# Frequentist Approach to Statistics

$P(D|H)$ Probability of seeing this data, given the (null) hypothesis

# Bayesian Approach to Statistics

$P(H|D)$ Probability of a given outcome, given this data

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# Differences Between Bayesians and Non-Bayesians
# What is Fixed?

**Frequentist**

- Data are a repeatable random sample
  - there is a frequency
- Underlying parameters remain constant during this repeatable process
- Parameters are fixed

**Bayesian**

- Data are observed from the realized sample.
- Parameters are unknown and described probabilistically
- Data are fixed

http://www.stat.ufl.edu/~casella/Talks/BayesRefresher.pdf

# Bayes' Theorem

$$P(A|B) = \frac{P(B|A)\,P(A)}{P(B)}$$

A key benefit: The ability to incorporate prior knowledge

*A key weakness: The need to incorporate prior knowledge*

# Matthews 1998

"…different people could use Bayes's Theorem and get different results"

"Faced with the same experimental evidence for, say, ESP, true believers could use Bayes's Theorem to claim that the new results implied that telepathy is almost certainly real.

Skeptics, in contrast, could use Bayes's Theorem to insist they were still not convinced."

"Both views are possible because Bayes's Theorem shows only how to alter one's prior level of belief -- and different people can start out with different opinions."

*http://junksciencearchive.com/sep98/matthews.html*

# Matthews 1998

“Fisher had achieved what Bayes claimed was impossible: he had found a way of judging the "significance" of experimental data entirely objectively. That is, he had found a way that anyone could use to show that a result was too impressive to be dismissed as a fluke.”

“All scientists had to do, said Fisher, was to convert their raw data into … a P-value”

“So just what were the brilliant insights that led Fisher to choose that talismanic figure of 0.05, on which so much scientific research has since stood or fallen ? Incredibly, as Fisher himself admitted, there weren't any. He simply decided on 0.05 because it was mathematically convenient.”

“Professor James Berger of Purdue University - a world authority on Bayes's Theorem - published a entire series of papers again warning of the "astonishing" tendency of Fisher's P-values to exaggerate significance. Findings that met the 0.05 standard, said Berger, "Can actually arise when the data provide very little or no evidence in favour of an effect".”

*http://junksciencearchive.com/sep98/matthews.html*