The Complete A Level Applied Maths Revision Sheet

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 → $\bar{x} = \frac{\Sigma x}{n}$ IQR → $Q_3 - Q_1$

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

→ $\sqrt{\frac{\Sigma x^2}{n} - \left(\frac{\Sigma x}{n}\right)^2}$ or $\sqrt{\frac{\Sigma(x-\bar{x})^2}{n}}$

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

Boxplots →

Interpolation →

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

Histograms → Area is proportional to frequency.

→ 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

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

$y = kb^x$ → $\log y = (\log b)x + \log k$

PROBABILITY

Set Notation

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

ξ → 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 → $\Sigma P(X = x) = 1$

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 → $X \sim N(M, \sigma^2)$ → M = Mean and σ = SD.

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

→ Symmetrical

→ Mean = Median = Mode

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

Z Normal → $Z \sim N(0, 1)$

→ $Z = \frac{X-M}{\sigma}$

→ We can use z values to find M 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 examples. → $P(x > 5) \Rightarrow P(Y > 5.5)$

$P(x \leq 3) \Rightarrow P(Y < 3.5)$

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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 → $\bar{X} \sim N(\mu, \frac{\sigma^2}{n})$ 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 the same either side of pulley.

Inextensible → Acceleration will the same on both sides.

Light → Ignore weight

g → $9.8\ ms^{-2}$ 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 → Displacement $S = ut + \frac{1}{2}at^2$

U → Initial velocity $S = \frac{1}{2}(u+v)t$

V → Final velocity $S = vt - \frac{1}{2}at^2$

a → Acceleration $V = u + at$

t → Time $V^2 = u^2 + 2aS$

VARIABLE ACCELERATION

PVA

Differentiate ↓ Position, Velocity, Acceleration ↑ Integrate

FORCES

Newton's 2nd Law → $\Sigma F = ma$

Weight → mg Tension → →←

Friction → $F \leq \mu R$ Thrust → ←→

Reaction → Act perpendicularly to point of contact.

Resultant → Sum of the forces acting on an object.

Equilibrium → $\Sigma F = 0$

MOMENTS

Moment = Force × Perpendicular Distance

Equilibrium → ΣCW moments = ΣACW moments

Tilting → A reactional force = 0

VECTORS

xi + yj

Units → i, east and j, north

Magnitude → $\sqrt{x^2+y^2}$

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

PROJECTILES

Max Height → $V_j = 0$

No air resistance → $a_i = 0$