

# Critical thinking and the justice system

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Winter 2018

# Learning objectives

By the end of today:

- Understand common tools used in the courtroom
- Understand and apply basic ideas from probability theory

# Evidence in the courtroom

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- Fingerprinting
- DNA evidence
- Eye witness testimony
- Video and audio
- Witness testimony
- Other physical evidence

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# What do you remember from the scene?

- How many people were involved in the crime (including the victim)?
- What were the robbers wearing?
- What language were they speaking?
- What else do you remember?

# Who committed the robbery?





# Which of these statements are false?

- The woman's coat is red
- The man dropped his camera
- The camera is silver
- The victim was wearing a backpack

# Conclusions

- Eye witness testimony is not always reliable. A number of factors may affect one's memory.

# DNA evidence

- DNA evidence can be mishandled like any other piece of evidence
- Often will get no match, or only close matches
- It depends on what data you are comparing the DNA evidence against



# DNA evidence

- Suppose you get DNA from a hair found at the scene of the crime and find six usable places in the genome to test. The chance that any given person is a genetic match at those six places is pretty small, say 1 in 5 million.
- If someone matches at those six places, are they likely the perpetrator?



A similar example to the DNA case

# Sudden Infant Death Syndrome

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# Sudden Infant Death Syndrome

- Sally Clark, a British woman, was accused of killing her two children who died at 11 and 8 weeks of age
- Sudden infant death syndrome occurs in about  $1/8543$  or 0.011% of children
- In the court case, an “expert witness” argued that the chance of two cases of SIDS in one family was then  $(1/8543) * (1/8543) = 1$  in 73 million
- Prosecutor argued that the chance Sally Clark was innocent was 1 in 73 million



Sudden Infant Death Syndrome

We want to know is Sally Clark  
innocent or guilty?

# Two main problems with argument

- Assumption of independence and probability of two cases of SIDS
- Further, the calculation is not a measure of guilt or innocence

# Calculating the probability of SIDS

- The number 1 in 73 million turns out to be too high
  - Does not account for fact that boys are more likely to die of SIDS
  - Does not account for fact that those with one SIDS case are more likely to have another
- It turns out a better estimate is something like 1 in 1,000,000

# Interpretation of calculations is incorrect

- 1 in 1,000,000 is the probability of deaths given she is not guilty, it is not the probability she is guilty given two deaths
- We want to know what is the probability she is guilty given two deaths
- We need to “condition” our calculations on whether or not she is guilty

To the white-board

# Conclusions

- Need to be critical of how reliable various pieces of evidence are
- More lines of evidence is better than a single source
- Need to be careful with interpretations of statistics, even from “experts”
  - This is particularly true with big and small numbers

# Homework for next week

- Work on Breast cancer problem