



DATA Sampling

Simple Random → Use a random number generator

Systematic → Number population → Select every 10 e.g.

Quota → Select a predetermined number of people with a given characteristic.

Opportunity → Select the most conveniently available people

Census → Survey the whole population

Stratified → Split the population into groups. The sample of a group will be proportionate to group's size.

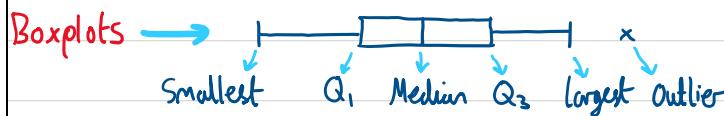
Averages and Spread

Mean → $\bar{x} = \frac{\sum x}{n}$ **IQR** → $Q_3 - Q_1$

Standard Deviation → $\sqrt{\text{Variance}}$

$$\rightarrow \sqrt{\frac{\sum x^2}{n} - (\frac{\sum x}{n})^2} \text{ or } \sqrt{\frac{\sum (x-\bar{x})^2}{n}}$$

Coding $y = \frac{x-a}{b}$ → $\bar{y} = \frac{\bar{x}-a}{b}$ and $\sigma_y = \frac{\sigma_x}{b}$



$$\text{If Median is } 18^{\text{th}} \text{ person} \rightarrow \frac{M-100}{120-100} = \frac{18-16}{21-16} \rightarrow M = 108\text{cm}$$

Histograms → Area is proportional to frequency.

$$\rightarrow \text{Frequency density} = \frac{\text{Frequency}}{\text{Class Width}}$$

CORRELATION + REGRESSION

Correlation

Types → Positive		Negative		No		Strong		weak

Regression

Independent Variable → Explanatory Variable, x

Dependent Variable → Response Variable, y

Equation → $y = a + bx$

Extrapolation → Making predictions outside of data range → Unreliable

Non-Linear Models

$$y = ax^n \rightarrow \log y = n \log x + \log a$$

$$y = Kx^c \rightarrow \log y = (c \log x) + \log K$$

PROBABILITY

Set Notation

\cap → Intersection \cup → Union A' → Not A

Σ → Universal Set \in → is an element of

Formulae

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$P(B|A) = \frac{P(A \cap B)}{P(A)}$$

Independence → $P(A \cap B) = P(A) \times P(B)$

Mutually Exclusive → $P(A \cap B) = 0$

DISTRIBUTIONS

Random Variables

Sum of Probabilities → $\sum P(x=x) = 1$

Binomial

Notation → $X \sim B(n, p)$ → n =trials and p =probability

Conditions → Fixed number of independent trials → n

→ Two possible outcomes → p and $(1-p)$

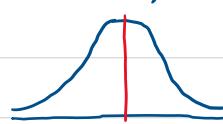
Normal

Notation → $X \sim N(\mu, \sigma^2)$ → μ =mean and σ =SD.

Conditions → Continuous distributions → $P(x=x)=0$

→ Symmetrical

→ Mean = Median = Mode



→ 68% lie within σ of μ . 95% lie within 2σ of μ .

Z Normal → $Z \sim N(0, 1)$

$$Z = \frac{X-\mu}{\sigma}$$

→ We can use Z values to find μ and σ

Approximating

Notation → $Y \sim N(np, np(1-p))$ $SD = \sqrt{np(1-p)}$

Condition → n large and p close to 0.5

Continuity Correction → $P(x>5) \Rightarrow P(Y>5.5)$
examples. $P(x \leq 3) \Rightarrow P(Y < 3.5)$



HYPOTHESIS TESTS

Binomial

One tailed → $H_0: p = 0.3$ $H_1: p < 0.3$

Two tailed → $H_0: p = 0.3$ $H_1: p \neq 0.3$ Split SL

Conclusion → Less likely than the SL, Reject H_0

→ More likely than the SL, Accept H_0

Critical Region → Set of values where we Reject H_0

Actual SL → Probability that the value will be in the CR.

→ Alternatively the probability H_0 is rejected incorrectly.

Correlation

Notation → Use ρ (rho) e.g. $H_0: \rho = 0$

Critical Values → Formula book, page 37

Conclusion → $|r| > CV$, Reject H_0

→ $|r| < CV$, Accept H_0

Normal

Notation → $\tilde{X} \sim N(\mu, \frac{\sigma^2}{n})$ $SD = \frac{\sigma}{\sqrt{n}}$

RANDOM DEFINITIONS

Stats

Discrete → Data that only takes certain values

Continuous → Data that can take an infinite set of different values.

Uniform Distribution → All outcomes are equally likely.

Mechanics

Smooth → No friction

→ Tension will be the same either side of pulley.

Inextensible → Acceleration will be the same on both sides.

Light → Ignore weight

$g \rightarrow 9.8 \text{ ms}^{-2}$ unless otherwise stated.

Uniform → Weight acts through centre

Speed → |velocity|

Distance → |displacement|

Bearings → Measured CW from North.

CONSTANT ACCELERATION

Velocity time graphs

Distance → Area under graph

Acceleration → Gradient

SUVATs

$S \rightarrow$ Displacement

$$S = ut + \frac{1}{2}at^2$$

$U \rightarrow$ Initial velocity

$$S = \frac{1}{2}(u+v)t$$

$V \rightarrow$ Final velocity

$$S = vt - \frac{1}{2}at^2$$

$a \rightarrow$ Acceleration

$$V = u + at$$

$t \rightarrow$ Time

$$V^2 = U^2 + 2as$$

VARIABLE ACCELERATION

PVA



FORCES

Newton's 2nd Law → $\sum F = ma$

Weight → mg Tension → $\rightarrow \leftarrow$

Friction → $F \leq \mu R$ Thrust → $\leftarrow \rightarrow$

Reaction → Act perpendicularly to point of contact.

Resultant → Sum of the forces acting on an object.

Equilibrium → $\sum F = 0$

MOMENTS

Moment = Force \times Perpendicular Distance

Equilibrium → $\sum \text{CW moments} = \sum \text{ACW moments}$

Tilting → A reactional force = 0 e.g.

VECTORS

$x_i + y_j$

Units → i, east and j, north

Magnitude → $\sqrt{x^2 + y^2}$

Direction → Sketch then use, $\tan^{-1}(\frac{y}{x})$

PROSPECTILES

Max Height → $V_f = 0$

No air resistance → $a_i = 0$