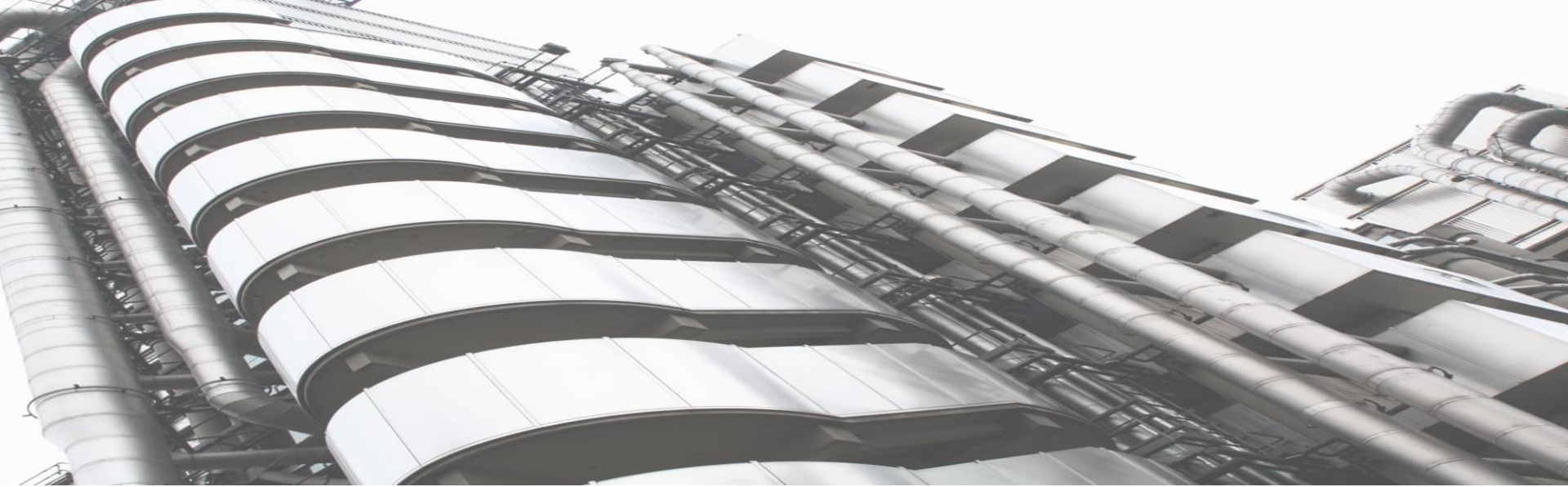

Parameter Error in the London Market
LMAG presentation – 26 March 2018

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Insight
Risk Consulting

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- Case study: Using expert judgement robustly

What is parameter error?

- Though language is not universal, parameter error is the uncertainty in the numbers used in any modelling exercise.
- This differs from model error and process error in most insurance paradigms.
- Parameters include both data and expert judgements. These are the variables in a programme or water in the pipe!
- And yes, don't forget about data… an expert judgement is often necessary but NOT sufficient to compensate for bad data.
- Use and inclusion of parameter error in our work is currently most prevalent in catastrophe modelling and some reserve risk methods.

Why is parameter error important?

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It affects real issues so as a concept it is important to understand.

When we use expert judgements within our work, using parameter error can help us make better decisions and adjust for credibility.

When the expert judgement is used directly, we need to communicate (in some way) the parameter error in those judgements.

POSITIVE OUTCOMES

Real issues

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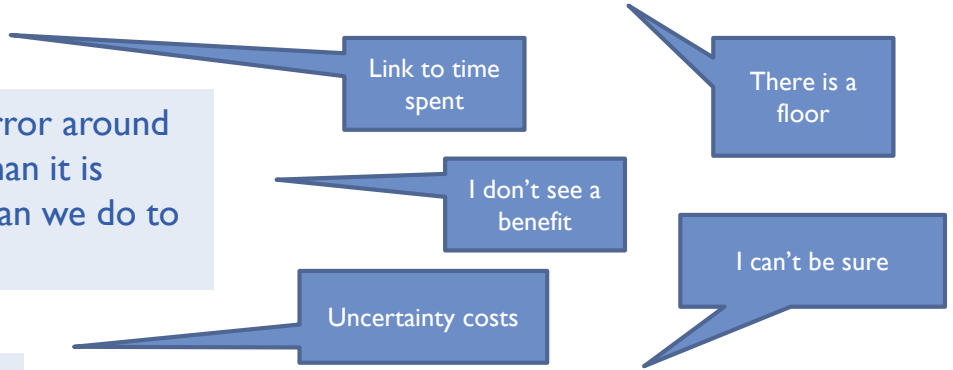
We are quickly asked to review the profitability of a sub-portfolio. We don't have the time to do as much as we'd like. What limitations are there in our work?

Everyone knows that our capital model correlation assumptions are very subjective. Is it worth trying to improve their accuracy?

In our capital model the parameter error around large claim severity is much greater than it is around large claim frequency. What can we do to improve our estimates?



We are choosing between providing capacity to one of two binders. One has provided a full history of their performance whilst the other has not. They both claim to be similar business with similar loss ratios. Which binder is riskier?

Ogden is material to our reserves. We don't currently have a good understanding of what may happen to the rate and then the potential impact. What work needs to be done? Is this parameter or process error anyway?...

Using parameter error

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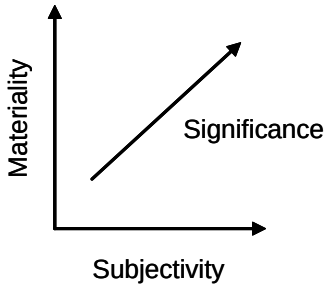
Use cases	Current practice	Recommendation
On-levelling	Historical rate and inflation indices are often subject to significant uncertainty. They are however often used in pricing and business planning work.	Parameter error should be considered in this exercise using appropriate credibility weights.
New lines of business	Underwriting and actuarial judgements are invaluable for new lines of business, but there is often no rigorous approach for considering their appropriateness.	As data becomes available, it is possible to gradually move away from judgemental prior estimates in a Bayesian framework.
Reserving with the Bornheutter-Ferguson	Reserving methods such as the BF bring in new parameters above the chain ladder, namely the IELR and use of development as a credibility weight.	What is the parameter error on the IELR vs the CL ultimate? Does the credibility weight (derived from the development factors) already reflect relative parameter error?
Stochastic reserving methods	Often included in standard methods e.g. Mack method and normal implementation of over-dispersed poisson bootstrap	The distinction between the parameter error and model error could be better understood in the more recognised models.
Catastrophe modelling	Secondary uncertainty in RMS is a type of parameter error.	Consider other areas of significant parameter uncertainty.
Case price a risk with limited data	Where there is little data to support the case pricing of a particular policy, using some kind of benchmark is likely.	There should be a sufficiently penal parameter error risk charge where data is poor, such that incentives to find / produce data increase.

Communicating parameter error

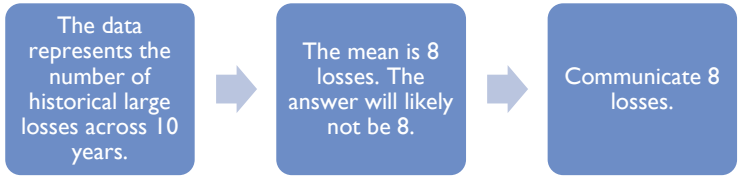
The difference between an actual and expected loss cost could be due to systemic or parameter error.

The difference between the real and assumed parameter is parameter error, whether a mean or standard deviation.

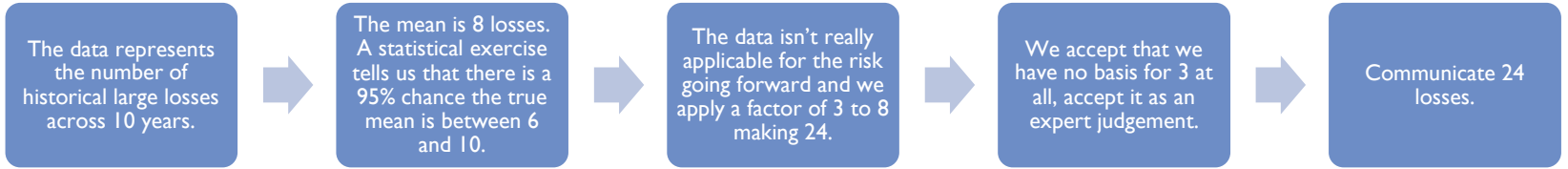
- This can be confusing as most non-statisticians will think the above two statements are essentially the same.
- This is standard error vs standard deviation – I had to remind myself of this a couple of years ago!
- Is standard error close to “a range of reasonable best estimates” and standard deviation close to “a range of possible outcomes”?
- I think about expert judgements in Solvency II. Standard error is a similar concept to subjectivity in the grid to the right.



Communicating parameter error



Is "24" better than "8"?



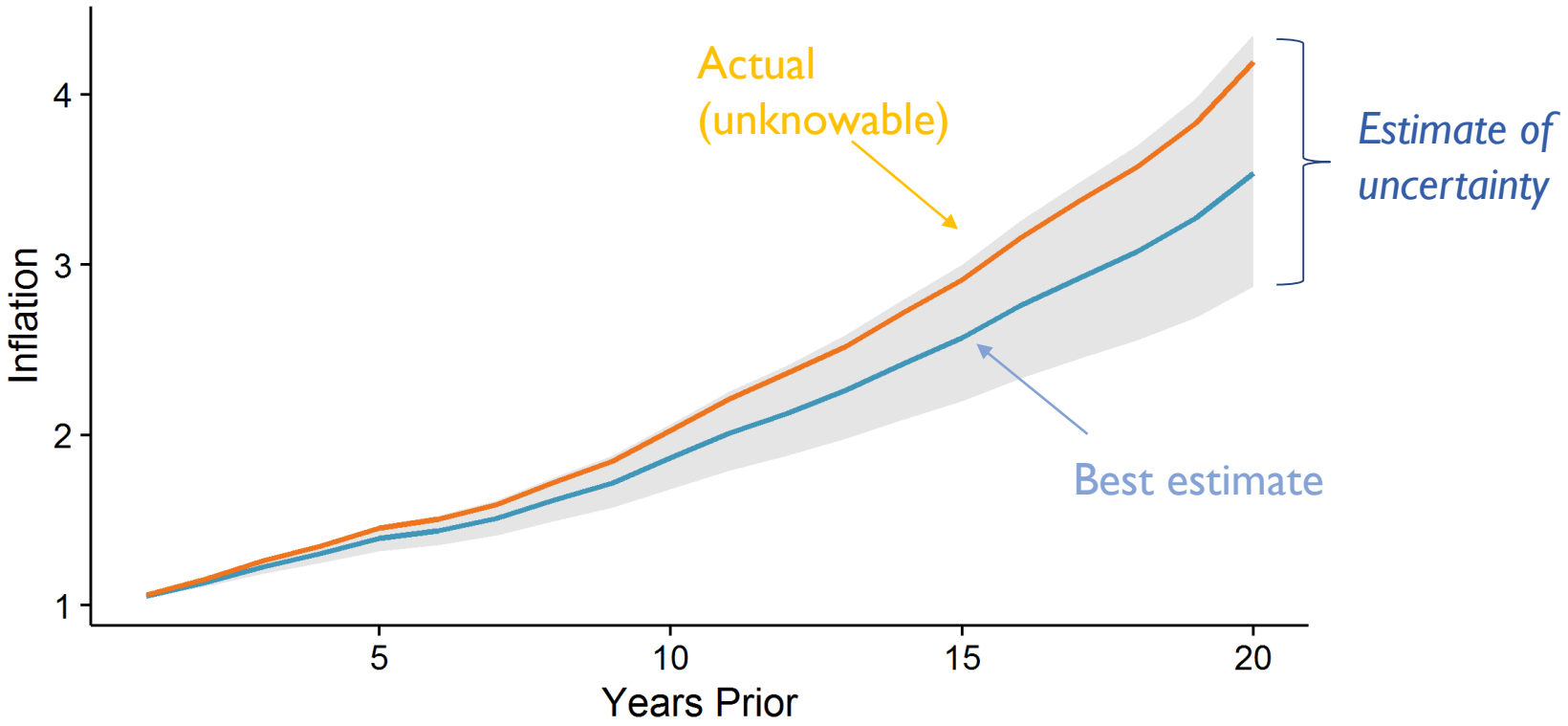
We are presented with some information that suggests some of the large losses weren't actually above the defined large threshold, and are asked to revise the analysis. What do we do?

The **significant** expert judgment is the scaling factor and this is where the focus should be.

Inflation adjustment

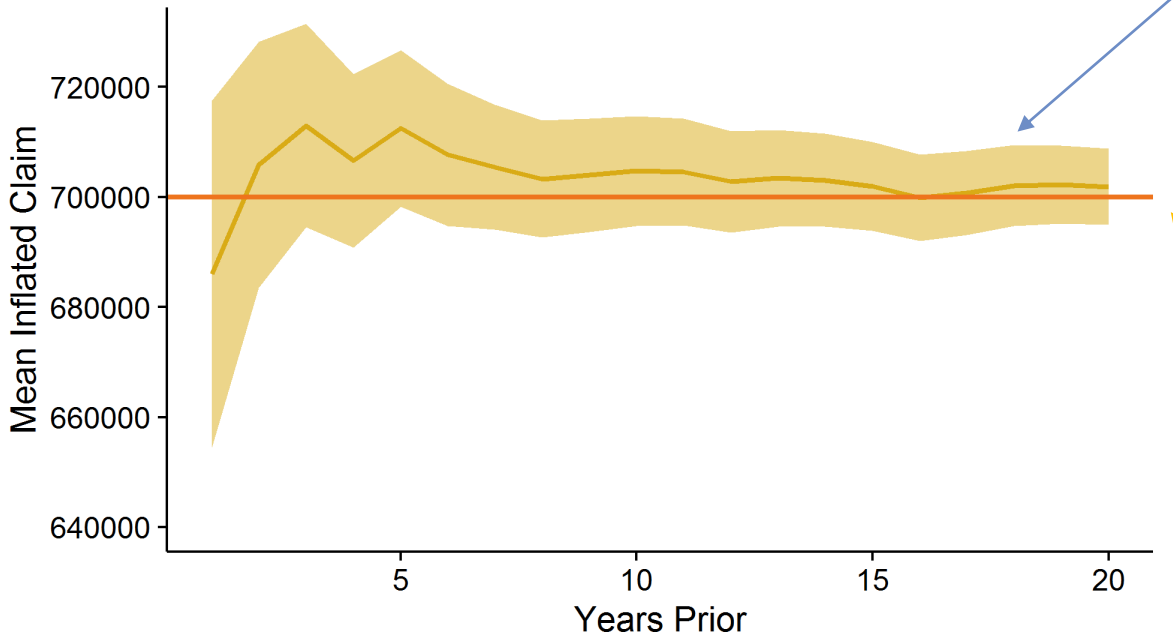
- Past claims need to be on-levelled, making assumptions about inflation.
- Those inflation figures are parameters in the subsequent model, and are subject to uncertainty.
- Here we estimate the mean of a claim severity distribution, subject to inflation uncertainty.
- Low number of claims per year, so previous years data is important, but we know the further back we go, the greater the inflation uncertainty.

Inflation


Actual
(unknowable)
Estimate of
uncertainty
Best estimate
Inflation
4
3
2
1
5
10
15
20
Years Prior

Effect on estimate of mean severity

(~5 claims per year)

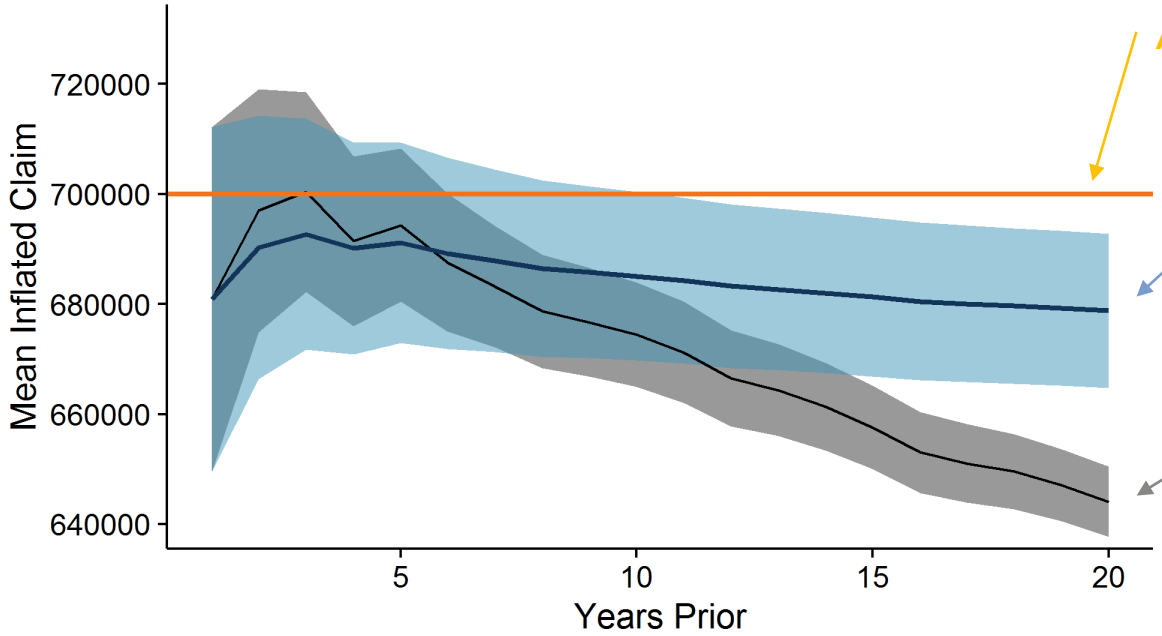


If you knew actual inflation (average and range from 200 simulations of claims history)

Actual underlying mean

Effect on estimate of mean severity

(~5 claims per year)



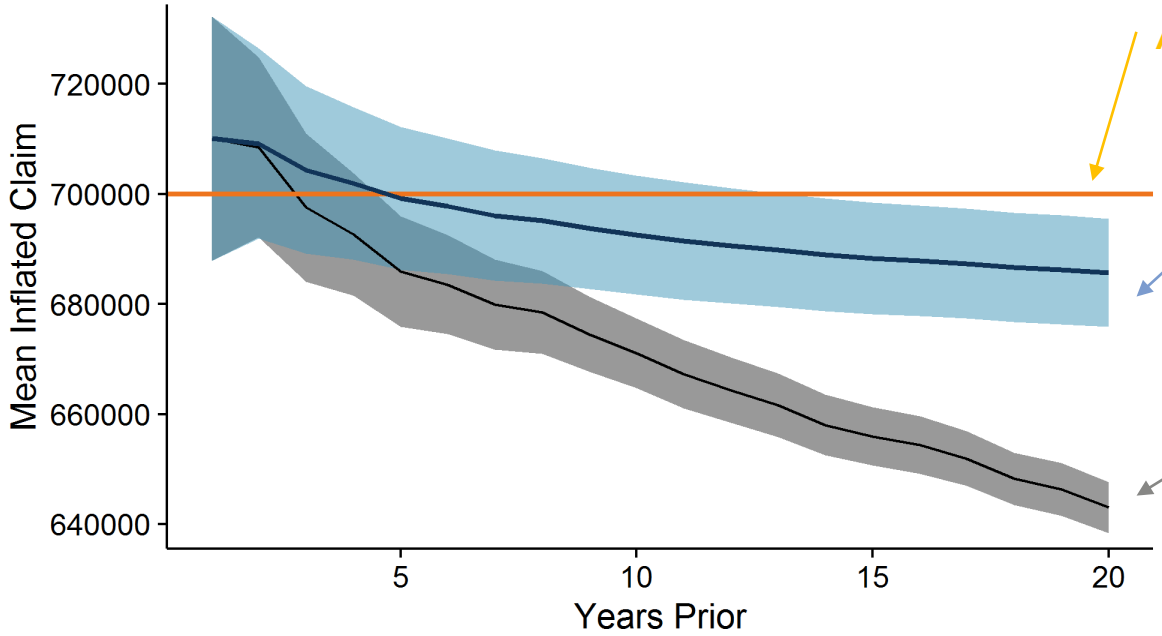
Actual underlying mean

Weighting average by uncertainty in inflation adjustment

Just using "best estimate"

Effect on estimate of mean severity

(~10 claims per year)



Actual underlying mean

Weighting average by uncertainty in inflation adjustment

Just using "best estimate"

Bayesian inference and expert judgement

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- The insurance industry puts a lot of weight on “expert judgement”.
- If an expert can estimate a number, they should also be able to estimate their certainty about that number – parameter error.
- When should expert judgement give way to data driven analysis?
- Bayesian methods with *subjective priors* represent a natural way to update an expert’s prior belief given new data

Example

- An insurer wants to write a new line of business, in which they have no prior experience.
- Q.) How to price?

  A.) Get an expert! Hire someone with prior experience in a similar field. They believe that claims costs will be well modelled by a Pareto distribution (here), and estimate a distribution based on their expected mean claims cost.
- Over the next few years, claims data comes in. Pareto distributed data is likely to fluctuate substantially – at what point do you change your price?

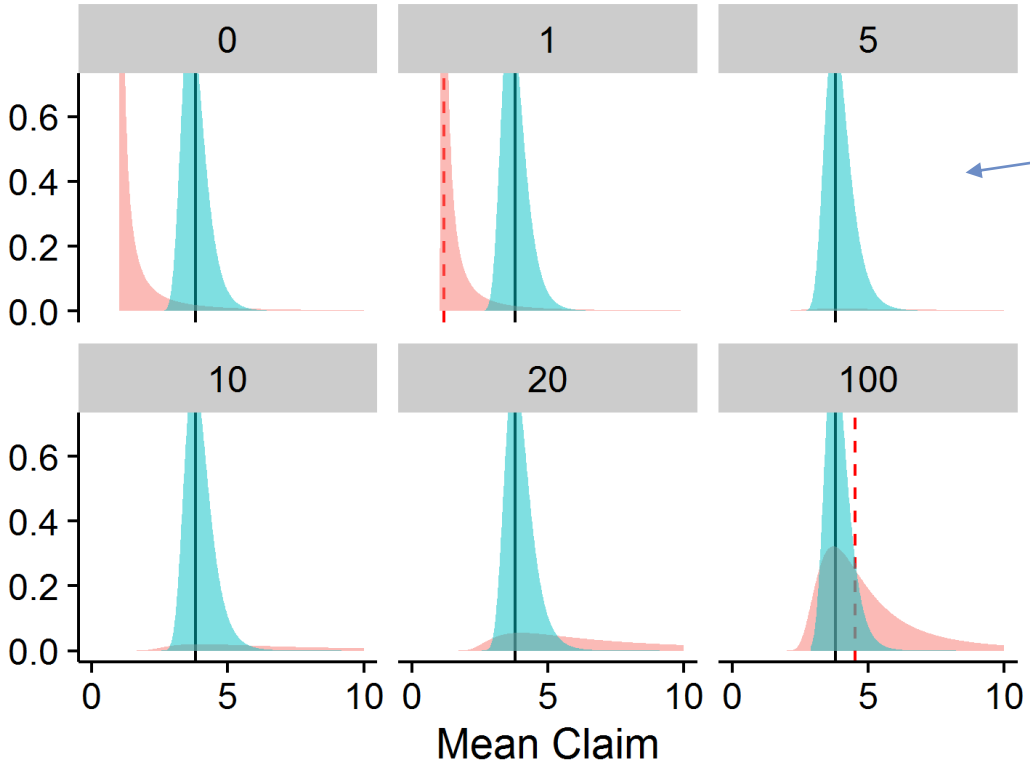
A Bayesian way

- The expert has some idea what they expect the loss cost to be. That is a *prior belief.* The expert should also be able to estimate how strong that belief is (e.g., upper and lower estimates at given confidence for the mean claims cost).
- That can be formulated as a *subjective* prior distribution (on the parameters governing the claims distribution).
- (Normally you use non-informative priors in Bayesian inference – to avoid biasing the data – here we *want* the expert's bias)

A Bayesian way (cont)

- As data is obtained, we update the prior distribution, given the data, to get a posterior distribution – using Bayes rule:
  - $P(k|Data) \propto P(Data|k)P_{prior}(k)$
  - Here k is the shape parameter of the Pareto distribution
- In this case, the calculation is analytic (no stochastic modelling required)

The result

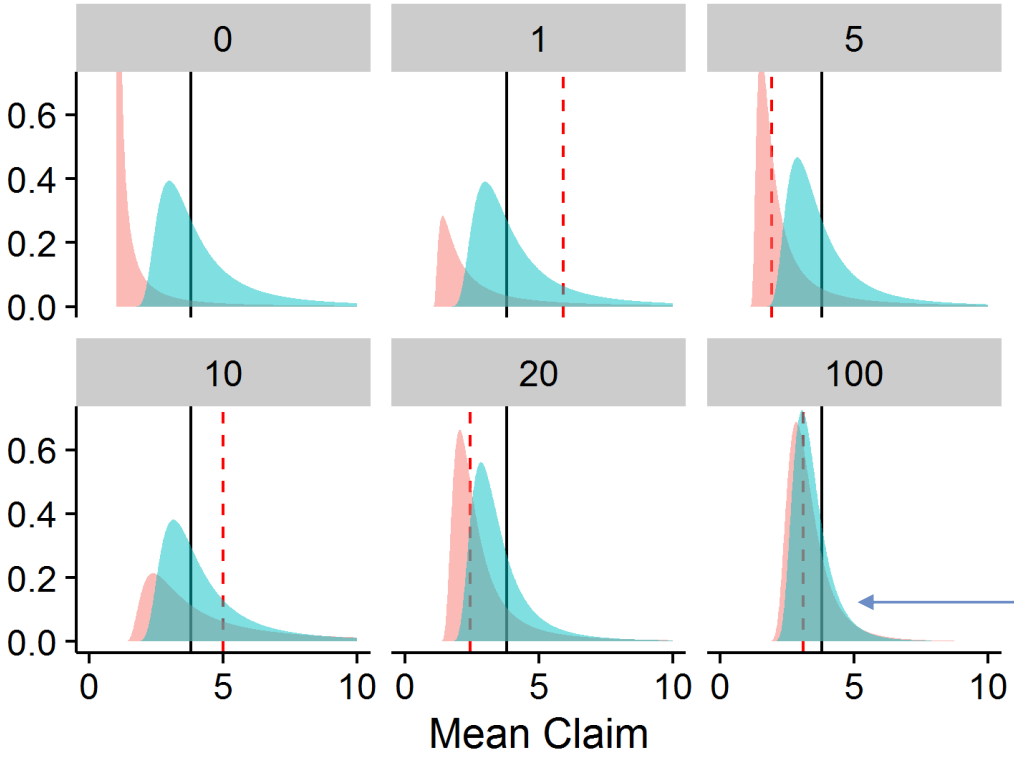


Good expert judgement means that distribution is close to actual, even with few claims

How good is the expert?

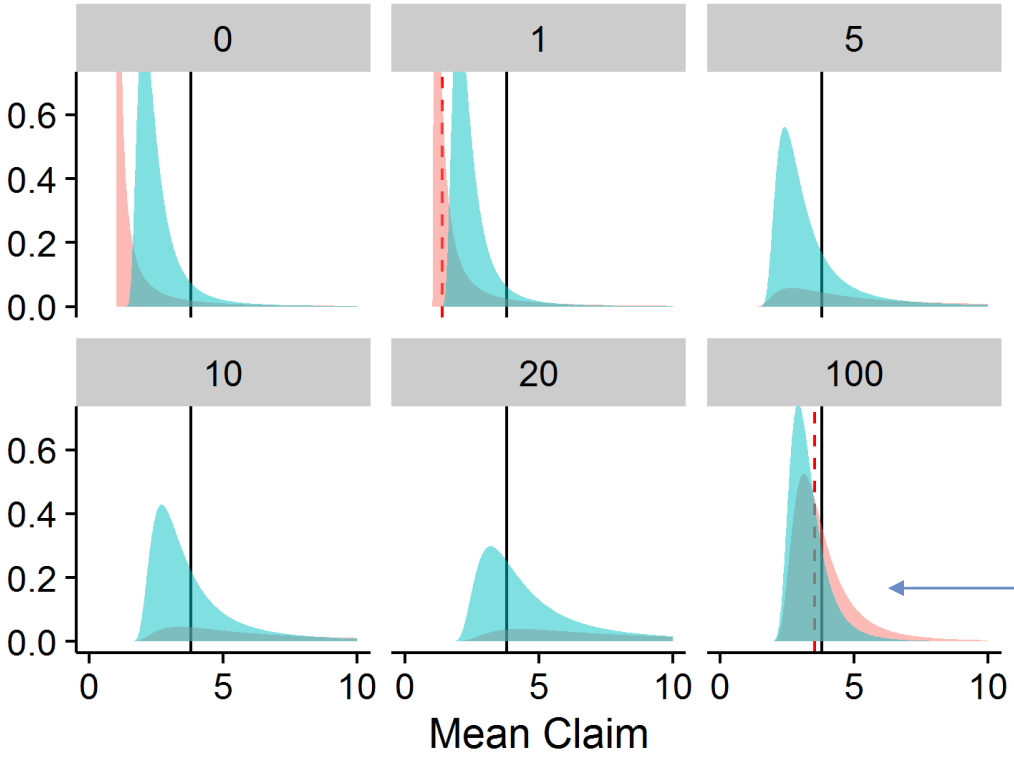
- Of course, the subjective prior only helps if it is accurate – as in previous case. The more precise it is while being accurate, the more help.
- If the expert is wrong, it will take more data to overwhelm that expert judgement.

Accurate, not precise



Expert judgement doesn't help so much as it's not very precise

Precise, not accurate



Expert judgment prior is slower to converge to actual

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POSITIVE OUTCOMES

Questions….

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