Strand 1: Statistics and Probability

The aim of the probability unit is two-fold: it provides certain understandings intrinsic to problem solving and it underpins the statistics unit. It is expected that the conduct of experiments (including simulations), both individually and in groups, will form the primary vehicle through which the knowledge, understanding and skills in probability are developed. References should be made to appropriate contexts and applications of probability.

It is envisaged that throughout the statistics course learners will be involved in identifying problems that can be explored by the use of appropriate data, designing investigations, collecting data, exploring and using patterns and relationships in data, solving problems, and communicating findings. This strand also involves interpreting statistical information, evaluating data-based arguments, and dealing with uncertainty and variation.

Strand 1: Statistics and Probability

Students learn about	Students working at FL should be able to	In addition, students working at OL should be able to	In addition, students working at HL should be able to
1.1 Counting	– list outcomes of an experiment – apply the fundamental principle of counting	– count the arrangements of n distinct objects ($n!$) – count the number of ways of arranging r objects from n distinct objects	– count the number of ways of selecting r objects from n distinct objects
1.2 Concepts of probability	– decide whether an everyday event is likely or unlikely to occur – recognise that probability is a measure on a scale of 0-1 of how likely an event is to occur – use set theory; discuss experiments, outcomes, sample spaces – use the language of probability to discuss events, including those with equally likely outcomes – estimate probabilities from experimental data – recognise that, if an experiment is repeated, there will be different outcomes and that increasing the number of times an experiment is repeated generally leads to better estimates of probability – associate the probability of an event with its long run relative frequency	– discuss basic rules of probability (AND/OR, mutually exclusive) through the use of Venn diagrams – calculate expected value and understand that this does not need to be one of the outcomes – recognise the role of expected value in decision making and explore the issue of fair games	– extend their understanding of the basic rules of probability (AND/OR, mutually exclusive) through the use of formulae • Addition Rule: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ • Multiplication Rule (Independent Events): $P(A \cap B) = P(A) \times P(B)$ • Multiplication Rule (General Case): $P(A \cap B) = P(A) \times P(B \mid A)$ – solve problems involving conditional probability in a systematic way – appreciate that in general $P(A \mid B) \neq P(B \mid A)$ – examine the implications of $P(A \mid B) \neq P(B \mid A)$ in context
1.3 Outcomes of random processes	– construct sample spaces for two independent events – apply the principle that in the case of equally likely outcomes the probability is given by the number of outcomes of interest divided by the total number of outcomes (examples using coins, dice, spinners, urns with coloured objects, playing cards, etc.)	– find the probability that two independent events both occur – apply an understanding of Bernoulli trials* – solve problems involving up to 3 Bernoulli trials – calculate the probability that the 1st success occurs on the n^{th} Bernoulli trial where n is specified	– solve problems involving calculating the probability of k successes in n repeated Bernoulli trials (normal approximation not required) – calculate the probability that the k^{th} success occurs on the n^{th} Bernoulli trial – use simulations to explore the variability of sample statistics from a known population and to construct sampling distributions – solve problems involving reading probabilities from the normal distribution tables

*A Bernoulli trial is an experiment whose outcome is random and can be either of two possibilities: "success" or "failure".

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1.4 Statistical reasoning with an aim to becoming a statistically aware consumer	– engage in discussions about the purpose of statistics and recognise misconceptions and misuses of statistics – discuss populations and samples – decide to what extent conclusions can be generalised – work with different types of data: categorical: nominal or ordinal numerical: discrete or continuous in order to clarify the problem at hand	– work with different types of bivariate data	
1.5 Finding, collecting and organising data	– clarify the problem at hand – formulate one (or more) questions that can be answered with data – explore different ways of collecting data – generate data, or source data from other sources including the internet – select a sample (Simple Random Sample) – recognise the importance of representativeness so as to avoid biased samples – design a plan and collect data on the basis of above knowledge	– discuss different types of studies: sample surveys, observational studies and designed experiments – design a plan and collect data on the basis of above knowledge	– recognise the importance of randomisation and the role of the control group in studies – recognise biases, limitations and ethical issues of each type of study – select a sample (stratified, cluster, quota – no formulae required, just definitions of these) – design a plan and collect data on the basis of above knowledge

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1.6 Representing data graphically and numerically	**Graphical** – select appropriate graphical or numerical methods to describe the sample (univariate data only) – evaluate the effectiveness of different displays in representing the findings of a statistical investigation conducted by others – use stem and leaf plots and histograms (equal intervals) to display data **Numerical** – use a variety of summary statistics to describe the data • central tendency: mean, median, mode • variability: range	**Graphical** – describe the sample (both univariate and bivariate data) by selecting appropriate graphical or numerical methods – explore the distribution of data, including concepts of symmetry and skewness – compare data sets using appropriate displays, including back-to-back stem and leaf plots – determine the relationship between variables using scatterplots – recognise that correlation is a value from -1 to +1 and that it measures the extent of the linear relationship between two variables – match correlation coefficient values to appropriate scatter plots – understand that correlation does not imply causality **Numerical** – recognise standard deviation and interquartile range as measures of variability – use a calculator to calculate standard deviation – find quartiles and the interquartile range – use the interquartile range appropriately when analysing data – recognise the existence of outliers	**Graphical** – analyse plots of the data to explain differences in measures of centre and spread – draw the line of best fit by eye – make predictions based on the line of best fit – calculate the correlation coefficient by calculator **Numerical** – recognise the effect of outliers – use percentiles to assign relative standing

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1.7 Analysing, interpreting and drawing inferences from data*	– recognise how sampling variability influences the use of sample information to make statements about the population – use appropriate tools to describe variability, drawing inferences about the population from the sample – interpret the analysis – relate the interpretation to the original question	– interpret a histogram in terms of distribution of data – make decisions based on the empirical rule	– recognise the concept of a hypothesis test – calculate the margin of error ($\frac{1}{\sqrt{n}}$) for a population proportion – conduct a hypothesis test on a population proportion using the margin of error

Students learn about	Students should be able to
1.8 Synthesis and problem-solving skills	– explore patterns and formulate conjectures – explain findings – justify conclusions – communicate mathematics verbally and in written form – apply their knowledge and skills to solve problems in familiar and unfamiliar contexts – analyse information presented verbally and translate it into mathematical form – devise, select and use appropriate mathematical models, formulae or techniques to process information and to draw relevant conclusions.

* The final syllabus will contain additional material in this section, which has been deferred for an interim peroiod until students coming through to senior cycle have completed the relevant revised syllabus material in the junior cycle.