



February 28, 2015

Via email to comments@actuary.org

Actuarial Standards Board
1850 M Street, NW, Suite 300
Washington, DC 20036

RE: Exposure Draft of Proposed Actuarial Standard of Practice on Modeling

Thank you for the opportunity to provide comments on the proposed Actuarial Standard of Practice (ASOP), *Modeling*. The American Academy of Actuaries¹ Casualty Practice Council (CPC) has reviewed the document and offers the comments below. We begin with some general comments followed by commentary on the specific questions posed in the request for comments and concluding with specific section comments. We have also enclosed a markup of the proposed ASOP for your ease of reference. The suggestions and edits that follow represent the view of the majority of CPC members.

General Comments

Two common functions performed by property/casualty actuaries are developing rates and estimating unpaid claims liabilities. For both exercises, we often distinguish our approaches between “methods” and “models.”² For example, traditional actuarial approaches for estimating unpaid claims liabilities include such approaches as incurred and paid methods, the Bornhuetter-Ferguson method, and the Cape Cod method, whereas other approaches, such as stochastic loss reserving, rely on building statistical models. The proposed modeling ASOP makes no distinction between methods and models. Perhaps the distinction lies in the fact that a model would be expected to be executable, implying a computer program and simulation-type model. As written, the ASOP leaves open that it could apply to both methods and models. Clarifying the scope of this ASOP would be helpful.

¹ The American Academy of Actuaries is an 18,000+ member professional association whose mission is to serve the public and the U.S. actuarial profession. The Academy assists public policymakers on all levels by providing leadership, objective expertise, and actuarial advice on risk and financial security issues. The Academy also sets qualification, practice, and professionalism standards for actuaries in the United States.

² According to ASOP No. 43, *Property/Casualty Unpaid Claims Estimates*:

2.5 Method - A systematic procedure for estimating unpaid claims.

2.6 Model – A mathematical or empirical representation of a specified phenomenon.

Proposed ASOP, *Property/Casualty Ratemaking*

2.5 Method - A systematic procedure for developing, reviewing, or changing rates.

2.6 Model – A mathematical or empirical representation of a specified phenomenon.

Request for Comments

1. Section 3.1.1 – Determining materiality is subject to actuarial judgment. Once that determination is made, the ASOP is clear in providing guidance to the actuary. However, we do have suggested changes to eliminate the phrase “heavily relied upon” and shorten the section as follows (some of the language was borrowed from ASOP No. 38, *Using Models Outside the Actuary’s Area of Expertise (Property and Casualty)*, Section 3.1):

“The extent of the application of the guidance in this ASOP should be consistent with the intended use of the model and its materiality to the results of the actuarial analysis. In assessing materiality, the actuary should be guided by ASOP No. 1, *Introductory Actuarial Standard of Practice*, section 2.6.”

We also suggest deleting the second paragraph of Section 1.2 or, alternatively, replacing it with a simple reference to Section 3.1.1.

2. This section, Section 3.1.3, is clear and appropriate.
3. We believe the guidance in Section 3.3.1(a)(2) would be clearer if only the one term “intended purpose” is used.
4. As noted in our general comments section above, we believe additional clarification is needed as to when the ASOP applies. However, once that determination is made, the standard provides sufficient guidance.

Specific Section Comments

Another area of practice for Property/Casualty practitioners is economic capital modeling and risk evaluation models, both of which are addressed by ASOP No. 46, *Risk Evaluation in Enterprise Risk Management*. These types of models often have multiple components, each of which may also be a model. We suggest two edits to recognize the component aspect of modeling (which is also addressed in ASOP No. 38.)

Section 2.2 –add “output from other models” as an additional source of data.

Section 2.8 – add an additional sentence at the end of the section: “A model may contain model components (i.e., nested models) that are also models, e.g., stochastic loss reserve estimation within an economic capital model.”

We also recommend that, within Section 3.2, the word “reasonably” be added in the second sentence, such that it reads:

“An actuary who is reviewing or evaluating a **model** should confirm that the **model** reasonably meets the **intended purpose**.”

While Section 3.3.1.a clearly states that the validation steps are not intended to be exhaustive, we suggest adding a statement as a new Section 3.3.1.a.4 in regards to convergence testing, such as:

“where applicable, testing the model projection results for convergence, noting the sensitivity to the selection of the number of simulations.”

A correctly programmed and specified model can produce invalid results if insufficient simulations are run.

We suggest adding a documentation requirement in Section 3.6 or 3.1.2 when the actuary is relying on a vendor model such as:

“When the actuary relies on a vendor model, the actuary should document the model used, e.g., vendor and version.”

The CPC appreciates this opportunity to provide comments to the ASB. We hope these observations are helpful, and we welcome further discussion. If you have any questions about our comments, please contact Lauren Pachman, the Academy’s casualty policy analyst, at pachman@actuary.org or (202) 223-8196.

Sincerely,

Shawna Ackerman, MAAA, FCAS
Vice President, Casualty Practice Council
American Academy of Actuaries

Enclosure



SECOND EXPOSURE DRAFT •

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**Proposed Actuarial
Standard of
Practice**

Modeling

**Comment Deadline:
March 1, 2015**

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

**Approved for Exposure by the
Actuarial Standards Board
November 2014**

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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 a second exposure draft of a proposed ASOP titled *Modeling*. Please review this exposure draft and give the ASB the benefit of your comments and suggestions. Each written response and each response sent by e-mail to the address below will be acknowledged, and all responses will receive appropriate consideration by the drafting committee in preparing the final document for approval by 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 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.

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

Modeling (Second 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. Unsigned or anonymous comments will not be considered by the ASB nor posted to the website. The comments will not be edited, amended, or truncated in any way. Comments will be posted in the order that they are received. Comments will be removed when final action on a proposed standard is taken. The ASB website is a public website, and all comments will be available to the general public. The ASB disclaims any responsibility for the content of the comments, which are solely the responsibility of those who submit them.

Deadline for receipt of responses in the ASB office: **March 1, 2015**

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Background

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.

A new exposure draft titled *Modeling* was released in June 2013 and was the work of that general Modeling Task Force. At that time, the task force pointed out that much of the exposure draft was drawn from the work of the Life Committee's task force that produced the discussion draft *Modeling in Life Insurance and Annuities* and recognized its members—Dale S. Hagstrom, David A. Brentlinger, Timothy C. Cardinal, Julie H. Fried, Jack L. Gibson, Ronald J. Harasym, and John O. Nigh—for their work.

Actuaries generally agree that almost all actuarial work involves modeling of some type and, at the direction of the ASB, both the first and second exposure drafts of this proposed modeling ASOP apply to all practice areas and all forms of models. However, in light of this very broad scope, both the first and second exposure drafts recognize that situations occur where use of the results of the model does not have a material financial effect, or no intended user is relying upon the results heavily, and full application of the guidance in this ASOP may not be necessary or practical. In these cases, the second exposure draft clarifies the actuary's use of professional judgment to determine whether full application of the guidance included in the standard is warranted.

As the guidance in this proposed modeling ASOP and ASOP No. 38 currently titled *Catastrophe*

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Modeling (for All Practice Areas) is intended to be coordinated, the ASB will 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 but does reflect guidance that the ASB and General Committee believe works in concert with the guidance in the second exposure draft of this proposed modeling ASOP.

First Exposure Draft

In June 2013, the ASB approved a first exposure draft with a comment deadline of September 30, 2013. Forty-eight comment letters were received and considered in making changes that are reflected in this second exposure draft. For a summary of issues contained in these comment letters, please see appendix 2.

Changes made to the second exposure draft in response to the comment letters include clarifying the following:

1. the ASOP's guidance;
2. guidance regarding the applicability of the modeling guidance;
3. the responsibility of the actuary when the actuary is part of a team;
4. guidance when the actuary is reviewing the modeling work of others; and
5. documentation versus disclosure guidance.

Given the extensive clarifications, the ASB believes it would be appropriate to obtain additional feedback on the proposed Modeling ASOP through the issuance of this second exposure draft. The ASB thanks everyone who took the time to contribute comments and suggestions on the first exposure draft.

Key Issues

In redrafting the standard, the reviewers focused on the following key issues:

1. making the standard clearer that actuarial judgment is needed to determine the extent to which full application of the standard is warranted, or alternatively whether following some of the guidance may not be necessary or practical given the intended application of the model and the project's objective;
2. enhancing the guidance for situations where the actuary may be relying on other team members, or other colleagues or vendors, who may or may not be actuaries, with respect

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to the development or use of some parts or all of a model, or may be relying on others to confirm that the requirements of this standard have been followed;

3. enhancing the guidance that applies when a model has material limitations or otherwise may not fulfill its intended purpose; and
4. providing a more complete discussion about the reasons why adding margins to assumptions or parameters might be appropriate.

Request for Comments

The ASB would appreciate comments on all areas of this proposed standard and would like to draw the reader's attention in particular to the following questions:

1. Section 3.1.1 discusses situations when the actuary judges whether full guidance is or is not warranted. Is this section clear and appropriate? If not what changes would you suggest?
2. Section 3.1.3 discusses the actuary's responsibility when the actuary is part of a modeling team. Is this section clear and appropriate? If not what changes would you suggest?
3. Section 3.3.1(a)(2) describes the degree of checking as being dependent on a list of possible factors, and this list includes both the "intended application" and the "project objective," which apply in different stages of modeling, rather than just referring to the "intended purpose," which encompasses either. Is this separate mention of the two possible stages of purpose helpful? Would the guidance be clearer if only the term "intended purpose" was used?
4. Does the proposed standard provide sufficient guidance to actuaries working with models?

The ASB voted in November 2014 to approve for exposure this draft standard.

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Modeling Task Force

Dale S. Hagstrom, Chairperson	
Maryellen J. Coggins	Kenneth R. Kasner
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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.

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MODELING

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

- 1.1 Purpose—This actuarial standard of practice (ASOP) provides guidance to actuaries selecting, designing, building, modifying, developing, using, reviewing, or evaluating **models** when performing actuarial services.
- 1.2 Scope—This ASOP applies to actuaries selecting, designing, building, modifying, developing, using, reviewing, or evaluating **models** when performing actuarial services. Using a model includes using the results of a model. This ASOP applies to all forms of **models** in all practice areas.

~~Given the wide use of models in actuarial practice, there may be situations where the model results either are not heavily relied upon or do not have material financial effects. In such situations, some of the guidance described in this ASOP may not be necessary or practical, as discussed in section 3.1. For example, efforts related to tasks such as data validation and sensitivity testing for models used in less critical situations may not need to be as rigorous as stated in this ASOP because the guidance might not be necessary or practical for the intended application of the model or for the project objective.~~

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.

- 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 Assumptions—**Input** to a **model** that represent expectations or possibilities based on professional judgment, or that may be prescribed by law or by others.
- 2.2 Data—**Input** to a **model** that represent facts or information collected from sources such as records, experience, experiments, surveys, ~~or~~ observations, or output from other models.

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- 2.3 **Granularity**—The level of detail built into a **model**. **Models** with a higher degree of **granularity** may provide more **model** precision or flexibility but may also require greater effort and expense to design, maintain, assemble, and run.
- 2.4 **Implementation**—An executable form of a **model**.
- 2.5 **Input**—Information such as **data**, **assumptions**, or **parameters** used in a **model** to produce output.
- 2.6 **Intended Application**—The designer’s planned uses for the **model**.
- 2.7 **Intended Purpose**—The **intended application** or the **project objective** or both, depending on the actuary’s role at the time actuarial services are performed. The **intended application** applies if the actuary’s role includes designing, building, or developing the **model**, or if the actuary’s role includes modifying, reviewing or evaluating the **model** before being selected or used in a specific project. The **project objective** applies if the actuary’s role includes selecting or using the **model** in a specific project or if the actuary’s role includes modifying, reviewing or evaluating the **model** when it is being selected or used in a specific project.
- 2.8 **Model**—A representation of relationships among variables, entities, or events using statistical, financial, economic, mathematical, or scientific concepts and equations. **Models** are used to help explain a system, to study the effects of different components, and to derive estimates and guide decisions. A **model** consists of: (1) a **specification**, (2) an **implementation**, and (3) one or more **model runs**. A model may contain model components (i.e., nested models) that are also models, e.g., stochastic loss reserve estimation within an economic capital model.
- 2.9 **Modeling**—Selecting, designing, building, modifying, developing, using, reviewing, or evaluating **models**.
- 2.10 **Model Risk**—The risk of adverse consequences from decisions made as a result of a **model** that does not adequately represent that which is being modeled.
- 2.11 **Model Run**—The output of a **model** derived from a given set of **input**.
- 2.12 **Parameters**—Mathematical, financial, economic, scientific, or statistical **input** to **models** that, when varied, result in different **model** output. Examples include expected values and coefficients of variables in mathematical distributions or regression formulas.
- 2.13 **Principal**—A client or employer of the actuary.
- 2.14 **Project Objective**—The specific goal or question the actuary is addressing when selecting or using a **model** to meet the needs of the **principal** or the actuary.
- 2.15 **Specification**—A description of a **model** that identifies the **inputs** and their interactions

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with each other to produce output through logic, algorithms, or a set of mathematical formulas.

Section 3. Analysis of Issues and Recommended Practices

- 3.1 **Application of ASOP Guidance**—The guidance in this ASOP applies to actuarial practice regarding **models** in all practice areas, subject to the following.

- 3.1.1 **Applicability of Guidance**—~~Full~~ **The extent of the application of the guidance in this ASOP should be consistent with the intended use of the model and its materiality to the results of the actuarial analysis. application of the guidance in this ASOP is appropriate when, in the actuary's professional judgment, intended users of the model rely heavily on the results and the use of the results of the model has a material financial effect. For example, corporate financial planning, ratemaking, and reserving models would typically require full application of the guidance.** In assessing materiality, the actuary should be guided by ASOP No. 1, *Introductory Actuarial Standard of Practice*, section 2.6.

~~In modeling situations where the results are either not heavily relied upon or do not have material financial effect, full application of the guidance in this ASOP may not be necessary or practical. For example, efforts related to tasks such as data validation or sensitivity testing may not need to be as rigorous as stated in this ASOP.~~

~~In deciding the extent to which the guidance in this ASOP applies, the actuary should use professional judgment, considering the extent of reliance by the intended user and the materiality of the financial effect. This consideration should be made within the context of the use of the model results and the requirements of the principal, based on facts reasonably known by the actuary at the time the actuarial services are performed.~~

~~If, in the actuary's professional judgment, circumstances are such that applying some or all of the guidance in this ASOP is not warranted for the specific intended purpose as described above, this is not considered a deviation. The actuary should be able to identify these circumstances, if asked.~~

~~If, in the actuary's professional judgment, circumstances are such that applying some or all of the guidance in this ASOP is warranted but such guidance is not followed, this is considered a deviation. For example, even if following warranted guidance is not practical, failure to follow such guidance is considered a deviation.~~

~~In instances where a deviation from guidance is material, the actuary should disclose that deviation from guidance as addressed in section 4.2.~~

- 3.1.2 **Models Developed by Others**—If the actuary uses a **model** designed or built by

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someone else, such as a vendor or colleague, there may be limited ability to understand the underlying workings of the **model**. However, the actuary should make a reasonable attempt, given the **project objective**, to have a basic understanding of the model including the following:

- a. the **intended application** of 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**.
- 3.1.3 Role of the Actuary on a Modeling Team—When the actuary is part of a **modeling** team, the actuary should confirm or may reasonably rely on others who have confirmed that the applicable guidance from this ASOP has been followed.
- 3.2 Model Meeting the Intended Purpose—The actuary should select, design, build, modify, develop, or use a **model** that meets the **intended purpose**. An actuary who is reviewing or evaluating a **model** should confirm that the **model** reasonably meets the **intended purpose**.
- 3.2.1 Designing, Building, Developing, Reviewing, or Evaluating the Model for the Intended Application—The actuary should confirm that the capability of the **model** is consistent with the **intended application** when the actuary designs, builds, develops, reviews or evaluates the **model**. In this confirmation, examples of items that the actuary should consider, if applicable, include but are not limited to the **granularity of inputs**, the relationships recognized, and the **model**'s ability to identify possible volatility around expected values.
- 3.2.2 Selecting, Reviewing, Evaluating, or Using the Model for the Project Objective—The actuary should select or use the **model** to meet the **project objective**, or review or evaluate the model and its use within this context. In the actuary's use of the **model**, efforts to improve the **model inputs** and formulas, documentation, controls, validation, and presentation of results should be consistent with the **project objective**.
- 3.2.3 Modifying the Model—When modifying a **model** to change the **intended application** or to improve the **model**'s ability to meet its **intended application**, the actuary should be guided by section 3.2.1. When modifying a **model** to improve the **model inputs**, formulas, and outputs to meet the **project objective**, the actuary should be guided by section 3.2.2.
- 3.2.4 Understanding the Model—The actuary's responsibilities may include expressing an opinion, using or communicating results, or preparing documentation based on or in relation to a **model**. In these instances, the actuary should understand:

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- a. important aspects of the **model** being used, including but not limited to, basic operations, important relationships, major sensitivities, strengths and potential weaknesses; and
 - b. whether, and the extent to which, the **model** can fulfill its **intended purpose**, given limited information, time constraints, and other practical considerations.
- 3.2.5 **Model Structure**—The actuary should evaluate whether the structure of the **model** is appropriate for the **intended purpose**. Where applicable and where appropriate for the **model's intended purpose**, the actuary's considerations should include the following:
- a. which provisions and risks specific to a business segment, contract, or plan are material and appropriate to reflect in the **model**;
 - b. whether grouping **model inputs** will produce reasonable results;
 - c. whether the use of the **model** requires a particular level of **granularity**;
 - d. whether deterministic or stochastic results, or both, are needed; and
 - e. whether the projection of future results might be materially influenced by the existence of choices and options available to the entity that is being modeled in whole or in part, its members, or its counterparties.
- 3.2.6 **Inputs to the Model**—The actuary should refer to ASOP No. 23, *Data Quality*, when selecting, reviewing, or evaluating **data** to be used in the **model**, either directly or as the basis for deriving **assumptions** and **parameters**.
- 3.2.7 **Assumptions and Parameters**—The actuary should use **assumptions** and **parameters** that are appropriate in light of the **model's intended purpose**.
- a. **Experience Reflected in Setting Assumptions and Parameters**—When setting **assumptions** and **parameters**, the actuary should consider using the following:
 1. **assumptions** and **parameters** based on actual experience, 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; and

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3. professional judgment to modify other available sources of information.
 - b. Margins—The actuary should determine whether adjusting the **assumption** or **parameter** to include a margin having a material effect would be appropriate. A margin might be included for reasons such as a) experience **data** that are not fully credible, b) conservatism, c) an adjustment for the cost of bearing risk, or d) future unpredictability.
 - c. Range of Assumptions and Parameters—The actuary should consider whether the range of **assumptions** and **parameters** used and the number of **model runs** analyzed reflect a range of conditions consistent with the **intended purpose**.
 - d. Consistency—The actuary should use **assumptions** and **parameters** for the **model** that are consistent with one another. For example, where appropriate, the actuary should use **assumptions** consistent with the underlying economic scenario(s) assumed in the **model**.

If material inconsistency among **assumptions** and **parameters** used by the actuary exists, whether (i) required by legal constraints or by the **principal**, (ii) the result of intentional redundancy such as added conservatism, or (iii) for any other reason, the actuary should disclose the inconsistency and the reasons for it in accordance with section 4.1.2. However, in the case of assumptions prescribed by applicable law (statutes, regulation, or other legally binding authority), the actuary's disclosure may be limited to identifying the possibility of an inconsistency with other assumptions.
 - 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 offer frequent opportunities to compare **assumptions** and **parameters** to emerging experience in the aggregate.
- 3.3 Mitigation of Model Risk—The actuary should examine the potential for **model risk** and undertake reasonable and appropriate steps to mitigate such risk, using validation, governance, and controls, as appropriate to the **intended purpose**.
- 3.3.1 Validation—The nature and degree of validation (including checking and analysis) selected by the actuary should be consistent with the complexity of the **model** and the **intended purpose**.
- a. Model Integrity—For each **model run** (or set of **model runs**) that is to be

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relied upon by the intended user, the actuary should validate that the **model** properly represents that which is being modeled. Validation of the **model** could include, but is not limited to, the following:

1. a reconciliation of relevant **model input** values to actual **data**, addressing and documenting the differences appearing in the reconciliation, if material;
 2. checking formulas, logic, and table references. The degree of checking that is appropriate will depend on the **intended application purpose; the project objective for which the model is being used; the context and nature of the model; the operating environment and controls; and whether there have been any changes to the model or the model environment; and**
 3. where applicable, testing the **model** projection results against historical actual results to verify that modeled results bear a reasonable relationship to actual results over a given time period; **and,**
 - 3-4. **where applicable, testing the model projection results for convergence, noting the sensitivity to the selection of the number of simulations.**
- b. **Analyzing the Output**—The actuary should take appropriate steps to evaluate whether the **model** results are reasonable. Depending on the **project objective**, the actuary should consider the following:
1. performing analytical tests on **model** results to assess their reasonableness;
 2. reconciling the results of a **model run** to prior **model runs**, given any changes in **assumptions** and **parameters**, **data**, formulas, or other aspects of the **model** since the prior **model run**. If such reconciliation is developed and appropriate to the **project objective**, the actuary should consider retaining the reconciliation;
 3. running tests of variations on key **assumptions** and **parameters** to test that the **model** has been used correctly and that changes in the results are consistent with the changes in those **assumptions** and **parameters**; and
 4. comparing **model** results to those of alternative **model(s)**.
- c. **Peer Review**—The actuary should consider obtaining a peer review, where practical and appropriate, depending on the **intended purpose** and the actuary's role. Such peer review, if obtained, may include items such as

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review of the reasonableness of the **input** to the **model**, the **model** construction, and the **model** results.

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- 3.3.2 **Appropriate Governance and Controls**—The actuary should use or, if appropriate, rely on others to use appropriate governance and controls to minimize **model risk**, to maintain the integrity of the **model**, and to avoid the introduction or use of unintentional or untested changes.
- 3.4 **Presentation of Results**—When the actuary presents results of the **model**, the actuary should explain methodology, key **assumptions** and **parameters**, possible limitations, and any material changes in any of these that were made since the most recent comparable **model** results were communicated.
- 3.4.1 **Explanation of Limitations of Models**—In actuarial reports that include information derived from **models**, the actuary should include explanations of the following, if applicable:
- a. the extent to which a **model** fails to fulfill its **intended purpose**, due to limited information, time constraints, or other practical considerations; and
 - b. any other material limitations of the **models** that have been used and the implications of those limitations.
- If there is anything to explain pursuant to (a) or (b), then the actuary should refer to section 4.1.
- 3.4.2 **Discussion of Models**—In actuarial reports that include information derived from **models**, the actuary should consider including explanations of the following:
- a. the **intended purpose** of the **models** and how the users' needs are addressed by those **models**; and
 - b. any uncertainty in **model** results.
- 3.4.3 **Reconciliation**—The actuary should consider including in the actuarial report a reconciliation to comparable items in a prior actuarial report. Such reconciliation, if any and where reasonably possible, should include an explanation of **assumptions** and **parameters** or methods that have changed materially from that prior actuarial report.
- 3.4.4 **Description of Conservatism or Optimism**—The actuary should consider including a description of the conservatism or optimism inherent in the **model inputs** and methodology selected in relation to anticipated future experience. Terminology may include language such as “conservative,” “most likely,” “reflecting asymmetric outcomes,” or “optimistic,” along with a description of the relationship to the anticipated future experience by appropriate quantitative, qualitative, or directional language.

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If applicable law (statutes, regulations, and other legally binding authority) specifies the **model inputs** or methodology, then this section 3.4.4 does not apply.

- 3.5 **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 Nos. 23 and 41 for guidance. When relying on projections or supporting analysis supplied by others, the actuary should refer to ASOP No. 23, deeming such projections or supporting analysis as **data** covered by that standard. Similarly, the actuary should refer to ASOP No. 41 with respect to the disclosure of responsibility for **data, assumptions, parameters, and methods**.

- 3.6 **Documentation**—For **model** results used in actuarial communications, the actuary should document the nature of the **data** used, and material **assumptions** and **parameters** used in the **model** and should follow the guidance of ASOP No. 41, including its section 3.2 in the case of an actuarial report. When the actuary relies on a vendor model, the actuary should document the model used, e.g., vendor and version.

The actuary should consider documenting the items mentioned in sections 3.4.1 and 3.4.2 of this standard, even if no actuarial report is created.

- 3.7 **Relation to Other ASOPs**—Other ASOPs provide specific **modeling** requirements, including guidance on selecting **assumptions, parameters, and data** (see ASOP No. 23) and providing disclosures (see ASOP No. 41). The actuary selecting, designing, building, modifying, developing, reviewing, evaluating, or using **models** should satisfy not only the requirements of this ASOP, but also any specific **modeling** requirements from an applicable ASOP. If such specific **modeling** guidance from an applicable ASOP is inconsistent with the guidance of this ASOP, the guidance of such other ASOP governs.

Section 4. Communications and Disclosures

- 4.1 **Actuarial Communications**—In any actuarial communication that uses the results of work subject to this ASOP, the actuary should disclose the following, as applicable:

- 4.1.1 **Failure to Meet Intended Purpose**—Any reasons that prevent the **model** from meeting its **intended purpose**, as discussed in sections 3.2.4 and 3.4.1. In this situation, the actuary should disclose the intended purpose of the model.
- 4.1.2 **Inconsistent Assumptions and Parameters**—Any material inconsistencies among **assumptions** and **parameters** and the reasons for such inconsistencies, as discussed in section 3.2.7(d).

- 4.2 **Deviation from Guidance in the Standard**—In any actuarial communication that uses the results of work subject to this ASOP, the actuary should refer to ASOP No. 41 and should include the following where applicable:

- a. the disclosure in ASOP No. 41, section 4.2, if any material **assumption**,

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parameter, or method was prescribed by applicable law (statutes, regulations, and other legally binding authority);

- 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.

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Appendix 1

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

Current Practices

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 often entering financial statements directly.

Actuaries often develop and use models when analyzing uncertain outcomes. In these instances, 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.

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 inputs, model code and calculations, and model outputs);
- confirmation that model results are reproducible upon rerun (if the model allows for such reproducibility);
- implementing a model change management process;
- specification, documentation, and programming standards for the implementation;
- procedures for secure back-up of the media storing the implementation and data;
- appropriate staff training or cross-training for continuity of use;
- 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.

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Appendix 2

Comments and Exposure Draft Responses

The first exposure draft of this proposed ASOP, *Modeling*, was issued in June 2013 with a comment deadline of September 30, 2013. Forty-eight comment letters were received, some of which were submitted on behalf of multiple commentators, such as by firms or committees. Some commentators submitted multiple letters. For purposes of this appendix, the term “commentator” may refer to more than one person associated with a particular comment letter. The Modeling Task Force carefully considered all comments received, reviewed the exposure draft, and proposed changes. The General Committee and the ASB reviewed the proposed changes and made modifications where appropriate.

Summarized below are the significant issues and questions contained in the comment letters and responses.

The term “reviewers” in appendix 2 includes the Modeling Task Force, the General Committee, and the ASB. Also, unless otherwise noted, the section numbers and titles used in appendix 2 refer to those in the first exposure draft.

TRANSMITTAL MEMORANDUM QUESTIONS	
Question 1: Does the proposed standard provide sufficient guidance to actuaries working with models?	
Comment	Some commentators felt that there was good guidance; some commentators felt there was insufficient guidance; and some commentators felt there was too much guidance (and would prefer there be no standard from the ASB). Some preferred that the information in the draft standard be put in the form of a practice note rather than a standard.
Response	The reviewers believe a standard on modeling is important because modeling is so widely performed in all actuarial practice areas. The reviewers have clarified the guidance in light of the comments summarized throughout this appendix. Given the wide range of models and situations using models, the reviewers believe the level of guidance as reflected in this ASOP is appropriate.
Comment	One commentator wanted the standard to state explicitly that a model is only an approximation of reality, not the reality itself. The concern is that a model is always in some sense “untrue” or “incorrect,” and discussing models as though they were or could be exact representations of reality is misleading. An “exact model” is actually just a calculation or determination that does not involve modeling at all.
Response	The reviewers agree and have included this concept in appendix 1. The reviewers believe that nothing in the definitions and guidance implies that models represent perfect representations of reality.
Comment	Some commentators proposed that any guidance already present in any other standard, and any guidance that could be used also for non-modeling work, be deleted from this standard.
Response	The reviewers believe that, since this standard applies to all actuarial work involving models, unlike existing standards that generally apply to specific applications of models, no change was made.

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Comment	Many commentators answered this question by suggesting changes to particular items, which are summarized in the relevant sections below.
Response	The responses of the reviewers depend on the specific comment, as listed below.
Question 2: Is the proposed standard sufficiently flexible to allow for new developments?	
Comment	Some commentators felt there was sufficient flexibility; some commentators felt there was insufficient flexibility; and some commentators felt there was too much flexibility.
Response	The reviewers believe there is sufficient flexibility at this time and made no change.
Question 3: The draft ASOP starts with a wide scope, but allows the actuary to use professional judgment to identify those instances (such as those involving minimal reliance by the user, or resulting in a non-material financial effect) where some guidance described in this ASOP is not appropriate or practical. Is this clear and appropriate?	
Comment	Some commentators felt this was clear and appropriate; some commentators found it unclear; some commentators felt the scope was still too wide; and some commentators accepted the wide scope and felt it was inappropriate to allow the actuary to make a judgment that some guidance is not appropriate or practical.
Response	In light of the questions and comments received, the reviewers reconsidered the scope issue and reaffirmed the approach in the standard (i.e. with application using professional judgment) as the best way to provide appropriate guidance in this wide area of practice.
Comment	Some commentators believe that the exposure draft's definitions and examples tended to make more sense for projection models than for predictive models, which are more akin to experience (or interrelationship) studies, while other types of models vary in other ways.
Response	The reviewers have clarified definitions and examples so that they are broadly applicable.
Comment	One commentator felt work covered by ASOP No. 4 should be excluded from the scope of this standard.
Response	The reviewers believe that this standard should apply to all practice areas and made no change.
Question 4: In those instances where some guidance described in this ASOP is not appropriate or practical and the deviations from guidance are “not material,” the actuary does not need to disclose these deviations. Is this clear and appropriate?	
Comment	Some commentators felt this was not only clear but also appropriate; some commentators found it unclear; some commentators felt the disclosures were too burdensome; and some commentators felt it was inappropriate to allow the actuary to make a judgment that some disclosure of immaterial deviations is not needed.
Response	The reviewers believe the guidance is appropriate and reflects the wide range of models in scope. (See related comments and responses below in section 1.2, Scope.)
Question 5: Appropriate documentation simplifies later use and development of current models as well as allowing easier review by principals and other actuaries. Section 3 contains guidance with regard to documentation. Is this guidance clear and appropriate?	
Comment	Some commentators felt this was not only clear but also appropriate; some commentators found it unclear; some commentators felt the documentation was too burdensome; some commentators suggested changes in placement of the guidance.
Response	As described in the sections below on documentation, this guidance was clarified. The reviewers narrowed the situations in which documentation is required.

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Question 6: Does the use of bold font to identify defined terms improve the readability and clarity of the standard? If not, what suggestions do you have to improve the recognition of defined terms in the standard?	
Comment	Some commentators supported the bolding of defined terms while others did not. Other commentators suggested including italics, capitalizing, quotation marks, and hyperlinks.
Response	The reviewers note the style of bolding defined terms is in accordance with current ASOP format and made no change.
SECTION 1. PURPOSE, SCOPE, CROSS REFERENCES, AND EFFECTIVE DATE	
Section 1.1, Purpose	
Comment	Several commentators suggested replacing “professional services” with “actuarial services” to be more consistent with ASOP No. 1, <i>Introductory Actuarial Standard of Practice</i> .
Response	The reviewers agree and made the change.
Comment	One commentator suggested that the application of the standard should be limited to actuarial models.
Response	The reviewers disagree since many actuaries perform actuarial services with respect to models that are not traditionally considered actuarial. Therefore, no change was made.
Section 1.2, Scope	
Comment	One commentator suggested adding “reviewing” to the list of stated activities. Another commentator suggested adding “evaluating” to provide guidance to actuaries who are responsible for evaluating, but not otherwise using, models.
Response	The reviewers agree and added both “reviewing” and “evaluating.”
Comment	One commentator suggested changes to the third paragraph to improve clarity.
Response	The reviewers disagree that the suggestions would improve clarity and, therefore, made no change.
Comment	Two commentators suggested that the complexity of a model should be added to “reliance by the user” and “financial effect” as an additional consideration for determining whether services with respect to a model are in scope.
Response	The reviewers considered this recommendation but believe that complexity in itself does not automatically make a model any more nor any less in scope. Actual applicability of the guidance is based on professional judgment, which can take into consideration whether and how the complexity of the model may relate to such applicability. Therefore, no change was made.
Comment	One commentator stated that it is unclear why the standard would be needed in the case of straight-forward calculations—even if they were relied upon and had a material financial effect—and recommended that the scope of the standard be scaled back.
Response	The reviewers spent a considerable amount of time discussing the scope of the standard and, after considering all suggestions, clarified the guidance where appropriate but made no change to limit the scope of the standard.
Comment	One commentator suggested that the language stating “where some guidance described in this ASOP is not appropriate or practical,” is unnecessary since the choice to apply the guidance is covered by the “deviation” language included in this and other ASOPs.
Response	The reviewers disagree and note that the aspects covered by deviation are not identical to the aspects covered by the judgment that certain guidance is not warranted and therefore not applicable (see section 3.1).

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Section 1.3, Cross References	
Comment	One commentator suggested modifications to the last sentence in this section to improve clarity.
Response	The language in this section is used consistently in ASOPs, and the reviewers disagree that the suggestion would enhance clarity. Therefore, no change was made.
Section 1.4, Effective Date	
Comment	Several commentators suggested that an effective date four months after adoption by the ASB may be too short a time period given the timelines of certain modeling projects that may be underway at the time of approval. One commentator suggested six months after approval, and another suggested twelve months.
Response	The reviewers have selected a transition period of nine months after adoption by the ASB.
SECTION 2. DEFINITIONS	
Comment	One commentator felt that the definitions of input, parameter, assumptions, and data appear to be circular.
Response	The reviewers eliminated certain examples that did not improve clarity and believe the revised definitions are appropriate for the use of the terms in this ASOP, and made no further changes.
Comment	Two commentators identified a selection of terms used in this ASOP that would benefit from explicit definitions.
Response	The reviewers considered each term and determined that the terms were generally understood and, therefore, made no change.
Comment	Two commentators suggested removing the terms “specification,” “implementation,” and “realization,” since these were not commonly used terms.
Response	The reviewers removed references to “realization” to improve clarity. However, the reviewers left in the terms “specification” and “implementation” since these are common modeling processes, but modified the definitions to improve clarity.
Section 2.1, Assumptions	
Comment	Two commentators suggested adding that assumptions may be prescribed.
Response	The reviewers agree and modified the definition.
Comment	Several commentators suggested that assumptions may not be inputs to a model.
Response	The reviewers believe the revised definition is appropriate for the use of the term in this ASOP and made no change.
Comment	One commentator suggested that assumptions are also based on experience.
Response	The reviewers believe the revised definition considers experience as the basis for “expectations” and made no change.
Comment	One commentator suggested that assumptions should not be limited to those based upon “professional judgment” and another commentator thought that the definition should be on “data and professional judgment.”
Response	The reviewers believe the reference to “professional judgment” is appropriate whether the assumptions are based strictly upon data or are more broadly determined and, therefore, made no change.

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Section 2.2, Data	
Comment	One commentator suggested that the meaning of the term “experience” is not commonly understood, and that the examples provided should also include experiments and surveys.
Response	The reviewers agree and modified the definition to clarify that the data sources noted are examples. The definition was further clarified by adding “experiments” and “surveys” to the language.
Section 2.3, Granularity	
Comment	Several commentators suggested that models with greater granularity may result in less credible results.
Response	The reviewers agree that greater granularity will not always improve results and note that “may” was included in the definition for this reason.
Comment	Several commentators felt that the definition of granularity was not clear, particularly the use of the term “cell.”
Response	The reviewers agree and simplified the definition, including eliminating references to the term “cell.”
Section 2.4, Implementation	
Comment	One commentator felt that the examples were of models, not of implementations.
Response	The reviewers agree and removed the examples.
Comment	Several commentators suggested that a model is not implemented until it is in use for its intended purpose.
Response	The reviewers disagree and made no change.
Section 2.5, Input	
Comment	Two commentators suggested that the definition of input should be modified to reflect “information fed into a model to get output.”
Response	The reviewers agree and modified the definition.
Comment	Two commentators suggested that the definition of input should not include assumptions as they “generally refer to the structure of the model.”
Response	The reviewers believe the revised definition is appropriate for the use of the term in this ASOP and made no change.
Comment	One commentator suggested modifying the definition to reflect an “including but not limited to” descriptor before “assumptions, data, or parameters” given that this list may not include all information included within a model (for example, a random number generator.)
Response	The reviewers agree and modified the definition to include “information such as” before “data, assumptions, or parameters.”
Comment	One commentator suggested that certain models produce parameters as output.
Response	The reviewers agree but believe this fact does not affect the meaning of the definition and, therefore, made no change.
Section 2.7, Intended Purpose	
Comment	Two commentators suggested adding the role of “reviewing” to the list of actuarial roles.
Response	The reviewers agree and made changes to better recognize the roles of modifying, reviewing and evaluating.

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Section 2.8, Margin	
Comment	Several commentators suggested adding conservatism as an additional reason for introducing a margin beyond compensating for a lack of credibility.
Response	Based on other comments received, the reviewers removed the definition. The reviewers agree with this specific comment and added the word “conservatism” to new section 3.2.7(b).
Comment	Several commentators suggested that the definition include reference to the cost of bearing risk.
Response	The reviewers removed the definition of margin but included the phrase “an adjustment for the cost of bearing risk” in new section 3.2.7(b).
Comment	Two commentators suggested that margins are added to assumptions and not to data as potentially implied by the definition.
Response	The reviewers removed the definition of margin and clarified the discussion of margin in new section 3.2.7(b).
Section 2.9, Model	
Comment	Two commentators suggested that “scientific” be added to the set of concepts and equations listed.
Response	The reviewers agree and made the change.
Comment	One commentator suggested that implementations are not always achieved solely through mathematical formulas, but may be achieved through logic and algorithms.
Response	The reviewers agree in part and made changes to include “logic and algorithms” in the definition of “specification.”
Comment	Several commentators suggested that the definition of a model is too broad. One of the commentators suggested that it should be narrowed to focus on business models.
Response	The reviewers believe the revised definition is appropriate for the use of the term in this ASOP and made no change.
Section 2.10, Modeling	
Comment	Three commentators suggested adding “reviewing” to the list of actuarial roles when modeling.
Response	The reviewers agree and made the change, and also added “evaluating.”
Comment	One reviewer suggested removing “using” from the list of roles.
Response	The reviewers disagree given the use of the term in the ASOP and made no change.
Section 2.11, Model Risk	
Comment	Two reviewers suggested replacing the words “a flawed model, inappropriate inputs, or misapplication of the model” with the language “the model not reasonably representing the situation (reality) under study.” Several other commentators did not think the examples provided covered all sources of model risk and felt that the definition was too narrow.
Response	The reviewers agree that the examples did not improve clarity nor did they cover all sources of model risk and, therefore, modified the definition to be similar to the suggested language.
Comment	One commentator offered that this definition was inconsistent with the definition of “model risk” within ASOP No. 43, <i>Property/Casualty Unpaid Claim Estimates</i> , which separately defines “process risk,” “parameter risk,” and “model risk.” Another commentator felt that the three separate definitions would be useful.
Response	The reviewers disagree given the use of the term in this ASOP and made no change.

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Section 2.12, Neutral	
Comment	Many reviewers were uncomfortable with the definition or thought it unnecessary.
Response	The reviewers agree and eliminated the definition and its use in section 3.4.3.
Section 2.13, Organization	
Comment	One commentator thought a definition of organization was unnecessary.
Response	The reviewers agree and removed the definition.
Comment	One commentator thought it was not common usage to refer to a benefit plan as an entity.
Response	The reviewers agree and removed the definition.
Section 2.14, Parameter	
Comment	One commentator suggested adding the term “scientific” to the list of types of model input included within the definition.
Response	The reviewers agree and made the change.
Comment	Several commentators suggested that referring to a parameter as an input may be confusing.
Response	The reviewers removed the last sentence in the definition since it did not appear to improve clarity. The reviewers believe the revised definition is appropriate for the use of the term in this ASOP and made no further change.
Section 2.15, Principal	
Comment	One commentator noted that because the definition was consistent with the definition in the <i>Code of Professional Conduct</i> (Code), that a reference to the Code would be sufficient.
Response	The reviewers believe that including the definition within the ASOP is useful to the user and, therefore, made no change.
Section 2.16, Project’s Objective	
Comment	One commentator noted that there may be more than one objective of a model.
Response	The reviewers agree that there may be more than one objective of a model. However, the reviewers believe that the definition is appropriate for the use of the term in this ASOP and, therefore, made no change.
Section 2.17, Realization	
Comment	Many reviewers were uncomfortable with the definition as written.
Response	The reviewers agree and eliminated the definition and its use in this ASOP, replacing it with “model run.”
Section 2.18, Reproducible	
Comment	One commentator thought the definition could be eliminated since the term was only used once in the guidance and could be removed.
Response	The reviewers agree, and removed the term and the reference to it.
Section 2.19, Specification	
Comment	One commentator noted that the definition was inconsistent with how the term was used in the definition of a model.
Response	The reviewers agree and removed the inconsistent language.

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Comment	One commentator thought the definition was too broad.
Response	The reviewers removed certain inconsistent language and believe that the resulting definition is appropriate for the use of the term in this ASOP, and made no further change.
SECTION 3. ANALYSIS OF ISSUES AND RECOMMENDED PRACTICES	
Comment	One commentator suggested that the exposure draft be modified so that it emphasizes the importance of the actuary's knowledge and understanding of the principal's situation at the time the actuary is constructing, validating, documenting, and analyzing the output of the model.
Response	The reviewers agree and have clarified the guidance in section 3.1.1 to address this concern.
Comment	One commentator expressed concern that the actuarial work covered by this standard may be compromised by limited time or budget. The commentator was concerned that this might be inconsistent with Precept 1 of the Code.
Response	The reviewers believe that the guidance in the standard is consistent with Precept 1. However, some revisions were made to the standard to improve clarity.
Section 3.1, Application of ASOP Guidance	
Comment	Two commentators indicated that this sentence was confusing as it was in potential conflict with the wording in section 3.1.1.
Response	The reviewers made changes to this section to improve clarity.
Comment	One commentator indicated the application of the guidance belongs in the scope section of the standard, as it addresses scope and does not provide guidance.
Response	The reviewers believe this section provides guidance by calling for professional judgment by the actuary when applying this standard.
Comment	Two commentators suggested that guidance in this ASOP be limited to actuarial models.
Response	The reviewers intend the broader application and made no change.
Section 3.1.1, Model Reliance and Financial Importance	
Comment	One commentator disagreed with the guidance provided in the last sentence of the second paragraph and felt that the resources committed should be consistent with the project objective, which should be influenced by, but not solely determined by, the degree of reliance and financial importance of decisions.
Response	The reviewers believe that determination of resources is a matter of professional judgment and have deleted the last sentence of the second paragraph.
Comment	One commentator indicated that full application of the guidance should apply in situations that do not have material financial effect.
Response	The reviewers disagree and made no change.
Comment	Two commentators indicated that "material financial effect" was not clear. One of these commentators suggested alternative wording to provide more clarity and the other questioned the party to whom the phrase applied.
Response	The reviewers agree and clarified the language.

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Comment	One commentator suggested adding an example where full application of guidance was appropriate.
Response	The reviewers agree and added examples.
Comment	One commentator asked how the guidance in this section should be applied if the actuary who uses a model that is not reliable leaves his or her employer before documenting that fact.
Response	The reviewers note that the answer to this question depends on the facts and circumstances and, therefore, made no change.
Section 3.1.2, Models Developed by Others	
Comment	One commentator suggested adding “or possible” to the end of the first sentence. Another commentator liked the section but indicated that the addition of “or possible” would be an improvement.
Response	The reviewers clarified the guidance, including deleting the phrase “and, therefore, full application of the guidance in this ASOP may not be necessary.”
Comment	Some commentators objected to a perceived lower standard of practice for an actuary who may lack understanding of the underlying workings of the model, creating a possible double standard.
Response	The reviewers believe that different guidance is warranted for actuaries using models developed by others.
Comment	Two commentators questioned why the actuary had to comply with sections 3.1.2 and 3.1.3 in all situations where the model being used by the actuary was developed or validated by someone else within the same firm.
Response	The reviewers agree with the commentator’s concern and added new section 3.1.3 to address such a situation.
Comment	One commentator indicated that the last sentence and the three items listed are not clear.
Response	The reviewers made clarifying changes to the language.
Comment	One commentator suggested replacing in section 3.1.2(a) “the basic workings of the model” with “the intended application of the model.”
Response	The reviewers made clarifying changes to the language.
Section 3.1.3, Responsibility of the Actuary	
Comment	One commentator suggested adding “or not possible” after “appropriate.”
Response	The reviewers clarified the guidance for circumstances when applying some or all of the guidance is not warranted, or is warranted but the guidance is not followed, because it is impractical or for other reasons. The guidance exposed as section 3.1.3 was moved into section 3.1.1.
Comment	One commentator felt that requiring the actuary to disclose the deviation where such deviation is material was too loose.
Response	The reviewers note that this is a standard requirement for disclosure of a deviation and made no change. The reviewers also note that “material” is defined in ASOP No. 1.
Comment	One commentator indicated that the language should be clarified that a judgment that “some or all of the guidance is not appropriate” is different from a material deviation from the standard.
Response	The reviewers have clarified that limiting the application of the guidance because of professional judgment is not a deviation from the standard.

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Comment	One commentator indicated that the standard should not force the actuary to defend why this standard is inappropriate.
Response	The reviewers do not intend for the actuary to have to show that the standard is inappropriate and clarified the guidance.
Section 3.2, Model Meeting the Intended Purpose	
Comment	One commentator questioned whether the standard provided any more guidance than already provided in the Code to “perform work with skill and care and take reasonable steps to avoid being misleading.”
Response	The reviewers disagree and believe there is a need for a standard on modeling.
Comment	Two commentators suggested adding “reviewing” to the scope of the standard.
Response	The reviewers agree and revised the language.
Section 3.2.1, Designing, Building, or Developing the Model for the Intended Application	
Comment	One commentator suggested adding “The actuary should consider the environment in which the model will be used, and develop a model that will be robust within that environment” to this section, as the standard is silent on the need to design and build models to prevent or minimize the likelihood of inadvertent corruption, misunderstanding, or unintentional misuse.
Response	The reviewers agree with the importance of considering the environment in all actuarial work, but sometimes the design work for the model is done before the environment is set. The reviewers believe that the guidance in the standard appropriately addresses these considerations. Therefore, no change was made.
Comment	One commentator suggested eliminating section 3.2.5 and moving relevant items to section 3.2.1.
Response	The reviewers note that the examples provided are meant to illustrate a principle but are not intended to be exhaustive. The reviewers do not believe that re-organizing the sections or adding the examples from section 3.2.5 would aid clarity and did not make the change.
Comment	One commentator suggested eliminating section 3.2.3 and expanding 3.2.1 to cover modification of the model.
Response	The reviewers intend section 3.2.1 to be applicable to actuaries creating a model and section 3.2.2 to be applicable to actuaries using an existing model. Section 3.2.3 concerns modifications and directs the actuary to either section 3.2.1 or section 3.2.2. Therefore, no change was made.
Comment	One commentator suggested the word “causal” be removed. Some relationships are correlative, not causal, in nature.
Response	The reviewers agree and removed the word.
Comment	One commentator noted the last sentence of the section lists required considerations for all designing, building, or developing work, so the commentator recommended that the list be a list of possible considerations depending on the application.
Response	The reviewers agree and added the words “if applicable” to improve clarity.
Comment	One commentator suggested adding ability to meet regulatory requirements and model scalability to the list.
Response	The reviewers note that examples provided are meant to illustrate a principle but are not intended to be exhaustive and, therefore, made no change.

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Comment	One commentator thought there were too many examples listed.
Response	The reviewers thought some examples would help illustrate the guidance but simplified the examples for further clarity.
Comment	One commentator suggested adding “If the actuary is aware of other models run for other purposes for the same entity, the inputs and assumptions for the same business should be the same or there should be a documented explanation for the difference.”
Response	The reviewers believe that section 3.2.7 of this ASOP (and other ASOPs) give appropriate guidance, and made no change.
Section 3.2.2, Selecting or Using the Model for the Project’s Objective	
Comment	One commentator suggested adding “When possible, the actuary should consider alternative or new methods and modeling solutions prior to selecting the final model for use.”
Response	The reviewers believe the standard sufficiently guides the actuary to confirm that the existing model meets the current project objective, and, therefore, made no change.
Comment	One reviewer recommended adding the phrase “and should be documented.”
Response	The reviewers believe that sections 3.4.1, 3.4.2, and 3.6 adequately cover documentation of this point and made no change.
Section 3.2.3, Modifying the Model	
Comment	Two commentators suggested adding “and Reviewing” to the section title.
Response	The reviewers note that “reviewing” is now covered in sections 3.2.1 and 3.2.2 to which the actuary is directed by this section 3.2.3. Therefore, the reviewers made no change.
Section 3.2.4, Understanding the Model	
Comment	One commentator suggested adding another responsibility to the existing list, such as “Consider documenting that tests used in the model produces expected results.”
Response	The reviewers note that “validating” and “documenting” are covered in section 3.3.1 and section 3.6, and made no change.
Comment	One commentator suggested moving items requiring the actuary to consider documenting certain items to section 3.6, Documentation. Another commentator suggested that the requirement was redundant with guidance in section 3.4.1(c).
Response	The reviewers agree and removed section 3.2.4(c) and 3.2.4(d), noting that sections 3.4 and 3.6 cover actuarial reports and documentation.
Comment	Several commentators suggested the guidance in section 3.2.4(c) should state “should document” rather than “should consider documenting.”
Response	The reviewers agree but believe that documentation and disclosure are better addressed in sections 3.4.1, 3.6, and 4.1.
Comment	One commentator suggested adding an additional requirement to “understand any elements of the model not developed by the actuary, such as stochastic economic scenarios and software package built-ins, like random number generators and statistical analyses.”
Response	The reviewers disagree and note that section 3.1.2 requires the actuary to have a basic understanding of a model developed by others and, therefore, made no change.
Section 3.2.5, Model Structure	
Comment	Several commentators suggested replacing “a contract or plan” in section 3.2.5(a) with “what is being modeled” or “project.”
Response	The reviewers note that this language is used to illustrate a specific example and made no change.

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Comment	One commentator suggested strengthening the requirement in section 3.2.5(d) to document the rationale for grouping data rather than consider whether such documentation is appropriate. Several commentators indicated that documentation discussed in this section should be addressed with other documentation issues in section 3.6. Another commentator indicated that documentation should include the methodology as well as the rationale.
Response	The reviewers believe that these issues are adequately addressed in section 3.6 and removed section 3.2.5(d).
Comment	One commentator suggested that the definition of model needs to clarify that different processes may apply to composite and component models as well as to subsequent interpolation/extrapolation and subjective adjustments.
Response	The reviewers agree that the concept of modeling includes the entire process that the actuary uses to determine a result and point to section 3.3.1 for guidance regarding validation of more complex or composite models. Therefore, no change was made.
Comment	One commentator indicated that it wasn't clear what the distinction was between guidance in section 3.2.5(b) and (c).
Response	The reviewers believe that there is a distinction in some actuaries' work and chose to retain the example.
Comment	One commentator suggested that the term "model structure" be defined for clarity.
Response	The details of model structure depend on the model. The reviewers do not believe that such a definition would add clarity, and made no change.
Comment	Two commentators suggested that the standard needs to provide more clarity with respect to the meaning of "grouping" for the purpose of section 3.2.5(b).
Response	The reviewers note that certain models can use fewer cells to reflect more simplification, involving the grouping of data and the averaging of assumptions. Given that the list is introduced as an example, where applicable and where appropriate, of items to consider, no change was made.
Comment	One commentator suggested adding an additional requirement to consider whether the complexity of the model specification will produce reasonable and reliable results.
Response	The reviewers believe the guidance is clear and made no change.
Section 3.2.6, Inputs to the Model	
Comment	One commentator suggested replacing the word "deriving" with something similar to "...and the quality of."
Response	The reviewers believe the guidance is clear and made no change.
Comment	Two commentators objected to referring the actuary to ASOP No. 23, <i>Data Quality</i> , with respect to assumptions and parameters for the model.
Response	The reviewers note certain models use assumptions and parameters based on studies of data. However, the language was clarified.
Section 3.2.7, Assumptions and Parameters	
Comment	One commentator suggested replacing "should consider" in section 3.2.7(a) with "should use."
Response	The reviewers believe that this change would have been too prescriptive, so no change was made.

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Comment	One commentator requested clarity regarding application of sections 3.2.6 and 3.2.7 with respect to data.
Response	The reviewers note appropriate data is covered in section 3.2.6 and appropriate assumptions in section 3.2.7.
Comment	Several commentators questioned the use of the term “credible” in section 3.2.7(a).
Response	The reviewers agree and changed “credible” to “reliable.”
Comment	One commentator questioned whether the standard should state that data should be selected to allow the model to meet the intended purpose.
Response	The reviewers revised current section 3.2.7(e) to refer to “input,” which includes “data” in addition to “assumption and parameters.”
Comment	One commentator suggested adding a requirement to document professional judgment if section 3.2.7(a)(3) applies.
Response	The reviewers believe that the documentation required in this standard is appropriate and, therefore, made no change.
Comment	One commentator suggested replacing “is significant” with “could have a material impact” in section 3.2.7(a)(4).
Response	The reviewers agree and clarified the language in the renumbered section 3.2.7(b).
Comment	A few commentators indicated that the example of considering margin was narrower than a full discussion of margins would require.
Response	The reviewers agree and expanded the example to clarify the possible consideration.
Comment	One commentator suggested that it be clarified that the actuary is responsible for following the guidance only when the actuary was the one using the model.
Response	The reviewers agree and clarified the language.
Section 3.3, Mitigation of Model Risk	
Comment	A few commentators suggested that using multiple models is also an acceptable mitigation method.
Response	The reviewers agree and a change was made to add this as an example in section 3.3.1(b)(4).
Section 3.3.1, Validation, Checking, and Analysis	
Comment	One commentator noted that Validation and Verification (Checking) are lumped together while they are actually separate functions. The commentator suggested the sections be split as Model Verification, Model Validation, and Model Review.
Response	The standard uses (and the reviewers use) “validation” to include a wide range of processes or even perspectives, including checking, recognizing that a wide range of models and terminology to describe them exists. The standard does not have different guidance for the two distinct functions, so this section was not split. The reviewers changed the title of this section and clarified the language.
Comment	One commentator believed that all possibilities mentioned for validation should be mandatory.
Response	The reviewers disagree because not all such examples apply in all situations.
Section 3.3.1(a), Model Integrity	
Comment	One commentator suggested an explicit reference to code review or the checking of subroutines or steps in a run be added.
Response	The reviewers believe that such an expansion would be more detailed than necessary in a standard and made no change.

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Comment	One commentator doubted the possibility of “eliminating model risk” to address the potential for adverse consequences from a model that is an approximation of reality.
Response	The reviewers agree and revised the definition of “model risk,” thus removing the idea of totally eliminating model risk.
Comment	One commentator asked for clarity on the distinction between sections 3.3.1(a)(1) and 3.3.1(a)(3).
Response	The reviewers note that section 3.3.1(a)(3) focuses on trends in comparison to section 3.3.1(a)(1), which may relate more to a balance sheet or other current data.
Comment	One commentator asked for clarification that a validation is not a “once and done” exercise and the actuary should evaluate the frequency at which the validation of “fit” of the model and model integrity should be performed.
Response	The reviewers note that the guidance refers to “each model run (or set of model runs)” and believe that this language provides adequate guidance. Therefore, no change was made.
Comment	One commentator stated that this section really needs a caution to use “out-of-sample” historical data lest the so-called “validation” simply turn into a self-fulfilling prophecy.
Response	The reviewers believe this is good material for a practice note on certain types of descriptive modeling, but is not appropriate guidance for a broad range of modeling. Therefore, no change was made.
Comment	One commentator believed that section 3.3.1(a)(4) could be eliminated because examining the potential for model risk and undertaking steps to mitigate it is already covered in section 3.3.2, Appropriate Governance and Controls.
Response	The reviewers agree and eliminated this section.
Section 3.3.1(b), Analyzing the Output	
Comment	One commentator stated that it was not clear how the example given parenthetically in section 3.3.1(b)(1) would test the reasonableness of the output.
Response	The reviewers removed the example to avoid confusion.
Comment	One commentator suggested deleting section 3.3.1(b)(2) as its guidance is covered in section 3.6.
Response	The reviewers note that the guidance in section 3.3.1(b)(2) describes a process whereas section 3.6 describes documentation, making both appropriate. However, both were clarified.
Comment	One commentator was concerned about the use of the term “sensitivity test” in section 3.3.1(b)(3).
Response	The reviewers clarified the guidance by removing “sensitivity” and describing the concept differently. The guidance directs the actuary to consider testing that certain functions are operating.
Section 3.3.1(c), Peer Review	
Comment	One commentator suggested that it be documented whether or not a model has been peer reviewed and what type was performed.
Response	The reviewers believe that such requirements would be beyond the range of appropriate guidance, and made no change.

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Comment	One commentator suggested adding further guidance as to what is intended as peer review, particularly that the review should involve performing some or all of the activities described in section 3.3.1(a) and (b), and that those activities are also subject to this ASOP.
Response	The reviewers believe the extent of peer review, if any, depends on the intended purpose and the role of the actuary, and should be left to the actuary and the peer reviewer to determine. However, the scope of the standard was expanded to include general review of models.
Comment	One commentator suggested adding that the actuary should consider obtaining a peer review of the reasonableness of model inputs in addition to obtaining a peer review of model construction and of the reasonableness of model outputs.
Response	The reviewers agree and made the change.
Section 3.3.2, Appropriate Governance and Controls	
Comment	One commentator recommended this ASOP be revised to clearly require that the actuary confirm that the results are reproducible or that similar seed produce similar outputs. Three other commentators believed that the example on reproducibility was too specific and should be removed.
Response	The reviewers believe that the emphasis should be on controls so that the actuary knows the results can be reproduced, if the model allows for such reproducibility. Therefore, the reviewers removed the example, and added it as an item in a list of possible controls that are sometimes used in current practice, as stated in appendix 1.
Comment	<p>One commentator suggested expanding this section after the first sentence to include the following:</p> <p>“These controls may include:</p> <ul style="list-style-type: none"> • Protection of access to use and modify the Model Implementation and Input • Rules for modification of the Model Implementation, Input, Output, and maintenance of audit trails • Specification, documentation, and programming standards for the Implementation • Procedures for secure back-up of the media storing the Implementations and Data • Appropriate staff training or cross-training for continuity of use • 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”
Response	The reviewers believe that detailed background information and examples are often more appropriately addressed in the appendix and, therefore, included these examples in appendix 1 (Current Practices).
Comment	One commentator requested more guidance in the form of a list of things for the actuary to consider such as, but not limited to, implementing a change management process, restricting access to model inputs, model code and calculations, and model outputs.
Response	The reviewers believe the guidance in the first sentence in section 3.3.2 is clear. In addition, the reviewers believe that detailed background information and examples are often more appropriately addressed in the appendix and, therefore, included these examples in appendix 1 (Current Practices)
Section 3.4, Presentation of Results	
Comment	One commentator suggested in the second sentence replacing “any changes” with “any material changes.”
Response	The reviewers agree and made the change.

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Comment	One commentator noted that explanation of changes from a prior model run may not be relevant or possible.
Response	The reviewers note that section 3.4.2 (now section 3.4.3) addresses this concern. In addition, the reviewers have made clarifying changes throughout this section.
Comment	One commentator suggested this entire section be placed in section 4, Communications and Disclosures.
Response	The reviewers believe section 3 should cover all substantive guidance with respect to modeling, which includes presentations of the results, and made no change.
Comment	Three commentators suggested changing “should consider including” to “should include” in sections 3.4.1, 3.4.2, and 3.4.3.
Response	The reviewers restructured these sections to clarify which items should be included and which should be considered for inclusion.
Section 3.4.1, Explanation of Model in Actuarial Report	
Comment	One commentator suggested it would be helpful if guidance were provided on the situations in which it would be appropriate to include such an explanation.
Response	The reviewers restructured this section as two sections to clarify which items should be included and which should be considered for inclusion.
Section 3.4.2, Reconciliation	
Comment	One commentator stated there should be an emphasis on materiality.
Response	The reviewers agree and made the change.
Section 3.4.3, Description of Judgment	
Comment	One commentator suggested adding to the end of the first sentence “and to the extent margin was included in the assumptions.”
Response	The reviewers disagree, given the guidance in section 3.2.7(b) as well as the guidance in ASOP No. 41, <i>Actuarial Communications</i> , section 3.2. Therefore, the reviewers believe the guidance is clear and made no change.
Comment	One commentator suggested terms such as “conservative” and “optimistic” may not be used, stating they are notoriously ambiguous and routinely lead to confusion.
Response	The reviewers disagree and believe the guidance is clear, and made no change.
Section 3.5, Reliance on Data or Other Information Supplied by Others	
Comment	One commentator questioned whether the reference to sections 4.2 and 4.3 was necessary, as it seems redundant.
Response	The reviewers agree and made the change.
Section 3.6, Documentation	
Comment	One commentator suggested there is nothing in this section that is specific to modeling.
Response	The reviewers agree and made changes to the language to focus the guidance on modeling.

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Comment	<p>One commentator suggested adding the following after the first sentence:</p> <ul style="list-style-type: none">• “Such documentation could include:• How the model meets the intended purpose• Potential limitations of the model• The rationale for grouping data”
Response	<p>The reviewers agree documentation could include some of these items, and made changes to the standard to improve clarity.</p>
Comment	<p>One commentator questioned what to do if time does not permit documentation prior to an actuary leaving a company.</p>
Response	<p>The reviewers note that the answer to this question depends on the facts and circumstances.</p>
Comment	<p>One commentator requested “practice area” be defined.</p>
Response	<p>The reviewers note this section has been revised and the phrase no longer appears in this section.</p>
Comment	<p>One commentator felt the discussion of “retention” had no parameters and questioned whether it was meant to imply unlimited. The commentator suggested including a reference to requirements associated with “while results are used” or a default of X years.</p> <p>Another commentator noted there are situations where documentation is not permitted to be retained. Therefore, an exemption should be allowed for situations where documentation, by policy or contractual agreements, must be returned or destroyed.</p>
Response	<p>The reviewers believe guidance on modeling does not need to address the retention period for documentation. Therefore, the reviewers changed the guidance to delete reference to “retention.”</p>
SECTION 4. COMMUNICATIONS AND DISCLOSURES	
Section 4.1.3, Inconsistent Assumptions	
Comment	<p>One commentator did not feel it should be a requirement to disclose and discuss inconsistency in situations where assumptions are prescribed by regulation or dictated by insurance regulators. The commentator believes that the actuary should be able to rely on the regulators’ expertise. If the regulator required a particular assumption, the regulator should understand the implications of such requirement.</p>
Response	<p>The reviewers agree and clarified the guidance for situations involving prescribed assumptions, as discussed in section 3.2.7(d).</p>