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Comments on Exposure Draft for ASOP No. 38

Comments submitted to comments@actuary.org

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Re: Proposed Revision of ASOP No. 38

Thank you for the opportunity to comment formally on the proposed revision to ASOP No. 38. This response is my personal opinion based on my own experience and analysis. I do not try to add authority by claiming that my response also represents the opinions of others, neither in my firm nor at my clients nor on the committees or task forces (on modeling standards or on extreme policyholder behavior) of which I am a member.

I have been involved in efforts to draft actuarial professional standards for modeling over several years, so my understanding and appreciation grow ever greater:

- (a) for the wide range of professional actuarial work that uses modeling,
- (b) for the wide range of financial operations and obligations of many kinds of entities, including insurers, pension (or other employee benefit) plans, and government programs, involving different sorts of risks,
- (c) for the wide range of audiences (and intended users) that need, and demand, different kinds of information from their actuaries' modeling work, and
- (d) for the wide range of different approaches, and the need for different approaches, to modeling.

The fundamental purpose served by the existing ASOP No. 38 is to cover particular professional services (setting premiums and capital needs) for specialty insurers of natural catastrophes such as hurricanes and earthquakes, and in particular to meet the needs of a dedicated audience (insurance regulators) concerned with getting fair and consistent answers to questions regarding difficult but fundamentally knowable risks, given the laws of nature whose effects are reproducible. Several of the participants working on this revision to ASOP No. 38 have outstanding professional experience grounded in the fundamental purpose of the existing ASOP No. 38, and these backgrounds make them vigilant to protect the current ability of the existing ASOP No. 38 to continue serving that particular community or audience. They have done an outstanding job in this respect on this project. Similarly, a disproportionate share of the comments posted thus far come from the community of regulators and actuaries already operating under the existing ASOP No. 38. However, such depth of experience (and concerns expressed), focused as they are on the existing purpose of ASOP No. 38, appear to have limited

the range of perspective brought to the discussions of this now vastly expanded and redirected exposure draft ASOP No. 38. I have no desire to limit the effectiveness of ASOP No. 38 with respect to the concerns of regulators in the insurance of natural catastrophes, but important changes are necessary for a vastly expanded ASOP No. 38 to also provide appropriate professional guidance where and when it will apply to other models for other purposes of more diverse audiences regarding other risks, especially because these risks can be caused by triggers completely different from those of natural catastrophes.

Because there are several dimensions in which the exposure draft ASOP No. 38 fails to account for needs outside of the original focus of the existing ASOP No. 38, I have attached three separate appendices, each communicating a distinct perspective. While each of them finds inappropriate guidance in largely the same sections of the proposed ASOP, I have separated these detailed discussions from one another because they present distinct perspectives that each ought to be considered by the ASB. These three perspectives are:

- I. The ASOP should recognize that models of man-made catastrophes should differ from the models of natural catastrophes because the former are modeling complex human behavior rather than the more predictable natural phenomena based on the science of physics.
- II. The ASOP should recognize that models designed to satisfy other users should differ from the models designed to satisfy regulators because the two alternative sets of users seek different information from the actuary, as different as a plausible range is different from a best estimate.
- III. The ASOP should recognize that the implied preference for a complex, expert-based (and usually black box) model over a classic actuarial approach to modeling not only would be a restraint of trade, but would also serve the public badly, especially when the risk is man-made and the user seeks more understanding than provided by a black box model. This implied preference for expert based models is new with the proposed ASOP; the existing ASOP No. 38 applies only if the model is already based on expertise outside the actuary's domain.

Again, I do not wish to disrupt the current guidance regarding natural catastrophe work for the benefit of regulators. In some cases, more broadly appropriate guidance ought be given, then followed by the exposure draft language -- identified as being guidance directed to the special situation of actuaries providing opinions to insurance regulators regarding risks arising from natural catastrophes whose effects are not materially instigated or directed by people. In other cases, no other text may need be added except language to limit the applicability of the exposure draft language to the special situation of actuaries providing opinions to insurance regulators regarding risks arising from natural catastrophes whose effects are not materially instigated or directed by people.

In overall response to the six questions posed by the ASB in its cover letter, let me summarize the conclusions from the three perspectives (in the appendices) as follows:

1. The definition in section 2.2 includes natural perils such as hurricanes, earthquakes, and tornados as well as other perils such as terrorist acts and pandemics. Is the inclusion of these other perils sufficiently clear and appropriate?

The inclusion of these other perils is neither clear nor appropriate.

Not clear. While natural perils are well defined by natural phenomena, whether or not damage occurs, many human events are labeled regularly catastrophes without uniform standards with respect to motivation, size or even context, and the proposed ASOP does not help the actuary to do so.

The label “terrorism” is applied sometimes to what is just violence perpetrated on a few victims by the mentally ill or by common criminals with motivations only superficially painted as being related to any international conspiracy or struggle. In a different context, the label “terrorism” is applied by authoritarian governments to any resistance to their rule by what others call “freedom fighters”, even simple acts of civil disobedience turned violent by government thugs. Even a nonviolent context such as computer hacking interfering with communications or financial records may be labeled “terrorism” by some but not so labeled by others.

Similarly, the label “pandemic” is unclear, and not only with respect to prevalence and severity. Suppose an epidemic affects many people severely but in only one country; it is not a pandemic according to the dictionary, so does the proposed ASOP not apply? Suppose a pandemic’s effect by country depends heavily on national and local protective measures taken, as well as individual precautions; are we discussing the same phenomenon in those different countries, given the importance of human behavior?

The proposed ASOP’s definition of catastrophe (implicit in the definition of catastrophe model) is wide ranging and could be applied to the unusual extremes of all sorts of human behavior underlying actuarial work in pensions, health insurance, life insurance, and P&C insurance outside the classic cases of hurricanes and earthquakes. Even beyond these basic inputs to all models in these various practice areas, suppose we are discussing the prevalence of (i) excessive personal weight, or (ii) lack of exercise, or (iii) poor diets, or (iv) substandard raising and educating of children, or (v) unemployment, or (vi) radical political views, or (vii) a mass mania creating a “bubble” of overvaluing assets without sufficient fear of risk, or (viii) a financial panic such as a “run on the bank”, or (ix) gains in longevity affecting long term liabilities for pension and post-retirement medical costs, or even (x) a flood of money causing a cycle of worsening inflation. All of these have

been described as epidemics because the condition can spread in some sense from person to person (or affect many at the same time). When does an unfortunate, and hopefully unlikely, mass outcome being modeled become a catastrophe (and a catastrophe model) covered by this proposed ASOP? How does the actuary know clearly whether or not the ASOP applies in any of these areas? If the reader doubts that the definition of “catastrophe model” in the proposed ASOP could be stretched to a model of, influenced by, any of these possible examples, I challenge the reader to imagine whether he or she could make the case that the ASOP did apply in hindsight if hired to do so by a plaintiff attorney.

Not appropriate. The proposed ASOP assumes that the concerns of regulators for the right premium to allow and the appropriate level of capital to require (which need to be recognized in guidance regarding the marketplace for insurance of natural catastrophes) will also be the concerns of other users of other actuarial models. Such other users may be less interested in a single “right” answer than in what an actuary can illustrate about the range of possible outcomes from many events and in terms which the client can relate to his or her other judgments and concerns.

Similarly, the proposed ASOP assumes that the desires of regulators for a single right answer (coming from a science based model using certified experts focused on an underlying phenomenon driven by natural laws) will be what is desired by other audiences wanting to understand the range of possible answers from multiple perspectives (of which the actuary may present only one or a few, using classical actuarial approaches of validating to experience using simpler aggregate models than fundamental ground-up causation models). These other audiences may recognize the unreliability of other models trying to account fundamentally and fully for all causes, which causes are both (a) much more numerous than a single natural phenomenon and (b) as unknowable as the motivations, decisions and actions of people. Thus, such other audiences may seek, in addition to any other “expert” advice they get, what a classic actuarial approach may give them while anchoring to actual experience in aggregate even as the actuarial approach must incorporate rare events with severe consequences, if only on a plausible basis.

A particular problem with the proposed ASOP when applied to phenomena driven not by a single natural phenomenon but by a complex mixture of human decisions is the proposed ASOP’s concept of identifying and relying on experts, preferably “certified” in some way. For the many events driven by human decisions, who would be the “certified experts” for all such causes of a catastrophe, much less the “certified experts” who could define all the interactions among the multiple causes? How does the actuary know how to identify “certified experts” on human behavior in these areas of initial causes and

subsequent interaction? The existing ASOP No. 38 applies only if the model is based on expertise outside the actuary's domain, but the proposed ASOP assumes that all cat models will be designed such that the actuary will lack expertise -- so the actuary is forced by the proposed ASOP to rely on non-actuarial experts.

2. The proposed revision applies only to the selection or use of models that are built specifically to address catastrophes. It does not apply to models that have, as part of their output, extreme events such as hyper-inflation or a stock market collapse. Is the scope of the ASOP and definition of catastrophe model sufficiently clear?

No. This is not clear. The definition of a catastrophe is not clear with respect to identifying (or helping the actuary to identify) thresholds of severity for an event to be a catastrophe. In addition, how a model could address only events beyond that threshold without potentially and naturally addressing events less severe (but leading to that threshold) is unclear and probably meaningless. So is such a model straddling the threshold therefore not covered by the proposed ASOP? Surely there are less severe earthquakes and short-lived tornados that do not produce catastrophes of whatever definition, so are models that would include such output (or input), along with more severe possibilities, not covered by the proposed ASOP? If such models would be covered by the proposed ASOP, then what reality does this provision have in excluding any other types of models?

For example, the applicability of the proposed ASOP as written is not clear in the situation of a model selected for risk management or capital management that is designed to examine the whole range of possible outcomes from the interaction of many perils and management actions. Only a few of the possible outcomes are extreme, but the more extreme outcomes receive a larger than proportional share of the attention in the risk management process. Perhaps this corporate model uses information from, or at least insights from, a specialty cat model as might be more clearly covered by the proposed ASOP except that it is operated by non-actuaries, who are not covered by the proposed ASOP. What is the applicability of the proposed ASOP to the corporate model?

If a model is selected to project surplus in business plans for an insurer with relatively little capital and surplus, so that any number of (hopefully unlikely) misfortunes could push the insurer into rehabilitation or insolvency, which would be a catastrophe for the company, its employees and its insureds, then is this a catastrophe model and does the proposed ASOP apply?

If a model built or selected for a purpose and audience that were the appropriate target for some of the original ASOP No. 38 guidance in this proposed ASOP (e.g., natural catastrophe-related filings with regulators), if that model went on to develop estimates for

the countrywide financial effects (whether hyper-inflation, a stock market collapse, or some other prediction) would the proposed ASOP no longer apply?

If the underlying point of the exception (cited in the question) that is used to carve out of scope the models built to anticipate human behavior (most easily measured in aggregate by economic indicators illustrated by the examples of hyper-inflation or stock market collapse), then it is unclear whether the proposed ASOP means to carve out of the scope all models that are fundamentally dealing with human decisions and behavior, rather than primarily dealing with natural phenomena. It would be better if the proposed ASOP made this exception for human modeling more explicit, even if only paragraph by paragraph where the guidance is inappropriate for models of human behavior.

3. The proposed ASOP does not apply when the actuary is only designing, building, modifying, or developing a catastrophe model (or a portion of a catastrophe model). Is this sufficiently clear and appropriate?

No. In my experience, using a model involves selecting assumptions or other parameter input, as well as updating the model for emerging judgments, so it is unclear whether the actuary is modifying or further developing the model when he or she uses it. Or is the proposed ASOP meant to apply only to an actuary selecting a pre-existing model with no judgment as to where and how it is used and not developing appropriate input? It is not clear.

In any case, would the proposed ASOP have the actuary ignore the guidance of the proposed ASOP while developing the model, but then not be able to use his or her model because of the guidance in the proposed ASOP? If the modeling guidance were appropriate (which I doubt in many cases where human behavior is part of what is being modeled), then the “scope guidance” to apply the “modeling guidance” only to “usage situations” and not to “modifying or development situations” is likely inappropriate.

4. The proposed ASOP now applies to all practice areas. Is that clear and appropriate?

It is clear, but not yet appropriate. If the flaws in the proposed ASOP identified in this response can be fixed, then application of the proposed ASOP to all practice areas may be appropriate. It is difficult to be definitive in this hypothetical situation until one sees how the flaws are fixed.

5. The proposed ASOP is intended to maintain the same level and quality of guidance as the current ASOP No. 38 in regards to property/casualty actuarial work involving the use of catastrophe models. Does the proposed ASOP meet that intent?

I assume the proposed ASOP meets that intent, given that the many responders from that community who seem satisfied with something that has changed so little from the original guidance that was, and remains, appropriate for their situation. However, this is the very problem when the scope has been expanded so much. The proposed ASOP needs to be revised so that it also gives appropriate guidance for other situations that are fundamentally different from the original situation for which the original guidance was written.

6. Is the proposed standard sufficiently flexible to allow for new developments in practice?

No. The proposed ASOP is little more than a restraint of trade in areas where models deal with human behavior or where the audience wants answers from many perspectives. The proposed ASOP in these areas is essentially a restraint of trade because, in effect, it narrows the choice of models used by actuaries to models not developed by actuaries, to models developed by professional modelers who seek to incorporate all causes and all interactions as if from fundamental research by “certified experts.” Such professional modelers have no way to validate all of the appropriate inputs and appropriate interactions, and they cannot even validate the overall results without reference to some simpler model, perhaps one that an actuary might build from traditional approaches to the aggregate problem.

Although encouraged by the proposed ASOP to select models developed with theoretical underpinnings of certified experts, sometimes actuaries and their clients do not need black box models, but rather they want easily validated and easily explained models that may well produce more robust results than an overly complicated model that hides the fact that it has to guess what humans will choose to do. The proposed ASOP is not flexible with respect to actuaries developing new models for new situations. It will discourage actuaries from developing new approaches for new clients with new needs different from those of regulators in the natural catastrophe market.

By the way, the UK actuarial standard of practice on modeling warns against models that are overly complicated. It prefers “parsimony” in modeling. It does not consider a more complicated model involving more unverifiable assumptions of how to use theoretical expert opinion to automatically be a better model. The proposed ASOP seems to encourage selection and use of such potentially over-theoretical models, at least with respect to man-made, or heavily man-influenced, catastrophes.

I appreciate all the work that went into the proposed ASOP, but I think the range of perspectives brought together was too narrow.

Appendix I. Modeling of man-made catastrophes versus natural catastrophes

The proposed ASOP No. 38 extends workable guidance designed (and appropriate) for most natural catastrophe models to become unworkable guidance for catastrophes triggered by human behavior. I accept that it may be desirable for a single ASOP to seek the broad scope of covering models of both types of catastrophes – natural catastrophes and man-made catastrophes. However, the resulting ASOP must cover both types of models with guidance appropriate to each. Therefore, a number of provisions in section 3 need to be rewritten to recognize the fundamental differences between the two types of catastrophes.

A. Fundamental differences in what can be known

1. Natural Catastrophes. The existing guidance in ASOP No. 38 serves well the interests of regulators dealing with hurricane and earthquake risks. We do not think of these natural catastrophes as man-made nor heavily man-influenced because even if people contribute to the total cost of a hurricane by building on a barrier island, their buildings are known exposures, and they do not trigger the hurricane with malevolent intent or by careless experiment. Because natural catastrophes are triggered by natural phenomena subject to scientific laws, we will assume all guidance in the proposed ASOP is feasible with respect to at least some natural catastrophes (hurricane and earthquake, although we doubt the guidance is feasible with respect to rarer phenomena such as asteroid and comet strikes). There is an acknowledged body of expert opinion regarding such catastrophes that proceeds in ways that the public can expect actuaries to follow and incorporate, to use the knowledge of experts that the public itself does not dispute.
2. Man-Made Catastrophes. However, the proposed ASOP as written is unworkable for models of effects from events that can be called catastrophes but that are man-made (or a result of human interactions, or at least heavily man-influenced). The public does not accept, nor should they accept, the idea that there is an identifiable group of experts who have enough knowledge to predict the mechanisms, frequency, and severity of terrorist acts or similar acts of war. Similarly, the public does not accept, nor should they accept, the idea that there is an identifiable group of experts who have enough knowledge to predict the frequency or outcomes of epidemics, which will depend on both natural and laboratory experimentation, as well as the complex interactions among governments, public and private organizations, and individuals and their families. The precise causes and interactions leading to the next epidemic may have never occurred in the past. Any possible application of a scientific law underlying some part of this process is made irrelevant by the need to guess the behavior of humans in any causal chain. For these much more complex events, the client does not usually ask the actuary to model a single orthodoxy, but rather asks the actuary to illustrate ranges of possible assumptions and

related outcomes, so that the client can make his or her own evaluations using the modeled scenarios that best reflect the assumptions a given individual prefers.

B. Provisions of the proposed ASOP that do not work for man-made catastrophes and must be redrafted with much less ambition for what any model and any actuary can do with respect to such man-made catastrophes are as follows:

3.1 Introduction—... **catastrophe models**. When using such a model, the actuary should:

- a. determine appropriate reliance on experts; ...
- d. determine that appropriate validation has occurred; ...

3.2 Appropriate Reliance on Experts—An actuary may rely on **experts** in the fields of knowledge used in the development of the **catastrophe model**. In determining the appropriate level of reliance, the actuary should consider the following:

- a. whether the individual or individuals upon whom the actuary is relying are **experts** in the applicable field;
- b. the extent to which the **catastrophe model** has been reviewed or opined on by **experts** in the applicable field, including any known significant differences of opinion among **experts** concerning aspects of the model that could be material to the actuary's use of the model; and
- c. whether there are standards that apply to the **catastrophe model** or to the testing or validation of the model, and whether the model has been certified as having met such standards.

3.3 Understanding of the Model— ...

3.3.1 Catastrophe Model Components—... the actuary should identify which fields of expertise were used in developing or updating the model, and should make a reasonable effort to determine if the model is based on generally accepted practices within the applicable fields of expertise. The actuary should also be familiar with how the model was tested or validated and the level of independent **expert** review and testing. ...

3.4 Appropriateness of the Catastrophe Model for the Project's Objective—...

- b. Developments in Relevant Fields—The actuary should make a reasonable effort to be aware of significant developments in relevant fields of expertise. The actuary should evaluate whether such developments are likely to materially affect the current actuarial analysis.

C. Discussion of how differences between types of catastrophes are not recognized in the provisions above of the proposed ASOP, such that these provisions of the proposed ASOP do not work for man-made catastrophes and must be redrafted

1. **Modeling people.** Modeling the behavior of people, both individually and in group settings, is potentially hugely more complicated than natural phenomena, and there are many more types of experts that may have something to contribute to the discussion of influences on such behavior. In behavioral sciences, just as individuals satisfy one basic necessity (but not maximize it) before they also seek other goals in a form of hierarchy, the modeler faces decisions of how many diverse forms of expertise to incorporate. *Given the complexity of human behavior in extreme situations, sections 3.1.a & d, 3.2, 3.3.1, and 3.4.a present overwhelming burdens to the actuary trying to select a model requiring an adequate amount of input needed to fully model extreme possibilities of human behavior that would qualify as a catastrophe as defined by the proposed ASOP.*
2. **Experts.** For many purposes, a catastrophe model will look at both a probability distribution of the incidence of catastrophe and a probability distribution of the severity of the catastrophes that do happen. It is plausible that natural catastrophes may generate similar modeling conclusions by different experts (among a relatively small universe of recognized experts) because their triggering events (regarding incidence) are essentially natural laws, and their severities can be modeled from knowing how they attack properties and people. However, when we move beyond natural catastrophes to those caused by people, especially those caused intentionally, then many more people (expertized by “experience”) will have an opinion of what to expect or fear, and it is not at all clear that any one “expert” has any better opinion than the man in the street. (Indeed, some will speak of “crowd sourcing” as a viable form of expertise.) Even if an expert on terrorism or war believes that he or she can predict and perhaps defeat the next move by the opponent in the deadly “chess game” by insightful modeling, the opponent will seek a different “game” (or dimension) in which to attack with unexpected means and results.

Whether in war or terrorism, what to expect is subject to many opinions, and there is a huge number of ways to model the future. Perhaps only a few will be valid opinions/models, but there is no consistent way to determine in advance which model will be valid with the same confidence that arises with natural catastrophe models based on a few, consistently operating natural laws. Who will turn out to be an expert with correct predictions (with the benefit of either luck or valid insights in any field that involves human interaction) and who will turn out to be an expert with mistaken opinions (at least this time) depends on a complex mixture of actions by many other people.

How can the actuary hope to follow the guidance of section 3.2 of the proposed ASOP? The guidance presents unresolvable burdens to the actuary trying to explain why only

certain experts on man-made catastrophes were considered. Where are the lists of experts on all aspects of man-made disasters?

3. **Extending modeling techniques.** People are often quite confident in their analyses when they apply techniques that have worked in one area to new areas, at least until emerging experience disproves the premise. For example, physicists and (rocket science) engineers were hired by Wall Street to apply their modeling techniques to investment markets, which worked well until they stopped working catastrophically in recent years. Similarly, risk assessment firms experienced in modeling earthquakes or hurricanes have confidently extended their techniques to modeling terrorism, but this will be both more arbitrary (with respect to setting parameters than cannot be independently validated) and more retrospective in aggregate (validating ultimately to what the classic actuarial model would validate to) than they acknowledge. Many more opinions (about all the actions that could be taken by evil people) would have to be considered by the model builder if the actuary wants to select a terrorism model complying with the proposed ASOP. It is not clear that such an expert-based model will be any more useful than an essentially retrospective model (in the nature of a classic actuarial model with simple mechanisms to add the possibility of more extreme events than have occurred in the historical period studied).

When risk assessment firms experienced in modeling earthquakes or hurricanes extend their techniques to modeling terrorism without many, many more types of input than they are accustomed to accounting for, and given that the assumptions they do allow for are difficult to validate, can the actuary selecting such a model be held to have violated the guidance of this proposed ASOP?

4. **Validating catastrophe models.** Catastrophes by common definition are relatively rare, so it may be impossible to know whether appropriate validation has occurred if the causes of catastrophes are changing (as they are when people are the ultimate cause), in contrast to the case of natural catastrophes in which the causes (natural laws) are not changing. *How shall the actuary hope to follow the guidance of sections 3.2.c and 3.3.1 of the proposed ASOP when selecting a model of human behavior? How can the actuary defend himself or herself if accused of failing to comply with the guidance in this proposed ASOP?*
5. **Certifying models.** With the relatively small number of natural catastrophe experts, one could imagine there may be standards against which such a model could be “certified”, but any such certification of a model of human behavior calls into question the expertise of someone setting himself up as an authority to certify such models. Certainly, different schools of thought will have their own views on what is generally accepted practices, but deciding which one holds the ultimate truth is as difficult as deciding on the one correct school of economics, politics, or international relations. It is difficult to define, much less know, the “level” of independent expert review and testing of a model of rare events that

will be triggered by different sets of people each time that a catastrophe occurs; yet this would be required in the proposed ASOP.

How can the actuary hope to follow the guidance of section 3.2.c of the proposed ASOP with respect to models of man-made disasters? Where are the certification standards for models of man-made disasters, and where does the actuary find a list of such certified models of human behavior for all the types of behavior in the extreme that might be covered by this proposed ASOP?

6. **Responding to needs of ultimate user determines modeling approach.** Certain natural catastrophes are excluded from common insurance policies, but special policies or riders are written to cover these gaps, and the insurance regulators have to deal with them. The regulators seek actuarial advice coming to a definite conclusion, and ASOP No. 38 reassures them the best possible answer in an uncertain world. Regulators could write a regulation expressing what they seek from an actuary making a filing with respect to natural catastrophe insurance (or any other type of catastrophe if they think they have the answers to the questions above), and maybe it would look like the current guidance from the existing ASOP No. 38. However, at least for other types of catastrophes (man-made catastrophes), there are other questions and decisions to be made by other clients. For some audiences, such as company management, the actuary may be asked to provide both an answer and sensitivity tests over a range of uncertainty. Other audiences, such as investors, view actuaries as providing only one of many diverse opinions which they seek to collect, to evaluate in terms of the assumptions input, and then to choose among for building their portfolio. They do not seek an actuarial model of human behavior that they cannot relate to their own perceptions. While the proposed ASOP makes reference to the “project objective,” much of the guidance actually requires work and research into human behavior not wanted by such a client and not in the project objective. For ultimate users seeking understanding from seeing a range, whether within a single actuarial model or from a range of models, it is not clear that the proposed ASOP recognizes the different questions being asked about the risks of man-made disasters.

Appendix II. Orientation to regulators' needs versus needs of other audiences from actuarial modeling of catastrophes

The proposed ASOP No. 38 extends workable guidance designed (and appropriate) for actuarial modeling to meet the needs of regulators of the marketplace for natural catastrophe insurance to become unworkable guidance for actuarial services to other clients with concerns different from those of regulators when considering catastrophes, especially those triggered by human behavior. I accept that it may be desirable for a single ASOP to seek the broad scope of covering different models designed to answer questions from either type of audience. However, the resulting ASOP must cover both types of models with appropriate guidance. Therefore, a number of provisions in section 3 need to be rewritten to recognize the fundamental differences between the two types of audiences, differentiated by their questions and needs for advice from the actuary.

A. Fundamental differences in what the audience seeks and hopes the actuary can provide

1. Regulators seek single answers. The current guidance in existing ASOP No. 38 serves well the interests of regulators dealing with hurricane and earthquake risks. A single best estimate answer for the expected cost of natural disasters, loaded by the provision for a specific return on a specific amount of capital assigned to the expected statistical variance of the natural catastrophe risk, allows the regulator to evaluate a specific premium scale proposed for regulatory approval (or to evaluate a specific reserve or capital provision for a company taking such risks). If most cat filings use essentially the same model (or one of only two or three similar models), then the regulator can achieve a great deal of consistency within a given insurer, among different insurers, and over time. Beyond seeing whatever claim distribution variance that is consistent with the proposed target capital, the regulator is not interested in seeing a variety of models with different approaches to the problem that may produce different answers. When what is being modeled is fundamentally knowable scientifically because it is triggered by natural laws repeatedly applied, then all that is needed (so that the few alternative models will produce essentially the same answer) is to call for the models to incorporate the expertise of a few experts who can be identified and certified. The regulator does not need to understand the workings of the black box; the regulator just needs for it to be certified by some expert.
2. Other users seek answers they can understand and relate to their own judgments, and they seek a range of possible answers and approaches when they are uncertain of their own judgments. However, the proposed ASOP as written is unworkable for actuaries advising clients who seek anything different from what a regulator seeks. Where it concerns

catastrophes, most clients of actuaries do not want a single best estimate answer coming out of a black box. They want to understand the model and the judgments made, so that they can compare those modeled judgments to the judgments they themselves might make. They want to know the range of answers that are possible, depending on the approach taken and the type of model used. They do not necessarily want to see a single, best estimate answer, always the same answer, and available only from a limited supply of models all based on the same certified experts.

This is especially true for man-made catastrophes because common sense shows the public that they should not accept the idea that there is an identifiable group of experts who have enough knowledge to predict the mechanisms, frequency, or severity of terrorist acts, or any other individual or mass human behavior. Similarly, the public does not accept, nor should they accept, the idea that there is an identifiable group of experts who have enough knowledge to predict the frequency or outcomes of epidemics, which could depend on both natural and laboratory experimentation, as well as depend on the complex interactions among governments, public and private organizations, and individuals and their families. What expert can determine whether a clever computer hacker will or will not be able to obtain all necessary records from some biologically secure research lab reproducing the 1918 influenza virus -- or the smallpox virus, for that matter? What expert can determine whether the clever computer hacker will then work with a biological lab employed by a terrorist to protect a few believers and then unleash the 1918 influenza virus or the smallpox virus on everyone else? For these unexpected events, the public (or client) does not ask the actuary to model a single orthodoxy, but rather to illustrate ranges of possible assumptions and related outcomes, so that the public (or client) can make his or her own evaluations using the modeled scenarios that best reflect the assumptions a given individual prefers.

B. Provisions of the proposed ASOP that do not work for non-regulator audiences and must be redrafted (with much less ambition for what any model and any actuary can do with respect to such catastrophes, and therefore less constraints on the variety of answers) are as follows:

- 3.1 Introduction—... catastrophe models. When using such a model, the actuary should:
 - a. determine appropriate reliance on experts; ...
 - d. determine that appropriate validation has occurred; ...
- 3.2 Appropriate Reliance on Experts—An actuary may rely on experts in the fields of knowledge used in the development of the catastrophe model. In determining the appropriate level of reliance, the actuary should consider the following:

- a. whether the individual or individuals upon whom the actuary is relying are experts in the applicable field;
- b. the extent to which the catastrophe model has been reviewed or opined on by experts in the applicable field, including any known significant differences of opinion among experts concerning aspects of the model that could be material to the actuary's use of the model; and
- c. whether there are standards that apply to the catastrophe model or to the testing or validation of the model, and whether the model has been certified as having met such standards.

3.3 Understanding of the Model— ...

3.3.1 Catastrophe Model Components—... the actuary should identify which fields of expertise were used in developing or updating the model, and should make a reasonable effort to determine if the model is based on generally accepted practices within the applicable fields of expertise. The actuary should also be familiar with how the model was tested or validated and the level of independent expert review and testing. ...

3.4 Appropriateness of the Catastrophe Model for the Project's Objective—...

- b. Developments in Relevant Fields—The actuary should make a reasonable effort to be aware of significant developments in relevant fields of expertise. The actuary should evaluate whether such developments are likely to materially affect the current actuarial analysis.

C. Discussion of how needs of other audiences are not recognized in the proposed ASOP sections quoted above, such that the provisions of the proposed ASOP do not work, certainly at least do not work for man-made catastrophes, and ought be redrafted.

1. **Modeling people.** Modeling the behavior of people, both individually and in group settings, is potentially hugely more complicated than natural phenomena, and there are many more types of experts that may have something to contribute to the discussion of influences on such behavior. In behavioral sciences, just as individuals satisfy one basic necessity (but not maximize it) before they also seek other goals in a form of hierarchy, the modeler faces decisions of how many diverse forms of expertise to incorporate. *Given the complexity of human behavior in extreme situations, sections 3.1.a & d, 3.2, 3.3.1, and 3.4.a present severe limitations to the actuary trying to select a model that either (a) incorporates a sufficient range of diverse input (needed to fully model extreme possibilities) or (b) takes alternative approaches to catastrophe modeling that are more "top-down" and easier to explain to a layman audience. These sections of the proposed ASOP need to be replaced when the intended purpose of the modeling is other than giving a single best estimate answer to a regulator.*

2. **Experts.** For many purposes, a catastrophe model will look at both a probability distribution of the incidence of catastrophe and a probability distribution of the severity of the catastrophes that do happen. It is plausible that natural catastrophes may generate similar modeling conclusions by different experts (among a relatively small universe of recognized experts) because their triggering events (regarding incidence) are essentially natural laws, and their severities can be modeled from knowing how they attack properties and people. However, when we move beyond natural catastrophes to those caused by people, especially those caused intentionally, then many more people (expertized by “experience”) will have an opinion of what to expect or fear, and it is not at all clear that any one “expert” has any better opinion than the man in the street. (Indeed, some will speak of “crowd sourcing” as a viable form of expertise.) Even if an expert on terrorism or war believes that he or she can predict and perhaps defeat the next move by the opponent in the deadly “chess game” by insightful modeling, the opponent will seek a different “game” (or dimension) in which to attack with unexpected means and results. Whether in war or terrorism, what to expect is subject to many opinions, and there is a huge number of ways to model the future. Perhaps only a few will be valid opinions/models, but there is no consistent way to determine in advance which model will be valid with the same confidence that arises with natural catastrophe models based on a few, consistently operating, natural laws. Who will turn out to be an expert with correct predictions (with the benefit of either luck or valid insights in any field that involves human interaction) and who will turn out to be an expert with mistaken opinions (at least this time) depends on a complex mixture of actions by many other people. It makes does not really make sense to attempt to find a single, best estimate answer, so it is good that regulators are not usually asked to rule on terrorism premiums or pandemic premiums because there is no credible basis for a single, best estimate answer to be filed. A sample situation in which the proposed ASOP’s emphasis on experts gives inappropriate guidance appears when an actuary is selecting a capital management model that includes a fixed formula component for a specified catastrophic risk. In this example, suppose a relevant audience such as rating agencies or European Solvency II regulators have settled on a cat risk formula such as 2.5 deaths per 1000 as the acceptable provision for pandemic deaths in a group life insurance line of business. It is misleading guidance for the proposed ASOP to suggest that “the actuary should consider” the various points a, b and c under 3.2.
- Even if the actuary could follow the guidance of section 3.2 of the proposed ASOP, the guidance may prevent the actuary from trying to develop answers (or at least sensitivity tests) that might be useful to a client with a particular view as to which expert opinions to adopt, nor to a client with a need for the widest possible range of plausible answers.*
3. **Extending modeling techniques.** More opinions and approaches ought be considered if the actuary wants to develop answers useful to a variety of clients who may be different

from regulators. And it ought be perfectly acceptable to use an essentially retrospective model (with a classic actuarial approach) for the ultimate user who may be seeking a variety of views and appreciates getting results from this approach that appears so independent from other prospective, expert approaches.

It seems that the actuary selecting a model (of man-made catastrophes) designed to comply with the proposed ASOP may nonetheless lose the ability to communicate with the client on issues of concern to the client, and certainly will lose the ability to respond with advice that the client can relate to.

4. **Validating catastrophe models.** Catastrophes by common definition are relatively rare, so it may be impossible to know whether appropriate validation has occurred if the causes of catastrophes are changing (as they are when ever-changing people are the ultimate cause), in contrast to the case of natural catastrophes in which the causes (natural laws) are not changing.

Especially when dealing with man-made (or man-influenced) catastrophes, including terrorism and pandemics, if the actuary is restricted to selecting the few, if any, models that have been validated in accordance with the guidance of sections 3.2.c and 3.3.1 of the proposed ASOP, the actuary may lose the ability to communicate with the client, and certainly will lose the ability to respond with advice that the client can relate to.

5. **Certifying models.** With the relatively small number of natural catastrophe experts, one could imagine there may be standards against which such a model could be “certified”, but any such certification of a model of human behavior calls into question the expertise of someone setting himself up as an authority to certify such models. Certainly, different schools of thought will have their own views on what is generally accepted practices, but deciding which one holds the ultimate truth is as difficult as deciding on the one correct school of economics, politics, or international relations. It is difficult to define, much less know, the “level” of independent expert review and testing of a model of rare events that will be triggered by different sets of people each time that a catastrophe occurs; yet this would be required in the proposed ASOP.

Especially when dealing with man-made catastrophes, including terrorism and pandemics, if the actuary is restricted to selecting the few, if any, models that have been certified in accordance with the guidance of sections 3.2.c. of the proposed ASOP, the actuary may lose the ability to communicate with the client, and certainly will lose the ability to respond with advice that the client can relate to.

6. **Responding to needs of ultimate user determines appropriate modeling approaches.** Certain natural catastrophes are excluded from common insurance policies, but special policies or riders are written to cover these gaps, and the insurance regulators have to deal with them. They seek actuarial advice coming to a definite conclusion, and ASOP No. 38 reassures them the best possible answer in an uncertain world. Regulators could write a regulation expressing what they seek from an actuary making a filing with respect to

natural catastrophe insurance (or any other type of catastrophe if they think they have the answers to the questions above).

However, there are other questions and decisions to be made by other parties concerned with catastrophes. This is true for all types of catastrophes, but especially for catastrophes other than natural catastrophes. For some audiences, such as company management, the actuary should provide both an answer and sensitivity tests over a range of uncertainty, including uncertainty about the best model approach. Other audiences, such as investors, view actuaries as providing only one of many diverse opinions which they seek to collect, to evaluate in terms of the assumptions input, and then to choose among for building their portfolio. They do not seek an actuarial model in which all decisions are hard-coded that is essentially a black box. While the proposed ASOP makes reference to the project objective, much of the proposed ASOP guidance requires work and research not accepted by the client with a project objective different from those of a regulator.

For ultimate users seeking understanding from seeing a range, whether within a single actuarial model or from a range of models, it is not clear that the solid requirements desired by regulators as users of natural catastrophe models (as represented by the sections of the proposed ASOP quoted in section B) will appropriately serve these other users with other needs, especially if the risk of a catastrophic deviation is only part of what determines their needs.

Appendix III. Preference for cat models based on non-actuarial expert approaches in lieu of models using a classic actuarial approach with explicit incorporation of cat risks

The proposed ASOP No. 38 extends workable guidance designed (and appropriate) for scientifically specialized natural catastrophe models to become unworkable guidance for all catastrophes and for all audiences by assuming, rather than asking whether classic actuarial approaches cannot be used to answer some questions by some audiences about a range of risks, and especially those triggered by human behavior. I accept that it may be desirable for a single ASOP to seek the broad scope of covering different models designed from different perspectives. However, the resulting ASOP must cover both types of models with guidance appropriate to each. Therefore, a number of provisions in section 3 need to be rewritten to recognize the fundamental differences between scientifically expert-based models and classic actuarial models that may be better able (than a model based on non-actuarial experts) to answer some questions in a straight-forward, understandable fashion. To not do so could be a restraint of trade violation by the ASB.

A. Fundamental differences in what kind of model may be useful

1. Natural Catastrophes. The current guidance in ASOP No. 38 serves well the interests of regulators dealing with hurricane and earthquake risks. It explicit applies only if the actuary believes the model uses expertise that the actuary does not have. We assume all guidance in the proposed ASOP is feasible for these situations. Evidently there is an acknowledged body of scientific expert opinion regarding such natural catastrophes that the regulators can expect actuaries to follow and incorporate, to use the knowledge of experts that the regulators do not dispute.
2. Man-Made Catastrophes. However, the proposed ASOP as written is unworkable for models that should reflect effects from events that can be called catastrophes but that are man-made (or man-influenced, or a result of human interactions). The first problem is that the proposed ASOP assumes that the cat model is in a form that uses expertise outside the actuary's domain, even though the potential scope of the ASOP covers the extremes of potential human behavior that classic actuarial models may be better designed to handle than models using other expertise. Models building up to a forecast from expert opinion regarding terrorist acts (or the control of epidemics or any other man-made or man-influenced catastrophe) may have to incorporate many more assumptions and parameters to replicate the theories of experts than they would have had to incorporate to forecast natural phenomena like hurricanes. Ultimately, the expert-based, theoretical model about human behavior must be validated against history evaluated in a way not so dissimilar from the classic actuarial model that is fundamentally retrospective. But the classic actuarial model would have been simpler to

use and to explain than the expert-based model that tries to appear more prospective. For these much more complex human behavior related events, whose appropriate modeling is not clear, the proposed ASOP should not indicate a preference for expert-based models to replace classic actuarial models. The classic actuarial model may permit greater understanding and validation from a “top-down” perspective. The classic (retrospective) actuarial model at the least allows an alternative form of modeling of human behavior in extreme situations, perhaps not using experts in the same way as they would be used for natural catastrophe models, and may provide legitimate competition in the market of ideas by differing from the models that would comply with the proposed ASOP.

B. Provisions of the proposed ASOP that do not work for traditional actuarial models of cat risks, especially with regard to man-made catastrophes, and must be redrafted with much less bias toward models based on non-actuarial experts are as follows:

- 3.1 Introduction—... catastrophe models. When using such a model, the actuary should:
 - a. determine appropriate reliance on experts; ...
 - d. determine that appropriate validation has occurred; ...
- 3.2 Appropriate Reliance on Experts—An actuary may rely on experts in the fields of knowledge used in the development of the catastrophe model. In determining the appropriate level of reliance, the actuary should consider the following:
 - a. whether the individual or individuals upon whom the actuary is relying are experts in the applicable field;
 - b. the extent to which the catastrophe model has been reviewed or opined on by experts in the applicable field, including any known significant differences of opinion among experts concerning aspects of the model that could be material to the actuary’s use of the model; and
 - c. whether there are standards that apply to the catastrophe model or to the testing or validation of the model, and whether the model has been certified as having met such standards.
- 3.3 Understanding of the Model— ...
 - 3.3.1 Catastrophe Model Components—... the actuary should identify which fields of expertise were used in developing or updating the model, and should make a reasonable effort to determine if the model is based on generally accepted practices within the applicable fields of expertise. The actuary should also be familiar with how the model was tested or validated and the level of independent expert review and testing. ...
- 3.4 Appropriateness of the Catastrophe Model for the Project’s Objective—...

b. **Developments in Relevant Fields**—The actuary should make a reasonable effort to be aware of significant developments in relevant fields of expertise. The actuary should evaluate whether such developments are likely to materially affect the current actuarial analysis.

C. Discussion of how differences between types of models are not recognized in the proposed ASOP above, such that the provisions of the proposed ASOP do not work for classic actuarial models of cat risks and must be redrafted

1. **Modeling people.** Modeling the behavior of people, both individually and in group settings, is potentially hugely more complicated than natural phenomena, and there are many more types of experts that may have something to contribute to the discussion of influences on such behavior. In behavioral sciences, just as individuals satisfy one basic necessity (but not maximize it) before they also seek other goals in a form of hierarchy, the modeler faces decisions of how many diverse forms of expertise to incorporate. While it may be possible to create a theoretical model for human behavior, actuaries have often found it more fruitful to create classic actuarial models for human behavior. (Examples of which that could be extreme enough to qualify as a catastrophe under the definition in the proposed ASOP are the purchase of insurance policies, the use of insurance policy options (such as premium persistency, surrender, lapsation, policy loans, dividend options, nonforfeiture elections, etc.), the use of employee benefit plan options (early retirement, form of annuity payout, etc.), non-recovery behavior during claim period (while on disability income claim) and many others.) It is possible to imagine extremes in such behavior variables occurring rarely enough to qualify under the definition of catastrophe given in the proposed ASOP. However, the proposed ASOP reveals a bias toward the selection and use of models based on the opinions of experts who may often not be actuaries, and the models would often not be the classic retrospective actuarial model with simple relationships easily explained.

Given the complexity of human behavior in extreme situations, sections 3.1.a & d, 3.2, 3.3.1, and 3.4.a show an unwarranted preference for the actuary to select models with much input from experts on catastrophes. The classic actuarial approach to modeling (essentially retrospective in many respects) would be discouraged for a number of perils, even though the perils would be inadequately modeled by more expert-based models, given the difficulty of modeling people reliably.

2. **Experts.** For many purposes, a catastrophe model will look at both a probability distribution of the incidence of catastrophe and a probability distribution of the severity of the catastrophes that do happen. It is plausible that natural catastrophes may generate similar modeling conclusions by different experts (among a relatively small universe of recognized experts) because their triggering events (regarding incidence) are essentially natural laws, and their severities can be modeled from knowing how they attack properties and people. However, when we move beyond natural catastrophes to those

caused by people, especially those caused intentionally, then whatever experts have to say must be blended with many more inputs and judgments to forecast the terrorist or epidemic catastrophe (or any of the other extreme behaviors that would meet the definition of catastrophe in the proposed ASOP). In comparison to the classic actuarial modeling approach, the expert-based model becomes unwieldy, difficult to parameterize uniquely, and ultimately less understandable or reliable for the client.

The guidance of sections 3.2 and 3.3.1 of the proposed ASOP shows a bias to the type of models developed by certain types of vendors (based on non-actuarial experts), even though they may be more expensive and serve some users less well than a classic actuarial model.

- 3. Extending modeling techniques.** People are often quite confident in their analyses when they apply techniques that have worked in one area to new areas, at least until emerging experience disproves the premise. For example, physicists and (rocket science) engineers were hired by Wall Street to apply their modeling techniques to investment markets, which worked well until they stopped working catastrophically in recent years. Similarly, risk assessment firms experienced in modeling earthquakes or hurricanes have confidently extended their techniques to modeling terrorism or pandemics, but this will likely be both more arbitrary (with respect to setting parameters than cannot be independently validated) and more retrospective in aggregate (validating ultimately to what the classic actuarial model would validate to) than they acknowledge. Given this reality, it ought be perfectly acceptable to use an essentially retrospective model (which I am calling the classic actuarial approach) so long as the actuary explains the nature of the model used.

The proposed ASOP should not encourage one form of model over another, especially if the more black box model is unlikely to produce more useful results for the client.

- 4. Validating catastrophe models.** Catastrophes by common definition are relatively rare, so it may be impossible to know whether appropriate validation has occurred if the model is as complex as an expert's explanation of how many human-based contingencies come together, in contrast to the case of natural catastrophes in which the causes are relatively simple. While still subject to changes in people, the simpler model not based on expert opinion from the bottom up has a better chance of having some validation.

It will be more difficult for the actuary to follow the guidance of sections 3.2.c when selecting a model based on experts to comply with section 3.3.1 of the proposed ASOP.

- 5. Certifying models.** With the relatively small number of natural catastrophe experts, one could imagine there may be standards against which such a model could be "certified", but any such certification of a model of human behavior calls into question the expertise of someone setting himself up as an authority to certify such models. Certainly, different schools of thought will have their own views on what is generally accepted practices, but deciding which one holds the ultimate truth is as difficult as deciding on the one correct school of economics, politics, or international relations. It is difficult to define, much less

know, the “level” of independent expert review and testing of a model of rare events that will be triggered by different sets of people each time that a catastrophe occurs.

Section 3.2.c of the proposed ASOP has this requirement. While it may be difficult to find a model of human behavior satisfying this requirement, it would be impossible to find a classic actuarial model that satisfies this requirement.

6. **Responding to needs of ultimate user should determine modeling approach.** Certain natural catastrophes are excluded from common insurance policies, but special policies or riders are written to cover these gaps, and the insurance regulators have to deal with them. They seek actuarial advice coming to a definite conclusion, and existing ASOP No. 38 reassures them the best possible answer in an uncertain world. Regulators could write a regulation expressing what they seek from an actuary making a filing with respect to natural catastrophe insurance (or any other type of catastrophe if they think they have the answers to the questions above), and such a regulation may well require the current guidance of the existing ASOP No. 38.

However, for other types of catastrophes, there are other questions and decisions to be made by other actors. For some audiences, such as company management, the actuary should be able to communicate simply what is being assumed, which is difficult with a black box filled with a long chain of expert suppositions about human behavior. Other audiences, such as investors, view actuaries as providing only one of many diverse opinions which they seek to collect, to evaluate in terms of the assumptions input, and then to choose among for building their portfolio. They can get the output of expert black boxes elsewhere; they often seek the additional insight provided by a classic actuarial (retrospective) model modified in transparent ways to include rarer, catastrophic events not present in the historical base period. While the redrafted standard makes reference to the project objective, much of the guidance requires work and research not accepted by the client and not part of the project objective defined by the client. For ultimate users seeking understanding from seeing what a classic actuarial model can add to their understanding, it is not clear that they would appreciate the more complex expert-based models (that would be necessary for models of man-made risks to meet the requirements developed in the existing ASOP No. 38 for the relatively simple expert-based models desired by regulators for natural catastrophe risks). The proposed ASOP should not force this type of model on sophisticated clients seeking different types of models.