

Unit S2 – Statistics

The examination

The examination will consist of one 1½ hour paper. The paper will contain about seven questions with varying mark allocations per question which will be stated on the paper. All questions may be attempted.

Candidates are expected to know any other formulae which might be required by the specification and which are not included in the booklet, *Mathematical Formulae including Statistical Formulae and Tables*, which will be provided for use with the paper. Questions will be set in SI units and other units in common usage.

Candidates are expected to have available a calculator with at least the following keys: +, −, ×, ÷, π , x^2 , \sqrt{x} , $\frac{1}{x}$, x^y , $\ln x$, e^x , sine, cosine and tangent and their inverses in degrees and decimals of a degree, and in radians; memory. Calculators with a facility for symbolic algebra, differentiation and/or integration are not permitted.

Formulae

Candidates will be expected to know and be able to recall and use the following formulae:

For the continuous random variable X having probability density function $f(x)$,

$$P(a < X \leq b) = \int_a^b f(x) dx.$$

$$f(x) = \frac{dF(x)}{dx}.$$

Prerequisites

A knowledge of the specification for S1 and its prerequisites and associated formulae, together with a knowledge of differentiation and integration of polynomials, binomial coefficients in connection with the binomial distribution and the evaluation of the exponential function is assumed and may be tested.

SPECIFICATION

NOTES

1. The Binomial and Poisson distributions

S	The binomial and Poisson distributions.	Candidates will be expected to use these distributions to model a real-world situation and to comment critically on their appropriateness. Cumulative probabilities by calculation or by reference to tables. Candidates will be expected to use the additive property of the Poisson distribution – eg if the number of events per minute $\sim \text{Po}(\lambda)$ then the number of events per 5 minutes $\sim \text{Po}(5\lambda)$.
S	The mean and variance of the binomial and Poisson distributions.	No derivations will be required.

N	The use of the Poisson distribution as an approximation to the binomial distribution.	
	2. Continuous random variables	
N	The concept of a continuous random variable.	
S	The probability density function and the cumulative distribution function for a continuous random variable.	<p>Use of the probability density function $f(x)$, where</p> $P(a < X \leq b) = \int_a^b f(x) dx .$ <p>Use of the cumulative distribution function</p> $F(x_0) = P(X \leq x_0) = \int_{-\infty}^{x_0} f(x) dx .$ <p>The formulae used in defining $f(x)$ will be restricted to simple polynomials which may be expressed piecewise.</p> $f(x) = \frac{dF(x)}{dx} .$
S	Relationship between density and distribution functions.	
S	Mean and variance of continuous random variables.	
S	Mode, median and quartiles of continuous random variables.	
	3. Continuous distributions	
N	The continuous uniform (rectangular) distribution.	Including the derivation of the mean, variance and cumulative distribution function.
S	Use of the Normal distribution as an approximation to the binomial distribution and the Poisson distribution, with the application of the continuity correction.	
	4. Hypothesis tests	
N	Population, census and sample. Sampling unit, sampling frame.	Candidates will be expected to know the advantages and disadvantages associated with a census and a sample survey.
N	Concepts of a statistic and its sampling distribution.	
N	Concept and interpretation of a hypothesis test. Null and alternative hypotheses.	Use of hypothesis tests for refinement of mathematical models.
N	Critical region.	Use of a statistic as a test statistic.

N One-tailed and two-tailed tests.

N Hypothesis tests for the parameter p of a binomial distribution and for the mean of a Poisson distribution.

Candidates are expected to know how to use tables to carry out these tests. Questions may also be set not involving tabular values. Tests on sample proportion involving the normal approximation will not be set.