

Statistics 2

Edexcel IAL S2 (WST02/01); a permitted applied unit of Further Mathematics
after the pure units and S1

1. Unit S2 at a glance

Unit S2 at a glance

WST02/01: 1 hour 30 minutes, 75 marks; the booklet carries the binomial, Poisson and Normal tables. Must-know: $B(n, p)$ mean np variance $np(1 - p)$; Poisson mean = variance = λ , rates scale with time; $\int f = 1$; uniform mean $\frac{a+b}{2}$, variance $\frac{(b-a)^2}{12}$.

2. Binomial and Poisson

Binomial and Poisson

Assumptions in context: independent trials with constant p ; events singly, independently at a constant rate. Mean 3 and variance 2.55 give $np = 3$, $np(1 - p) = 2.55$, so $p = 0.15$, $n = 20$. Poisson approximates binomial when n is large and p small: $B(80, 0.1) \approx Po(8)$, $P(X \geq 12) = 0.112$.

3. Continuous random variables

Continuous variables

$f = F'$; median solves $F = \frac{1}{2}$; mode maximises f . WST02's CDF $k(6x^2 - x^4)$ on $[0, 1]$:
 $k = \frac{1}{5}$; $P(X > 0.6) = 0.594$; median from $2m^4 - 12m^2 + 5 = 0$ is 0.671; mode 1; mean
 $0.64 < \text{median} < \text{mode}$ means negative skew.

4. Piecewise and uniform

Piecewise and uniform

The triangular pdf $\frac{2x}{21}$ then $\frac{2(6-x)}{15}$ normalises to $(2k-7)^2 = 0$: $k = 3.5$, $E(X) = \frac{19}{6}$, $\text{Var} = \frac{109}{72}$. Uniform with $P(2 < X < 5) = \frac{3}{16}$, mean 6: $b - a = 16$, $a + b = 12$, so $[-2, 14]$; $\text{Var} \frac{64}{3}$, $E(X^2) = \frac{172}{3}$, and probabilities are lengths over 16.

5. Samples and statistics

Sampling

Census: complete but slow, costly, maybe destructive; sample: fast, cheap, sampling error. A statistic contains sample values only. The bead-score distribution takes 3, 6, 9, 12 with probabilities $\frac{125}{343}, \frac{150}{343}, \frac{60}{343}, \frac{8}{343}$; counting 9-point sets gives $B(n, \frac{60}{343})$ and $n = 16$ for $P(Y \geq 1) > 0.95$.

6. Hypothesis tests

Hypothesis tests

H_0 keeps the claimed parameter; accumulate tails to find the critical region and quote the actual level. Po(10) at 3%: $X \leq 3$ or $X \geq 18$, actual 2.46%, observed 16 outside — insufficient evidence. Insurance test at 10%:

$P(X \geq 11 \mid B(25, 0.3)) = 0.0978 < 0.10$: reject H_0 , evidence the proportion rose.

7. Normal approximations

Normal approximations

$B(200, 0.3) \approx N(60, 42)$: at least t means boundary $t - 0.5$, and $z = \frac{t-0.5-60}{\sqrt{42}} = -1.62$ gives $t = 50$. For $B(40, 0.3)$, exact accumulation: $P(X \leq 7) = 0.0553$, $P(X \leq 6) = 0.0238$, so the largest r with $P(X < r) < 0.05$ (fewer than r) is 7.

Check yourself

Check yourself

State distribution assumptions in context; solve moment pairs; scale Poisson rates; normalise piecewise densities; medians, modes and skewness; uniform facts both directions; census versus sample; statistics; small sampling distributions; one- and two-tailed tests with critical regions and actual levels; continuity-corrected normal thresholds.