# STATISTICS MODULE

# Vishwa Hindu Parishad of America (DC Chapter)

# *Shantiniketan Camp 2014*

by:

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# Statistics/Probability in Ancient India

# Mahabharata and Gambling

# The Dice Game

- Shakuni, Duryodhana's uncle, "facilitates" a dice game against Yudishthira
- Key observation: dice loaded…game is a cheat!
- Yudishthira loses kingdom and wealth
- Gambles wife and kin into servitude
- Yudishthira and the gambler's fallacy
  – Gambler's fallacy and statistics/probability

# Outcome of Dice Game

# The Story of Nala and Rituparna

# Nala & Rituparna

- **Nala:** skilled charioteer
- **Rituparna:** skilled dice-player
- **Synopsis:** Rituparna asks Nala to teach him the skill of an efficient charioteer. In return, Nala asks to be taught in the art of dice.
- **Outcome:** Nala uses the skill he learned from Rituparna to win back his kingdom from his brother Pushkara (whom he had previously lost his kingdom via poor dice-playing).

# Gambling in Ancient India vs. Modern-Day Arbitrage

*"A great man knowing mantra and medicine sees a cockfight in progress. He talks to the owner of the two birds separately in a mysterious way. He tells one that 'if your bird wins, you give me the amount you bet, and if it loses, I will give you 2/3 of that amount.' Then he goes to the owner of the other bird where on those same conditions he promised to pay ¾ of the amount. In either case, he earned a profit of only 12 pieces of gold. **O mathematician [statistician], blessed with speech, tell me how much money did the owner of each bird bet."***

**Source:** *Ganita Saara Samgraha* (Hindi trans. By L.C. Jain)
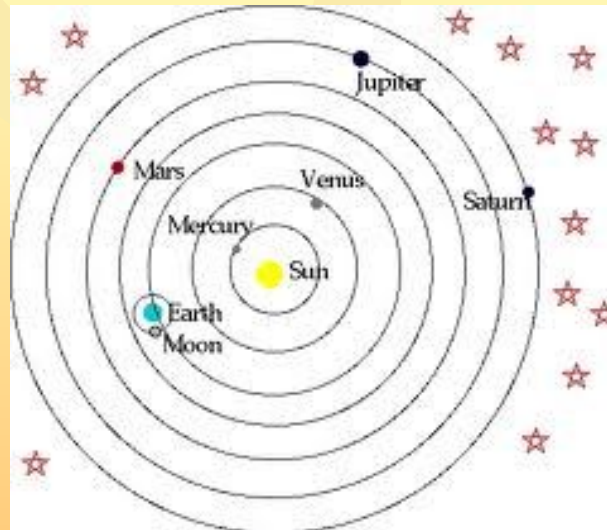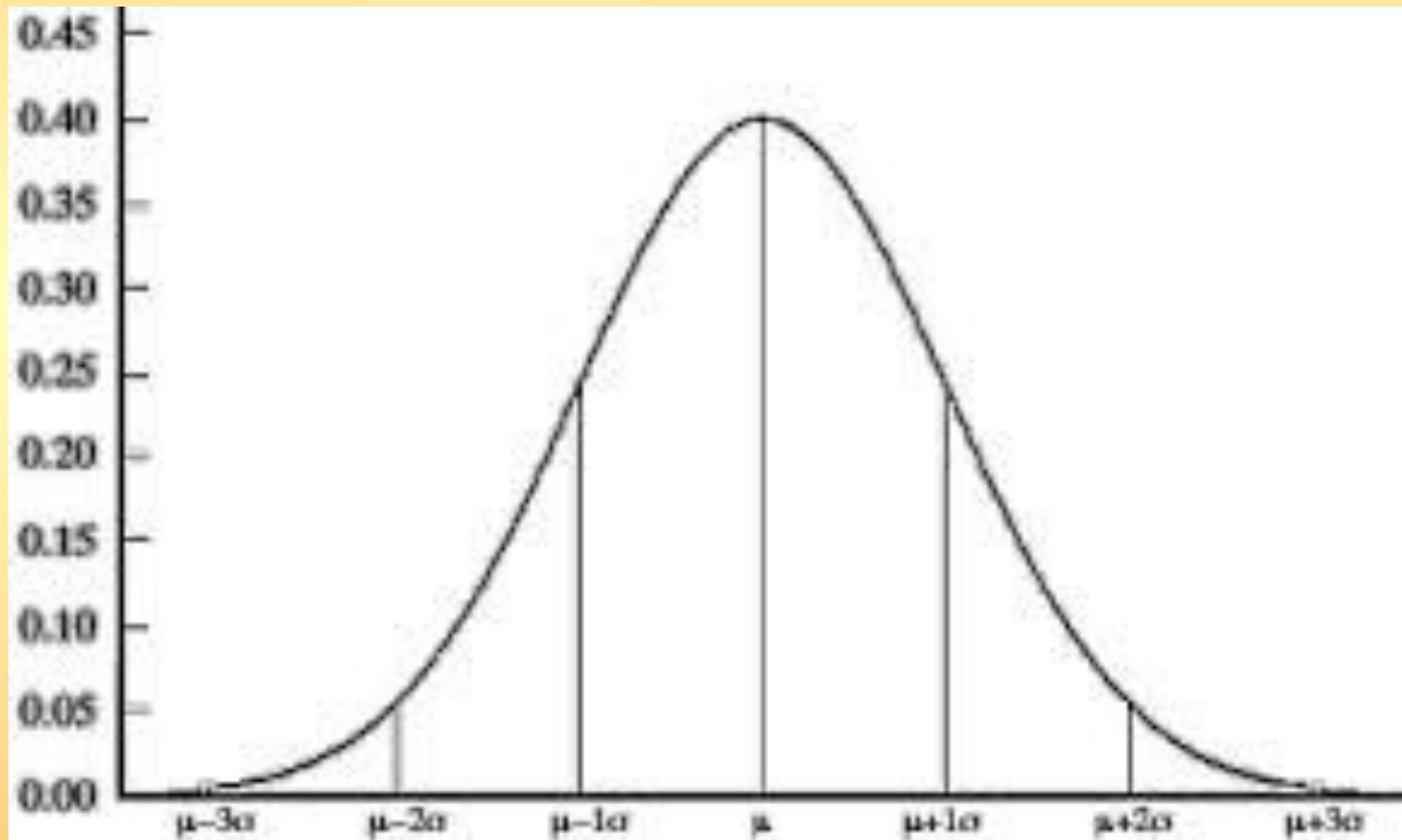
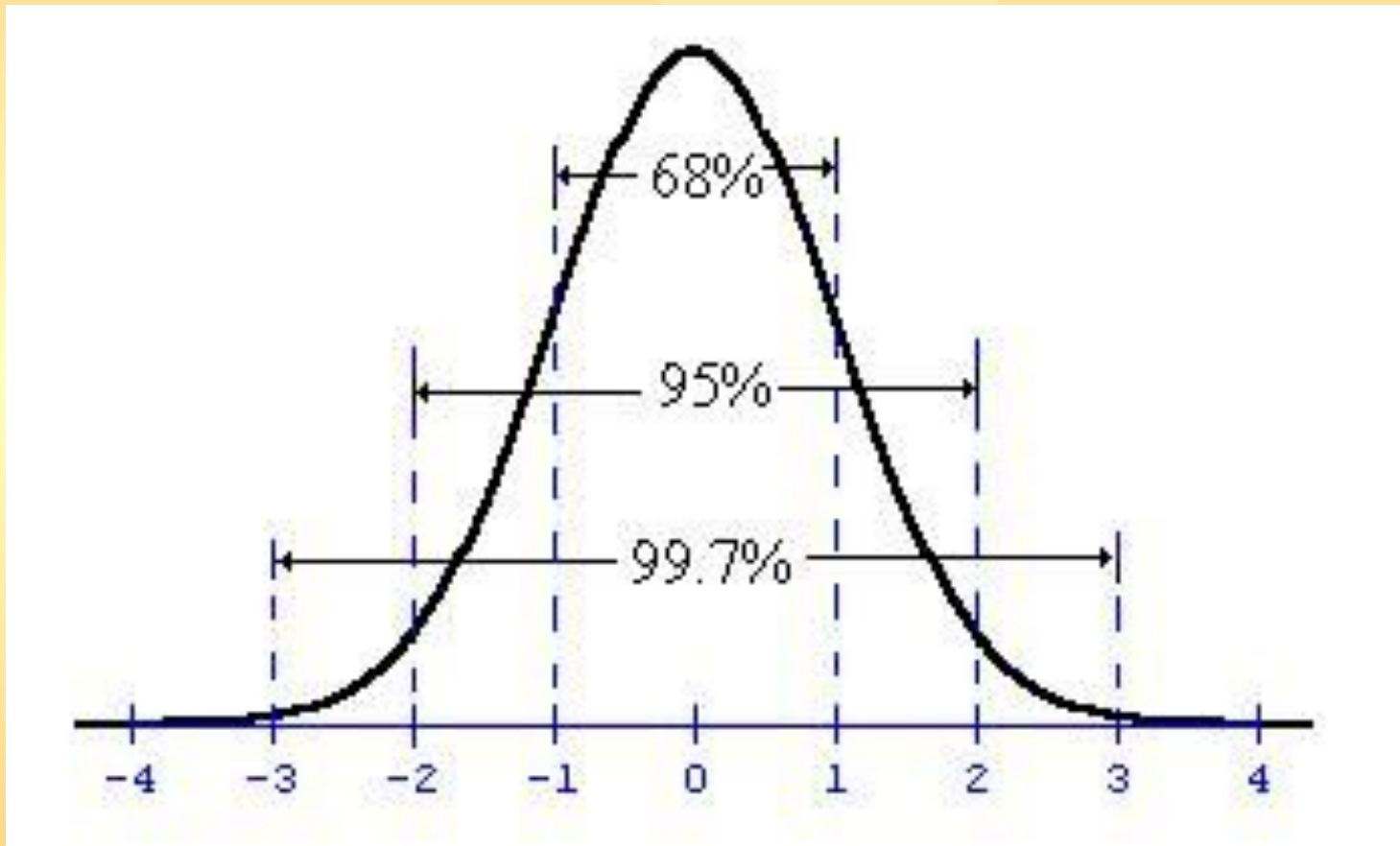# "Statistical Camp"

# Our Favorite Statistic

- The average (or the mean)
  - Easy to compute
- Indian planetary models used averages
  - Also concerned with *deviations* from average

# Our Favorite Distribution: The Normal (Gaussian) Distribution

# Standard Normal Distribution

# The Birthday Problem: Part I (Questions)

- Q: What is the chance that you share a birthday with someone?

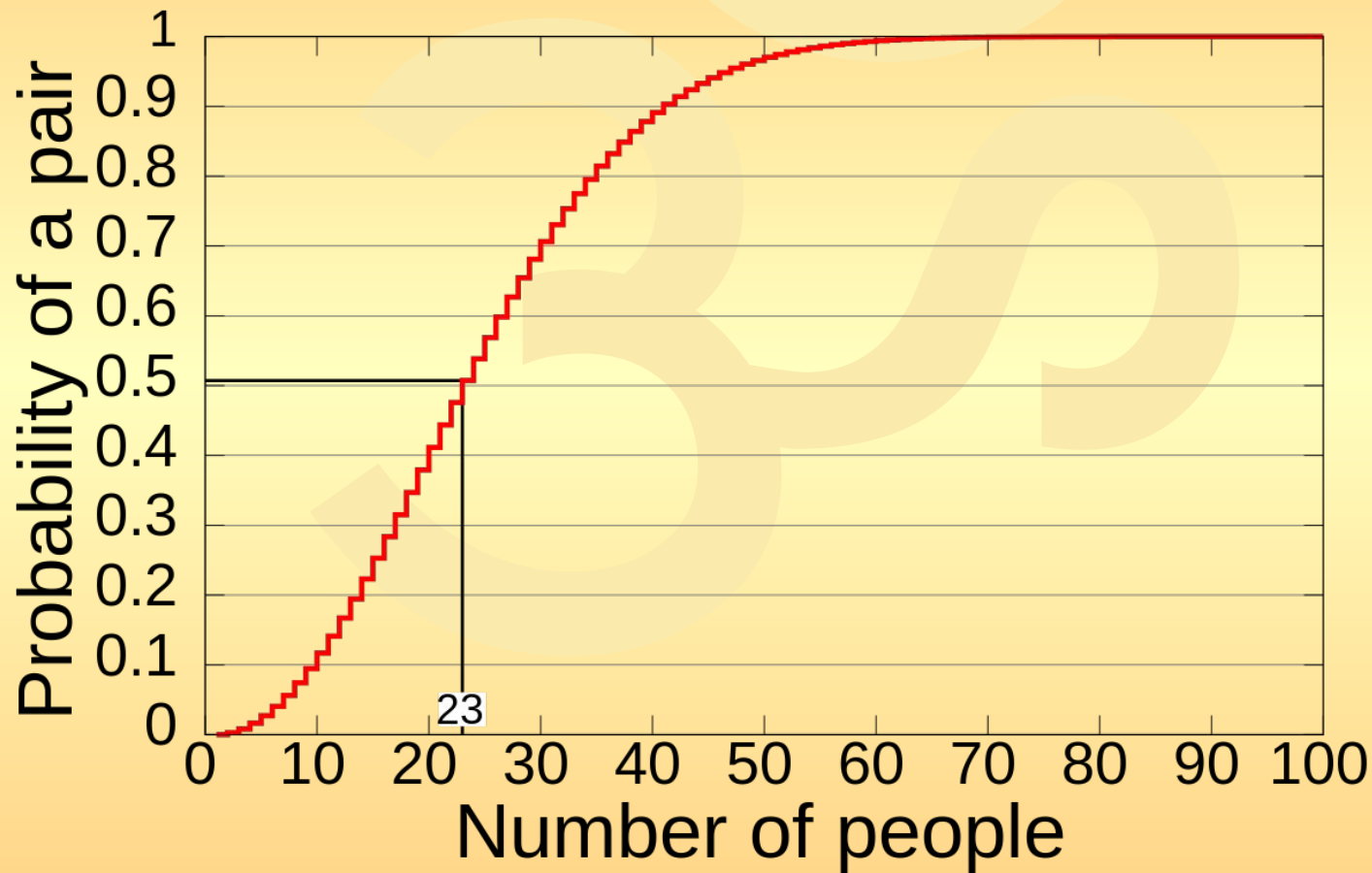- Q: How many persons would be needed so that the chance is, say, at least 50%?

# The Birthday Problem: Part II (Solution)

- Pr{at least 2 persons share birthday}
  = 1 – Pr{no persons share birthday}

- Suppose there are n persons. The result is:
  **= 1 – [364/365]x[363/365]x…x[(365-n+1)/365]**
  **= p(n)**

- Q: What about those born on Feb. 29th?

# The Birthday Problem: Part III (Schematic of p(n))
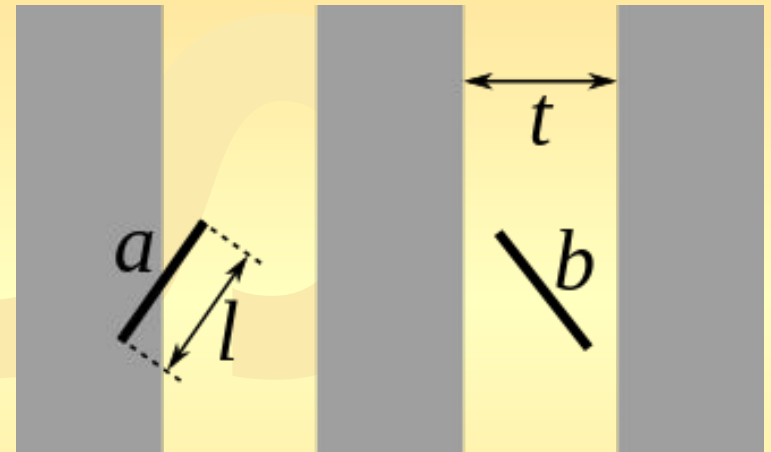
# Buffon's Needle Problem

- Suppose we have a **floor** made of parallel strips of **wood**, each the same width, and we drop a **needle** onto the floor. What is the **probability** that the needle will lie across a line between two strips?

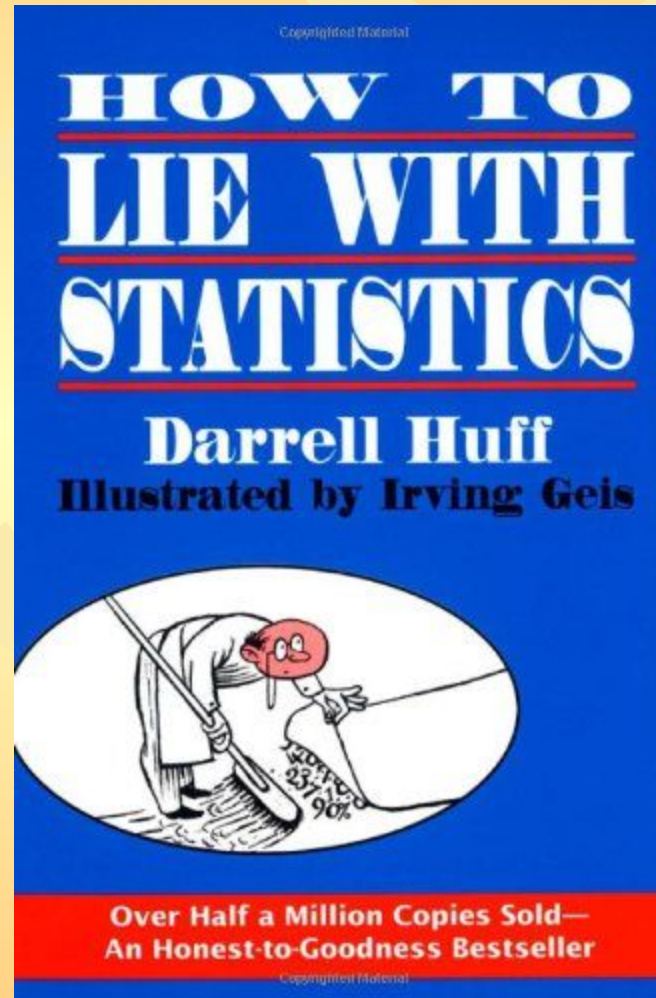- How can we use this experiment to estimate the irrational number π?



**Note:** 'needle a' lies across the
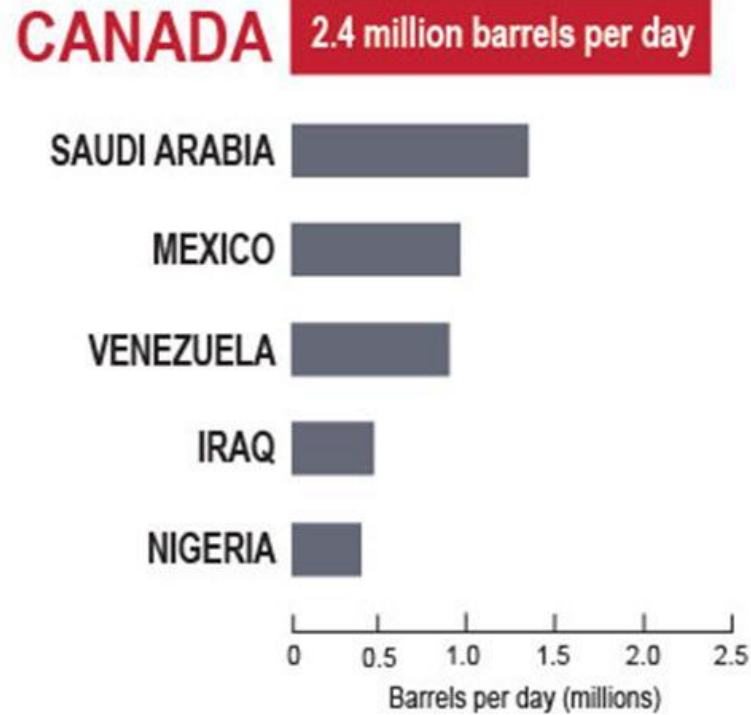line while 'needle b' does not.

Source:
Wikipedia

# *How To Lie With Statistics*

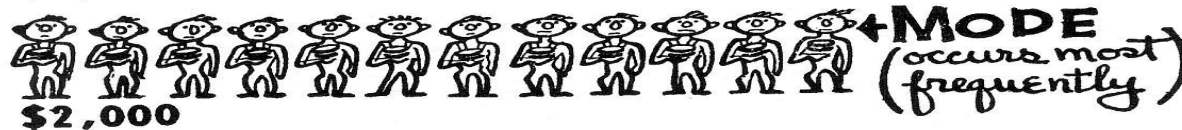# Example: How to Lie -- or *Mislead:*



CANADA | 2.4 million barrels per day

SAUDI ARABIA

MEXICO

VENEZUELA

IRAQ

NIGERIA

0 | 0.5 | 1.0 | 1.5 | 2.0 | 2.5

Barrels per day (millions)
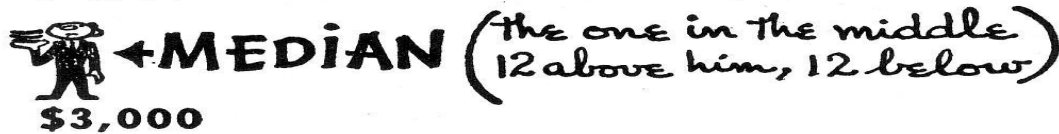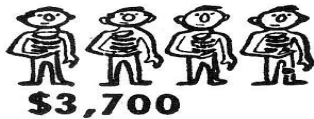
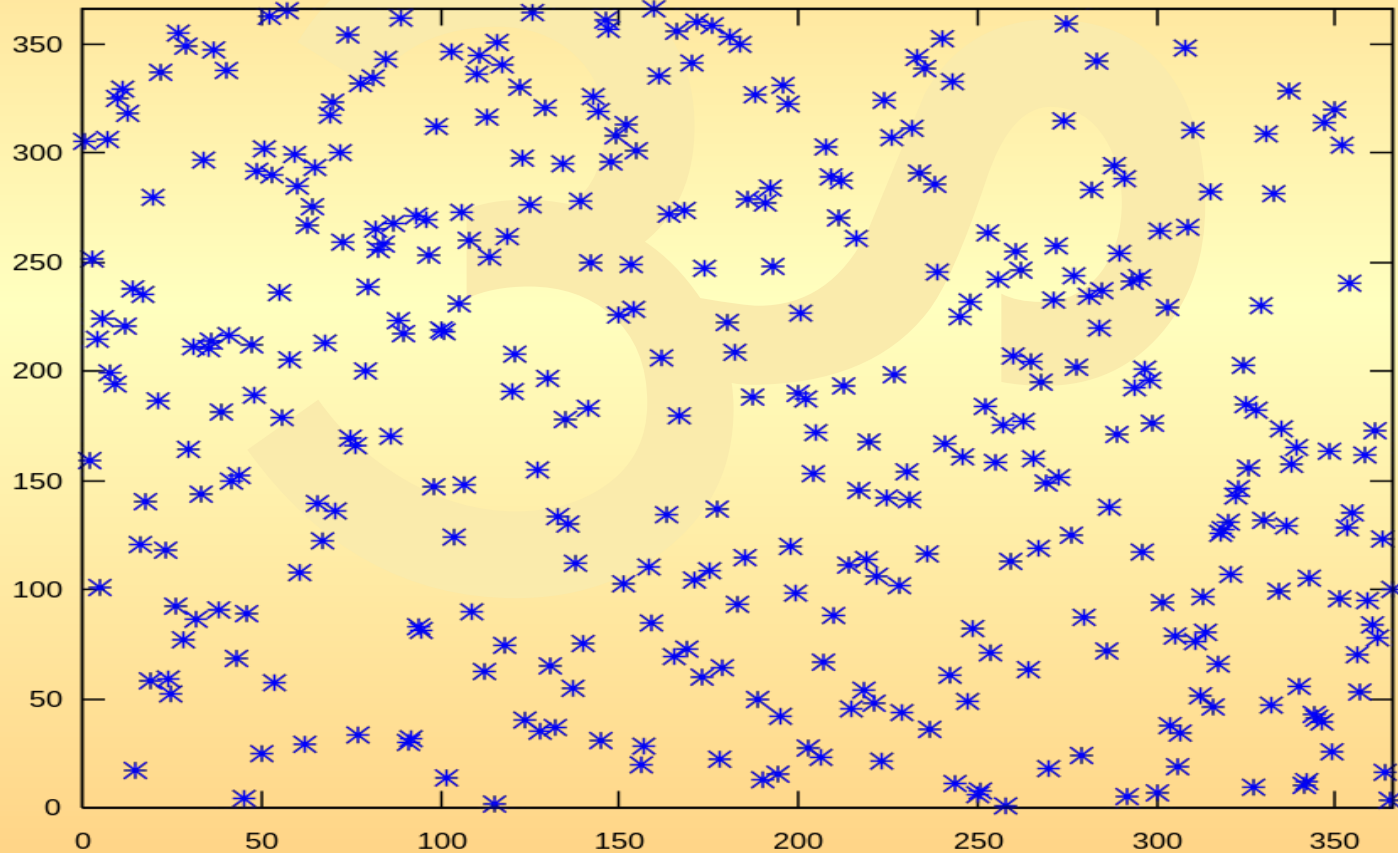* Source: U.S. Department of Energy, 2013.

# A Classic "Lie"

# Probability in Action: The Vietnam Draft Lottery of 1969

- Days of the year numbered 1, 2, 3, …, 366. (Include leap year.)

- Numbers placed in a jar (cf. figure at right).

- Q: Was it fair?

- Q: Are there sources of bias to consider?

# Scatter Plot: The Vietnam Draft Lottery of 1969

# Famous Indian Statisticians and their Legacies

# P.C. Mahalanobis

- Birthdate: 29$^{th}$ Jun. 1893
- Birthplace: Calcutta, Bengal
- Education: U. of Calcutta;
  Univ. of Cambridge
- **Founder:** Indian Statistical Institute
- Key work area: sample surveys
- Derived the *Mahalanobis Distance*
  - Study of European & Indian marriages
  - Queried which castes married Europeans

# Professor C.R. Rao

- Birthdate: 10th Sep. 1920
- Birthplace: Hadagali, Kingdom of Mysore
- Education: Andhra Univ; Univ. of Calcutta Univ. of Cambridge (PhD, ScD)
- Select accolades:
  - **U.S. Medal of Science**
  - **India Science Award**
- "A living legend" (American Statistical Association)
- Top 10 Indian scientists of all time! (*The Times of India*)
- Derived the *Cramer-Rao Lower Bound*.
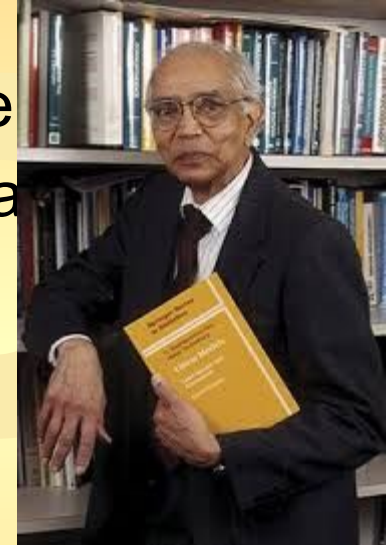
# The Indian Statistical Institute

- Main campus: Kolkata, West Bengal
- Grew out of Statistical Laboratory from Presidency College, Kolkata set up by P.C. Mahalanobis
- Formed in 1931
- One of India's most prestigious universities -- focus mainly on Statistics (and other fields as well)
- Influenced the establishment of National Institute of Statistical Sciences (NISS) in RTP, North Carolina.

# Who Wants to be a Statistician? (Possible Career Paths)

# Some "Compelling" Reasons

- Math/Stat rated top job in U.S. in 2014 (and in previous years, too. Source: *Forbes*)

- "Interdisciplinary charm"
  - "Statisticians get to play in everyone's backyard" (Source: Prof. John Tukey)
  - "Statistics is not a discipline like physics, chemistry or biology where we study a subject to solve problems in the same subject. We study statistics with the main aim of solving problems in other disciplines." (Source: Prof. C.R. Rao*)

- More than just a "number cruncher"

# Academia

- College/University professors
  - Tenure-track
  - Teaching track
- Research scientists
  - Laboratories
  - Medical schools
- Consulting center

# Federal / Civil Service

- National Statistics Office
  - U.S. Census Bureau
  - Bureau of Labor Statistics
- U.S. Department of Agriculture
  - National Agriculture Statistics Service
  - Recall the *Kaniyaa* and ancient Indian farms
- Military branches
- Economic agencies

# Private Sector

- Banking industry
  - Quantitative analysts / researchers
- Hedge funds
  - "Wall Street quants"
  - Goal: seek out arbitrage (recall Nala/Rituparna)
- Multilateral institutions
  - World Bank, IMF, IADB
- Actuarial Science

# Statisticians & the "New MBA"

- Computational Finance / Quantitative Finance

- Statistical programming / computing

- Probabilistic arbitrage opportunities

- New breed of "quantitative MBAs"

# Parting Quote…Somewhat Ironic…
# But True!

**"All models are wrong, but some are useful."**

(Source: Prof. George E.P. Box)