MODELING CAVEATS:
Risks Associated with the Construction and Use of (Actuarial) Models

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The opinions expressed in this presentation are my own, and do not necessarily represent the official opinion of my employer, the California Department of Insurance.
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**Agenda:**

1. First: The Good News
2. Next, the Warning: Modeling May Be Accompanied with (Hidden) Dangers and Using Models Involves Taking Risks
3. Some Examples of (Wrong) Models Usage Resulting in Spectacular and Not So Spectacular Failures
4. Many Stakeholders with Varying Interests
5. Modeling Done for Other Purposes and in Other Disciplines
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6. What is a “Model”?

7. Major Components of Modeling Processes

8. Two Issues: Credibility of Internal Company Data and Reasonability of Margins for Provision for Adverse Deviation (PAD)

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11. Modeling Interest Rate/Yield Curves: Stochastic Interest Rate Generators
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First: The Good News

- It is natural to be a little bit stressed out:
  - This is true for company actuaries: They will be estimating reserves using PBR for the first time; and,
  - It is also true for regulators: They will be reviewing such estimates for the first time.

- But relax. No need to worry too much:
  - Expect plenty of guidance/advice from the NAIC, AAA, SOA, leading consulting companies and rating agencies regarding acceptable models to use, reasonable assumptions to employ, etc.
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- You are doing this for the first time.
- You have deterministic calculation of reserves as points of reference.
- Rating agencies will be monitoring your reserves.
- Regulators are also new to PBR, and, moreover, they will anticipate shortcomings in the PBR when done for the first time.
- Barring spectacular unexpected external developments, models usually work well and produce reasonable results.
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Next, the Warning: Modeling May be Accompanied with (Hidden) Dangers and Using Models Involves Taking Risks

- Sometimes, despite the existence of all the safety checks, a defective model becomes popular and gains widespread acceptance and use.
- Resulting in (sometimes very severe) adverse financial consequences for the company and (perhaps even) for society.
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Some Examples of (Wrong) Models Usage Resulting in Spectacular and Not So Spectacular Failures

- Long-Term Capital Management (LTCM)
- Gaussian Copula: ‘The Formula That Killed Wall Street’
- (The near collapse of) American International Group
- Long-term care insurance premium development
- Executive Life Insurance Company
- The Enron scandal
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Many Stakeholders with Varying Interests:

- Insurers: Management, employees, shareholders
- Policyholders
- Regulators: Solvency, fairness, politics, bureaucracy
- General public: Taxpayers
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Modeling Done for Other Purposes and in Other Disciplines

- Modeling done by actuaries for other purposes: Rate development, budgeting, company strategic planning, appraisal, etc.
  - Example: Modeling to forecast trend increase in PMPM claim costs
- Modeling done by economists
- Modeling done by engineers
- …
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What is a “Model”? Modeling Defined.

- Many definitions of “model”
- Here is one:
  
  “(T)he term model refers to a quantitative method, system, or approach that applies statistical, economic, financial, or mathematical theories, techniques, and assumptions to process input data into quantitative estimates.”

Taken from FRB: Supervisory Letter SR 11-7, on “Guidance on Model Risk Management,”

https://www.federalreserve.gov/bankinfreg/srletters/sr1107.htm
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Major Components of Modeling Processes

- The data input
- Assumptions: Explicit and implicit
- The “engine”: The equations or the black box that process input data and assumptions to produce the desired output
- The output/outcome
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Two Issues: Credibility of Internal Company Data and Reasonability of Margins for Provision for Adverse Deviation (PAD)

Credibility Issues:

- Need to decide when the (internal company) data set is not credible, partially credible, or fully credible.
- When the data is not credible or partially credible, need to decide the external or industry data that will replace the company data or combined with the company data.

Reasonability of Margins:

- How do we decide on the size of “reasonable” margins for PAD?
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Modeling Mortality Rates and Policyholder Behavior

- Modeling for mortality and policyholder behavior – lapse rates/policy loans, etc.: Relatively an easy task, if done separately.
- Modeling interaction between changes in mortality rates, changes in macro economic conditions, and changes in policyholder behavior: More challenging.
- Actuaries have lots of expertise and experience in this area.
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Modeling Stock Market Returns

- The need to model stock market returns:
  - Insurers did not have to do such modeling in the past.
  - Guarantees provided regarding (minimal) stock market returns.
  - Need to support reserves with “enhanced” returns.
  - Investment returns and discount rates for reserve are related but need not be identical.

- Professionals other than actuaries also have expertise in this area, perhaps even more than actuaries. For example: financial analysts and economists.

- Transparency regarding who participates in gains and who shares in pain of losses.
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Modeling Interest Rates/Yield Curve: Stochastic Interest Generators

- Perhaps the key element in PBR work.
- Quite different from modeling mortality and lapse rates.
- Past history need not be a good indicator of future outcome.
- The two key assumptions:
  - Ultimate or “normal” level of interest rates
  - The speed of convergence to normal value
- Developments in external world – political, social, international – will be significant determinants of future interest rates: How do you model external developments?
What are we modeling?
- Risk free rates, or
- Spreads of investment grade bonds over risk free rates, or
- Return on junk bonds, or
- Interest rates in the U.S. or in Europe or in Japan. (Interest rates in the U.S. will be affected by what happens in the rest of the world.)
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Secular Stagnation, Negative, or Very Low Interest Rates and Insurance Company Operation

- The phenomenon of negative or very low (nominal) interest rates.
- A temporary development or something that may last for a long time?
- If not a temporary phenomenon, will your company be able to operate in low interest rate environment?
- What is happening to real interest rates?
- What is going on with the inflation rate?
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Ms. Frances Oldham Kelsey and Thalidomide Prescription Drug

Frances Kathleen Oldham Kelsey, CM (July 24, 1914 – Aug. 7, 2015) was a Canadian pharmacologist and physician. As a reviewer for the U.S. Food and Drug Administration, she refused to authorize thalidomide for market because she had concerns about the drug's safety.
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Kelsey received the President's Award for Distinguished Federal Civilian Service from President John F. Kennedy in 1962.
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Flight 1549 and Captain Chesley B. “Sully” Sullenberger
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- **The Enron Scandal:**