GCSE

Edexcel GCSE in Statistics (1398)

First examination 2007

February 2007

Teacher's guide: scheme of work

Contents

Introduction

The scheme of work is structured so each topic contains:

- module number

- suggested teaching time

- contents, referenced back to the National Curriculum Programme of Study

- objectives for pupils at the end of the module

- ideas for differentiation and extension activities

- endorsed publishers' resources, referenced to textbook chapters and sections

- issues regarding assessment of the module

- ideas for homework tasks

- notes for general mathematical teaching points and common misconceptions.

It contains material common to Edexcel GCSE Mathematics and GCSE Statistics specifications. The material has been separated into GCSE Mathematics content and GCSE Statistics content for each tier. These are included to help teachers identify topics which are common to both qualifications.

In the prior knowledge section, references to modules in the GCSE Mathematics sections of this scheme of work will be in *italics*.

The bold number **(1)** in brackets refers to the module number in the GCSE Mathematics (Linear) scheme of work publications for reference.

Key to publishers' resources

Each topic in the Statistics scheme of work contains a section where the content of the topic has been referenced to endorsed textbooks for the course.

The endorsed publisher for the course is currently Heinemann (Harcourt).

Publisher	Textbook	Chapter

Please note that these references are to the first editions of the textbooks. Contact information for the publisher can be found on page 57.

For GCSE Mathematics publishers' references, please refer to the GCSE Mathematics (Linear) scheme of work. This is available through the Edexcel website www.edexcel.org.uk.

Foundation tier

Scheme of work
GCSE Mathematics
Data handling topics

GCSE Mathematics − Handling Data

Module   **Maths 1**   **Time**: 4 – 6 hours

GCSE tier: **Foundation**

Contents: **Collecting data**

HD3a   Designing and using data-collection sheets for grouped discrete and continuous data

HD3a   Collecting data using various method

HD3b   Gathering data from secondary sources

HD3c   Designing and using two-way tables

Prior knowledge

• An understanding of why data needs to be collected.

• Some idea about different types of graphs.

Objectives

By the end of the module the student should be able to:

• design a suitable question for a questionnaire

• understand the difference between: primary and secondary data; discrete and continuous data

• design suitable data capture sheets for surveys and experiments

• understand about bias in sampling.

Differentiation and extension

• Carry out a statistical investigation of their own including designing an appropriate means of gathering the data.

Assessment issues

• Written testing to assess knowledge of content.

• Their own statistical investigation.

• GCSE coursework for statistics.

Homework

• Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

• Completion of data collection exercise statistical project.

Notes

• Students may need reminding about the correct use of tallies.

• Emphasise the differences between primary and secondary data.

• If students are collecting data as a group they should all use the same procedure.

• Emphasise that continuous data is data that is measured.

GCSE Mathematics − Handling Data

Module   **Maths 2**   **T**ime: 5 – 7 hours

GCSE tier: **Foundation**

Contents: **Displaying data 1**   **Charts and graphs**

HD4a   Drawing and producing a wide range of graphs and diagrams

HD5b   Interpreting a wide range of graphs and diagrams and drawing conclusions

Prior knowledge

- An understanding of why data needs to be collected and some idea about different types of graphs.

Objectives

By the end of the module the student should be able to:

- represent data as:
    - bar charts (including dual bar charts)
    - pictograms
    - line graphs
    - histograms (intervals with equal width)
    - frequency polygons
- choose an appropriate way to display discrete, continuous and categorical data.

Differentiation and extension

- Carry out a statistical investigation of their own and use an appropriate means of displaying the results.
- Use a spreadsheet to draw different types of graphs.
- Collect examples of charts and graphs in the media which have been misused, and discuss the implications.

Assessment issues

- Written testing to assess knowledge of content.
- Their own statistical investigation.
- GCSE coursework for statistics.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.
- Completion of a simple statistical project.

Notes

- Clearly label all axes on graphs and use a ruler to draw straight lines.
- Many students enjoy drawing statistical graphs for classroom displays.

GCSE Mathematics − Handling Data

Module   **Maths 3**   **Time**: 5 – 7 hours

GCSE tier: **Foundation**

Contents: **Statistical measures 1   Small data sets**

HD4b   Finding the (mode) median, mean and range of small data sets with discrete data

HD4a   Drawing and producing a stem and leaf diagram

HD5a   Relating summarised data to the initial questions

HD5d   Comparing distributions and making inferences, using the shapes of distributions and measures of average and spread

Prior knowledge

- Some experience of the measures of averages.

- Ability to order numbers.

Objectives

By the end of the module the student should be able to:

- find the mode, the median, the mean, and the range for (small) sets of data

- use a stem and leaf diagram to sort data

- know the advantages/disadvantages of using the different measure of average.

Differentiation and extension

- Collect data from class — children per family etc.

- Find measures of average for data collected in a frequency distribution.

- Use stem and leaf diagrams with unusual stems, eg 234.1, 234.6, 235.1, …

- Discuss occasions when one average is more appropriate, and the limitations of each average.

- Compare distributions and making inferences, using the shapes of distributions and measures of average and spread, eg 'boys are taller on average but there is a much greater spread in heights'.

Assessment issues

- Written testing to assess knowledge of content.

- A group work assessment through selected questions and mini-projects.

- GCSE coursework for statistics.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

- Collect data at home for processing in class.

Notes

- Students tend to select modal class but identify it by the frequency rather than the class description.

- Explain that the median of grouped data is not necessarily from the middle class interval.

GCSE Mathematics − Handling Data

Module	**Maths 4**	**Time**: 3 – 5 hours
GCSE tier:	**Foundation**	
Contents:	**Probability 1**	

HD4c	Understanding and using the probability scale
HD5g	Using the vocabulary of probability to interpret results involving uncertainty and prediction
HD4f	Identifying different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1
HD4e	Listing all outcomes for single events, and for two successive events, in a systematic way

Prior knowledge

- Some idea of chance and the likelihood of an event happening; and recognition that some events are more likely than others.

- Experience of using the language of likelihood.

Objectives

By the end of the module the student should be able to:

- use the language of probability to describe the likelihood of an event

- represent and compare probabilities on a number scale

- list outcomes for single mutually exclusive events and write down their probability.

Differentiation and extension

- Write down probabilities of events that may or may not happen.

- Play simple probability games, predicting outcomes eg horse race for sum of two dice.

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Where possible introduce practical work to support the theoretical work.

- Only fractions, decimals or percentages should be used for probability.

GCSE Mathematics − Handling Data

Module   **Maths 5**   **Time**: 1 – 2 hours

GCSE tier: **Foundation**

Contents: **Displaying data 2   Pie charts**

HD4a   Drawing and producing pie charts

HD5b   Interpreting pie charts

Prior knowledge

- Measuring and drawing angles.

- Fractions of simple quantities.

Objectives

By the end of the module the student should be able to:

- represent categorical data in a pie chart

- interpret categorical data in a pie chart.

Differentiation and extension

- Draw comparative pie charts (equal radii).

- Compare pie charts for, eg boys and girls, to identify similarities and differences.

Assessment issues

- Written testing to assess knowledge of content.

- Draw a pie chart from data they have collected.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature.

Notes

- Accurate drawing skills need to be reinforced.

- Angles should be correct to within 2°.

GCSE Mathematics − Handling Data

Module   **Maths 6**   **Time**: 3 – 5 hours

GCSE tier: **Foundation**

Contents: **Displaying data 3   Time series**

HD4a   Drawing and producing a time series

HD5b   Interpreting a time series

Prior knowledge

- Experience of collecting, interpreting, displaying and calculating with data.

Objectives

By the end of the module the student should be able to:

- represent data as a time series

- identify trends in data over time

- identify exceptional periods by comparison with similar previous periods.

Differentiation and extension

- Make predictions by considering trends of line graphs for time series.

- Additional work on making predictions based on current trends, using time series and/or moving averages.

- Collect data from the internet (eg RPI) and analyse it for trend.

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- All working should be presented clearly, with descriptions of trends expressed as clearly as possible.

GCSE Mathematics — Handling Data

Module	**Maths 7**	**Time**: 6 – 8 hours

GCSE tier: **Foundation**

Contents: **Probability 2**

HD4d	Understanding and using estimates or measures of probability from theoretical models (including equally likely outcomes), or from relative frequency
HD4f	Identifying different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1
HD5h	Comparing experimental data and theoretical probabilities
HD5i	Understanding that if they repeat an experiment, they may — and usually will — get different outcomes; and that increasing sample size generally leads to better estimates of probability and population characteristics

Prior knowledge

- Probability 1.

- Ability to read from a two-way table.

Objectives

By the end of the module the student should be able to:

- write down the theoretical probability for an equally likely event

- estimate a probability by relative frequency

- know that a better estimate for a probability is achieved by increasing the number of trials.

Differentiation and extension

- The work can be extended to include that of the Higher syllabus.

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Students can be unsure of the relationship P(not n) = 1 − P(n).

- Only fractions, decimals or percentages should be used for probability.

GCSE Mathematics — Handling Data

Module	Maths 8	**Time**: 5 – 7 hours

GCSE tier: **Foundation**

Contents: **Scatter graphs and correlation**

HD4a	Drawing and producing a scatter graph
HD5b	Interpreting scatter graphs
HD5f	Appreciating that correlation is a measure of the strength of association between two variables
HD5f	Distinguishing between positive, negative and zero correlation using lines of best fit
DH5f	Appreciating that zero correlation does not necessarily imply 'no correlation' but merely 'no linear relationship'
HD4h	Drawing lines of best fit by eye, understanding what these represent
NA6c	Draw a line of best fit through a set of linearly related points and find its equation

Prior knowledge

- Plotting coordinates.

- An understanding of the concept of a variable.

- Recognition that a change in one variable can affect another.

- Linear graphs.

Objectives

By the end of the module the student should be able to:

- draw and produce a scatter graph

- appreciate that correlation is a measure of the strength of association between two variables

- distinguish between positive, negative and zero correlation using a line of best fit

- appreciate that zero correlation does not necessarily imply 'no correlation' but merely 'no linear relationship'

- draw lines of best fit by eye and understand what it represents

- find the equation of the line of best and use it to interpolate/extrapolate.

Differentiation and extension

- Vary the axes required on a scatter graph to suit the ability of the class.

- Carry out a statistical investigation of their own including; designing an appropriate means of gathering the data, and an appropriate means of displaying the results.

- Use a spreadsheet, or other software, to produce scatter diagrams/lines of best fit. Investigate how the line of best fit is affected by the choice of scales on the axes.

Assessment issues

- Written testing to assess knowledge of content.

- Test a given hypothesis either using data provided or by collecting data from the class.

- Their own statistical investigation.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

- Completion of simple statistical project.

Notes

- Students should realise that lines of best fit should have the same gradient as the correlation of the data.

- Clearly label all axes on graphs and use a ruler to draw straight lines.

GCSE Mathematics − Handling Data

Module   **Maths 9**   **Time**: 6 – 8 hours

GCSE tier: **Foundation**

Contents: **Statistical measures 2   Large data sets**

HD4b   Identifying the modal class for grouped data

HD4g   Finding the median for large data sets

HD4g   Calculating an estimate of the mean for large data sets with grouped data

HD5j   Using relevant statistical functions on a calculator or spreadsheet

Prior knowledge

- Statistical measures 1.

- Finding the average of two number (ie the midpoint).

Objectives

By the end of the module the student should be able to:

- identify the modal class interval in grouped and ungrouped frequency distributions

- find the class interval containing the median value

- find the mean of an ungrouped frequency distribution

- find an estimate for the mean of a grouped frequency distribution by using the mid-interval value

- use the statistical functions on a calculator or a spreadsheet to calculate the mean for discrete data.

Differentiation and extension

- Find the mean for grouped continuous data with unequal class intervals.

- Collect continuous data and decide on appropriate (equal) class intervals; then find measures of average.

- Find the median by cumulative frequency diagram.

- Consider other measures of spread, eg interquartile range; appreciate advantages/limitations of the range.

- Use the statistical functions on a calculator or a spreadsheet to calculate the mean for continuous data.

Assessment issues

- Written testing to assess knowledge of content.

- Test a given hypothesis either using data provided or by collecting data from the class.

- GCSE coursework for statistics.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

- Completion of simple statistical project.

Notes

- Students should be aware that the actual mean can not be calculated from a grouped frequency distribution; and that using the midpoint of the class intervals gives the best estimate for the mean.

- The modal class is found for grouped frequency distributions in which the class intervals have an equal.

Foundation tier

Scheme of work
1389
GCSE Statistics

Module 1   **GCSE Statistics**   **Time**: 2 – 3 hours

GCSE tier: **Foundation**

Contents: **The collection of data 1**

1b   Types of data

1c   Population and sampling

1d   Collecting data

2h   Estimation

Prior knowledge

GCSE Mathematics Foundation *Module 1* **(6)** Collecting data.

Objectives

By the end of the unit the student should be able to:

- know the difference between quantitative and qualitative data

- recognise understand and use categorical and rank scales of measurement

- understand the difference between a population and a sample, and that sample data is used to estimate values in the population

- understand the effect of sample size on estimates of population values

- understand, design and use a sample frame (list) to select a random sample or a stratified sample (only one category is required)

- generate and use random numbers to select a random sample

- understand aspects of accuracy, reliability and bias in secondary data (including data collected from the internet).

Differentiation and extension

- Take a stratified sample with more than one category, eg gender and age group.

- Investigate the accuracy/consistency of data collected from the internet.

- Generate practical examples of:

    i   categorical scales

    ii   rank scales of measurement.

Resources

Heinemann (Harcourt)   Edexcel GCSE Statistics   Chapter: 2

Assessment issues

- Written testing to assess knowledge of content.

- Plan and collect data for coursework.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Aspects of this module will be enhanced by practical applications of the theory.

Module 2   **GCSE Statistics**   **Time**: 2 – 3 hours

GCSE tier: **Foundation**

Contents: **The collection of data 2**

1d   Collecting data

Prior knowledge

GCSE Statistics Foundation Module 1 — The collecting of data 1.

Objectives

By the end of the unit the student should be able to:

- obtain primary data by questionnaires and experiments

- understand the advantages and disadvantages of using interviews versus questionnaires

- understand the role, and use of, pilot studies and pre-testing

- understand the advantages and disadvantages of open and closed questions in the design of questionnaires

- appreciate the problems in: the distribution and collection of questionnaires; the errors in recorded answers; non-response and missing data.

Differentiation and extension

- Investigate the usability of real-world data collection sheets, eg tax return, passport application, national census.

- Investigate how the manner of an interview could affect the outcome (students role-play interviews).

- Investigate a leading question — does it really affect the response?

Resources

Heinemann (Harcourt)   Edexcel GCSE Statistics   Chapter: 2

Assessment issues

- Written testing to assess knowledge of content.

- Plan and collect data for coursework.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Knowledge of the national census is required.

Module 3   **GCSE Statistics**   **Time**: 9 – 10 hours

GCSE tier: **Foundation**

Contents: **Processing**, **representing and analysing data 1**

2a   Tabulation

2b   Diagrams and representations

Prior knowledge

GCSE Mathematics Foundation *Module 2* **(7)** Displaying data 1: Charts and graphs.

GCSE Mathematics Foundation *Module 5* **(18)** Displaying data 2: Pie charts.

Objectives

By the end of the unit the student should be able to:

- represent and interpret data as:
    - multiple or composite bar charts
    - vertical line (stick) graphs for discrete data
    - cumulative frequency diagrams
    - population pyramids
    - line graphs (including comparisons of line graphs)
    - choropleth maps
    - pie charts (for comparison)
- identify the shape and simple properties of frequency distributions (including symmetry, positive and negative skew)
- transform from one presentation to another (eg bar chart to pie chart)
- combine categories to simplify tables with an understanding of the problems caused by over simplification
- understand the reasons for choosing particular representations.

Differentiation and extension

- Further examples of these graphs (particular graphs used for comparison).
- Investigate the misrepresentation of statistics in the media.
- Compare information presented in different forms, eg pie chart and bar chart.

Resources

Heinemann (Harcourt)   Edexcel GCSE Statistics   Chapter: 3, 4, 5 and 7

Assessment issues

- Written testing to assess knowledge of content.
- Present and interpret data collected for coursework.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Emphasise the correct choice of representation (with reasons).

Module 4   **GCSE Statistics**   **Time**: 8 – 9 hours

GCSE tier: **Foundation**

Contents: **Processing**, **representing and analysing data 2**

2c   Measures of central tendency

2d   Measures of dispersion

Prior knowledge

GCSE Mathematics Foundation *Module 3* **(11)** Statistical measures 1: Small data sets.

GCSE Mathematics Foundation *Module 7* **(34)** Statistical measures 2: Large data sets.

Objectives

By the end of the unit the student should be able to:

- use a cumulative frequency curve to work out an estimate for the median of a grouped frequency distribution (discrete and continuous data)

- work out the quartiles, percentiles and interquartile range for discrete and continuous data presented either as a list, frequency distribution or grouped frequency table

- construct interpret and use box plots (including comparisons of box plots)

- understand the advantages and disadvantages of each of the measures of dispersion (including range, quartiles, interquartile range and percentiles)

- use an appropriate measure of central tendency and dispersion to compare distributions

- appreciate that a full comparison of distributions needs at least a measure of central tendency and a measure of dispersion.

Differentiation and extension

- Students compare themselves to published statistics, eg BMI, birth weight charts.

- Use box plots to compare heights of students in each year group of the school.

- Use a cumulative frequency curve to find an estimate for, eg the number of people taller than 170 cm.

- Investigate the use of percentile range in real-world statistics.

Resources

Heinemann (Harcourt)   Edexcel GCSE Statistics   Chapter: 5

Assessment issues

- Written testing to assess knowledge of content.

- Present and interpret data collected for coursework.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Σ and $\bar{x}$ notation is expected.

Module 5   **GCSE Statistics**   **Time**: 4 – 5 hours

GCSE tier: **Foundation**

Contents: **Processing**, **representing and analysing data 3**

2f   Scatter diagrams and correlation

2g   Time series

Prior knowledge

GCSE Mathematics Foundation *Module 7* **(33)** Scatter graphs and correlation.

Objectives

- Identify independent and dependent variables.

- Fit a line of best fit passing through $(\bar{x}, \bar{y})$ to the points on a scatter graph.

- Understand the pitfalls of interpolation and extrapolation.

- Plot points as a time series graph and as moving averages Draw a trend line by eye and use it to make a prediction.

- Identify and discuss the significance of seasonal variation by visual inspection of time series graphs.

Differentiation and extension

- Investigate the relationship between variables, eg hand span v foot length, volume v surface area of cubes.

- Analyse real-world time series graphs for trends, eg FT100 index over 3 years.

Resources

Heinemann (Harcourt)   Edexcel GCSE Statistics   Chapter: 6 and 7

Assessment issues

- Written testing to assess knowledge of content.

- Present and interpret data collected for coursework.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Explain that: correlation does not guarantee a causal relationship between the variables; unrelated variables may exhibit linear correlation.

Module 6   **GCSE Statistics**   **Time**: 5 – 7 hours

GCSE tier: **Foundation**

Contents: **Probability**

4   Probability

Prior knowledge

GCSE Mathematics Foundation *Module 4* **(12)** Probability 1.

GCSE Mathematics Foundation *Module 6* **(29)** Probability 2.

Objectives

- Understand the meaning of the words event and outcome.

- Understand the terms random and equally likely.

- Use probability to assess risk (eg insurance).

- Produce and use a sample space.

- Understand the terms mutually exclusive and exhaustive.

- Understand the addition law P(A or B) = P(A) + P(B).

- Understand the multiplication law P(A and B) = P(A) × P(B).

Differentiation and extension

- Do calculations without the use of a calculator, eg probabilities with harder fractions.

- Generate sample spaces which require careful specification, eg drawing cards from a pack of cards.

- Use tree diagrams to calculate probabilities with/without replacement, eg sweets from a bag.

Resources

Heinemann (Harcourt)   Edexcel GCSE Statistics   Chapter: 8

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Probabilities may be expressed as fractions, decimals or percentages, ie not as ratios (odds).

Higher tier

Scheme of work
GCSE Mathematics
Data handling topics

GCSE Mathematics — Handling Data

Module	**Maths 1**	**Time**: 3 – 5 hours
GCSE tier:	**Higher**	
Contents:	**Collecting data**	

HD2d	Identifying which primary data they need to collect and in what format, including grouped data, considering appropriate equal class intervals
HD2d	Selecting and justifying a sampling scheme and a method to investigate a population
HD3a	Collecting data using various method, including observation, controlled experiments, data logging, questionnaires and surveys
HD3a	Designing and using data-collection sheets
HD3b	Gathering data from secondary sources
HD3c	Designing and using two-way tables
HD3d	Dealing with practical problems such as non-response or missing data

Prior knowledge

- An understanding of why data needs to be collected.

- Experience of simple tally charts.

- Experience of inequality notation.

Objectives

By the end of the module the student should be able to:

- design a suitable question for a questionnaire

- understand the difference between: primary and secondary data; discrete and continuous data

- design suitable data capture sheets for surveys and experiments

- understand about bias in sampling

- choose and justify an appropriate sampling scheme, including random and systematic sampling

- deal with practical problems in data collection, such as non-response, missing and anomalous data.

Differentiation and extension

- Carry out a statistical investigation of their own including designing an appropriate means of gathering the data.

- An investigation into other sampling schemes, such as cluster and quota sampling.

Assessment issues

- Written testing to assess knowledge of content.

- Their own statistical investigation.

- GCSE coursework for statistics.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

- Completion of data collection exercise for statistical project.

Notes

- Students may need reminding about the correct use of tallies.

- Emphasise the differences between primary and secondary data.

- If students are collecting data as a group they should all use the same procedure.

- Emphasise that continuous data is data that is measured.

GCSE Mathematics — Handling Data

Module   **Maths 2**   **Time**: 1 – 3 hours

GCSE tier: **Higher**

Contents: **Displaying data 1   Charts and graphs**

HD4a   Drawing and producing a wide range of graphs and diagrams

HD5b   Interpreting a wide range of graphs and diagrams and drawing conclusions

Prior knowledge

- An understanding of the different types of data: continuous; discrete; categorical.

- Experience of inequality notation.

- Ability to multiply a number by a fraction.

- Use a protractor to measure and draw angles.

Objectives

By the end of the module the student should be able to:

- represent data as:
    - pie charts (for categorical data)
    - bar charts and histograms (equal class intervals)
    - frequency polygons

- choose an appropriate way to display discrete, continuous and categorical data

- understand the difference between a bar chart and a histogram

- compare distributions shown in charts and graphs.

Differentiation and extension

- Carry out a statistical investigation of their own and use an appropriate means of displaying the results.

- Use a spreadsheet to draw different types of graphs.

- Collect examples of charts and graphs in the media which have been misused, and discuss the implications.

Assessment issues

- Written testing to assess knowledge of content.

- Their own statistical investigation.

- GCSE coursework for statistics.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

- Completion of a simple statistical project.

Notes

- Clearly label all axes on graphs and use a ruler to draw straight lines.

- Many students enjoy drawing statistical graphs for classroom displays.

GCSE Mathematics — Handling data

Module   **Maths 3**   **Time**: 3 – 5 hours

GCSE tier: **Higher**

Contents: **Displaying data 3   Time series**

HD4a   Drawing and producing a time series

HD5b   Identifying seasonal trends in time series

HD5c   Looking at data to find patterns

HD4f   Calculating an appropriate moving average

HD5j   Interpreting social statistics

Prior knowledge

- Experience of plotting points.

- Ability to work out an average.

- Displaying data 1.

Objectives

By the end of the module the student should be able to:

- represent data as a time series

- identify trends in data over time

- calculate a moving average.

Differentiation and extension

- Make predictions by considering trends of line graphs for time series.

- Additional work on making predictions based on current trends, using time series and/or moving averages.

- Collect data from the internet (eg RPI) and analyse it for trend.

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- All working should be presented clearly, with descriptions of trends expressed as clearly as possible.

GCSE Mathematics − Handling Data

Module   **Maths 4**   **Time**: 3 – 5 hours

GCSE tier: **Higher**

Contents: **Displaying data 4   Scatter graphs and correlation**

HD4a   Drawing and producing a scatter graph

HD5b   Interpreting a scatter graph

HD5h   Appreciating that correlation is a measure of the strength of association between two variables

DH5f   Appreciating that zero correlation does not necessarily imply 'no correlation' but merely 'no linear relationship'

HD5f   Distinguishing between positive, negative and zero correlation and using a line of best fit

HD4i   Drawing a line of best fit by eye, and understanding what these represent

Prior knowledge

- Plotting coordinates.

- An understanding of the concept of a variable.

- Recognition that a change in one variable can affect another.

Objectives

By the end of the module the student should be able to:

- draw and produce a scatter graph

- appreciate that correlation is a measure of the strength of association between two variables

- distinguish between positive, negative and zero correlation using a line of best fit

- appreciate that zero correlation does not necessarily imply 'no correlation' but merely 'no linear relationship'

- draw a line of best fit by eye and understand what it represents

- use a line of best fit to interpolate/extrapolate.

Differentiation and extension

- Vary the axes required on a scatter graph to suit the ability of the class.

- Carry out a statistical investigation of their own including; designing an appropriate means of gathering the data, and an appropriate means of displaying the results.

- Use a spreadsheet, or other software, to produce scatter diagrams/lines of best fit. Investigate how the line of best fit is affected (visually) by the choice of scales on the axes.

Assessment issues

- Written testing to assess knowledge of content.

- Test a given hypothesis either using data provided or by collecting data from the class.

- Their own statistical investigation.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

- Completion of simple statistical project.

Notes

- Students should realise that lines of best fit should have the same gradient as the correlation of the data.

- Clearly label all axes on graphs and use a ruler to draw straight lines.

GCSE Mathematics — Handling Data

Module   **Maths 5**   **Time**: 1 – 3 hours

GCSE tier: **Higher**

Contents: **Statistical measures 1   The mean (large data sets)**

HD4e   Finding the mean for large data sets

HD4e   Finding the mean for large data sets with grouped data

Prior knowledge

- Knowledge of finding the mean for small data sets.

- Ability to find the mid point of two numbers.

Objectives

By the end of the module the student should be able to:

- find the mean of data given in an ungrouped frequency distribution

- use the mid interval value to find an estimate for the mean of data given in a grouped frequency distribution

- understand and use the sigma notation for the mean of ungrouped, and grouped, data.

Differentiation and extension

- Use statistical functions on calculators and spreadsheets.

- Use statistical software to calculate the mean for grouped data sets.

- Estimate the mean for data sets with ill defined class boundaries.

- Investigate the affect of combining class intervals on estimating the mean for grouped data sets.

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

- Completing of data handling coursework.

Notes

- Students should understand that finding an estimate for the mean of grouped data is not a guess.

- Some students may find the sigma notation difficult to understand at first.

- The connection between sigma f and n should be established clearly.

GCSE Mathematics — Handling Data

Module	**Maths 6**	**Time**: 7 – 9 hours
GCSE tier:	**Higher**	
Contents:	**Probability**	

HD4c	Listing all outcomes for single events, and for successive events, in a systematic way
HD4d	Identifying different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1
HD4g	Knowing when to add or multiply two probabilities
HD4h	Using tree diagrams to represent outcomes of compound events, recognising when events are independent
HD5h	Comparing experimental data and theoretical probabilities
HD4i	Understanding that if they repeat an experiment they may —and usually will — get different outcomes, and that increasing sample size generally leads to better estimates of probability and population parameters

Prior knowledge

- Understand that a probability is a number between 0 and 1.

- Know how to add, and multiplying fractions and decimals.

- Experience of expressing one number as a fraction of another number.

- Recognise the language of statistics, eg words such as likely, certain, impossible.

Objectives

By the end of the module the student should be able to:

- list all the outcomes from mutually exclusive events, eg from two coins, and sample space diagrams

- write down the probability associated with equally likely events, eg the probability of drawing an ace from a pack of cards

- know that if the probability of an event occurring is p than the probability of it not occurring is $1 - p$

- find the missing probability from a list or table

- know that the probability of A or B is $P(A) + P(B)$

- know that the probability of A and B is $P(A) \times P(B)$

- draw and use tree diagrams to solve probability problems (including examples of non-replacement)

- find estimates of probabilities by considering relative frequency in experimental results (including two-way tables)

- know that the more an experiment is repeated the better the estimate of probability.

Differentiation and extension

- Binomial probabilities.

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Students should express probabilities as fractions, percentages or decimals.

- Fractions needed not be cancelled to their lowest terms.

GCSE Mathematics — Handling Data

Module	**Maths 7**	**Time**: 7 – 9 hours

GCSE tier: **Higher**

Contents: **Statistical measures 2   Median and interquartile range (large data sets)**

HD4a	Drawing and producing stem and-leaf diagrams
HD4e	Finding the median, quartiles and interquartile range for large data sets
HD4a	Drawing and producing cumulative frequency tables and diagrams
HD4a	Drawing and producing box plots for grouped continuous data
HD5d	Comparing distributions and making inferences, using shapes of distributions and measures of average and spread, including median and quartiles
HD5b	Interpreting cumulative frequency diagrams and box plots and drawing conclusions

Prior knowledge

- Experience of inequality notation.
- Ability to plot points.
- Understand how to find the median and range for small data sets.
- Understand the difference between discrete and continuous data.

Objectives

By the end of the module the student should be able to:

- find the median and quartiles for large sets of ungrouped data
- draw a cumulative frequency table for grouped data (using the upper class boundary)
- draw a cumulative frequency curve for grouped data
- use a cumulative frequency diagram to find estimates for the median and quartiles of a distribution
- use a cumulative frequency diagram to solve problems, eg how many greater than a particular value
- draw a box plot to summarise information given in cumulative frequency diagrams
- compare cumulative frequency diagrams and box lots to make inferences about distributions.

Differentiation and extension

- Understand the distinction between a cumulative frequency curve and a cumulative frequency polygon.
- Compare more than three distributions.
- Use statistical software to produce cumulative frequency diagrams and box plots.
- Identify and represent outliers for box plots.

Assessment issues

- Written testing to assess knowledge of content.

- Their own statistical investigation.

- GCSE coursework for statistics.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- No distinction is made for cumulative frequency curves and cumulative frequency polygons.

- Students should check that their answers for mean, median and mode lie within the given range of data.

GCSE Mathematics — Handling data

Module	Maths 8	**Time**: 5 – 7 hours

GCSE tier: **Higher**

Contents: **Displaying data 2   Histograms**

HD4a	Drawing and producing histograms for grouped continuous data
HD5b	Interpreting a histogram
HD5d	Understanding frequency density

Prior knowledge

- Displaying data 1.

Objectives

By the end of the module the student should be able to:

- complete a histogram from a frequency table

- complete a frequency table from a histogram

- use a histogram to work out the frequency in part of a class interval.

Differentiation and extension

- Carry out a statistical investigation of their own and use an appropriate means of displaying the results.

- Investigate how the choice of class width affects the shape of a distribution.

Assessment issues

- Written testing to assess knowledge of content.

- Their own statistical investigation.

- GCSE coursework for statistics.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

- Completion of a simple statistical project.

Notes

- Label clearly all axes on graphs (frequency density).

- Emphasise the difference between a histogram and bar charts/graphs pupils have previously encountered.

Higher tier

Scheme of work
1389
GCSE Statistics

Module 1   **GCSE Statistics**   **Time**: 3 – 4 hours

GCSE tier: **Higher**

Contents: **The collecting of data 1**

1b	Types of data
1c	Population and sampling
1d	Collecting data
2h	Estimation

Prior knowledge

GCSE Mathematics Higher *Module 1* **(8)** Collecting data

Objectives

By the end of the unit the student should be able to:

- recognise understand and use categorical, rank, interval and ratio scales

- understand the difference between a population and a sample, and that sample data is used to estimate values in the population

- understand the effect of sample size on estimates of population values

- understand, design and use a sample frame (list) to select a random sample or a stratified sample (more than one category)

- understand and use systematic, quota, convenience and cluster sampling

- understand the strengths and weaknesses of various sampling methods, including bias, influences and convenience

- generate and use random numbers to select a random sample

- estimate population size based on the Peterson capture/recapture method and understand the appropriateness of the assumptions in practice

- understand aspects of accuracy, reliability and bias in secondary data (including data collected from the internet).

Differentiation and extension

- Take samples from a population to find estimates for the mean of the population. Discuss the variability of the estimates — how does sample size effect the variability of the estimates?

- Investigate the accuracy/consistency of data collected from the internet.

- Generate practical examples of categorical, rank, interval and ratio scales of measurement.

- Investigate the limitations of the national census — is it truly a census?

- Investigate how professional statisticians, eg Gallop, collect data. How reliable are these statistics?

- Investigate how random numbers are generated. How 'random' is a random number on your calculator?

Resources

Heinemann (Harcourt)   Edexcel GCSE Statistics   Chapter: 2

Assessment issues

- Written testing to assess knowledge of content.

- Plan and collect data for coursework.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Use real-world examples as often as possible.

Module 2   **GCSE Statistics**   **Time**: 2 – 3 hours

GCSE tier: **Higher**

Contents: **The collection of data 2**

1d   Collecting data

Prior knowledge

GCSE Statistics Higher Module 1 — The collecting of data 1

Objectives

By the end of the unit the student should be able to:

- obtain primary data by questionnaires, experiment or simulations

- understand the advantages and disadvantages of using interviews versus questionnaires

- understand the role, and use of, pilot studies and pre-testing

- understand the advantages and disadvantages of open and closed questions in the design of questionnaires

- appreciate the problems in: the distribution and collection of questionnaires; the errors in recorded answers; obtaining truthful responses in sensitive cases

- comment on the design of experiments (including replication, randomisation and matched pairs).

Differentiation and extension

- Investigate the collection of data by blind, and double-blind, experiments.

- Design a complex data collection form.

- Investigate the usability of real-world data collection sheets, eg tax return, passport application, national census.

- Investigate how the manner of an interview could affect the outcome (students role-play interviews).

- Investigate a leading question — does it really affect the response?

Resources

Heinemann (Harcourt)   Edexcel GCSE Statistics   Chapter: 2

Assessment issues

- Written testing to assess knowledge of content.

- Plan and collect data for coursework.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Use real-world examples as often as possible.

Module 3   **GCSE Statistics**   **Time**: 2 – 3 hours

GCSE tier: **Higher**

Contents: **Processing**, **representing and analysing data 1**

2a   Tabulation

2b   Diagrams and representations

Prior knowledge

GCSE Mathematics Higher *Module 2* **(9)** Displaying data 1: Charts and graphs

Objectives

By the end of the unit the student should be able to:

- represent and interpret data as:
    - population pyramids
    - line graphs (including comparative line graphs)
    - choropleth maps
    - comparative pie charts (area proportional to frequency)
    - cumulative frequency step polygons (including comparative step polygons)
- transform from one presentation to another (eg bar chart to pie chart)
- combine categories to simplify tables with an understanding of the problems caused by over simplification
- understand the reasons for choosing particular representations
- appreciate that poorly presented data can be misleading
- identify the shape and simple properties of frequency distributions (including symmetry, positive and negative skew)
- appreciate that many populations can be modelled by the normal distribution.

Differentiation and extension

- Calculate estimates for the mean of grouped data for class intervals of different width. How does the choice of class width affect the accuracy of the estimate?
- Investigate poorly presented data in the media — produce a class display.
- Produce a list of populations that could be modelled by a normal distribution.
- Compare population pyramids over time, to identify similarities, differences and trends in a population.

Resources

Heinemann (Harcourt)   Edexcel GCSE Statistics   Chapter: 3, 4, 5 and 7

Assessment issues

- Written testing to assess knowledge of content.
- Present and interpret data collected for coursework.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Use real-world examples as often as possible.

- Encourage a critical appreciation of how information is conveyed through the media.

Module 4 **GCSE Statistics**   **Time**: 6 – 7 hours

GCSE tier: **Higher**

Contents: **Processing**, **representing and analysing data 2**

2c   Measures of central tendency

2e   Further summary statistics

Prior knowledge

GCSE Mathematics Higher *Module 5* **(28)** Statistical measures 1: The mean (large data sets)

Objectives

By the end of the unit the student should be able to:

- understand the effects of transformations of data on the mean, mode and median

- understand the effect on the mean, mode and median of changes in the data (including the addition or withdrawal of a population or sample member

- calculate and use a weighted mean

- calculate and use a geometric mean

- use numerical interpolation to calculate the median and quartiles of a grouped frequency distribution

- understand and calculate chain base index numbers and weighted index numbers

- understand how the Retail Price Index (RPI) is calculated.

Differentiation and extension

- Investigate the use of index numbers in other areas, eg trade, production. Who calculates these numbers, and who uses them?

- Use numerical interpolation and graphical methods to find estimates of the median of a distribution. Compare the accuracy of these estimates, eg how does the choice of class interval affect these calculations?

- Calculate the combined mean for two, or more, distributions.

Resources

Heinemann (Harcourt)   Edexcel GCSE Statistics   Chapter: 5

Assessment issues

- Written testing to assess knowledge of content.

- Present and interpret data collected for coursework.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Σ and $\bar{x}$ notation is expected.

- Tied ranks (Spearman's rank correlation coefficient) will not be tested in the examination.

Module 5   **GCSE Statistics**   **Time**: 6 – 7 hours

GCSE tier: **Higher**

Contents: **Processing**, **representing and analysing data 3**

2d   Measures of dispersion

2h   Quality assurance

4   Probability

Prior knowledge

GCSE Mathematics Higher *Module 7* **(40)** Statistical measures 2: Median and interquartile range.

Objectives

By the end of the unit the student should be able to:

- formally identify outliers (using $LQ - 1.5 \times IQR$ and $UQ + 1.5 \times IQR$) and understand the effect of anomalous data

- calculate variance and standard deviation

- understand the shape and properties of the normal distribution

- appreciate that the normal distribution can be use to model some populations

- calculate, interpret and use standardised scores to compare values from different frequency distributions

- plot sample means, medians and ranges over time to view consistency against a target value in cases where a process is off-target

- understand the advantages and disadvantages of each of the measures of dispersion (including range, quartiles, interquartile range, percentiles, deciles, inter-percentile range, variance and standard deviation).

Differentiation and extension

- Investigate the effects of transformations of data on measures of spread.

- Calculate and use other measures of spread, eg median deviation.

- Use tables to work out normal probabilities.

- Investigate how points are awarded in, for example, the decathlon.

Resources

Heinemann (Harcourt)   Edexcel GCSE Statistics   Chapter: 5, 7 and 9

Assessment issues

- Written testing to assess knowledge of content.

- Present and interpret data collected for coursework.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

For the normal distribution:

- mean = mode = median
  Approximately 95% of the values are within ±2 standard deviations of the mean
  Virtually all values are within ±3 standard deviations of the mean
  (Use of normal probability tables are not required).

Module 6   **GCSE Statistics**   **Time**: 4 – 5 hours

GCSE tier: **Higher**

Contents: **Processing**, **representing and analysing data 4**

2f	Scatter diagrams and correlation
2g	Time series

Prior knowledge

GCSE Mathematics Higher *Module 3* **(19)** Displaying data 3: Time series

GCSE Mathematics Higher *Module 4* **(25)** Displaying data 4: Scatter graphs and correlation

Objectives

- Identify independent and dependent variables.

- Fit a line of best fit passing through $(\bar{x}, \bar{y})$ to the points on a scatter graph.

- Calculate an equation for the line of best fit and use it to make predictions.

- Understand the pitfalls of interpolation and extrapolation.

- Interpret the gradient and intercept of a line of best fit.

- Comment on whether a straight line is appropriate.

- Select a non-linear model based on the forms $y = ax^n + b$, $y = ax^2 + bx$ and $y = ka^x$

   (for $n = 2, -1$ or $\dfrac{1}{2}$ only).

- Calculate and use Spearman's rank correlation coefficient.

- Plot time series and moving averages; draw a trend line by eye and use it to make a prediction.

- Identify and discuss the significance of seasonal variation by visual inspection of time series graphs.

- Recognise seasonal effect at a given data point and average seasonal effect.

Differentiation and extension

- Harder examples of calculating an equation for the line of best fit, eg when the axes do not start at (0, 0).

- Use software to draw scatter graphs and lines of best fit.

- Calculate Spearman's rank correlation coefficient for tied ranks.

- Interpret the significance of Spearman's rank correlation coefficient.

- Calculate and use the product moment correlation coefficient.

Resources

Heinemann (Harcourt)   Edexcel GCSE Statistics   Chapter: 6 and 7

Assessment issues

- Written testing to assess knowledge of content.

- Present and interpret data collected for coursework.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- Trend lines (for time series graphs) will not be expected to pass through the point $(\bar{x}, \bar{y})$.

Module 7   **GCSE Statistics**   **Time**: 4 – 5 hours

GCSE tier: **Higher**

Contents: **Probability**

4   Probability

Prior knowledge

GCSE Mathematics Higher *Module 6* **(39)** Probability

Objectives

- understand the relationship between odds and probability

- use simple cases of the binomial and discrete uniform distribution

- use simulation to estimate more complex probabilities

- understand and use Venn diagrams

- Understand and use P(A or B) = P(A) + P(B) – P(A and B) and
  P(A and B) = P(B given A) × P(A)

Differentiation and extension

- Draw and use Venn diagrams for harder examples, eg 3 overlapping circles.

- Harder conditional probability, eg without the use of a tree diagram.

- Calculate binomial probabilities using Pascal's triangle to determine binomial coefficients.

- Calculate and use the expectation of a binomial probability distribution (np).

- Draw bar charts to show binomial probability distributions. Investigate the shape for different values of n and p.

Resources

Heinemann (Harcourt)   Edexcel GCSE Statistics   Chapter: 8 and 9

Assessment issues

- Written testing to assess knowledge of content.

Homework

- Homework at each stage could comprise consolidation of work in class by completion of exercises set, additional work of a similar nature, or extension work detailed above.

Notes

- The expansion of $(p + q)^2$ is expected. In all other cases the expansion of $(p + q)^n$ will be given.

Endorsed publishers' contact information

Heinemann (Harcourt)

Harcourt
Halley Court
Jordan Hill
Oxford OX2 8EJ

Telephone: 01865 888 080
Website: www.harcourt.co.uk
Email: orders@heinemann.co.uk