

Ma4 Handling data

Using and applying handling data

1) Pupils should be taught to:

Problem solving

- a. carry out each of the four aspects of the handling data cycle to solve problems:
 - i. specify the problem and plan: formulate questions in terms of the data needed, and consider what inferences can be drawn from the data; decide what data to collect (including sample size and data format) and what statistical analysis is needed
 - ii. collect data from a variety of suitable sources, including experiments and surveys, and primary and secondary sources
 - iii. process and represent the data: turn the raw data into usable information that gives insight into the problem
 - iv. interpret and discuss the data: answer the initial question by drawing conclusions from the data
- b. select the problem-solving strategies to use in statistical work, and monitor their effectiveness (these strategies should address the scale and manageability of the tasks, and should consider whether the mathematics and approach used are delivering the most appropriate solutions)

Communicating

- c. communicate mathematically, with emphasis on the use of an increasing range of diagrams and related explanatory text, on the selection of their mathematical presentation, explaining its purpose and approach, and on the use of symbols to convey statistical meaning

Reasoning

- d. apply mathematical reasoning, explaining and justifying inferences and deductions, justifying arguments and solutions
- e. identify exceptional or unexpected cases when solving statistical problems
- f. explore connections in mathematics and look for relationships between variables when analysing data
- g. recognise the limitations of any assumptions and the effects that varying the assumptions could have on the conclusions drawn from data analysis.

Specifying the problem and planning

2) Pupils should be taught to:

- a. see that random processes are unpredictable
- b. identify key questions that can be addressed by statistical methods
- c. discuss how data relate to a problem; identify possible sources of bias and plan to minimise it
- d. identify which primary data they need to collect and in what format, including grouped data, considering appropriate equal class intervals; select and justify a sampling scheme and a method to investigate a population, including random and stratified sampling
- e. design an experiment or survey; decide what primary and secondary data to use.

Collecting data

3) Pupils should be taught to:

- a. collect data using various methods, including observation, controlled experiment, data logging, questionnaires and surveys
- b. gather data from secondary sources, including printed tables and lists from ICT-based sources
- c. design and use two-way tables for discrete and grouped data
- d. deal with practical problems such as non-response or missing data.

Processing and representing data

4) Pupils should be taught to:

- a. draw and produce, using paper and ICT, pie charts for categorical data, and diagrams for continuous data, including line graphs (time series), scatter graphs, frequency diagrams, stem-and-leaf diagrams, cumulative frequency tables and diagrams, box plots and histograms for grouped continuous data
- b. understand and use estimates or measures of probability from theoretical models, or from relative frequency
- c. list all outcomes for single events, and for two successive events, in a systematic way
- d. identify different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1
- e. find the median, quartiles and interquartile range for large data sets and calculate the mean for large data sets with grouped data
- f. calculate an appropriate moving average
- g. know when to add or multiply two probabilities: if A and B are mutually exclusive, then the probability of A or B occurring is $P(A) + P(B)$, whereas if A and B are independent events, the probability of A and B occurring is $P(A) \times P(B)$
- h. use tree diagrams to represent outcomes of compound events, recognising when events are independent
- i. draw lines of best fit by eye, understanding what these represent
- j. use relevant statistical functions on a calculator or spreadsheet.

Interpreting and discussing results

5) Pupils should be taught to:

- a. relate summarised data to the initial questions
- b. interpret a wide range of graphs and diagrams and draw conclusions; identify seasonality and trends in time series
- c. look at data to find patterns and exceptions
- d. compare distributions and make inferences, using shapes of distributions and measures of average and spread, including median and quartiles; understand frequency density
- e. consider and check results, and modify their approaches if necessary
- f. appreciate that correlation is a measure of the strength of the association between two variables; distinguish between positive, negative and zero correlation using lines of best fit; appreciate that zero correlation does not necessarily imply 'no relationship' but merely 'no linear relationship'
- g. use the vocabulary of probability to interpret results involving uncertainty and prediction [for example, 'there is some evidence from this sample that ...']
- h. compare experimental data and theoretical probabilities
- i. understand 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.