AND EFFECTIVE DATE	
Section 1.1, Purpose	
Comment	One commentator wasn't clear on what "developing" entails and suggested either deleting it or better explaining what this term is intended to cover.
Response	The reviewers believe that the term "developing" as used in this draft ASOP is sufficiently clear and therefore made no change. However the reviewers removed the reference to "building" to avoid potential confusion with "developing."
Section 1.2, Scope	
Comment	One commentator wasn't sure whether the term "principal" or "intended user" should be used in this section and section 3.1, but believed that if the term "intended user" is used, it should either be defined or there should be a cross-reference to the definition of the term in ASOP No. 41, <i>Actuarial Communications</i> .
Response	The reviewers believe "intended user" should be used and added a definition in section 2.
Comment	One commentator suggested not limiting the application of the standard to situations where the material effect is financial in nature.
Response	The reviewers agree and clarified the scope.
Comment	One commentator suggested moving the "simple model" exception from the first paragraph to the third paragraph and utilizing the simple model definition language in this third paragraph.
Response	Based on the comments received, the reviewers believe that the concept of a "simple model" was not helpful and deleted it. Therefore, the reviewers made no change in response to this comment.
Comment	One commentator indicated the definition of "simple model" as worded would not be effective in excluding many projects from the standard requirements applicable to models that are not simple models. While the commentator supported the use of professional judgement in this determination, the commentator suggested that the language could be improved by changing the exception language from a model that is "transparent and can be predicted..." to a model that is "transparent or can be predicted..."
Response	Based on the comments received, the reviewers believe that the concept of a "simple model" was not helpful and deleted it. Therefore, the reviewers made no change in response to this comment.
Comment	One commentator questioned use of the word "heavily" and wondered if "materially" would be a better word. The commentator also requested additional guidance as to how to assess if a model is heavily relied upon.
Response	The reviewers removed the word "heavily," modified the section to highlight the use of professional judgment, and made other edits to improve clarity.
Comment	One commentator suggested changing "all" in the first sentence to "any."
Response	The reviewers agree and made the change.
Comment	One commentator suggested excluding from the scope any calculation that is a deterministic snapshot present value as of a given date using a single set of variables that are pre-determined for the intended purpose and specific situation, or for a collection of many individual such calculations, called a "measure."
Response	The reviewers disagree with this specific recommendation but clarified section 1.2, Scope.
Comment	One commentator stated there are problems with the broad scope, in that the guidance does not cover everything.
Response	The reviewers believe the guidance, as clarified, is appropriate.

FOURTH EXPOSURE DRAFT—December 2018

Section 1.4, Effective Date	
Comment	One commentator indicated the application of the effective date is not clear for a model that is selected or used prior to the effective date but has been modified in some manner after the effective date.
Response	The reviewers believe the guidance is clear and made no change.
SECTION 2. DEFINITIONS	
Comment	One commentator suggested that the term “modeling team” be added to the section 2 definitions.
Response	The reviewers believe that the guidance regarding “modeling team” in section 3.3 may not have been sufficiently clear and removed the concept.
Section 2.1, Assumptions	
Comment	One commentator noted the definition does not account for relationships where predictors and loss are multiplicative.
Response	The reviewers believe the terms “expectations” and “possibilities based on professional judgement” allow for this relationship, and made no change.
Comment	One commentator indicated that this definition should specifically include margins.
Response	The reviewers disagree with explicitly referencing “margins” in the definition of “assumptions,” and made no change.
Comment	One commentator indicated the definition implies that assumptions are developed via a process outside the model and once developed are treated as input items to the model. The commentator suggested that this may not always be the case, particularly as it applies to predictive modeling.
Response	The reviewers revised the standard in various sections to be appropriate for statistical modeling and predictive modeling.
Section 2.2, Data	
Comment	One commentator suggested including the model’s valuation date as a data item.
Response	The reviewers disagree and made no change.
Section 2.3, Granularity	
Comment	One commentator suggested the definition be revised to address predictive modeling.
Response	The reviewers removed the definition of “granularity” and used the concept where relevant. The reviewers clarified the guidance to address predictive modeling.
Section 2.4, Implementation	
Comment	Several commentators found this definition unclear, inconsistently used in the standard and suggested alternative language.
Response	The reviewers agree and removed the definition.
Section 2.6, Intended Purpose (now section 2.5)	
Comment	Two commentators suggested this definition could be clearer if it better explained which of the two “definitions” applies to the role the actuary is playing with regard to each model.
Response	The reviewers clarified the definition of intended purpose.
Section 2.7, Model	
Comment	One commentator found the definition to be inadequate in describing predictive modeling.
Response	The reviewers agree and added language to include concepts related to the use of predictive modeling.

FOURTH EXPOSURE DRAFT—December 2018

Comment	One commentator found it difficult to determine how to address a project in which several models are linked together to generate results. The commentator also suggested adding “actuarial” to the list of concepts and equations that are used in a model in the first sentence and defining the term “model results.”
Response	In response to another comment, the reviewers clarified the definition of parameters to state “some types of models, such as predictive or statistical models, produce estimates of parameters, which may be used as input to other models.” However, no further changes were made to the definition of “model” in response to this comment.
Comment	One commentator suggested deleting the word “simplified.”
Response	The reviewers disagree and made no change in response to this comment.
Comment	One commentator suggested the second sentence should consider including the phrase “past & future” as a model can help explain retrospective and prospective matters.
Response	The reviewers believe the guidance is sufficiently clear and made no change in response to this comment.
Comment	Two commentators requested examples of what constituted a model for purposes of the standard and what did not.
Response	The reviewers believe that section 1.2, Scope, provides sufficient guidance and made no change to the definition of “model” in response to this comment.
Comment	One commentator indicated that the last sentence seems to describe the model development process, not a model evolving.
Response	The reviewers agree, removed the last sentence, and moved it to appendix 1.
Section 2.9, Model Risk (now section 2.8)	
Comment	One commentator suggested adding the word “systemic” to reinforce the negative nature of relying solely on a model.
Response	The reviewers disagree and made no change.
Section 2.11, Parameters (now section 2.12)	
Comment	Several commentators indicated this definition doesn’t necessarily apply to predictive or pricing models where output of these models is often used as input to other models.
Response	The reviewers agree and revised the definition of “parameters.”
Section 2.12, Simple Model	
Comment	Several commentators indicated they felt this definition was not sufficiently clear and wanted specific examples of “simple models.” Other commentators suggested eliminating the definition and incorporating the concept elsewhere.
Response	The reviewers agree the term “simple models” was neither sufficiently clear nor helpful and therefore removed the definition.
Section 2.13, Specification	
Comment	One commentator indicated that this definition seems awkward if applied to predictive modeling, where model outputs are rarely discussed. Also the commentator believes a specification is the relationship and error structure.
Response	The reviewers believe that the guidance is sufficiently clear and made no change in response to this comment.

FOURTH EXPOSURE DRAFT—December 2018

SECTION 3. ANALYSIS OF ISSUES AND RECOMMENDED PRACTICES	
Section 3.1, Application of ASOP Guidance (now covered in section 1.2, Scope)	
Comment	One commentator thought the example in the first paragraph was unnecessary. The commentator indicated that it all depends on materiality.
Response	The reviewers disagree, expanded the example to improve clarity, and moved it to section 1.2, Scope.
Comment	One commentator indicated that the example of a “corporate financial planning model” typically being covered by the proposed ASOP was not clear. The commentator indicated “if this example is intended to refer to something specific in the insurance industry, consideration should be given to clarifying the wording (for example, to “corporate financial planning for an insurance company.”) It was also not clear to the commentator whether annual pension valuation models will be subject to the proposed ASOP.
Response	The reviewers agree, added the additional example of “pension plan contribution and cost projection models,” and added further context for the examples to improve clarity. The example has been moved to section 1.2, Scope.
Comment	One commentator indicated that the requirements imposed on actuaries by sections 3.1-3.3 when working in modeling teams and/or with models developed by others and the burdens placed on their work product in these situations are “onerous, impractical and add little to no value” and that “the criteria in the [exposure draft] are much too extensive and unreasonable.”
Response	The reviewers revised the section to clarify guidance when more than one actuary is involved in a modeling project. The revised language has been moved to section 1.2, Scope.
Comment	One commentator indicated that the need to disclose something in the situations described in this paragraph presents difficulties and cited several examples where disclosure guidance was unclear, particularly in the case of services related to “simple models.” The commentator indicated that it may make more sense to have the requirement be that the actuary considers whether disclosing this information is useful in the given situation.
Response	The reviewers revised section 1.2, Scope, which now includes language previously included in section 3.1, and removed references to “simple model.”
Comment	One commentator suggested adding “Any model should include disclaimers and caveats relating to its use or the impact of third party provided data or assumptions.” The commentator also indicated that there was no discussion as to how to determine “materiality” for purposes of this section.
Response	The reviewers believe the guidance is appropriate and made no change in response to this comment.
Comment	One commentator indicated that the placement of the terms “and” and “or” when describing applicability could potentially lead to exclusion of modeling situations that should be covered by the standard. The commentator indicated that it narrows the scope of this ASOP to require that both conditions be satisfied.
Response	The reviewers disagree with the recommendation to broaden the scope by using “or” rather than “and,” and made no change in response to this comment.
Comment	One commentator recommended that a statement be added to section 3.1 indicating that heavy reliance should be assumed where the output is required for governmental or financial reporting purposes and, to the actuary’s knowledge, the results provided to the intended user will be used to satisfy that requirement.
Response	The reviewers believe the guidance is clear and made no change in response to this comment.

FOURTH EXPOSURE DRAFT—December 2018

Comment	One commentator also suggested that the section be modified to address the possibility that an actuary may be unable to determine if the results of the model are material to the intended user and suggested that the following language be added to the third paragraph: “In the absence of other information to the contrary, the actuary may assume a result that is a small percentage of a related data point (such as compensation for a benefit cost) is not material.”
Response	The reviewers believe the guidance is clear and made no change in response to this comment.
Section 3.2, Models Developed by Others (now section 3.3, Reliance on Models Developed by Others)	
Comment	Two commentators suggested adding other requirements including “knowledge of the model’s assumptions” and “check reasonability of results.”
Response	The reviewers believe that the existing language provides sufficiently clear guidance and made no change.
Comment	Some commentators suggested deleting the words “continued to” because there will be a time when it is first used.
Response	The reviewers agree and made the change.
Comment	Some commentators suggested that the items listed in section 3.2 may not always be applicable and suggested replacing “including” with “such as.”
Response	The reviewers agree with the concept but added “as appropriate” instead of changing “including” to “such as.”
Comment	One commentator suggested adding “If the actuary does not have enough information about the model to comply with applicable sections of this standard, then the actuary should either not use the model or should disclose the concerns as described in sections 3.6.1 and 3.6.2.”
Response	The reviewers disagree and made no change in response to this comment.
Comment	One commentator expressed concern that the dividing line between sections 3.2 and 3.3 (or guidance provided in these sections) was vague and could be interpreted as a higher bar of responsibility than is intended.
Response	Given this comment and others received that directly addressed previous section 3.3, the reviewers removed section 3.3 to improve clarity.
Comment	One commentator indicated that the standard should require documentation that the actuary has a limited ability to obtain information and the actuary should disclose that the actuary is using a model not created by that actuary. The commentator raised the question of whether there should be a reliance letter stating that a third party prepared and provided to the actuary the model in question.
Response	The reviewers agree in part and added disclosure requirements in current section 3.3 in response to this comment.
Section 3.3, Reliance on Another Actuary on a Modeling Team	
Comment	Several commentators suggested that the guidance would be difficult to apply as written. In particular, commentators thought the guidance didn’t address a) how a junior member of a team would become “reasonably satisfied,” b) whether the guidance is sufficient if a member of a team is a non-actuarial expert, and c) how the guidance responds to the actuary as a reviewer of model output that is then shared with an intended user.
Response	The reviewers agree that there are situations to which the draft guidance did not directly respond and that the inclusion of the guidance wasn’t sufficiently helpful. Therefore, the reviewers removed the section, replacing it with “reliance” language more commonly found in other ASOPs.

FOURTH EXPOSURE DRAFT—December 2018

Section 3.4, Model Meeting the Intended Purpose (now section 3.1)	
Comment	One commentator indicated that model usage outside the intended use should be permitted under the standard in specific situations to avoid stifling innovation, but should require disclosure of rationale of the appropriateness of the new usage.
Response	The guidance requires the model to meet the current intended purpose. Therefore, the reviewers made no change.
Section 3.4.1, Designing, Building, or Developing the Model for the Intended Purpose (now section 3.1.1, Designing, Developing, or Modifying the Model)	
Comment	Several commentators suggested specifically addressing “overfitting,” as it is a primary concern in developing a predictive model that meets its intended purpose.
Response	The reviewers agree and added guidance regarding overfitting in current section 3.1.4(d).
Comment	One commentator requested clarification of the phrase “relationships recognized,” as it is not clear to which relationships this refers and suggested using the term “dependencies.”
Response	The reviewers agree and made the change.
Comment	One commentator indicated that the example in this section was not appropriate for this section and should, instead, be included in the examples of model governance and controls in appendix 1.
Response	The reviewers agree and made the change.
Section 3.4.2, Selecting or Using the Model for the Intended Purpose (now section 3.1.2, Selecting, Using, Reviewing, or Evaluating the Model)	
Comment	One commentator suggested changing “efforts to revise the inputs” to “revisions to inputs” for additional clarity.
Response	The reviewers agree and made the change.
Section 3.4.3, Reviewing, Evaluating, or Modifying the Model (now in sections 3.1.1 and 3.1.2)	
Comment	One commentator suggested changing the title of this subsection to “Reviewing, Evaluating or Modifying the Model for the Intended Purpose” and changing the term “planned uses” to “intended purpose” in the first sentence to be consistent with the other subsections. The commentator also suggested rewording the last sentence to be more consistent with the current definition of “model” and provided suggested language.
Response	The reviewers clarified the guidance in sections 3.1.1 and 3.1.2.
Section 3.4.4, Understanding the Model (now section 3.1.3)	
Comment	Two commentators suggested using the phrase “dependencies” rather than the phrase “relationships.”
Response	The reviewers agree and made the change.
Comment	One commentator felt that there should be a clearer guidance than currently provided in sections 3.4.4 and 3.8 for model documentation proportioned to the level of materiality and risk associated with the model.
Response	The reviewers removed model documentation from section 3.4.4 (now section 3.1.3) and modified section 3.6 in the current exposure draft to include the following: “The degree of such documentation should be based on the professional judgment of the actuary, and may vary with the complexity and purpose of the actuarial services.”
Section 3.4.5, Model Structure (now section 3.1.4)	
Comment	One commentator suggested adding “if any” to the guidance in sections 3.4.5(a) and 3.4.5(d).
Response	The reviewers agree and made the change in current sections 3.1.4(a) and 3.1.4(e).

FOURTH EXPOSURE DRAFT—December 2018

Comment	One commentator asked for additional clarification of the terms “the structure of the model” and “entity or its counterparties.” The commentator suggested that the standard incorporate a definition of “model structure” and suggested adding the phrase “be expected to” before “have a material effect.”
Response	The reviewers believe that the use of “structure” in “model structure” applies its common meaning. The reviewers deleted the phrase “entity or its counterparties,” believing it was unnecessary. The reviewers added the phrase “be reasonably expected to” in current section 3.1.4(e).
Comment	One commentator felt that the example in section 3.4.5(c) was too specific and narrow and suggested alternative language of “whether the form of the model is appropriate such as deterministic, stochastic, predictive, etc.”
Response	The reviewers agree and made a similar change to current section 3.1.4(b).
Section 3.4.6, Data (now section 3.1.5)	
Comment	One commentator suggested changing “deriving” to “deriving, estimating, or testing.”
Response	The reviewers agree and made the change.
Section 3.4.7, Assumptions and Parameters (now section 3.1.6, Assumptions and Parameters Used as Input)	
Comment	One commentator suggested that the guidance specify that the assumption based on experience should be modified so that the experience would become representative of the underlying environment expected to be present at the time when the model will be applied.
Response	The reviewers agree and added language in current section 3.1.6(a).
Comment	One commentator suggested that “margin” should be defined in section 2.
Response	The reviewers note that “margin” is used only in current section 3.1.6(b) and believe that the guidance is clear.
Comment	Several commentators noted that section 3.4.7 applied to projection modeling and not to predictive modeling.
Response	The reviewers agree and modified current section 3.1.6 to apply to models that use assumptions and parameters as input.
Comment	One commentator suggested the guidance be modified to require an actuary who chooses to include a margin to explicitly disclose and quantify the impact of the margin. Another commentator suggested disclosing the use of margins. Several commentators suggested that the use of margins and the rationale for selecting the margin used should be disclosed.
Response	The reviewers disagree and made no change in response to these comments.
Comment	One commentator questioned the use of “should consider” in section 3.4.7(a) while using “may consider” in section 3.4.7(b).
Response	The reviewers believe the guidance is appropriate and made no change.
Comment	One commentator suggested adding possible reasons why an actuary might choose not to include margins to this section.
Response	The reviewers disagree and made no change in response to this comment.
Comment	One commentator also suggested adding the following language: “Range of Assumption and Parameters—The actuary should consider whether a range of assumptions and parameters should be used, and if so, whether the number of model runs analyzed reflects a range of conditions consistent with the intended purpose.”
Response	The reviewers agree and made the change.

FOURTH EXPOSURE DRAFT—December 2018

Comment	Several commentators also suggested generalizing section 3.4.7(c) to recognize the possibility that a range of assumptions might not be used in the model.
Response	The reviewers agree and clarified the guidance in current section 3.1.6(c).
Comment	One commentator questioned why sections 3.4.7(a) and 3.4.7(b) are separated into two sub-sections.
Response	The reviewers believe the guidance in these two different areas is appropriate and therefore made no change in response to this comment.
Comment	One commentator suggested adding the sentence “When considering inclusion of a margin within a model, the potential impact to the model results should be reviewed to ensure it has the intended impact in aggregate (for example, more conservative).”
Response	The reviewers agree and modified current section 3.1.6(b).
Comment	One commentator suggested adding “credible” to the list of items the actuary should consider using in 3.1.7(a)(1).
Response	The reviewers disagree and made no change.
Comment	One commentator suggested changing the reference in 3.4.7(d) from section 4.1.3 to section 4.2.3.
Response	The reviewers changed the reference to the appropriate section.
Comment	One commentator suggested that this section should provide for a broader basis for selection of assumptions that does not potentially conflict with existing guidance and recommended that 3.4.7 be changed to reflect that for work subject to ASOP No. 27 and/or ASOP No. 35 that as appropriate for the intended purpose the assumption should either represent the actuary’s future expectations, estimates inherent in market data or a combination of both.
Response	The reviewers agree with the concept and modified the language in current section 3.1.6(a).
Comment	One commentator did not see how margins fit within the scope of this ASOP and believed the subject of margins is already adequately addressed in other ASOPs and therefore the discussion of margins in this standard might introduce confusion. Several commentators believed that the concept of a margin may not apply at all to certain types of models such as predictive or statistical models.
Response	The reviewers clarified the guidance with respect to margins.
Comment	The commentator found the example in section 3.4.7(d) regarding consistency unclear and found the guidance in section 3.4.7(a) confusing.
Response	The reviewers agree, removed the example regarding “consistency” from current section 3.1.6(d), and clarified the guidance in current section 3.1.6(a).
Section 3.5.1, Validation (now section 3.5.2, Model Validation)	
Comment	One commentator requested definitions of “operating environment” and “controls” be added to section 2.
Response	The reviewers believe defining these terms would not improve clarity and, therefore, made no change.
Comment	One commentator also indicated that the terms “model runs” and “projection results” used in section 3.5.1 do not apply to predictive models.
Response	The reviewers clarified the definition of “model run” in current section 2.9 and changed “model projection results” to “model output” in current section 3.5.2.
Comment	One commentator suggested that section 3.5.1(a)(3) seemed to address output and that it might be moved to section (b).
Response	The reviewers have restructured all of prior section 3.5 to improve clarity.

FOURTH EXPOSURE DRAFT—December 2018

Comment	One commentator suggested adding additional considerations as examples of items specific to predictive modeling, such as variable selection and how it relates to preventing overfitting of the model in section 3.5.1.
Response	The reviewers note that current section 3.1.4 incorporates part of this suggestion, and other sections such as 3.1.6 have been clarified in response to this comment.
Comment	One commentator indicated that it was not clear what is intended by guidance to reconcile inputs to “actual information,” especially because section 3.5.1(a)(3) refers to testing “against historical actual results.”
Response	The reviewers clarified the guidance in current section 3.5.
Comment	Several commentators questioned what was meant by the phrase “the residual risk that may remain after the model integrity efforts” and were unsure how to measure or evaluate it and how it differed from “evaluating the overall appropriateness for the intended purpose.”
Response	The reviewers agree and clarified the guidance in current section 3.5, including deleting reference to “residual risk.”
Comment	Several commentators suggested the term “peer review” is a very complex topic that can mean different things to actuaries working in different organizations and practice areas. The commentators recommended removing the phrase “peer review,” addressing it in ASOP No. 1, <i>Introductory Actuarial Standard of Practice</i> , or providing additional guidance on the subject. One commentator thought the examples were limited and recommended waiting for the completion of a separate project to address peer review.
Response	The reviewers removed the phrase “peer review” in this standard but retained discussion of review by another professional in current section 3.5.3.
Comment	One commentator indicated that section 3.5.1(a) appears to involve circular logic that should be addressed.
Response	The reviewers agree and clarified the guidance, including deleting reference to “residual risk” in current section 3.5.
Comment	One commentator requested a definition of “appropriate governance and controls” in section 3.5.2.
Response	The reviewers added a definition for “governance and controls” in current section 2.3.
Comment	One commentator suggested that nature and degree of validation discussed in the stem of section 3.5.1 should not be determined by the “complexity” of the model but rather by the importance of the model.
Response	The reviewers clarified the guidance to include a range of criteria for consideration in current section 3.5.
Comment	One commentator suggested that the degree of reconciliation, checking, and testing referred to in section 3.5.1(a) should also depend on the potential impact of model results.
Response	The reviewers clarified the guidance to include a range of criteria for consideration in current section 3.5.
Comment	One commentator suggested that overfitting is an important concept in many areas of modeling and is not discussed.
Response	The reviewers agree and added guidance on the subject in current section 3.1.4(d).
Comment	One commentator suggested re-organizing section 3.5.1 into two clearly labeled sections: static validation (which should be included and is not optional) and dynamic validation that addresses section 3.5.1(a)(3).
Response	The reviewers disagree but reorganized current section 3.5 to improve clarity.

FOURTH EXPOSURE DRAFT—December 2018

Comment	One commentator suggested that the intended purpose of the model is much more important than the complexity when considering how much validation is necessary. A complex model that affects few customers or has a small effect should not require complex validation.
Response	The reviewers disagree with the comment but clarified current section 3.5.
Comment	One commentator noted that there are instances where the past is not relevant to a validation (for example, disruption, shock sensitivities, etc.).
Response	The reviewers agree and modified current section 3.5.2.
Section 3.6, Presentation of Results (now deleted)	
The guidance in this section was modified, with some disclosures eliminated and the others moved to section 4.	
Comment	One commentator was concerned that the exception noted in section 3.6.4 for inputs or methodology specified by law may lead to practitioners curtailing necessary disclosures, and suggested adding the following sentence to the second paragraph of section 3.6.4: "... The actuary should refer to ASOP No. 41, section 4.2 for guidance."
Response	The reviewers modified the guidance and incorporated certain disclosures within section 4.
Comment	One commentator suggested that the proposed ASOP may require multiple layers of disclosure about various component models to the ultimate intended user, which may cause disclosures material to intended users to be lost in the noise of required but immaterial disclosures about the component models.
Response	The reviewers believe the guidance is clear and made no change in response to this comment.
Comment	One commentator believed that there were too many qualifiers in this section that weakened the guidance, and recommended removing the qualifiers in the stem of section 3.6, section 3.6.2, section 3.6.3 and 3.6.4. The commentator also recommended changing the words 'possible model limitations' to 'any model limitations' or simply 'model limitations', suggested providing more guidance regarding the meaning of the phrase "as applicable depending upon the type of model" in section 3.6.4, and questioned whether the actuary should address assumed conservatism in assumptions specified by law.
Response	The reviewers modified the guidance and incorporated certain disclosures within section 4.
Comment	One commentator suggested that the second sentence of section 3.6 was weak, perhaps because of the use of both "If appropriate" and "should consider." The commentator suggested that at a minimum, documentation should be in the form of an informal actuarial summary if not a formal actuarial report.
Response	The reviewers modified the guidance and incorporated certain disclosures within section 4. The reviewers note that current section 3.6 provides guidance on documentation.
Section 3.6.1, Explanation of Limitations of Models	
Comment	Two commentators suggested the reference at the end of this section should be changed from section 4.1 to section 4.2.2.
Response	The reviewers agree, modified the guidance, and incorporated certain sections into section 4.
Comment	Several commentators were concerned that "the extent to which a model fails to fulfill its intended purpose" might be read as more quantitative than intended, difficult to quantify or burdensome. One commentator believed that the intended meaning should either be taken as more qualitative, or at a minimum, clarified. Another commentator objected to the word "fails."
Response	The reviewers modified the guidance and incorporated certain disclosures within section 4.
Comment	One commentator pointed out inconsistencies in the use of "should" and "should consider" between guidance in section 3.6 and section 4.2 and suggested that the disclosure of other material limitations in section 3.6.1(b) should be referenced in section 4.2.2. The commentator also suggested that section 3.6.2 should use "should" and not "should consider," to describe the intended purpose.
Response	The reviewers modified the guidance and incorporated certain disclosures within section 4.

FOURTH EXPOSURE DRAFT—December 2018

Comment	One commentator questioned the distinction in the guidance for presentations and reports (section 3.6) and for documentation (section 3.8). The commentator noted that the lists in these sections are not consistent, as one section includes “data” and the other section excludes it. The commentator recommends combining these two sections into a single section that includes the items the actuary should document/explain, should consider documenting/explaining, or may consider documenting/explaining.
Response	The reviewers modified the guidance and incorporated certain disclosures within section 4.
Section 3.7, Reliance on Data or Other Information Supplied by Others (now section 3.2)	
Comment	One commentator indicated that the standard was not clear when an actuary is subject to the requirements in sections 3.2, 3.3 and 3.7 and questioned whether there was potential overlap or conflicting guidance between the situations covered by these sections. The commentator suggested moving section 3.7 to be adjacent to sections 3.2 and 3.3 to avoid confusion if these requirements are intended to apply in different circumstances.
Response	The reviewers agree and deleted prior section 3.3 to improve clarity.
Comment	One commentator suggested removing the first “other” in the second sentence to improve clarity.
Response	The reviewers removed the second and third sentences to improve clarity.
Section 3.8, Documentation (now section 3.6)	
Comment	One commentator indicated it wasn't clear whether the guidance in the first paragraph of this section required documentation in the actuarial communication/report (the likely intent) or in internal work papers. The commentator also indicated that it was not clear whether “subsequent users” are limited to “intended users,” and finally the commentator indicated that the guidance wasn't clear why a distinction was made between what must be documented in an actuarial communication as opposed to what must be documented in an actuarial report as defined in ASOP No. 41. The commentator requested that these items be clarified.
Response	The reviewers agree, modified the language to improve clarity, and removed the reference to “subsequent users.”
Comment	One commentator suggested the guidance in the second paragraph be strengthened by replacing “should consider” with “should” as these are all items the actuary should be documenting. The commentator suggested that since the guidance applies to all of section 3.6, it would be appropriate to replace ‘sections 3.6.1 and 3.6.2’ with ‘section 3.6.’ The commentator indicated that if no actuarial report is created, the actuary should consider documenting the items mentioned in section 3.6 and sections 3.6.1 and 3.6.2 of this standard, and the actuary may consider documenting other items mentioned in sections 3.1-3.7 that the actuary believes may be helpful to subsequent users.
Response	The reviewers modified the guidance to improve consistency between current section 3.6 and current section 4.
Comment	One commentator stated the language “... should follow the guidance of ASOP No. 41, including section 3.2 in ASOP No. 41” was redundant.
Response	The reviewers agree and made the change.
Comment	One commentator indicated that ASOP No. 41 appears to require completion of an actuarial report in all situations that are subject to the scope of this standard, so the current guidance in section 3.8 applicable to situations where no actuarial report is created appears to be in conflict with the guidance in ASOP No. 41.
Response	The reviewers agree and clarified language in current section 3.6.

FOURTH EXPOSURE DRAFT—December 2018

Section 3.9, Relation to Other ASOPs (moved to section 1.2, Scope)	
Comment	Several commentators noted that this section only refers to potential conflicts with ASOP Nos. 23, Data Quality, and 41, and requested that the proposed ASOP be changed to specifically state that, to the extent there is any conflict with ASOP Nos. 3, <i>Continuing Care Retirement Communities</i> ; 4; 6, <i>Measuring Retiree Group Benefits Obligations and Determining Retiree Group Benefits Program Periodic Costs or Actuarially Determined Contributions</i> ; 7, <i>Analysis of Life, Health, or Property/Casualty Insurer Cash Flows</i> ; 27; 35; and 44, <i>Selection and Use of Asset Valuation Methods for Pension Valuations</i> , then those ASOPs shall govern.
Response	The reviewers clarified the guidance regarding other ASOPs and moved this guidance to section 1.2.
Comment	One commentator requested that the proposed standard incorporate the concepts of assumptions (or methods) prescribed by law and assumptions (or methods) prescribed by another party utilized in ASOP 4.
Response	While the reviewers disagree with the suggestion of directly including the concept of “assumptions (or methods) prescribed by another party as used in ASOP No. 4” within this standard, the reviewers modified section 1.2 to include the following: “The guidance in this ASOP does not apply to actuaries when performing services with respect to individual pension benefit calculations, as described in section 1.2 of ASOP No. 4, <i>Measuring Pension Obligations and Determining Pension Plan Costs or Contributions</i> .” The reviewers made no additional changes in response to this comment.
SECTION 4. COMMUNICATIONS AND DISCLOSURES	
Comment	One commentator indicated they would like the standard to clarify that deviations for reasons of practicability and professional judgement purposes need not be disclosed.
Response	The reviewers disagree and made no change.
Section 4.2, Actuarial Report (now section 4.1, Required Disclosures in an Actuarial Report)	
Comment	One commentator suggested that all guidance pertaining to disclosure should also be mentioned in section 4.
Response	The reviewers agree and amended the list of disclosure items in section 4.
Section 4.2.1, Scope of Actuary’s Responsibility (now deleted)	
Comment	Two commentators indicated current wording suggests the need to identify all of the actuaries on the modeling team along with their associated responsibilities, and that is onerous and unnecessary.
Response	The reviewers removed the disclosure and note the requirements for identification of responsible actuaries in actuarial communications is provided in section 3.1.4 of ASOP No. 41.
Section 4.2.2, Failure to Meet Intended Purpose (now deleted)	
Comment	One commentator stated that section 4.2.2, which requires disclosure of a model’s intended purpose in certain circumstances, is redundant with ASOP No. 41, which requires the disclosure of the purpose of an engagement, and is therefore unnecessary.
Response	The reviewers disagree that stating the intended purpose of the model is unnecessary and added section 4.1(a) for clarification.