Monday afternoon, 22nd Sept 2025

Session 1: Probabilities and likelihoods

Probability 101

Kolmogrov's axioms (requirements for a probability distribution)

1)

2)

3)

Independence: p(A, B)

Conditonal Probability

↪ **Chain rule for probability**

Marginal

Bayes theorem

Ex: Testing for rare disease 🤒

Given a positive test, how likely is it that I have the disease?

Let the state space variables be:
A: Test is positive
B: Have disease

"Rare" disease: p(B) = 0.03, and suppose the test is 97% effective (i.e, p(A|B) = 0.97), and has a false positive rate of 1% ($p(A\,|\,\bar{B}) = 0.01$)

Describing distributions

$\mathbb{E}_p[x] =$

$\mathrm{Var}(x) =$

Bernoulli distribution

$$\mathrm{Bernoulli}(k;p) = \begin{cases} p, & k = 1 \\ (1-p), & k = 0 \end{cases} \quad =$$

^^ Can you write the above more succinctly?

What is the mean and variance of the distribution?

Binomial distribution: find the mean and variance

$$\mathrm{Binomial}(k;p) = \binom{n}{k} p^k (1-p)^k$$