Chapter 11 Probability

Specification

FS coverage and range
Use probability to assess the likelihood of an outcome

FS exemplification
Calculate theoretical probabilities
Compare probabilities
Put events in order of likelihood on a probability scale
Single events only
List outcomes of events

GCSE

GCSE specification

SP m Understand and use the vocabulary of probability and probability scale

SP n Understand and use estimates or measures of probability from theoretical models (including equally likely outcomes), or from relative frequency

SP o List all outcomes for single events, and for two successive events, in a systematic way and derive relative probabilities

Edexcel GCSE course

Specification A:

Foundation 26.1–26.2, 26.4–26.5, 26.7

Higher 28.1, 28.3–28.4

Specification B:

Foundation Unit 1: 5.1–5.2, 5.5–5.6, 5.8

Higher Unit 1: 5.1, 5.4–5.5

Resources

General resources
Coins
Dice
Coloured cubes
Bag

Resource sheets
11.1

ActiveTeach resources
Video
ResultsPlus Knowledge Check
ResultsPlus Problem Solving
Question Audio
Animations

Lesson 1

Objectives

- Learn to identify the information needed to calculate probabilities
- Use a numerical scale from 0 to 1 to express and compare probabilities
- Learn to calculate experimental probability from the results of an experiment
- Use probability to make conclusions

Starter

- Ask students to complete the calculations on Resource sheet 11.1. Check answers and ask if students can predict the topic for the lesson with any certainty.

Main teaching and learning

- Make a link from the Starter activity to probabilities expressed as decimals, fractions or percentages on a 0 to 1 (or 0 to 100%) scale. Using *Take a look:* Outcome of a football match and *Take a look:* Songs on an MP3 player (p107), ask: *How do we decide the probability of an event?* Compare the use of theoretical probability and past records/experimental data.
- Show words about tomorrow's possible weather conditions: snow, sun, rain, cloud, etc. Ask students to put the words in order of probability on a probability scale. Ask: *How would weather forecasters assign actual numerical possibilities?*
- Ask students to complete *Have a go* Q1–4, recording all answers on a probability scale.
- Collect experimental data for an event with an unknown probability, for example, the probability of a dropped drawing pin landing point up. Pairs of students should carry out 10 trials each and then estimate the probability. The results of all of the trials should be combined using a spreadsheet to track relative frequency and identify a more reliable experimental probability.
- Discuss quality control and why it is important in manufacturing.
- Ask students to complete Q5–7.

Issues and misconceptions

- A variety of methods may be used by individual students to calculate fractions of a quantity. Their equivalence can be checked.
- Students need to make correct decisions about what arithmetical operations are required in different situations. They need to check that their answers make sense and in particular should never accept a probability greater than 1 or less than 0.

Support

- Some students may find general revision of fractions, decimals and percentages helpful. The Starter gives an opportunity to revise both decimal calculations where the number of decimal places varies (as in Q2) and using fractions with varying denominators (Q4).

Extension

- Ask students how probabilities of defective products would be used by a manufacturer to decide on pricing to secure profit.

Plenary

- Discuss the reasons why the cost of car insurance varies.

Formative assessment

- Ask students to mark each other's numerical answers to Q1–4, taking care to credit equivalent fractions, decimals and percentages.

Homework

- Ask students to find a variety of references to probability or chance in the media. For example, in relation to weather forecasts and health issues.

Lesson 2

Objectives

- Learn how to set up and use tables to list all the outcomes of two combined events
- Use lists of outcomes to make conclusions

Starter

- Announce that you are going to toss two coins. Ask students to predict the result using two hands – both hands on head for two heads, both hands on hips for two tails, one on head and one on hip for head and tail. Students who predict incorrectly sit down until only one student remains standing. Discuss strategies used and the fact that a head and tail is most likely as order was not specified.

Main teaching and learning

- Discuss ways of recording the results for tossing two coins, for example, tabulate possible results in a sample space and then present them as a tree diagram. Compare this to *Take a look:* A game using dice (p110).
- Ask students to complete *Have a go* Q8–10, presenting the information for Q9 in both a sample space and a tree diagram.
- Explain the criteria for winning the 'Scissors, paper, stone' game and ask students to investigate the probabilities of various outcomes if two players play, using a diagram of their choice.
- Discuss *Take a look:* Comparing chances of winning (pp111–12), looking at how all outcomes are presented.
- Divide students into pairs and ask them to design an unfair game to be played with two dice. They should show all possible outcomes in a suitable diagram and show why the game is unfair. They should then play the game and record the results, for later comparison with the theoretical probabilities.

Issues and misconceptions

- Tree diagrams are used here to represent possible outcomes but are not labelled with probabilities for calculation as in GCSE Mathematics.
- Ensure that students understand that two or more events shown as stages in a tree diagram may actually take place at the same time.

Support

- Ensure that students are comfortable comparing the size of decimals or fractions to decide most likely events.

Extension

- Ask students to write down the probability of the couple in Q10 having 0, 1, 2 or 3 boys. Then ask them to do the same for a family of four children. Ask: *What do you notice?*

Plenary

- Ask: *When is a sample space most suitable? When is a tree diagram best to use?*

Formative assessment

- Ask each pair of students to peer-assess another pair's work on the unfair dice game, assessing the clarity of instructions, accuracy of sample spaces and calculation of probabilities.

Homework

- Ask students to play the unfair dice game they have designed and compare the results with the theoretical probabilities. They should comment on their results and why they may have varied.

Lesson 3

Objectives

- Use suitable forms, including tree diagrams, to represent the problem
- Compare the outcomes
- Show the solution to the problem clearly

Starter

- Place two or three colours of cubes or similar in a bag. Ask each student to remove one cube and replace it, recording the results for all to see. When all students have selected a cube once, ask them to make a prediction about the proportion of colours in the bag. Repeat the activity, review the prediction and then reveal the contents of the bag.

Main teaching and learning

- Discuss the need for a large number of trials for reliable experimental probability. Relate this to *Have a go* Q11 (p112).
- Divide students into groups of three and ask them to each work out the probabilities for each flavour of sweet in one bag (A, B or C). They should then combine their results to make general predictions, sketching a graph showing what sweets could be expected in a bag. Compare the results obtained by each group.
- Discuss how probability is used in business. For example, historic data can be used to predict the risk of events and insurance premiums set accordingly.
- Divide students into pairs and ask each pair to work on either Game 1 or Game 2 from *Take a look:* Comparing chances of winning. Ask them to imagine that the games are being run at a school fundraising event and to consider how competition entry prices and prizes would need to be set in order to ensure a profit. Propose that prizes are set at £10, £20 or £50 and ask students to calculate how much should be charged for competition entry to ensure break-even, 50% or 100% profit.

Issues and misconceptions

- For Q11, students need to notice that the total number of sweets varies for each bag. Totals for each variety in all three bags will need to be found to calculate overall probabilities.

Support

- For the competition activity above, remind students how to calculate percentage profit.

Extension

- Ask students to plot graphs for each level of prize money in the competition activity, to show how percentage profit varies according to entry fee charged.

Plenary

- Group each pair of students who worked on Game 1 in the competition activity above with another pair who worked on Game 2, and ask each pair to present their findings to the other.

Formative assessment

- During the Plenary, each pair of students should check the other pair's solutions, assessing accuracy and clarity of working.

Homework

- Ask students to investigate all the factors that would affect the cost of car insurance with a particular company and find out different premiums charged for different models of car and driver characteristics.