A mystery story: Why has Bayesian Analysis been used so little?

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Is prediction sacrilegious?

- Statistics started as analysis of history – the study of frequencies of past events.
- Thomas Bayes proposed that probability formulas could predict future events.
- But one reaction was that only God knows what will happen in the future, so predictions infringe on God's domain.
- A second reaction was that probabilities are ideas in people's brains – subjective phenomena. Very controversial!

Ronald Fisher produced a revolution

- **Around 1920, Bayesian analysis required much knowledge of algebra and elaborate computation.**
- **Fisher created a method that required no algebra and little computation – relevant numbers come from tables.**
- **NHSTs became universal successes. Everyone studies them and uses them. Journals require them.**
- **But serious deficiencies and complaints.**

World War II showed the power of Bayesian analysis

- **Statisticians used Bayesian analyses to break the German and Japanese secret codes,**
- **and to predict the locations of submarines at sea.**
- **British military assigned hundreds of people to making statistical analyses.**

Bayesian analysis once had enthusiastic support from prestigious business schools

- During the 1960s, professors at Harvard and Chicago urged business schools to teach Bayesian analysis to MBA students.
  - They produced books and teaching materials.
- But, their efforts failed, and Bayesian analysis did not become mainstream in business education, business research or the social sciences.

Why Bayesian analyses failed

1. **Bayesian analyses relied on users' understanding of algebraic formulas. Neither MBA students nor researchers were comfortable with reliance on algebra.**
2. **Prior distributions, data distributions, and posterior distributions had to be mutually compatible. Books listed combinations from which users could choose.**

This failure was disappointing

- **Bayesian posterior distributions provide much better information than do statistical significance tests.**
- **Prior distributions describe the uncertainty of hypotheses.**
- **Posterior distributions describe the uncertainty of inferences.**
- **Prior distributions can make inferences more accurate.**

Two current challenges for use of Bayesian statistics

1. **Statisticians at most universities have not promoted Bayesian methods.**
   - **Bayesian statisticians have been concentrated at just a few universities (Cambridge, Duke).**
2. **Social scientists are familiar with NHSTs tests.**

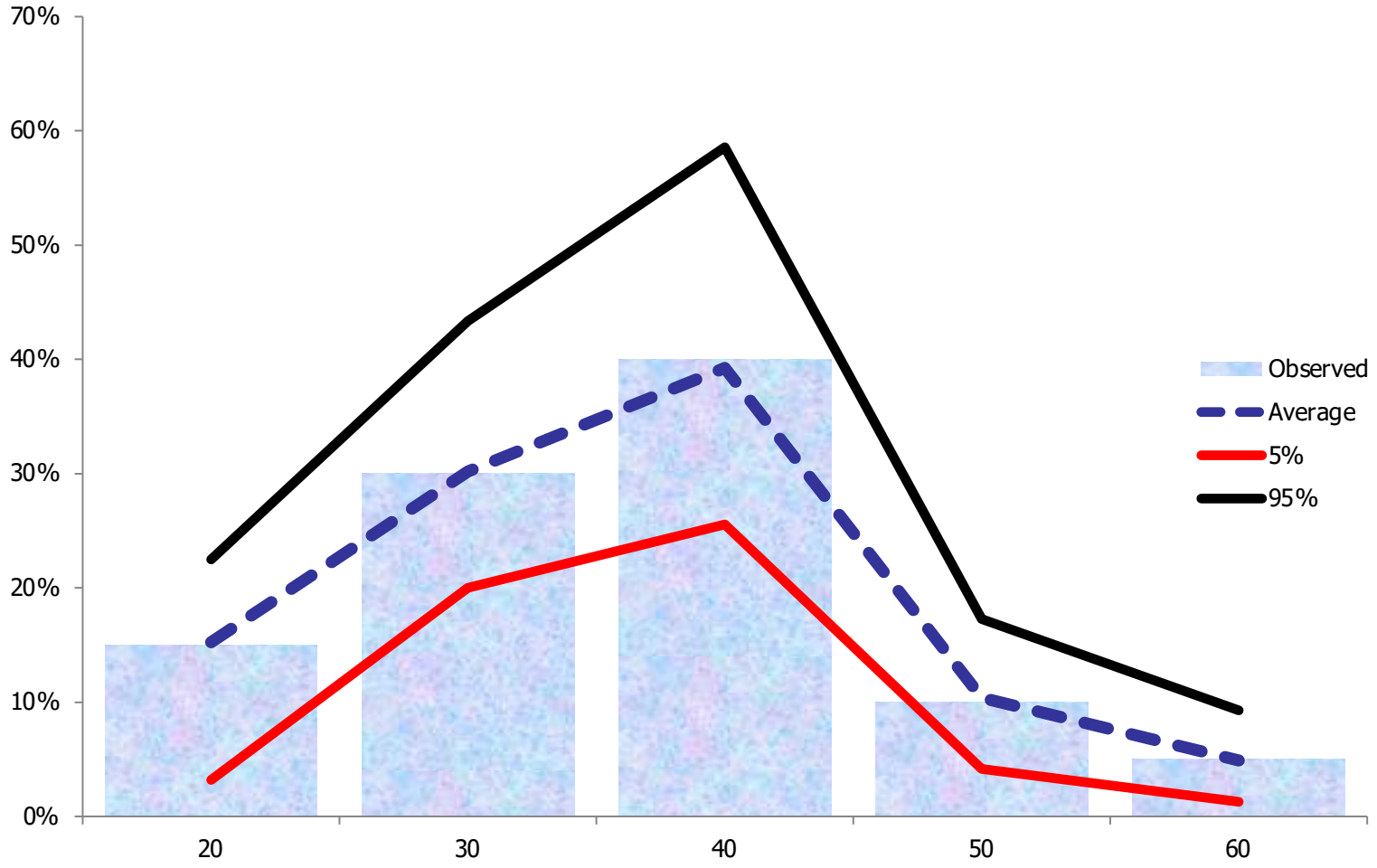
Change started around 1970

- **Books about Bayesian statistics:**
  - **In 200 years, 1769 to 1969, only 15 books**
  - **In 20 years, 1970 to 1989, 30 books**
  - **In 10 years, 1990 to 1999, 60 books**
- **Bayesian methods have become prevalent in electrical engineering, insurance, and educational testing.**
- **Doctoral students in business have been taking classes in other schools.**

Faster computers have made algebra unnecessary and numerical calculation feasible

- Today's computers are fast enough to translate distributions into thousands of specific examples.
  - This numerical approach can accommodate all kinds of distributions.
- An optional advantage: The numerical approach makes it possible to "bootstrap" the data you actually have instead of making assumptions about unobserved data.

Example: Bootstrapping to estimate confidence intervals from small samples (20 observations, 100 resamples)



Available software

WinBugs	**Google "winbugs"**	**Low-level programming language: Software free from University of Cambridge. Supports bootstrapping.**
BugsXLA	**Google "BugsXLA"**	**Free add-in for Excel. Provides Excel interface for WinBugs analyses of linear models: Available from University of Cambridge or philwoodward.co.uk.**
Stata	**Google "Stata"**	**Many universities have site licenses. Supports bootstrapping.**
SAS/STAT	**Google "SAS"**	**Many universities have site licenses.**
R	**Google "R-project"**	**Low-level language: Software free from the R-project.**
Instructions		***The BUGS Book: A Practical Introduction to Bayesian Analysis***