AARHUS UNIVERSITY

Methods 2 - 3

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Sampling distributions and generative models

- Sampling and measurement as different points of view
- Three sources of error
  - Sampling error
  - Measurement error
  - Model error

Estimates

- Parameters: unknown quantities (example: regression model)
- Estimand: a parameter to be estimated from data
- Standard errors represent estimation uncertainty
- Square-root-of-number-of-observations law

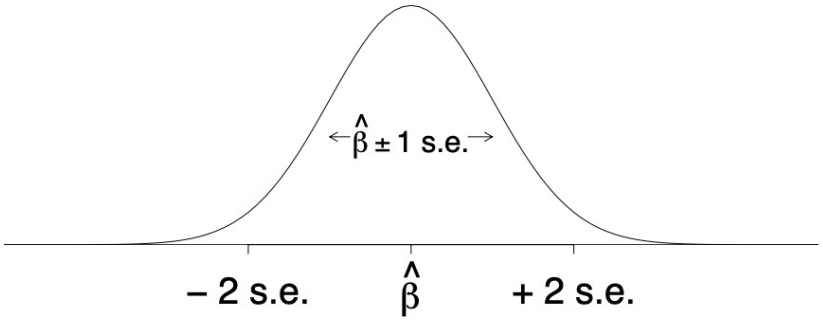

Figure 4.1 *Distribution representing uncertainty in the estimate of a quantity of interest β. The range of this distribution corresponds to the possible values of β that are consistent with the data. In this case, we have assumed a normal distribution for this sampling distribution and therefore we have assigned an approximate 68% chance that β will lie within 1 standard error (s.e.) of the point estimate, $\hat{\beta}$, and an approximate 95% chance that β will lie within 2 standard errors. Assuming the model is correct, it should happen only about 5% of the time that the estimate, $\hat{\beta}$, falls more than 2 standard errors away from the true β.*

Confidence intervals

- Hard to interpret!
- Many who work with them don't know the correct interpretation

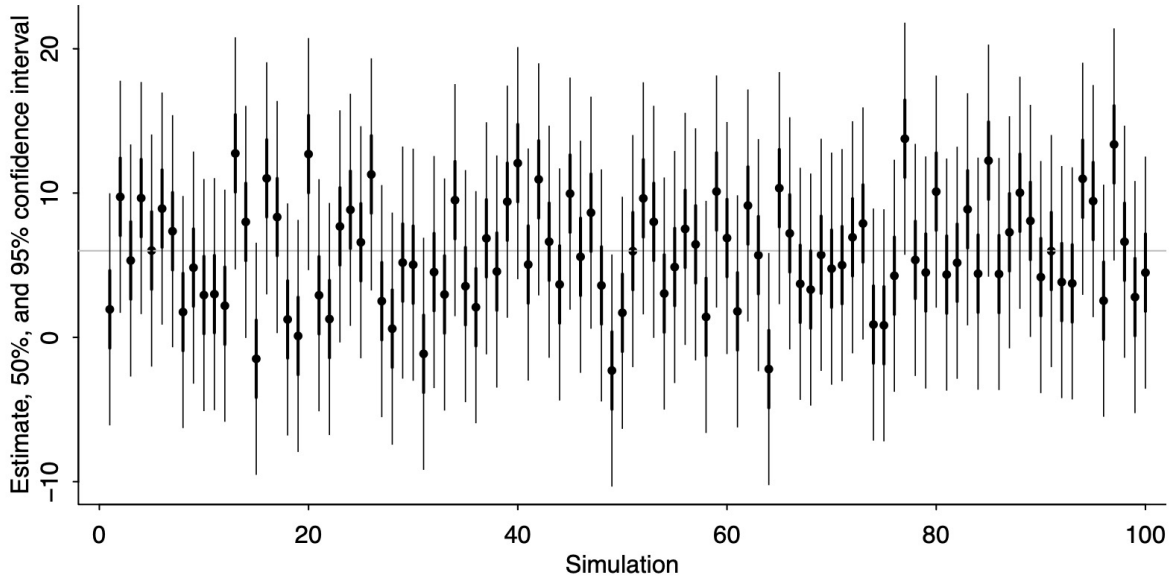

Figure 4.2 *Simulation of coverage of confidence intervals: the horizontal line shows the true parameter value, and dots and vertical lines show estimates and confidence intervals obtained from 100 random simulations from the sampling distribution. If the model is correct, 50% of the 50% intervals and 95% of the 95% intervals should contain the true parameter value, in the long run.*

Hypothesis testing and statistical significance

- Classical statistics: null hypothesis significance testing
- Type 1 and type 2 errors (old concept)
- Type M and type S errors (new concept)

- Problems with statistical significance:
  - Statistical significance is not practical importance
  - Non-significance is not the same as zero
  - The difference between significant and non-significant may not be significant
  - Researcher degrees of freedom, p-hacking, forking paths
  - The statistical significance filter

Sampling

- Has become cheap and easy
- Is needed to understand your model
- Before fitting and after
- Summarizing a sample
- Median and median absolute deviation (MAD)