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Parameter Error in the London Market

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04 October 2017

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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 systemic error in most insurance paradigms.
- Borrowed from the capital modelling world, parameters include both data and expert judgements. These are the variables in a programme or water in the pipe!

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Why is parameter error important?

It will better charge for uncertainty at contract or portfolio level.

Actuaries need to think more about data inadequacies.

Clearer communication of ‘significant’ and not just ‘material’ assumptions would be a step forward.

POSITIVE OUTCOMES

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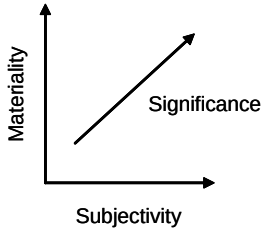
Understanding parameter error

- Deja vu
  - Is this the same as material assumptions and limitations in reserving work?
  - This feels like the Solvency II ‘expert judgement’ conversation
- Parameter error
  - It is easily sensitivity tested in most calculations (unlike model error)
  - should be a core part of the “range of reasonable best estimate” and “range of possible outcomes” conversation
  - can be prioritised by significance which is materiality and subjectivity



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Current market practices

- Capital modelling – This should be in our distributions (just to be difficult, there is often parameter error in our variability assumptions).
- Pricing – This could be charged for in a technical premium.
- Reserving – This should be an important part of our communication.
- Risk – This should be measured, monitored and mitigated.

Current market practices

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.
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.

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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.

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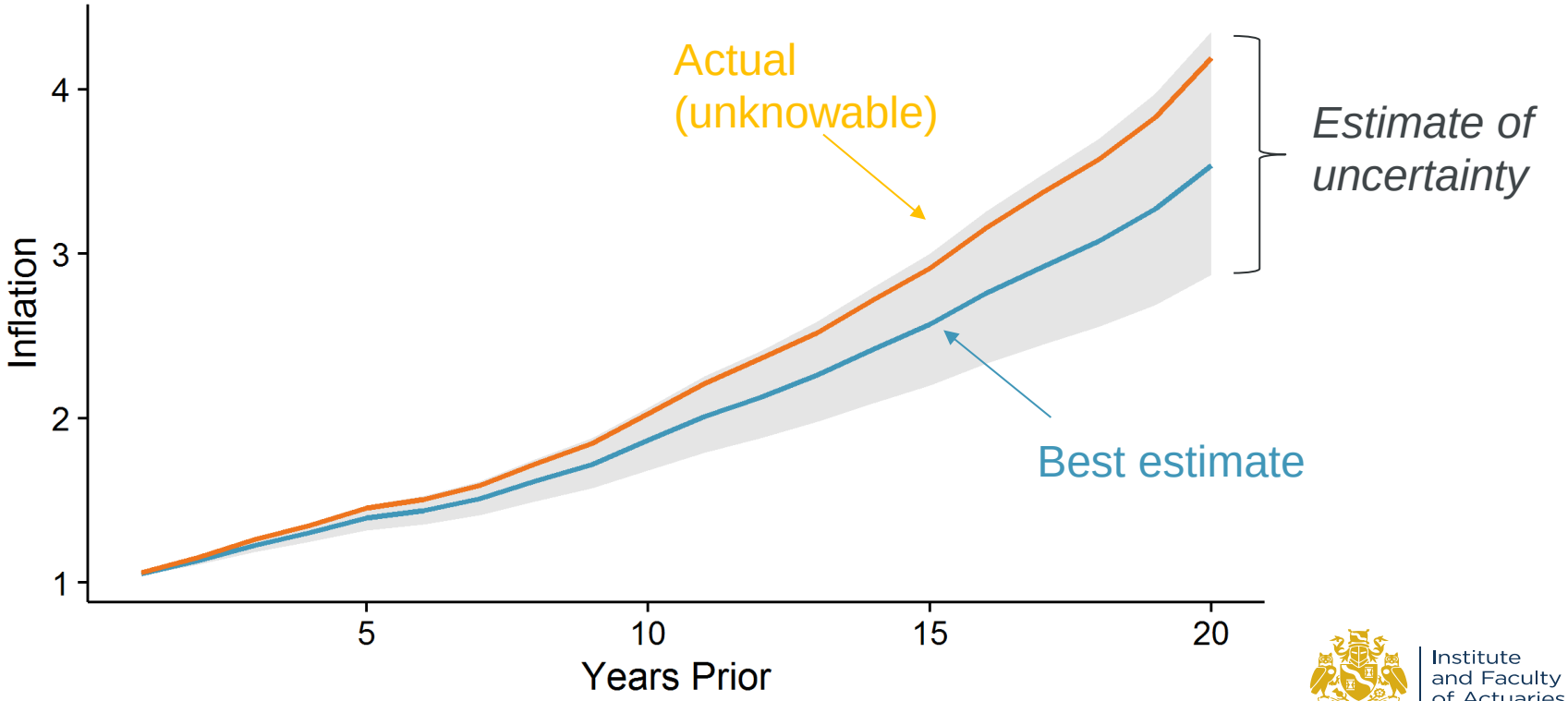
Inflation



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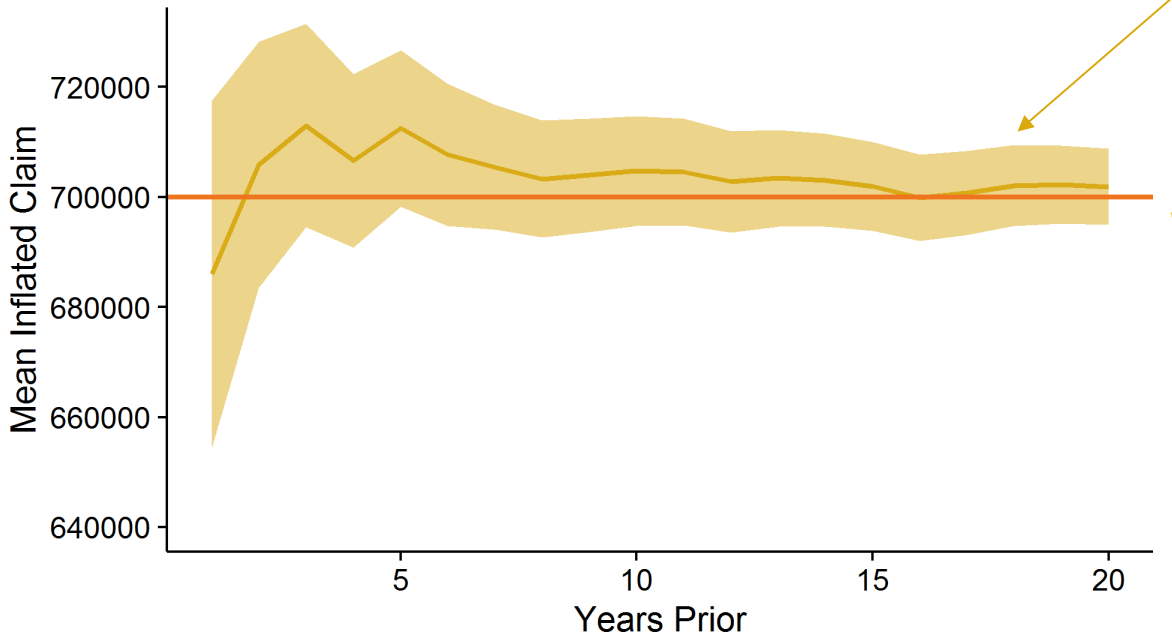
Effect on estimate of mean severity

(~5 claims per year)



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

Actual underlying mean

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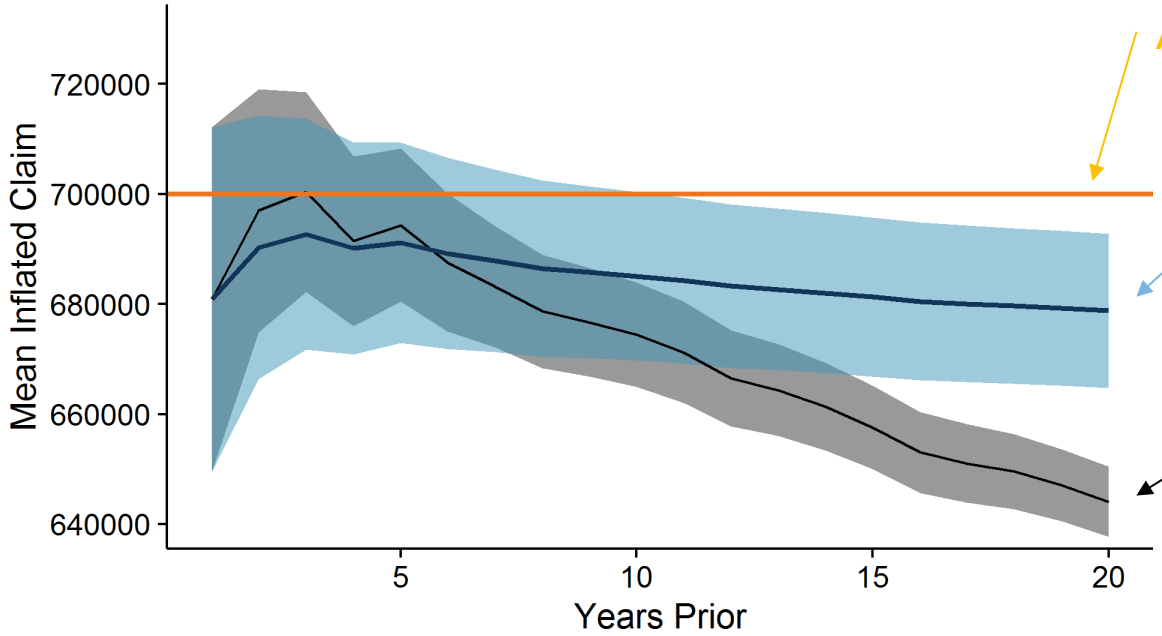
Effect on estimate of mean severity

(~5 claims per year)



Actual underlying mean

Weighting average by uncertainty in inflation adjustment

Just using “best estimate”

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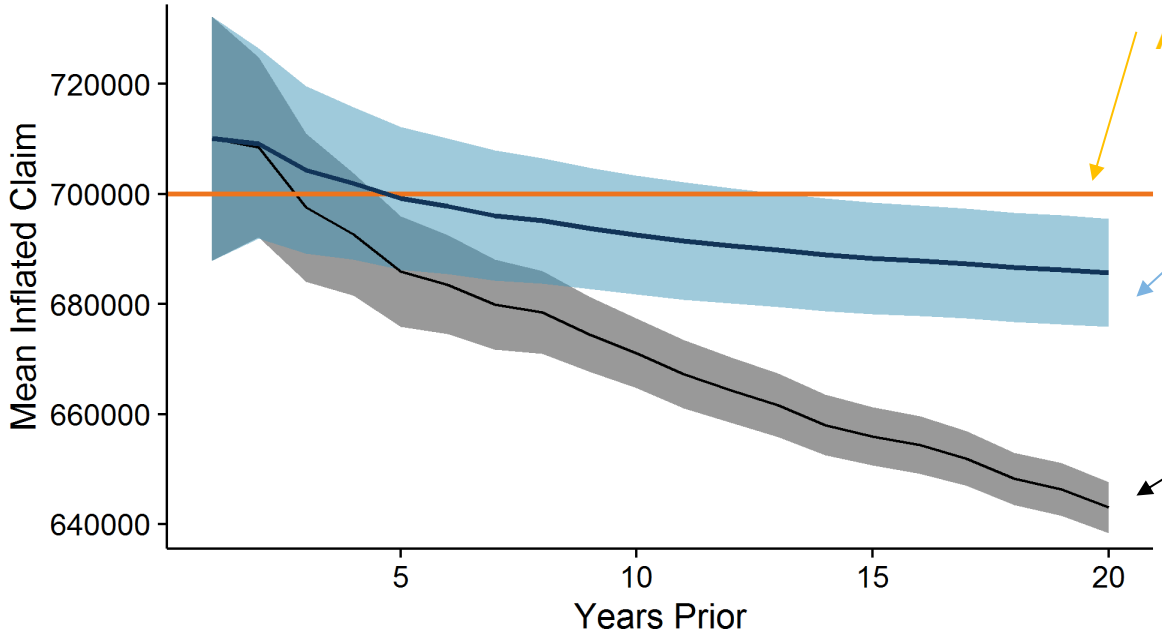
Effect on estimate of mean severity

(~10 claims per year)



Actual underlying mean

Weighting average by uncertainty in inflation adjustment

Just using “best estimate”

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Bayesian inference and expert judgement

- 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

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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)

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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)

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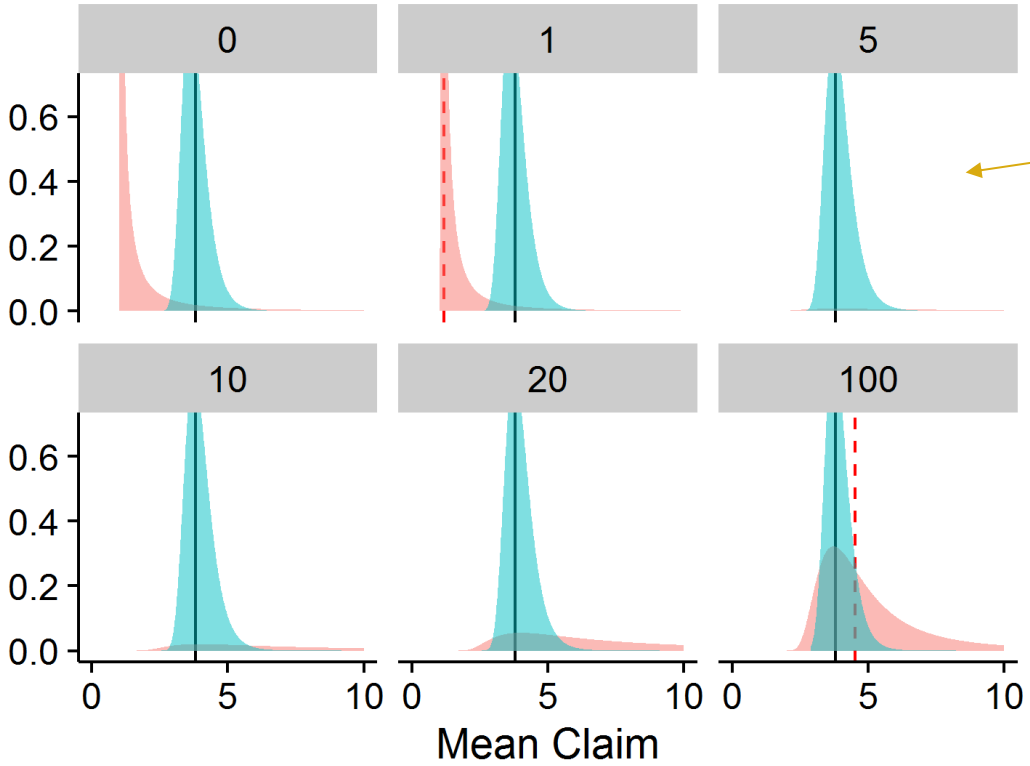
The result



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

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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.

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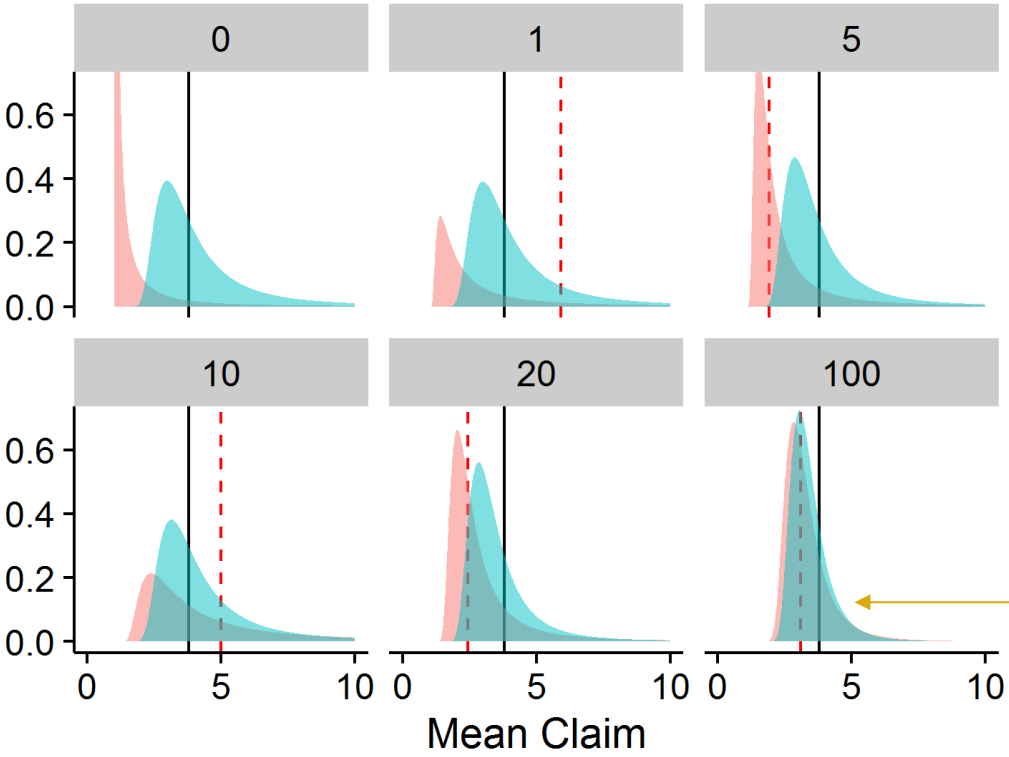
Accurate, not precise



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

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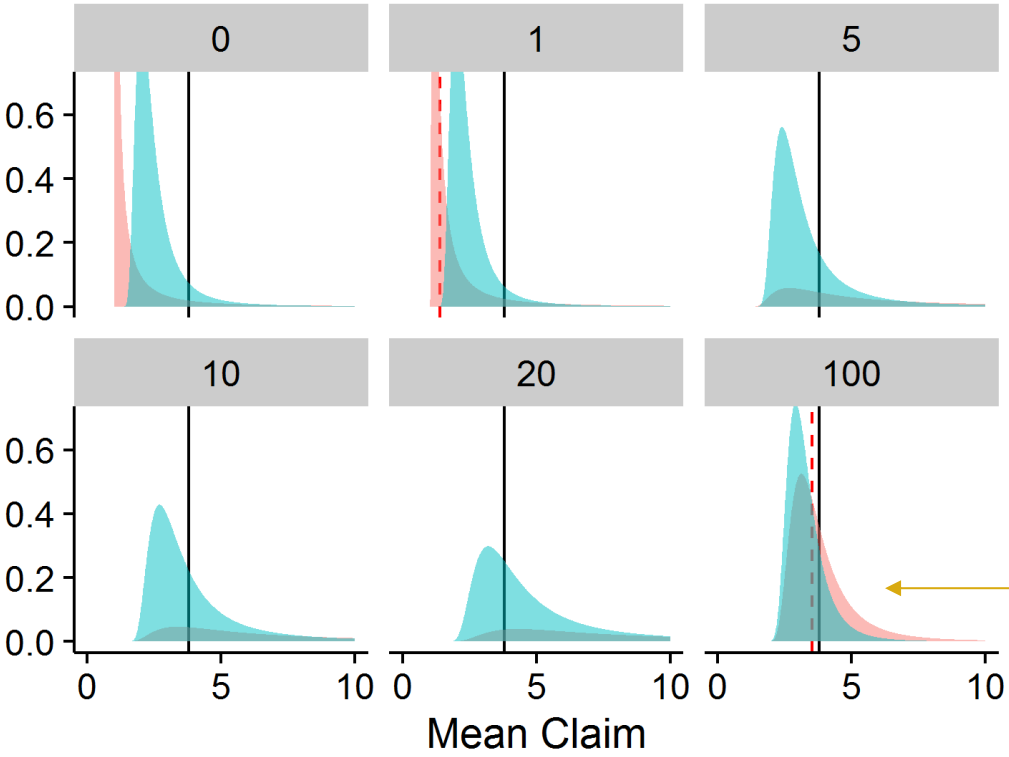
Precise, not accurate



Prior

Non-informative (Jeffreys)

Subjective (Expert)

Expert judgment prior is slower to converge to actual

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Why is parameter error important?

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POSITIVE OUTCOMES

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THE SEQUEL…

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