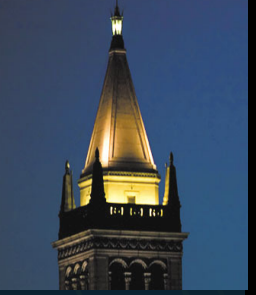


DS 102: Data, Inference, and Decisions

Lecture 11

Ani Adhikari

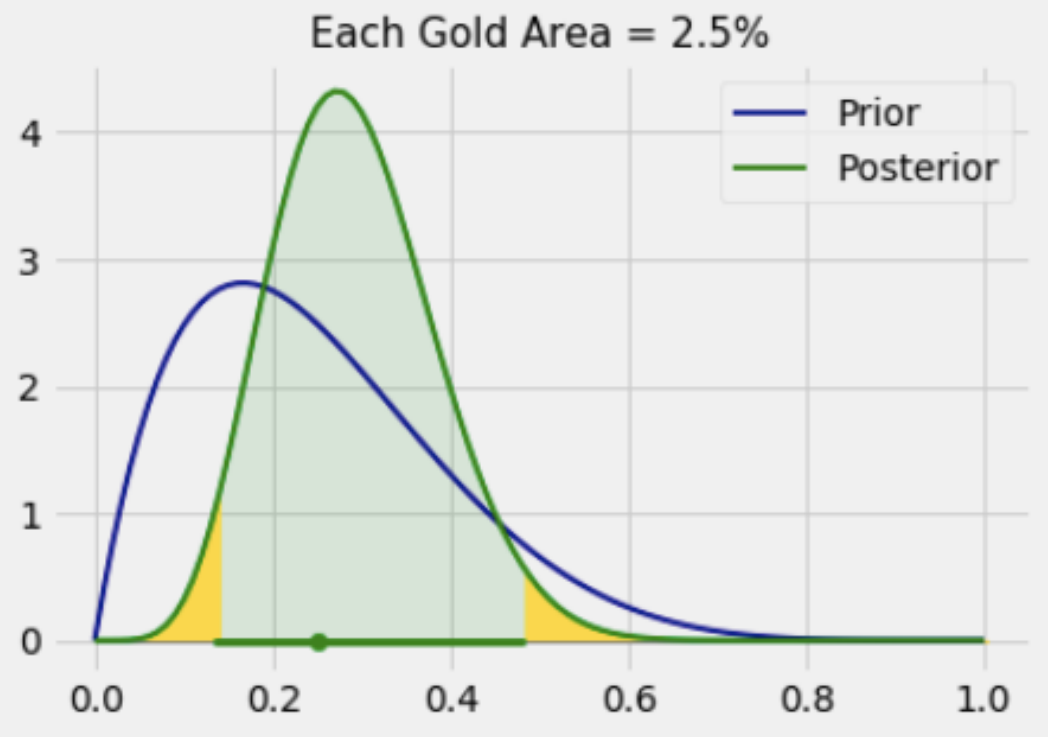
University of California, Berkeley

Intervals for Estimation: Confidence and Credible

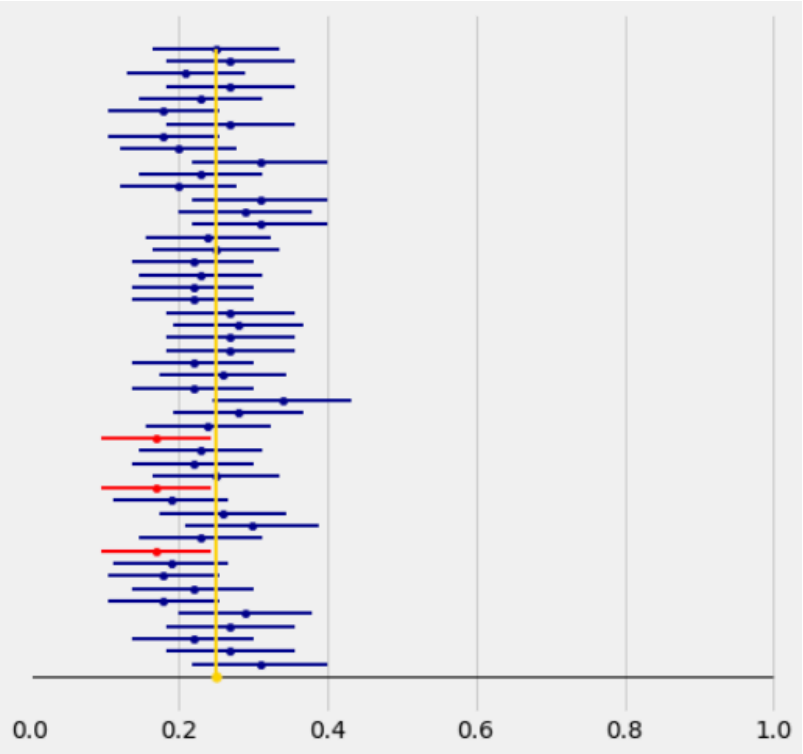
Two Perspectives

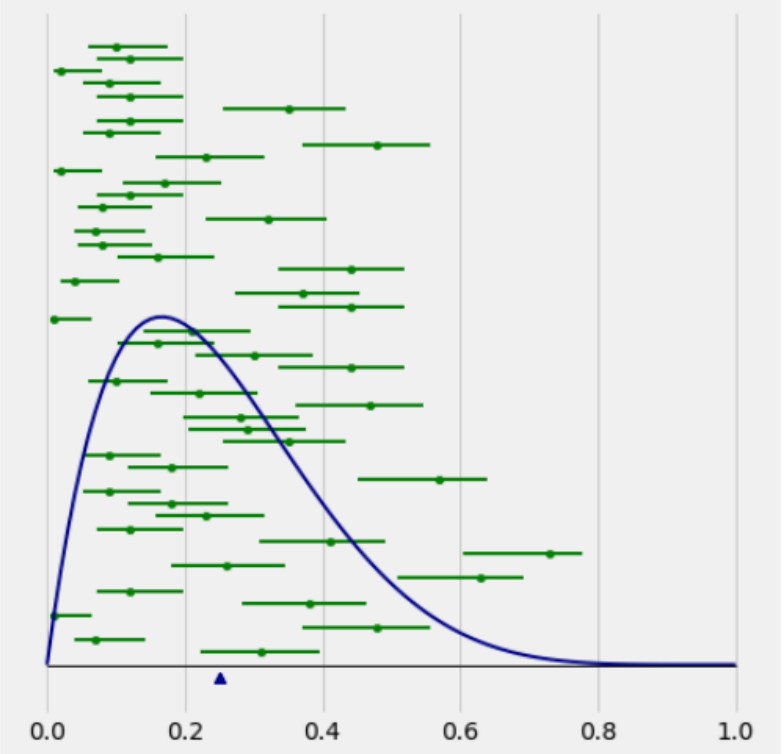
- Bayesian perspective
  - conditional perspective--inferences should be made conditional on the actual observed data, not on possible data one could have observed
  - natural in the setting of a long-term project with a domain expert
  - the optimist---let's make the best use possible of our sophisticated inferential tool
- Frequentist perspective
  - unconditional perspective---inferential procedures should give good answers in repeated use
  - natural in the setting of writing software that will be used by many people for many problems
  - the pessimist--let's protect ourselves against bad decisions given that our inferential procedure is a simplification of reality

95% Credible Interval



Comparison





Discussion Question

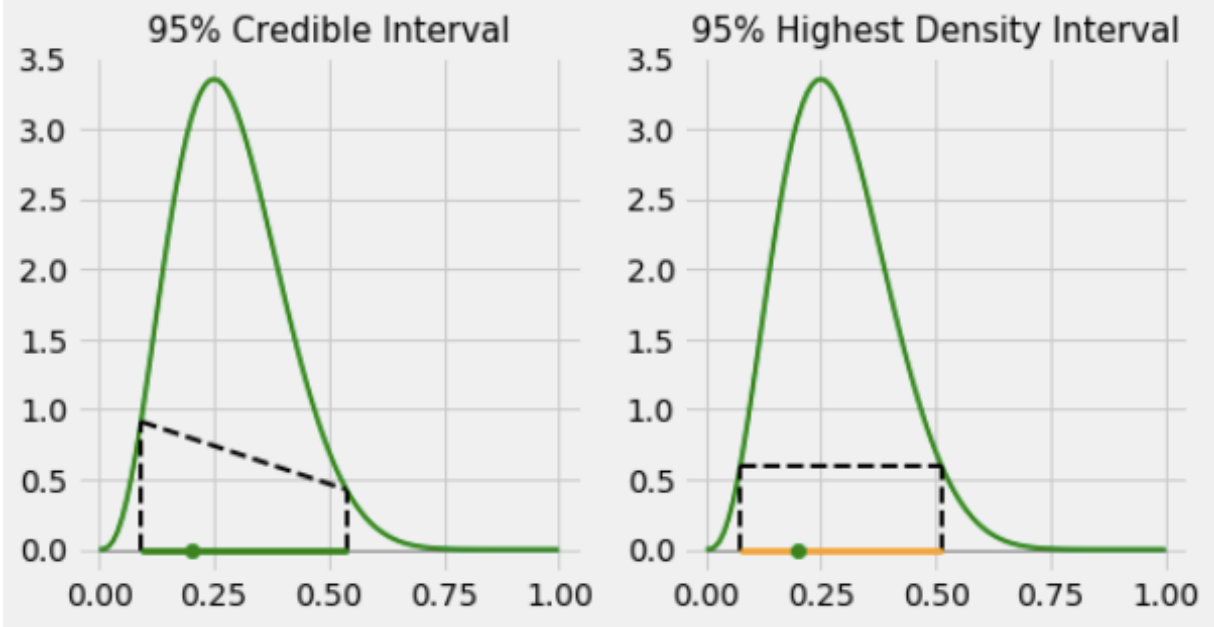
- You want to buy an item online
- It's a new item and there are only two sellers, neither of which has a long track record of sales
- You don't know anything about the sellers except for their ratings:
  - Seller A: 9 satisfied, 1 unsatisfied
  - Seller B: 5 satisfied, 0 unsatisfied
- How would you choose?

Highest Density Interval (HDI)

Posterior:
Beta (4, 10)

Credible Interval:
(.091, .538)

HDI: (.075, .515)



2011: Banned in UK Courts

Law

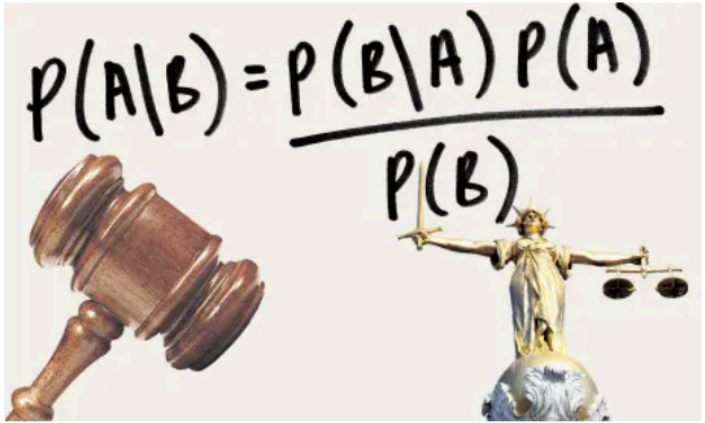
A formula for justice

Bayes' theorem is a mathematical equation used in court cases to analyse statistical evidence. But a judge has ruled it can no longer be used. Will it result in more miscarriages of justice?

Angela Saini

Sun 2 Oct 2011 16.30 EDT

87 69



Bayes' theorem. Photograph: guardian.co.uk

It's not often that the quiet world of mathematics is rocked by a murder case. But last summer saw a trial that sent academics into a tailspin, and has since swollen into a fevered clash between science and the law.

https://www.theguardian.com/law/2011/oct/02/formula-justice-bayes-theorem-miscarriage

2012: Against Credible Intervals

AAPOR

American Association for Public Opinion Research

THE LEADING ASSOCIATION OF PUBLIC OPINION AND SURVEY RESEARCH PROFESSIONALS

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Understanding a "credibility interval"

October 7, 2012

AAPOR Statement: Understanding a "credibility interval" and how it differs from the "margin of sampling error" in a public opinion poll

Summary:
AAPOR urges caution in the interpretation of a new quantity that is appearing with some nonprobability opt-in, online polling results – the ***credibility interval***. The credibility interval is not the margin of sampling error (MOE) that the public has come to understand as the statistical uncertainty of probability based scientific polls. Instead, credibility

Publications/Media

AAPOR Publications

AAPOR Newsletter

AAPOR Press Releases

https://www.aapor.org/Publications-Media/Public-Statements/Understanding-a-credibility-interval%E2%80%9D.aspx

2012: For Credible Intervals

Ipsos Public Affairs

Credibility Intervals for Online Polling

Ipsos Reid is moving away from the use of "classical" margins of error to demonstrate confidence in the accuracy of our online polling results. We have adopted Bayesian Credibility Intervals as our standard for reporting our confidence in online polling results.

https://www.ipsos.com/sites/default/files/2017-03/IpsosPA_CredibilityIntervals.pdf

2019: Never Mind

https://www.ipsos.com/en/about-us

World War II Estimation Problem

https://www.flickr.com/photos/dougsheley/3078954291/

Accuracy of Allied Estimates

Month	Statistical estimate	Intelligence estimate	German records
June 1940	169	1,000	122
June 1941	244	1,550	271
August 1942	327	1,550	342

Solutions

Model: Observed serial numbers are *k* draws made at random without replacement from 1, 2, 3, … *N* where *N* is unknown.

Frequentist approach: *N* is unknown but fixed. Use

$$\hat{N} = Y_{(k)} + \frac{Y_{(k)} - k}{k} \quad \text{where } Y_{(k)} \text{ is the sample max}$$

Bayesian approach: *N* is a random variable; put a prior on *N* (often taken to be uniform on an interval of integers) and construct a credible interval or HDI.