



Teaching New GCSE Maths Specifications Number, Probability & Statistics

Trainer Handbook

Teaching New GCSE Maths Specifications: Number, Probability & Statistics

On arrival

Prepare the PowerPoint and projector. Display slide 1, 'Would you rather have ...'

Suggested timings are:

09:30-10:00	Refreshments & starter
10:00-10:15	Welcome and introductions
10:15-10:45	Session 1: Fractions and decimals
10:45-11:15	Session 2: Percentages
11:15-11:30	Session 3: Evaluating statements
11:30-11:45	<i>Break</i>
11:45-12:45	Session 4: Tackling examination questions
12:45-13:00	Session 5: Four 4's problem
13:00-13:45	<i>Lunch</i>
13:45-14:45	Session 6: Probability
14:45-15:00	<i>Break</i>
15:00-15:50	Session 7: Statistics
15:50-16:00	Review & evaluation

Note: Identify beforehand what you could miss out/shorten if you find that something in a session has taken much longer than anticipated. The participants can be told if you have omitted an activity and that they can still download the activities.

Teaching New GCSE Maths Specifications: Number, Probability & Statistics

Starter activity: Would you rather have ...

Aims:

- To engage delegates on arrival.
- To start delegates thinking.

Timing: Participants complete activity as they arrive.

Activity

- **Slide 1:** On arrival, and following registration, direct delegates to slide and suggest that they estimate, discuss and look up any relevant information.
- Those who complete the activity could think of alternative “would you rather have.....” question.

Feedback:

Don't take feedback at this stage – leave the activity open. Return to the activity briefly when suitable.

Teaching New GCSE Maths Specifications: Number, Probability & Statistics

Session 1: Fractions and decimals

(Adapted from: NCETM Thinking Through Mathematics)

Aims:

To help:

- Interpret decimals and fractions.
- Reflect and discuss approaches to equivalence and operations.

Resources:

- NPS2.1-3 Multiple representation cards
- A4 Plain paper

Timing: approximately 30 min. Dependent on how long the interpretation takes you may have to consider to what extent you lead the discussion on operations. However make sure that all participants have an opportunity to comment at this stage.

Activity:

Interpreting multiple representations

- If any find this more challenging than expected guide them toward matching two sets at first. Indicate number of squares in NPS2.2 etc.
- Those who finish quickly could be asked if they could produce fraction cards?

Operations of fractions

- Work through slides discussing the approaches and calculations used.
- Consider how you might apply these to operations of decimals or percentages.

Reflection

- In addition to the questions on the slide you may like to ask the following:
 - What are the advantages of this approach?
 - What responses would students have?
 - What questions might students ask?

Teaching New GCSE Maths Specifications: Number, Probability & Statistics

Session 2: Percentages

(Adapted from: *Improving Learning in Mathematics N7*)

Aims:

To help:

- Make links between percentages, decimals and fractions.
- Represent percentage increase and decrease as multiplication.
- Recognise the inverse relationship between increases and decreases.

Resources:

- NPS3 Card sets
 - Card set A – Money
 - Card set B – Percentages
 - Card set C – Words
 - Card set D – Decimals
 - Card set E – Fractions
- Calculators

Timing: approximately 30 min.

Activity:

Using percentages to increase quantities

- Ask participants to work in threes or fours. They will need plenty of table space for the activity, so you may need to push tables together. Give each group Card sets A – *Money* and B – *Percentages*.
- Ask them to place the money cards in the form of a square on the table.
- Ask them to take it in turns to place *Percentages* cards between each pair of *Money* cards to show the correct percentage increase or decrease. Cards may be horizontal, vertical or diagonal. Blank cards are provided if they wish to make new cards.
- When they have done this, introduce Card sets C and D. Ask them to add these to the arrangement on the table.
- Finally, when they have completed this stage, give out Card set E and ask them to place these in position.

Teaching New GCSE Maths Specifications: Number, Probability & Statistics

- **NB:** It is not necessary for them to match all sets; but to have understood the reasoning behind the approach.
- Those who finish quickly could be asked if they could produce additional cards?

Reflection

- Take feedback from each group in turn, rotating the questions posed.
- In addition to the questions on the slide you may like to ask the following:
 - What difficulties would students have and how would they overcome them?

Teaching New GCSE Maths Specifications: Number, Probability & Statistics

Session 3: Evaluating statements

(Adapted from: *Improving Learning in Mathematics N2*)

Aims:

To help:

- Understand the properties of number operations;
- Substitute integers, fractions, decimals and negative numbers into statements and equations in order to test their validity;
- Address common misconceptions about the effect of addition, subtraction, multiplication, division, squaring and finding square roots.

Resources:

- NPS4

Timing: approximately 15 min.

Activity:

- Ensure the three statement cards sometimes/always/never are placed around the room before you begin, preferably on three different walls!
- Progress through each slide asking participants to consider each in turn and stand by the statement they believe to be most appropriate.
- Debate across the room, allow movement etc ... They have been sat down to long!!!
- Pose questions such as; what if X was a fraction, negative etc.
- It is a good idea to take a volunteer from each statement to say why they are there and why others should move to be with them. Once each has had their say allow participants to move should they wish. Then ask any who moved why etc.. and continue until everyone wants to be at the same statement!

Reflection

- In addition to the questions on the slide you may like to ask the following:
 - How would students react to this approach?
 - What other approaches could you use?

Teaching New GCSE Maths Specifications: Number, Probability & Statistics

Session 4: Tackling examination questions

Aims:

To help delegates to:

- Understand some of the general changes within the new specification.
- Examine the difficulties that this presents to students.
- Investigate ways of supporting students with these changes.

Resources:

- NPSspecexamq1-5
- NPSspecexamexample
- NPS5
- Flip chart paper & glue sticks
- Plain set of cards

Timing: approximately 60 min.

Activity:

Introduction into new exam questions

- Ask delegates to consider question on the slide.
- Lead discussion on the questions “lack of scaffolding” and the move to have more like this in the new look papers.
- Get participants to consider how students would feel about answering this question.
- Give participants in groups of 3/4 the card set NPS5 and ask them to put them in an order that might have been asked in a more structured question.
- Get participants to consider how students would **now** feel about answering this question.
- **NB:** Mark scheme works on cost per day then year not the way our ordered reasoning cards work. It is worth discussing if anyone would have written a different set of cards ... leading to this.

Teaching New GCSE Maths Specifications: Number, Probability & Statistics

Solving questions - Carousel (this should be fast paced)

- Each group/table is given one of the specimen exam questions.
- Groups write a set of ordered reasoning cards as per previous exercise (then pass to next group with question).
- Each group now orders cards as given and sticks to flip chart paper with question at the top in order (pass to next group).
- Each group checks order and completes the question (pass to next group).
- Each group now marks the question (pass to next group).
- Each group now checks and reviews completed marked question.

Reflection

- In addition to the questions on the slide you may like to ask the following:
 - What was the easiest/hardest part?
 - What strategies can students apply to questions with less scaffolding?

Teaching New GCSE Maths Specifications: Number, Probability & Statistics

Session 5: Four 4's problem

Aims:

To help:

- Gain an understanding of knowledge of operations.
- Provide alternate strategies to practicing basic number operations.

Resources:

- Post it notes various colour packs
- Flip chart with 1 to 50 written on (post it size numbers)

Timing: approximately 15 min.

Activity:

- Give each table/group a different colour post it pack, create some competitiveness!
- Invite delegates (in groups) to make any number between 1 and 50 inclusive using four 4's and any operations they wish. Writing their solution on a post it.
- They then place post it over the number on a flip chart (1 to 50 fits nicely, as 5 by 10 on flip chart paper) claiming that number!
- Groups complete to claim as many as possible in the time given. Once a number has been claimed it cannot be claimed by another group, although it is recommend to suggest they go to flip chart and see what others have done/used and "challenge incorrect solutions".
- This can be continued over lunch if desired!!

Reflection

- Consider how students would find this.
- How it would demonstrate ability to manipulate operations.
- How it can act as an indicator of current understanding.
- Could they come up with alternatives? Four 3's or Five 5's for example.

Teaching New GCSE Maths Specifications: Number, Probability & Statistics

Session 6: Probability

(Adapted from: Bowland Assessment tasks and *Improving Learning in Mathematics S7*)

Aims:

To help:

- Consider the use of games within learning.
- Use past examination papers creatively.
- Analyse the demands made by examination questions.
- Discuss and clarify some common misconceptions about probability.

Resources:

- Number game sheet (NPS6)
- Spinner question sheets 1 & 2 (NPS7)
- A coin!
- Probability evaluation cards (NPS8)
- Excel number generator

Timing: approximately 60 min.

Activity:

Number game

- Run excel to produce two random whole numbers between 1 to 10. Multiple the numbers and delegates place product in one of the boxes.
- Continue with further numbers whilst delegates continue to place numbers (in size order) until they are unable to keep in size order. Last man standing wins!
- Play again if wish.
- Through lead discussion:
 - Examine where 50 might be placed and why?
 - What would students say, before or after playing?
 - Compare to a 100 square.
 - What is the probability that the product will be 10 or below?
 - What is the probability that the product will be 90 or above? etc.
- Play again if wish.

Teaching New GCSE Maths Specifications: Number, Probability & Statistics

Spinner bingo

- Show slides in turn.
- Lead discussion on outcomes.
- This is designed to stimulate thinking prior to the next exercise.

Developing an exam question

- Ask learners to work in pairs on the GCSE examination question on Sheet 1 – *Spinners*.
- When everyone has had time to have a go at this, hold a whole group discussion on the approaches used.
- Invite learners to suggest answers to question 2, explaining their reasoning. Discuss any disagreements.
- Finally, consider the concept of mutually exclusive outcomes adding to 1. Why don't the three probabilities add up to 1? eg. Max winning a prize does not exclude the possibility that Amy will also win a prize.
- There are many other questions an examiner might ask about this situation. Ask delegates to suggest alternatives. In doing this, they should not seek to change the situation in any way, but simply ask new questions about the given situation.
- Examples might be:
 - Draw a tree diagram to show the outcomes
 - What is the probability that nobody wins a prize?
 - What is the probability that only one person wins a prize?
 - What is the probability that two people win a prize?
 - What is the probability of getting a multiple of 5 or a multiple of 4?
 - Or harder questions where you multiply probabilities: What is the probability that Amy wins two games in a row?
- Hand out Sheet 2 – *Template for spinners questions*.
- Ask learners to write their own GCSE question using this template.
- Get delegates to pass their questions on to the next pair
- Where delegates have difficulty answering questions, the question-writers should explain what they intended and act as a teacher, helping the others to answer the questions.

Teaching New GCSE Maths Specifications: Number, Probability & Statistics

Heads or Tails

- Debate; is it better to change or stick if correct? How many times would you need to be correct to win?
- Delegates stand and choose Head (place their hands on their head) or Tail (place their hands on their rear!).
- Flip coin, read out result.
- Those incorrect sit, those correct remain standing.
- Repeat until only one standing.
- Debate; is it better to change or stick if correct?
- How many times would you need to be correct to win?
- What are the misconceptions that students have?
- Explain you are going to consider this further in the next exercise.

Evaluating probability statements

- Give each pair of delegates the card set NPS8.
- Ask them to take each card in turn and decide whether it is a true statement or a false statement.
- Tell them to be prepared to give reasons for their decisions.
- Rotating around the tables ask each in turn to give the answer to one of the cards and why. Making sure to tease out common misconceptions.
- Key ones to watch out for are:
 - 'Special' events are less likely than 'more representative' events. In A & C
 - All outcomes are assumed to be equally likely. In D & E
 - Later random events 'compensate' for earlier ones. In G & I
 - Sample size is irrelevant. In J

Reflection

- In addition to the questions on the slide you may like to ask the following:
 - Do games have a role in learning?
 - What do students learn by writing questions?
 - Suggest further examples that illustrate the misconceptions in probability.

Teaching New GCSE Maths Specifications: Number, Probability & Statistics

Session 7: Statistics

(Adapted from: *Improving Learning in Mathematics S5*)

Aims:

To help:

- To assess knowledge and understanding of data representation diagrams.
- Understand and interpret bar charts and pie charts (inc. box and whisker plots extension).
- To gain a clearer understanding of statistics such as Mean/Mode/Median.

Resources:

- Post its
- Bar & Pie chart cards (NPS9)
 - Card set A – Bar Charts
 - Card set B – Pie Charts
 - Card set C – Box Plots (extension only)
- Mystery clue sheet (NPS10)

Timing: approximately 50 min.

Activity:

Data representation

- Ask delegates to make a quick sketch on sticky notes of different ways of representing data.
- Make sure you use a separate piece of paper for each diagram. It doesn't have to be neat or accurate but does need to be recognisable!
- Display collectively, all view and discuss.
- Did they self regulate?
 - Collectively sort each others
 - Separate bar charts and histograms

Teaching New GCSE Maths Specifications: Number, Probability & Statistics

Interpreting bar charts and pie charts

- Hand out Card set A – *Bar charts* and Card set B – *Pie charts* to groups of 3/4 delegates.
- Ask them to match the cards from each set.
- Ask each group in turn what they found easiest/hardest, what strategies did they use?
- (*Hand out Card set C – Box Plots only as an extension if delegates are familiar with them.*)
- Show slide comparing bar charts and ask for answers with reasons. (*Note: both wines have the same mean score of 3.5.*)
- Ask how students might view this question:
 - Would they commit if unsure?
 - Is there a right answer?

An average mystery!

- Give out Clue cards and display slide showing table.
- Ask delegates fill in the two way table using the clues provided.

Reflection

- In addition to the questions on the slide you may like to ask the following:
 - How would students respond to these activities?
 - What questions would students ask during the activities and how would you respond?