Belfairs Academy

Mathematics Fundamentals Year 12 – Applied

Statistics

Knowledge	Skills
Data Collection	
• Understand and use the terms 'population' and 'sample'. Use samples to make informal inferences about the population. • Understand and use sampling techniques, including simple random sampling and opportunity sampling. • Select or critique sampling techniques in the context of solving a statistical problem, including understanding that different samples can lead to different conclusions about the population.	• Students will be expected to comment on the advantages and disadvantages associated with a census and a sample. • Students will be expected to be familiar with: simple random sampling, stratified sampling, systematic sampling, quota sampling and opportunity (or convenience) sampling.

Knowledge	Skills
Measures of location and spread	
• Interpret measures of central tendency and variation, extending to standard deviation.	• Measures of central tendency: mean, median, mode. • Measures of variation: variance, standard deviation, range and interpercentile ranges. • Use of linear interpolation to calculate percentiles from grouped data is expected.

• Be able to calculate standard deviation, including from summary statistics.	$S_{xx} = \sum(x-\bar{x})^2 = \sum x^2 - \frac{(\sum x)^2}{n}$ **Use of standard deviation =** $\sqrt{\frac{S_{xx}}{n}}$ **(or equivalent) is expected but the use of** $S = \sqrt{\frac{S_{xx}}{n-1}}$ **(as used on spreadsheets) will be accepted.**

Knowledge	**Skills**
Representations of data and correlation	
• Interpret diagrams for single-variable data, including understanding that area in a histogram represents frequency. • Connect to probability distributions. • Interpret scatter diagrams and regression lines for bivariate data, including recognition of scatter diagrams which include distinct sections of the population (calculations involving regression lines are excluded). • Understand informal interpretation of correlation. • Understand that correlation does not imply causation. • Recognise and interpret possible outliers in data sets and statistical diagrams. • Select or critique data presentation techniques in the context of a statistical problem. • Be able to clean data, including dealing with missing data, errors and outliers.	• Any rule needed to identify outliers will be specified in the question. For example, use of Q1 – 1.5 × IQR and Q3 + 1.5 × IQR or mean ± 3 × standard deviation. • Students will be expected to draw simple inferences and give interpretations to measures of central tendency and variation

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Knowledge	Skills
Probability	
• Understand and use mutually exclusive and independent events when calculating probabilities. • Link to discrete and continuous distributions. •	• Venn diagrams or tree diagrams may be used. Set notation to describe events may be used. Use of $P(B \mid A) = P(B)$, $P(A \mid B) = P(A)$, $P(A \cap B) = P(A)\,P(B)$ in connection with independent events. • students should understand that area under the curve represents probability in the case of a continuous distribution.

Knowledge	Skills
Statistical Distributions	
• Understand and use simple, discrete probability distributions (calculation of mean and variance of discrete random variables is excluded), including the binomial distribution, as a model; calculate probabilities using the binomial distribution.	• Students will be expected to use distributions to model a real-world situation and to comment critically on the appropriateness. Students should know and be able to identify the discrete uniform distribution. The notation $X \sim B(n, p)$ may be used. Use of a calculator to find individual or cumulative binomial probabilities.

Knowledge	Skills
Hypothesis Testing	
• Understand and apply the language of statistical hypothesis testing, developed through a binomial model: null hypothesis, alternative hypothesis, significance level, test statistic, 1-tail test, 2-tail test, critical value, critical region, acceptance	• Understand and apply to two tailed tests

• Conduct a statistical hypothesis test for the proportion in the binomial distribution and interpret the results in context. Understand that a sample is being used to make an inference about the population and appreciate that the significance level is the probability of incorrectly rejecting the null hypothesis.	• Hypotheses should be expressed in terms of the population parameter p

Mechanics

Knowledge	**Skills**
Modelling in Mechanics	
• Understand and use fundamental quantities and units in the S.I. system: length, time, mass. Understand and use derived quantities and units: velocity, acceleration, force, weight, moment.	• Students may be required to convert one unit into another e.g. km h-1 into m s-1

Knowledge	**Skills**
Constant and Variable Acceleration	
• Understand and use the language of kinematics: position; displacement; distance travelled; velocity; speed; acceleration.	• Students should know that distance and speed must be positive.
• Understand, use and interpret graphs in kinematics for motion in a straight line: displacement against time and interpretation of gradient; velocity against time and interpretation of gradient and area under the graph.	• Graphical solutions to problems may be required.
• Understand, use and derive the formulae for constant acceleration for motion in a straight line.	
• Use calculus in kinematics for motion in a straight line	

$v = \frac{dr}{dt}, \ a = \frac{dv}{dt} = \frac{d^2r}{dt^2}$ $r = \int v \ dt, \ v = \int a \ dt$	

Knowledge	Skills
Forces and Motion	
• Understand the concept of a force; understand and use Newton's first law.	• Normal reaction, tension, thrust or compression, resistance.
• Understand and use Newton's second law for motion in a straight line (restricted to forces in two perpendicular directions or simple cases of forces given as 2-D vectors);	• Problems will involve motion in a straight line with constant acceleration in scalar form, where the forces act either parallel or perpendicular to the motion. • Problems may involve motion in a straight line with constant acceleration in vector form, where the forces are given in i − j form or as column vectors.
• Understand and use weight and motion in a straight line under gravity; gravitational acceleration, g, and its value in S.I. units to varying degrees of accuracy.	• The default value of g will be 9.8 m s−2 but some questions may specify another value, e.g. g = 10 m s−2
• Understand and use Newton's third law; equilibrium of forces on a particle and motion in a straight line (restricted to forces in two perpendicular directions or simple cases of forces given as 2-D vectors); application to problems involving smooth pulleys and connected particles;	• Connected particle problems could include problems with particles in contact e.g. lift problems