

How Statisticians Changed The World

Presented by

Nigel Marriott
Chartered Statistician

5 Statisticians Who Changed The World

- **Pierre de Fermat (1601-1665)**
 - Measuring Probability and Risk
- **Reverend Thomas Bayes (1702-1761)**
 - Data-Driven Decision Making
- **Florence Nightingale OM (1820-1910)**
 - Collecting, Summarising and Presenting Data
- **Sir Ronald Fisher (1890-1962)**
 - Designing Experiments and Drawing Conclusions from Results
- **W. Edwards Deming (1900-1993)**
 - Quality Control & Continuous Improvement
 - Statistical Consulting

Pierre de Fermat

- One of the most famous mathematicians of all time, best known for Fermat's Last Theorem which was finally proved in 1995.
- First person to decipher the basic laws of probability.
- Inspiration came from a friend of a friend who was a gambler.
- The gambler had been playing a game which had been interrupted before it was finished and the players couldn't agree on a fair way to divide the pot.
- Fermat decided the fairest way was to divide according to each player's probability of winning at the point of interruption.
 - E.g. if player A has a 70% chance of winning, he should get 70% of the pot.
 - Same principle is used in one-day cricket to decide the run target for the batting side whose innings has been interrupted by rain (Duckworth/Lewis)
- The gambling, insurance, investment, risk management industries all owe their existence to the laws of probability first set out by Fermat.

Are You Classical or Bayesian?

- Imagine you are on a jury.
- The law requires you to start by assuming that the defendant is innocent, consider the evidence and decide if guilty or not guilty.
- The standard of proof is “Guilty beyond reasonable doubt”. An alternative saying is “Low probability of innocence”.
- There are two ways of reasoning. Which would you use and why?
 1. **“How likely is it that the defendant is innocent given the evidence I have heard”**
 2. **“How likely is the evidence I have heard assuming the defendant is innocent” .**

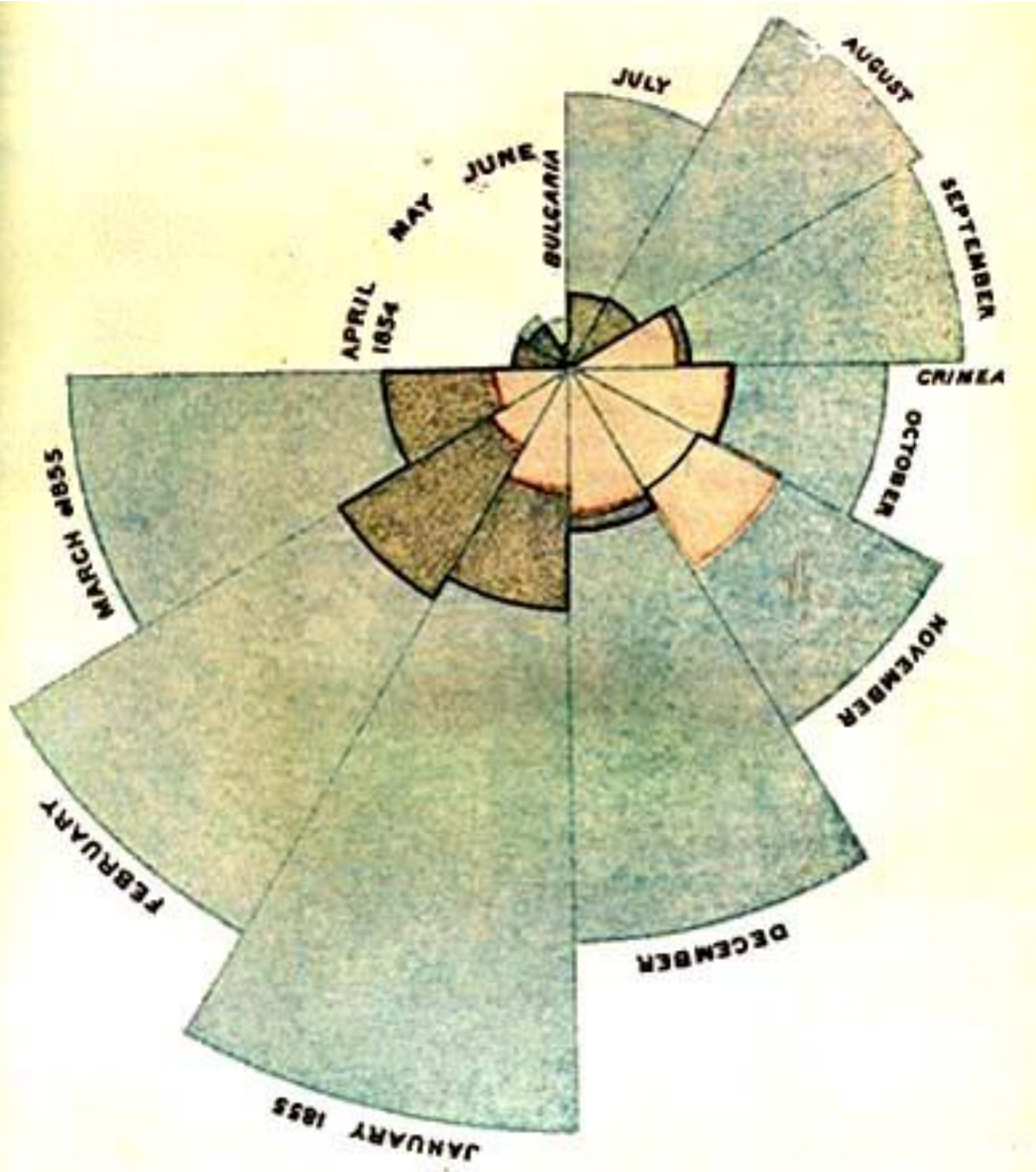
Thomas Bayes & Ronald Fisher

1. **“How likely is it that the defendant is innocent given the evidence I have heard”**
 - Statisticians say **“What is the Probability of the Hypothesis given the Data?”**
 - This is **Bayesian Statistical Thinking** based on the ideas of Revd Thomas Bayes.
 - Reasoning is more intuitive but calculations usually require a computer. The discovery of the planet Neptune in 1846 was a rare exception.
 - The Law Lords have ruled that Bayesian reasoning is illegal in court!
 2. **“How likely is the evidence I have heard assuming the defendant is innocent” .**
 - Statisticians say **“What is the Probability of the Data given the Hypothesis?”**
 - This is **Classical Statistical Thinking** as championed by Sir Ronald Fisher.
 - Reasoning is not intuitive but calculations are simpler.
- Fisher & Bayes’ work laid the foundations for all methods of drawing of conclusions from data and making decisions based on data today. However, statisticians spend a lot of time arguing which is the better way of reasoning!
 - Underlying this is the idea of statistical proof on which all trials and experiments today should be based on. Medical and drug trials are a classic example.

Florence Nightingale

- Most well-known for improving the standards of nursing, hygiene and sanitation in military and civilian hospitals and reducing deaths from secondary infections.
- Less well-known is how she achieved this. After all, this was Victorian Britain and men were definitely in charge and not likely to listen to the opinions of women.
- In the Crimean War of 1854-56, she systematically collect data on causes of death of soldiers and developed new ways of summarising and presenting her results.
 - Her charts made it easy for anyone to realise that soldiers were 7 times more likely to die due to hospital diseases rather than battlefield wounds.
 - She then devised & implemented new ways of nursing and reduced the hospital mortality rate from 60% to 2%.
- Her work was recognised by Queen Victoria and the Prime Minister and she repeated her work in hospitals in Britain.

Florence Nightingale's CoxComb



- Each wedge is a separate month from April 1854 to March 1855.
- The size of the wedge represents total number of deaths in Crimea in that month.
- Cause of deaths are represented by the colours.
- Yellow – battlefield wounds
- Green – preventable hospital infections
- Brown – other causes

W. Edwards Deming

- How did Japan become an economic superpower following WWII?
- By manufacturing and exporting high quality and reliable goods that people around the world wanted and could afford.
- Between 1947 & 1956, Deming taught the Japanese the statistical methods of quality control and continuous improvement of products and process that underpinned their economic success.
 - Honoured by Emperor Hirohito in 1960.
 - Annual Deming prize is a prestigious honour in Japan.
- Deming was the first true statistical consultant and expanded his ideas to include all aspects of business including management and leadership. He saw statistical thinking as a crucial management skill.
- The dramatic improvement in productivity in America in the 1990s owed a lot to ideas such as Six Sigma which is a philosophical development of Deming ideas started by Motorola and GEC.