

# Bayes Statistics: Past , Present and the Future

——In honor of the 250th  
anniversary of Bayes'theorem

# Contents

➤ Past

➤ Present

➤ Future

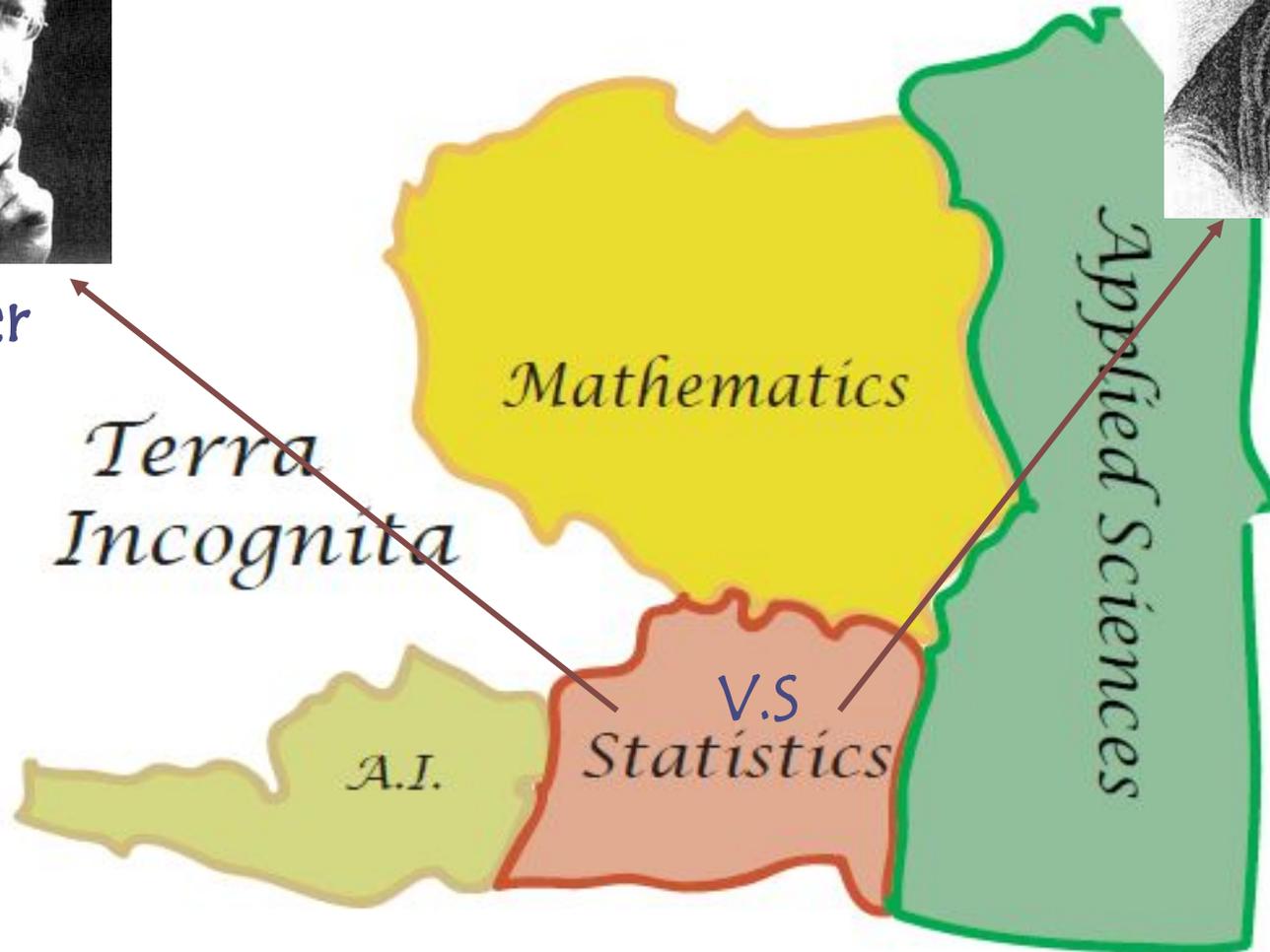
# Greater mathematical world



Fisher



Bayes



# Statistics

- ❖ Frequentist Neyman , Fisher and E. Pearson
  - ◆ Confidence inference
  - ◆ Probability
- ❖ Bayesian Bayes and Laplaces
  - ◆ Bayes' theorem
  - ◆ Prior information and posterior information

# Bayes Rule(1763)

- ❖ 250th anniversary in 2013
- ❖ Always influential, usually controversial

$$P(A|B) = P(B|A)P(A)/P(B)$$

?



# Prior

A prior probability for a parameter is a description of what is known a priori about the parameter to be estimated.

- ❖ Informative
- ❖ Weakly informative
- ❖ Least informative
- ❖ Uninformative



# From the view of Bayesian

## Information

prior  
information

sample  
information

## Method

loss  
function

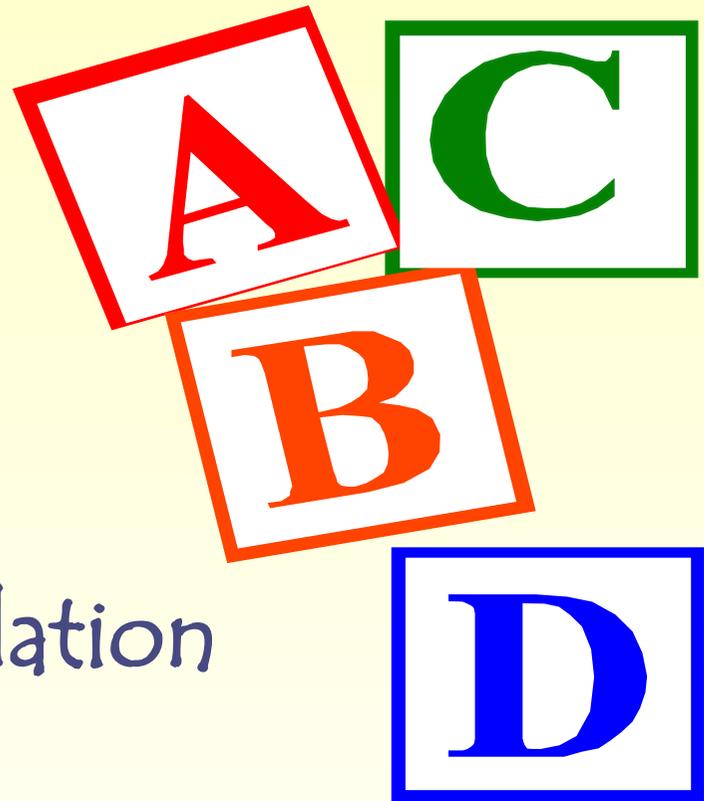
## Result

more  
believable

easier to  
understand

# From the view of Frequentist

- ❖ Uninformative priors
- ❖ “Subjective”
- ❖ High dimensions calculation



## A.O'Hagan said . . . .

- ❖ Persuade sb without thinking carefully about using the Bayesian approach does not conform to the original intention of Bayesian statistics.
- ❖ There is no reason to go too extreme to knock Bayesian drum.

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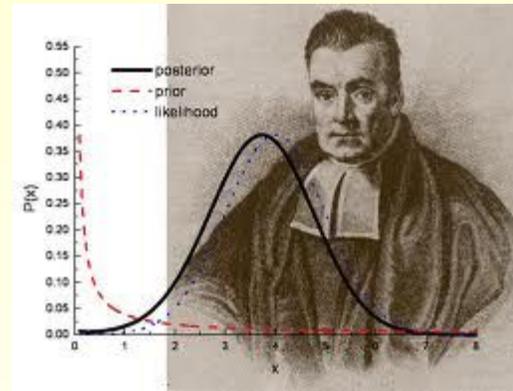
# Bayes' Theorem in the 21th Century

Big Data

Software

Life Sciences

MCMC

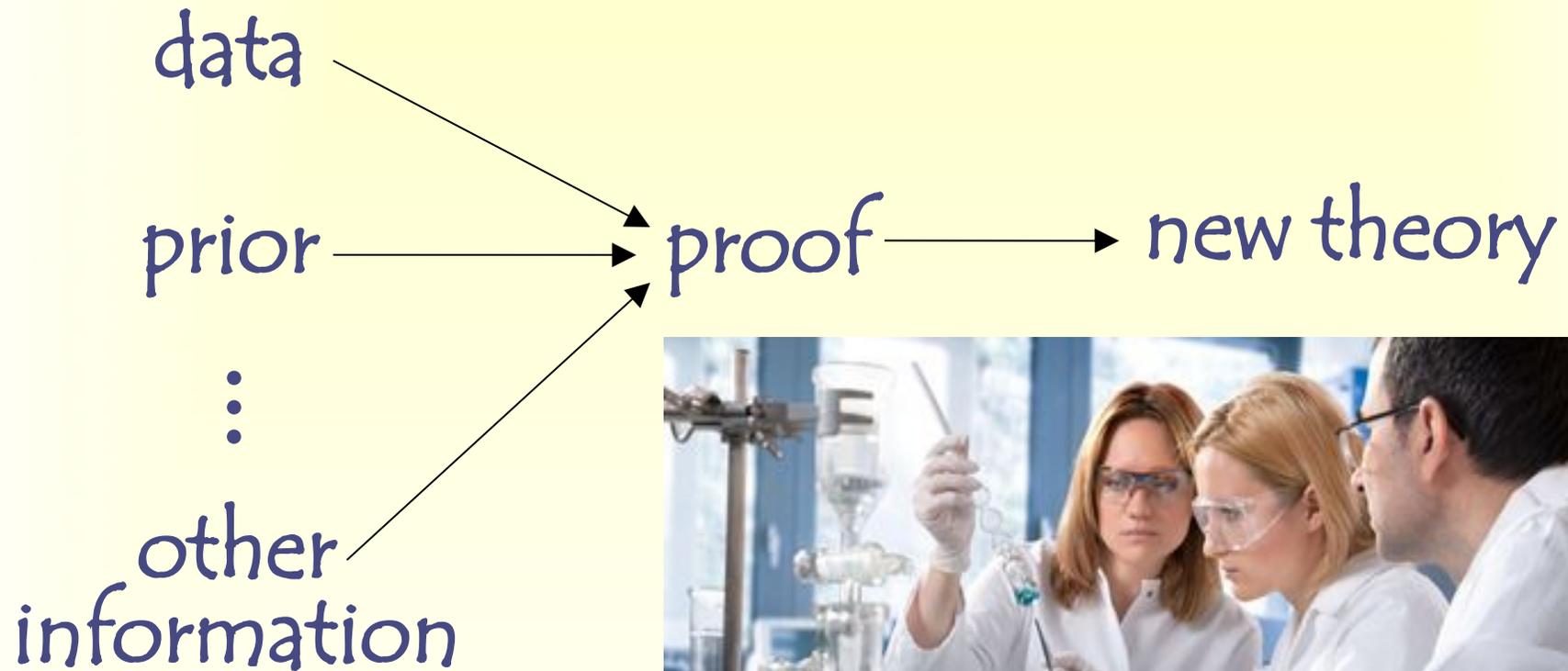


Actuarial  
Science

Bootstrap

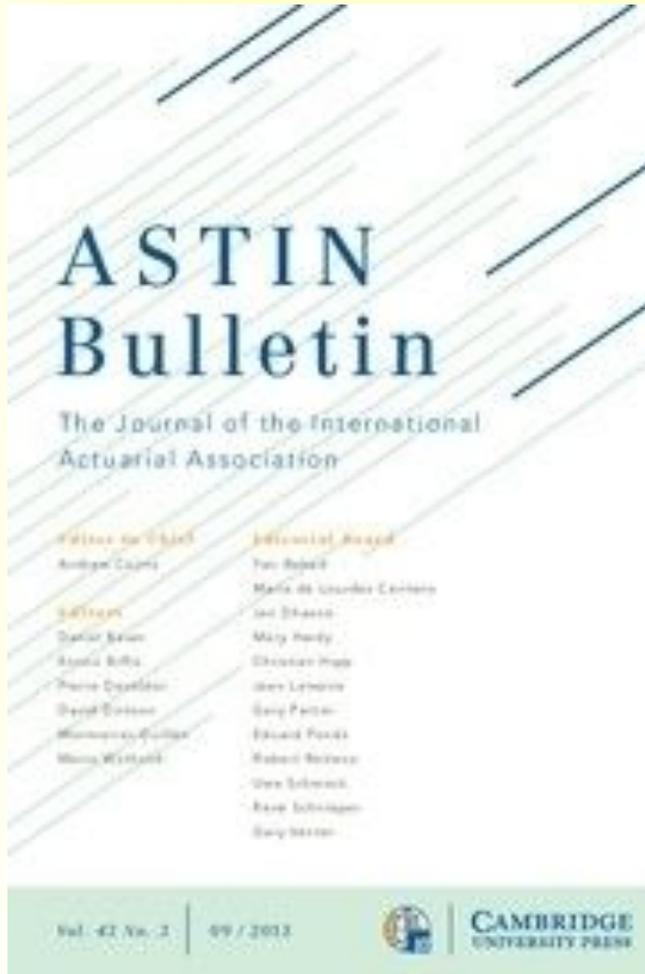


# Life Sciences

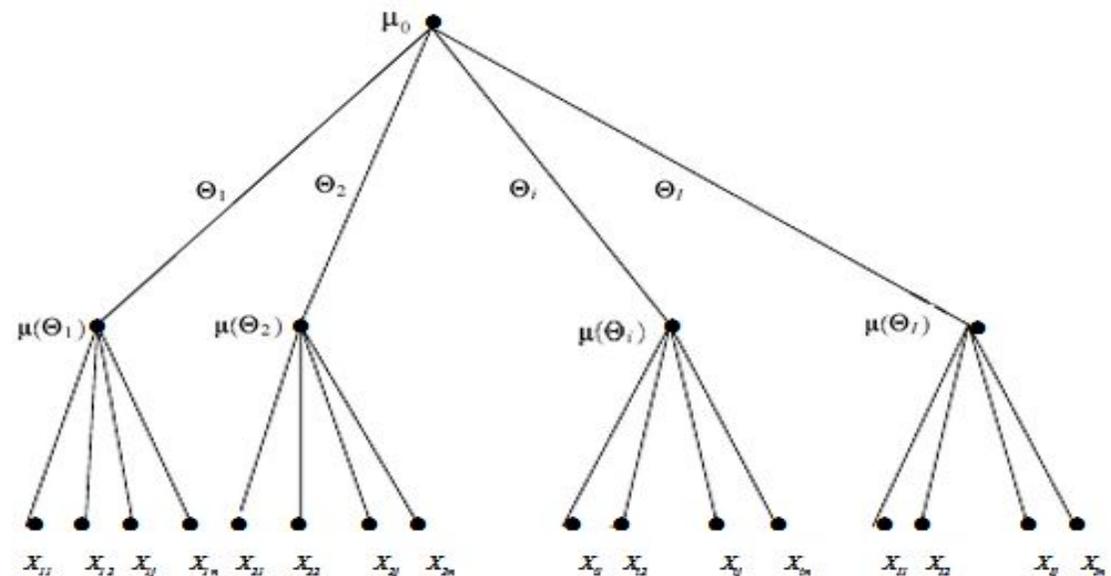




# Actuarial Science

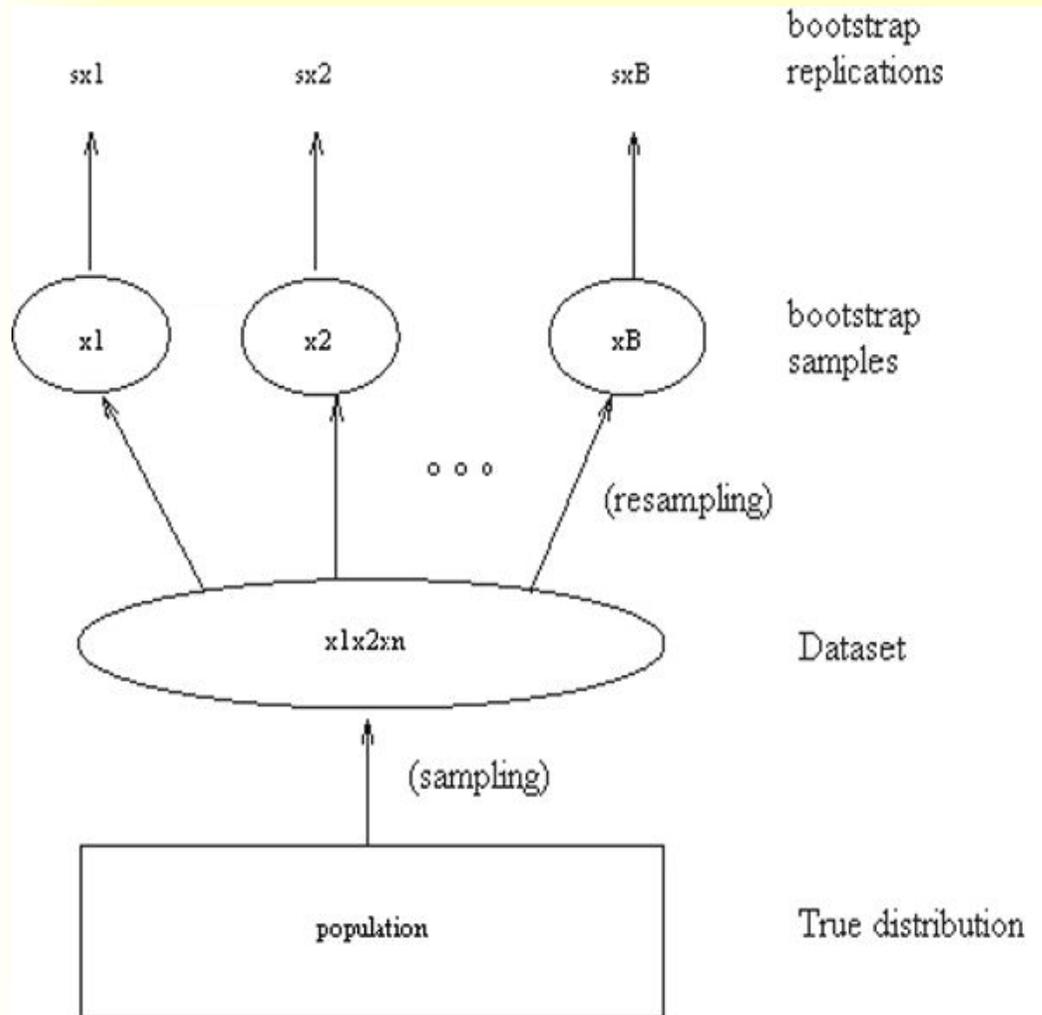


## The Bühlmann–Straub Model





# Bootstrap



Being or relating to a process that is self-initiating or self-sustaining



# MCMC

Markov Chain

Monte Carlo

MCMC methods are a class of algorithms for sampling from probability distributions based on constructing a Markov chain that has the desired distribution as its equilibrium distribution.

?





# WinBUGS

Win---Windows

B---Bayesian Inference

U---Using

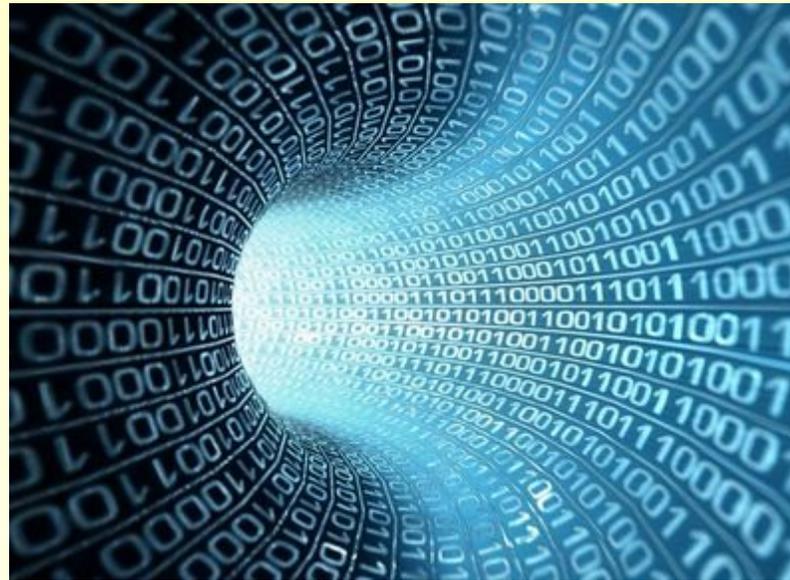
G---Gibbs

S---Sampling





# Why Bayesian and Big Data ?



Bayes' Rule can help  
mining the signal from  
big data sets.

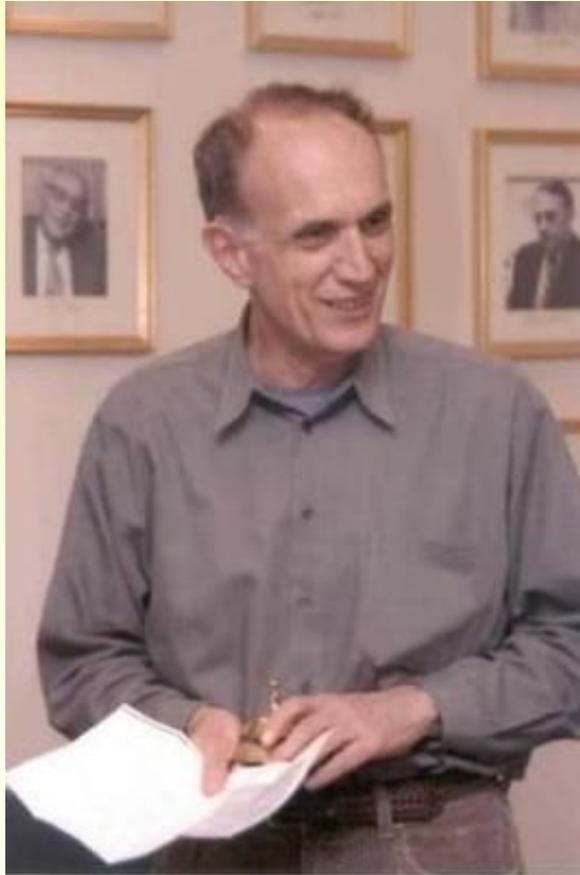


# LaplacesDemon

LaplacesDemon is an R package for Bayesian inference, and is freely available for download.



# Bradley Efron



Bradley Efron (born May 24, 1938) is an American statistician best known for proposing the bootstrap resampling technique.



# Xiao-Li Meng



Dean of the Graduate School of  
Arts and Sciences Whipple  
V.N.Jones Professor of Statistics

## Research Interests

- ❖ Statistical principles and foundational issues.
- ❖ Effective deterministic and stochastic algorithms for Bayesian ;MCMC.
- ❖ Bayesian inference, ranking and mapping.

# Contents

➤ Past

➤ Present

➤ Future

# The future...

- ❖ Learn from each other
  - ❖ Fuse
  - ❖ Empirical Bayes
- parametric Bayes
- non-parametric Bayes

There are two potent arrows in the statistician's quiver, and there is no need to go hunting armed with only one.

# Relevant information

## Web

- ❖ [www.bayesian-inference.com](http://www.bayesian-inference.com)
- ❖ [bayes-stat.github.io](http://bayes-stat.github.io)

## Article

- ❖ A 250-YEAR ARGUMENT: Belief, Behavior, and the Bootstrap——Bradley Efron
- ❖ A Statistically Significant Future for Bayes' Rule——R. van Hulst

Thanks!

