



A Short History of Probability

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French Society in the 1650's

- Gambling was popular and fashionable
- Not restricted by law
- As the games became more complicated and the stakes became larger there was a need for mathematical methods for computing chances.





Enter the Mathematicians

- A well-known gambler, the chevalier **De Mere** consulted **Blaise Pascal** in Paris about a some questions about some games of chance.
- **Pascal** began to correspond with his friend **Pierre Fermat** about these problems.





Classical Probability

- The correspondence between Pascal and Fermat is the origin of the mathematical study of probability.
- The method they developed is now called the **classical approach** to computing probabilities.
- The method: Suppose a game has n equally likely outcomes, of which m outcomes correspond to winning. Then the probability of winning is m/n .



Problems with the Classical Method

- The classical method requires a game to be broken down into equally likely outcomes.
 - It is not always possible to do this.
 - It is not always clear when possibilities are equally likely.



Experience

- Another method, known as the **frequency method** had also been used for some time.
- This method consists of repeating a game a large number of times under the same conditions. The probability of winning is then approximately equal to the proportion of wins in the repeats.
- This method was used by **Pascal** and **Fermat** to verify results obtained by the **classical method**.

Early Generalizations

- James Bernoulli proved that the frequency method and the classical method are consistent with one another in his book *Ars Conjectandi* in 1713.



Early Generalizations

- Abraham De Moivre provided many tools to make the **classical method** more useful, including the **multiplication rule**, in his book **The Doctrine of Chances** in 1718.
- The book was popular, eventually going through three editions.





From Games to Science

- Throughout the 18th century, the application of probability moved from games of chance to scientific problems:
 - Mathematical theory of life insurance - life tables.
 - Biological problems - what is the probability of being born female or male?

Applied Probability

- Pierre-Simon Laplace presented a mathematical theory of probability with an emphasis on scientific applications in his 1812 book *Theorie Analytique des Probabilités*.
- Unfortunately, Laplace only considered the **classical method**, leaving no indication on how the method was to be applied to general problems.





Stagnation the Frustration

- After the publication of Laplace's book, the mathematical development of probability stagnated for many years.
- By 1850, many mathematicians found the **classical method** to be unrealistic for general use and were attempting to redefine probability in terms of the **frequency method**.
- These attempts were never fully accepted and the stagnation continued.

Axiomatic Development

- Andrey Kolmogorov developed the first rigorous approach to probability in his 1933 monograph *Grundbegriffe der Wahrscheinlichkeitsrechnung*.
- He built up probability theory from fundamental axioms in a way comparable with *Euclid's* treatment of geometry.





Probability Today

- Modern research in probability theory is closely related to the mathematical field of **measure theory**.
- Modern innovators in the field include **Patrick Billingsley** (University of Chicago), **Yuan Shih Chow** (Columbia), **Kai Lai Chung** (Stanford), **Samuel Karlin** (Stanford), **Rolf-Dieter Reiss**, **Sheldon Ross** (Berkeley), **Henry Teicher** (Rutgers) and many many more...