THE ACADEMY OF ST NICHOLAS	Y12 Applied	CH05 3.1	Statistics – Probability	Lessons 4

Essential Knowledge Milestones

- Calculate probabilities for single events
- Draw and interpret Venn diagrams
- Understand 'mutually exclusive' and 'independent' events and determine whether two events are independent
- Use and understand tree diagrams

Success Criteria

- ❑ You can extract the probabilities of single events from a variety of scenarios including from sample spaces, tables and histograms
- ❑ You can use 'set notation' to calculate the appropriate probabilities from Venn diagrams combining two or three events
- ❑ You can draw Venn diagrams given a list of appropriate data
- ❑ You can define mutually exclusive events and know how that looks in the context of a Venn diagram
- ❑ You can define independent events and can use the 'multiplication rule' to determine whether events are independent
- ❑ You can set up and fully label a tree diagram of successive events
- ❑ You can use all probability formulae confidently

Assumed Prior Knowledge/ Links / Interleaving

GCSE (9-1) in Mathematics at Higher Tier

- P1 Record, describe and analyse the frequency of outcomes of probability experiments using tables and frequency trees
- P2 Apply ideas of randomness, fairness and equally likely events to calculate expected outcomes of multiple future experiments
- P3 Relate relative expected frequencies to theoretical probability, using appropriate language and the 0–1 probability scale
- P4 Apply the property that the probabilities of an exhaustive set of outcomes sum to one; apply the property that the probabilities of an exhaustive set of mutually exclusive events sum to one
- P6 Enumerate sets and combinations of sets systematically, using tables, grids
- P7 Construct theoretical possibility spaces for single and combined experiments with equally likely outcomes and use these to calculate theoretical probabilities
- P9 Tree diagrams and Venn diagrams

Teaching Points

- Tree and Venn diagrams should have been covered at GCSE but will need to be recapped as one way of looking at probabilities.
- The focus at this level is on independent and mutually exclusive events in probability calculations. Students should be confident in the definitions of both independent and mutually exclusive events and how to use their properties to solve real-life probability problems.
- This is absolutely vital and students need to be dissuaded from what they think they knew from GCSE. Many will churn out 'if it's OR you add them and if it's AND you multiply them' without any consideration of mutually exclusive or independent. You need to ensure that they are aware of these limitations. Make that explicit in all that you do.
- I have put a pack together to explore these ideas and to investigate why. It's quite heavy to get right but if they can leave lesson 1 with that understanding I think it's a really worthwhile task.
- It's worth exploring the formula book so that student know exactly what is available in the exam and how it supports them and their learning.
- Cover showing independence but be aware that the use of set notation is not required at AS level. At this level this is done by showing the product of the probabilities of two events gives the probability of both events occurring together. Understanding of conditional probability is not expected at AS level.
- Proof of independence is a big area of exam questions so students must be absolutely clear on using this. As soon as they read/hear that question their heads need to go straight to 'multiplication rule'
- Students do not need to be aware of probability density functions however they should understand that probability is represented by the area under a curve in a continuous distribution. This could be mentioned here and comparisons drawn by using the binomial model as a bar chart in the next unit.
- When working on Venn diagrams ensure that student's work form the 'most overlaps' out and not filling in as they read the question.
- Although conditional probability doesn't formally appear here there has been exam questions that expect some sort of knowledge so it is worth briefly covering.

Potential Barriers to Access /Misconceptions	**Opportunities for Reasoning/Problem Solving/Proofs**
• Students may confuse 'independent' and 'mutually exclusive'. • Many will churn out 'if it's OR you add them and if it's AND you multiply them' without any consideration of mutually exclusive or independent. You need to ensure that they are aware of these limitations. Make that explicit in all that you do. • Using a diagram almost always helps students to answer probability questions. When drawing a Venn diagram, students should remember to include a box defining the universal set. • Some students will find it difficult to set up tree diagrams without a skeleton. Ensure that you talk about events and outomes to help them to build it. • When proving independence from a Venn diagram some students will only chose to multiply the 'cresents' rather that the full circles when doing P(A)xP(B)	• When using the 'concepts' sheet there is so much excellent discussion that can occur. Students ill be keen to point out why the addition rule doesn't work unless they're mutually exclusive. Some will be able to extend that and tell you what the addition formula actually is and why! • Include questions of the type where *A* and *B* are independent which use Venn diagrams and informal use of the addition rule but where both P(*A*) and P(*A* ∩ *B*) for example are unknown; the solution relies on a knowledge of independence. (Set notation not required) • Some probability questions particularly when using Venn diagrams will need to involve equations or even simultaneous equations. Look out for the P questions in the textbook.

Key Mathematical Vocabulary	Sample space, exclusive event, complementary event, discrete random variable, continuous random variable, mathematical modelling, independent, mutually exclusive, Venn diagram, tree diagram.

Personal Development	**Notes**	**Resources**
Pupils are taught that they must 'respect' each other's opinions and well-being when working collectively in class. Pupils to learn that mathematicians have 'ambition' to push boundaries when aiming to solve new problems **Resilience** – never giving up! Building confidence across the problem solving aspects of the course. **Ambition** – living life to the full – fulfilling dreams and aspirations – linking to future career and ambition plans. **Respect** – respect for others – the 9 protected characteristics **Personal Best** – First Work – Best Work every time		• TBAT understand probability concepts worksheet • Accompanying spreadsheet of answers for discussion