GCSE

Specification

Edexcel GCSE in Statistics (1389)

First examination 2004

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Authorised by Peter Goff

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Contents

Introduction

This specification widens the provision for Key Stage 4 students and beyond in mathematically related subjects. The assessment comprises one written exam paper and coursework.

The principal aim of this course is to increase students' awareness of the role accurate statistical representations, calculations, reasoning and interpretation can play in their lives. For a broader view of the rationale, please refer to page 4.

Key features-

This specification:

- offers a course of study which complements the GCSE in Mathematics
- is suitable for either a one year or two year course of study
- is based on good practice in statistics
- emphasises the theoretical, practical and applied nature of the subject
- is suitable for cross-curricular studies and activities
- provides a background for the study of statistics beyond GCSE
- is supported by
  - coursework guidance and support
  - endorsed textbooks
  - INSET events.

Summary of the specification content

This specification comprises the following subject content:

1 Planning and data collection

Planning a line of enquiry or investigation

Types of data

Census and sample data

Sampling techniques

Collecting or obtaining data

2 Processing, representing and analysing data

Methods of tabulation

Diagrams and similar forms of representation

Measures of central tendency

Measure of dispersion

Summary statistics

Scatter diagrams, correlation and regression

Time series

Quality assurance

Estimation

3 Reasoning, interpreting and discussing results

Inference and other reasoning

Interpretation and conclusions

Communication of reasoning

4 Probability

Definitions and calculations

Discrete probability distributions

The written papers will, over a period of time, include questions on all of the above content but may not cover all in any one examination.

Summary of scheme of assessment

	Examination Paper 75% (External Assessment)	**Coursework 25% (Internal Assessment)**
Foundation Tier (G – C)	Paper 1F 2 hours Section A: Short questions Section B: Longer questions	Paper 2 (both tiers) Teacher marked coursework consists of one major project.
Higher Tier (D – A*)	Paper 1H 2 hours 30 mins Section A: Short questions Section B: Longer questions	

Availability of external assessment

First assessment of this specification will be in June 2004. Assessment will be available in each summer examination session thereafter.

Prior learning and progression

This specification builds on the knowledge, understanding and skills set out in the National Curriculum for England Key Stage 3 programme of study for Data handling (Ma4).

It is expected that candidates entering for this GCSE will have the mathematical and numerical skills associated with the National Curriculum Key Stage 3 programme of study. Candidates entering for the Foundation Tier will also be expected to be familiar with the following mathematics:

(a) accuracy of data

(b) significant figures and decimal places

(c) fractions, percentages and decimals

(d) fractional or percentage change

(e) proportion and factors

(f) manipulation of fractions

(g) efficient use of a calculator, including redundant figures, accuracy and rounding

(h) the sigma notation

(i) the selection of scales for graphical representation of variables

(j) reading graphs, including obtaining interpolated and extrapolated values

In addition candidates entering for the Higher Tier will be expected to be familiar with the following:

(k) the equation of a straight line in the form $y = mx + c$, with the meaning of m and c

(l) graphs that can be transformed to straight lines

(m) exponential curves

Questions may be set that involve the material listed above, but these topics will always appear in context and will not be examined separately.

This qualification is a recognised part of the National Qualifications Framework. It complements GCSE Mathematics whilst also providing a basis in statistics for candidates who may wish to progress to further study of the subject at Level 3 of the National Qualifications Framework.

Forbidden combinations and links with other subjects

There are no forbidden combinations for this specification. There is some natural linkage between this specification and the Edexcel GCSE in Mathematics.

QCA Codes

Every specification is assigned to a national classification code indicating the subject area to which it belongs. Centres should be aware that candidates who enter for more than one GCSE qualification with the same classification code will have only one grade (the highest) counted for the purpose of the school and college performance tables.

The classification code for this specification is 2510.

The QCA National Qualifications Framework (NQF) code is known as a Qualification Accreditation Number (QAN). This is the code that features in the DfES Funding Schedule – Section 96 and is to be used for all qualification funding purposes.

The QAN number for this qualification is:

- 100/2753/1 GCSE in Statistics

Specification aims and assessment objectives

National Qualifications Framework criteria

This specification is based on the common criteria and the GCSE criteria, which are prescribed by the regulatory authorities including QCA and are mandatory for all awarding bodies.

The GCSE in statistics covers both levels 1 and 2 of the National Qualifications Framework. The Foundation Tier is broadly equivalent to level 1 and the Higher Tier is broadly equivalent to level 2.

Rationale

Statistics is a subject which, almost uniquely, combines a theoretical perspective with mathematical methods and practical applications. As such, statistics is essentially a hands on, practical subject which deals with obtaining, representing and processing data in order to extract information (often numerical) and making inferences beyond that possible from consideration of the raw data itself. The Victorian Prime Minister Benjamin Disraeli is often quoted as saying 'there are three kinds of lies: lies, damned lies and statistics'; this controversial remark belittles the status of a subject which seeks to make informed views based on what is often only partial knowledge. There may well be 'lies' and there may also be 'damned lies' but there are also 'those who understand statistics' and 'those who do not'. This course is specifically designed to provide students with a broader base of statistical understanding.

One of the basic principles of statistics is about making inferences about a population from the evidence extracted from an appropriately drawn sample. The basis of all high quality statistical analysis is the obtaining of good, reliable data. The data needs to be both accurate and in a usable form so that samples which are truly representative of the whole population may be drawn and used to draw accurate and correct inferences about the population. Everything we do in terms of statistical analysis is of little value unless we have properly collected our data. Under these circumstances, it follows that any course in Statistics will only adhere to the true nature of the subject if it provides students with adequate opportunities for them to undertake a range of practical work. Therefore a large part of this course should be practically based with specification content arising, as often as possible, as a natural consequence of the practical work undertaken.

It is anticipated that some of the practical work undertaken will extend beyond that which can be formally tested in written examination papers. This could include surveys and should include use of ICT, for instance to generate random numbers with spreadsheets, and obtaining information from the Internet. It is also anticipated and expected that statistics be taught holistically to demonstrate and reinforce the true nature and especially the various aspects of the subject. This will include the determining and designing of a line of enquiry, the appropriate collection of data, the choice and use of appropriate statistical language and methods and the interpretations, inferences and conclusions made from the analysis.

Students should also be taught to appreciate the value of studying statistics from a cross-curricular point of view by drawing on the statistical content of other subject areas such as geography, science, business studies, economics and psychology. They should also be taught to place an emphasis on the relationship between the theoretical perspectives behind the subject and the practical side of the subject and to apply statistics to lines of enquiry in areas such as scientific, environmental, social or political problems.

A fair proportion of what is reported in the media has some form of statistical basis and in the more numerate work place there is an increasing number of occupations which require the use or interpretation of statistical methods or data. One of the main aims of this specification is to provide students with the skills and insights that will enable them to be more aware and make more informed judgements of the statistics presented to them.

Aims

The aims set out below describe the educational rationale for students following a course in statistics at GCSE level. These aims should be read in conjunction with the associated assessment objectives since not all of the aims can be translated into measurable outcomes or objectives.

A course based on this GCSE Statistics specification should enable students to:

- acquire and develop a greater understanding of the basic concepts of statistics and probability in ways which encourage awareness, satisfaction, enjoyment and confidence in the subject and its applications to everyday or real-life situations with which candidates are familiar, including other disciplines and, if desired, consider the potential of further study
- develop knowledge, skills and understanding in the areas of statistical methods and concepts and in probability; to communicate effectively in statistical terminology and also to communicate effectively an awareness of both the power and the limitations of data, methods and concepts
- recognise lines of enquiry suitable for statistical analysis, determine the suitability and methods of collection of data for analysis, apply relevant statistical techniques and be able to make deductions, inferences and draw conclusions
- interpret statistical information presented in a variety of forms, present statistical information in a variety of forms, appropriate to the information and the context and to communicate interpretations by written or oral reports
- further develop their awareness of the importance and the limitations of statistical information to society as a whole.

Assessment objectives

AO1	Analyse the suitability of a potential line of enquiry or statistical problem, plan an appropriate strategy, describe and use suitable methods to collect and select data.
AO2	Analyse and interpret data in a form suitable to solve statistical and probability problems.
AO3	Perform relevant computations and calculations using the facts and language of statistics and probability correctly.
AO4	Analyse written and statistical evidence to identify inferences, deductions, conclusions and interpretations of statistical information.

Scheme of assessment

Entry tiers

Candidates for this qualification must be entered for one of two tiers. The Higher Tier is targeted at grades A* to D, and the Foundation Tier is targeted at grades C to G. A safety net is provided for candidates entered for the Higher Tier in this specification, and an allowed grade E can be awarded on the Higher Tier. Candidates failing to achieve grade E on the Higher Tier will be reported as Unclassified.

The grades available for each tier are as follows:

Tier	Target Grades
Foundation	G to C
Higher	D to A*

Assessment of the specification consists of:

For Foundation Tier candidates:

Paper	Weighting	Time	Marks
Paper 1F	75%	2 hours	Section A (28 marks)
			Section B (52 marks)
Paper 2 (coursework)	25%	One major project	40 marks

For Higher Tier candidates:

Paper	Weighting	Time	Marks
Paper 1H	75%	2 hours 30 mins	Section A (35 marks)
			Section B (65 marks)
Paper 2 (coursework)	25%	One major project	40 marks

Section A on papers 1F and 1H will consist of mainly short questions set on standard statistical techniques, diagrams, probability, etc.

Section B on papers 1F and 1H will consist of longer questions set in context, giving candidates the opportunity to analyse written and statistical evidence.

Relationship of assessment objectives to external assessment

	AO1	AO2	AO3	AO4	Overall
Written papers	10 – 12½%	15 – 22½%	20 – 32½%	15 – 22½%	75%
Coursework	5 – 7½%	5 – 7½%	5 – 10%	4 – 6%	25%
Overall	15 – 20%	20 – 30%	25 – 42½%	19 – 28½%	100%

External assessment

Examination papers 1F and 1H

- Examination papers 1F and 1H will be combined question/answer books containing both shorter and longer questions.
- Examination papers will offer an assessment across the grades available in the tier.
- Questions on the Higher Tier examination paper (1H) will assume knowledge from the Foundation Tier.
- Diagrams will not necessarily be drawn to scale and measurements should not be taken from diagrams unless instructions to this effect are given.
- Formulae sheets will be provided for both the Foundation and the Higher Tier.

Calculators

- Candidates will be expected to have access to a suitable electronic calculator for the examination papers.
- The electronic calculator to be used by candidates attempting examination paper 1F should have, as a minimum, the following functions:
- $+$, $-$, $\times$, $\div$, x^2, $\sqrt{x}$, memory, constant function, brackets, x, Σx, Σfx, a random number key, and the facility to enter data for statistical calculation.
- The electronic calculator to be used by candidates attempting examination paper 1H should have, as a minimum, the following functions:
- $+$, $-$, $\times$, $\div$, x^2, $\sqrt{x}$, memory, constant function, brackets, x, Σx, Σfx, σ, a random number key, and the facility to enter data for statistical calculation.
- Calculators with any of the following facilities are prohibited from any examination:
- databanks; retrieval of text or formulae; QWERTY keyboards; built-in symbolic algebra manipulation; symbolic differentiation or integration.

Internal Assessment

Coursework

The minimum coursework requirement is one major project which allows students to apply the statistical knowledge skills and techniques in a specific context.

Students may submit one statistical project only.

Brief notes of each student's achievements should be made on the Candidate Record Form (see *Appendix 2*) or on the work of the student at the relevant place.

Some coursework assessment must be conducted in the classroom under the direct supervision of the teacher. Although students may conduct research in the field, in museums or in public libraries, they must undertake some of the associated or development work under circumstances in which teachers can see them at work and discuss their findings, and hence authenticate each student's work with confidence. It may be appropriate for some of the work to be undertaken by a group of students, provided that the teacher can reliably assess the contribution of each individual student. In particular, this might be appropriate when collecting a large amount of data, which several students could then be given shared access to, in order that they can then proceed with their own individual projects utilising this data.

The project chosen and data collected should enable the student to satisfy the assessment objectives and coursework assessment criteria. The project must be based on data collected from primary and/or secondary sources by the student, and these sources must be clearly acknowledged.

Edexcel will provide project outlines for centres to select and integrate into their own schemes of work. Centres may choose to use these projects or generate their own projects. The assessment criteria that will be used to assess the statistical projects are given in *Appendix 1*. It may be appropriate for students to undertake projects which relate to data generated in other subject areas such as geography, science, citizenship or physical education. Work carried out as part of a statistics project might also be used as a contribution to coursework submitted for assessment of another curricular area.

The use of ICT should be encouraged. Students may interrogate databases for secondary data, or set up their own database for storage of collected information. ICT can be used to model situations, or assist in the analysis and presentation of data. However, it is important that in using the computer, each student details the decisions taken at each stage and detailed reasons should be given as to why particular computer facilities have been used, as distinct from other possible avenues of presentation.

Use of assessment criteria for statistical projects

The assessment criteria for statistical projects are subdivided into three areas. These areas are:

- planning the project
- processing data
- interpreting and evaluating results.

Mark descriptions comprising a number of statements are provided for each area of the project. Descriptions are given for mark bands within each area. A candidate who fails to satisfy the description for a mark of 1 in an area should be awarded a mark of 0 (zero) for that area.

Whenever assessments are made, the mark descriptions given in the assessment criteria for statistics projects should be used to judge the mark within each area which best fits the candidate's performance. The statements within a description should not be taken as discrete and literal hurdles, all of which must be fulfilled for a mark to be awarded.

The mark descriptions within an area are designed to be broadly hierarchical. This means that, in general, a description at a particular mark subsumes those at lower marks. Therefore the mark awarded need not be supported by direct evidence of achievement of lower marks in each area.

It is assumed that in order to access higher marks, projects will involve a more sophisticated approach and/or a more complex treatment.

Teacher-assessors are required to award marks in each of the three areas of the criteria. Marks in these three areas should be totalled to give a mark for the project out of 40. This mark should be recorded on the Candidate Record Form.

Internal assessment moderation procedures

Detailed internal assessment moderation procedures will be communicated to centres making estimated entries.

Quality of written communication (QoWC)

This specification does not formally assess the quality of written communication. Many of the elements of the key skill of communication may be delivered through this specification by the use of appropriate teaching and learning styles.

Awarding, reporting and equivalence

The grading, awarding and certification of this specification will comply with the requirements of the appropriate Code of Practice, which is published by QCA. Qualifications will be graded and certificated on an eight grade scale from A* to G.

GCSEs have broad equivalence to General National Vocational Qualifications in the following terms:

- four GCSEs at grade D to G and four GCSEs at grade A* to C are equivalent to one six-unit GNVQ at Foundation and Intermediate level respectively.

Overall differentiation is achieved within the specification by allowing levels of entry in two overlapping tiers. These tiers of entry allow a full and balanced opportunity for candidates at all levels of attainment to show what they know, understand and can do. Coursework provides differentiation by outcome. The examination papers provide differentiation by task.

Assessment language

Assessment of this specification will be available in English only. Assessment materials will be published in English only and all written and spoken work submitted for examination and moderation must be produced in English.

Students with particular requirements

Regulations and guidance relating to students with special requirements are published annually by the Joint Council for General Qualifications and are circulated to examinations officers. Further copies of guidance documentation may be obtained from the following address or by telephoning 0870 240 9800.

Edexcel will assess whether or not special consideration or concession can be made for students with particular requirements. Requests should be addressed to:

Special Requirements
Edexcel
Stewart House
32 Russell Square
London WC1B 5DN

Private candidates

This specification is not available to private candidates.

Specification content

The subject content for GCSE Statistics examination papers is presented in two tiers: Foundation and Higher.

In each tier the content is divided into two columns. The left-hand column comprises the concise content description. The right-hand column gives further guidance in the form of examples, or more detailed description.

Additional material introduced in the Higher Tier and not included in the Foundation Tier is shown in **bold**.

Foundation Tier

1 The collection of data

Content	Notes
(*a*) Planning	
Students should be taught to:	
specify a line of enquiry to be investigated; breaking it down into more manageable parts and sub-questions when necessary;	
specify a hypothesis to be tested;	Terminology such as null hypothesis will not be required. A hypothesis such as 'as motor cycles get older their value is likely to go down' will be expected.
determine the data required for a line of enquiry, selecting an appropriate method of obtaining the data.	Use a questionnaire rather than an open-ended interview. Explain the rationale behind a sampling method.
(*b*) Types of data	
Students should be taught to:	
recognise that data can be obtained from primary or secondary sources;	Primary sources could include raw data, surveys, questionnaires which may have more than two categories, investigations and experiments, etc whilst secondary sources could include databases, published statistics, newspapers, internet pages, etc.
recognise the difference between quantitative and qualitative variables;	Number of pets is quantitative, favourite name is qualitative.
recognise the difference between discrete and continuous data;	Number of people is discrete, whilst height is continuous.
recognise, understand and use scales of measurement – categorical, rank;	The registration letter, say P, on a car represents a period of time from 1 August 1996 to 31 July 1997.
categorise data through the use of well defined, precise definitions, intervals or class boundaries;	The use of class boundaries such as $0 < a \leq 5$ and terms such as class width and class interval will be expected.
understand the meaning of bivariate data which may be discrete, continuous, grouped or ungrouped;	Plotting and interpreting points in a 2D framework is expected.
understand, use and define situations for grouped and ungrouped data.	The construction and use of two-way tables, obtained from surveys and questionnaires.

Content	Notes
(*c*) Population and sampling	
Students should be taught to:	
understand the meaning of the term population;	The definition of 'population' can vary – eg it could be a family or the cars in a car park.
understand the word census, especially with regard to well defined, small scale and large populations, eg National census;	A census obtains information about every member of a population.
understand the reasons for sampling and that sample data is used to estimate values in the population;	Reasons to include time and efficiency, and impossibility of reaching the whole population in many circumstances.
understand the terms random, randomness and random sample;	The relation between 'random' and 'equally likely' may be tested.
generate and use random numbers using a random number table, calculator or computer including the use of a spreadsheet;	
understand, design and use a sampling frame;	Designing a sampling frame might be tested.
be able to select a simple random sample or a stratified sample by one category as a method of investigating a population;	An appreciation of an appropriate sample size will be expected, as will the ability to make a random selection or sample from a population using tables of random numbers or a calculator. Examples of one category might include male/female or KS2/KS3/KS4.
have a basic idea of the concept of bias, how it might occur in a sampling procedure and how it might be minimised.	Possible bias in sources of secondary data, eg vested interests.
(*d*) Collecting data	
Students should be taught to:	
collect or obtain data by observation, surveys, experiments (including controlled experiments), counting, data logging, questionnaires and measurement;	Writing improved or good questions for a questionnaire will be expected.
obtain primary data by questionnaires or experiment;	
understand the effects of accuracy on measurements;	Knowing that measured data such as length or time is subject to some error. For example, that every measurement is taken to a given level of accuracy.

Content	Notes
understand the advantages and disadvantages of using interviews versus questionnaires;	Deciding which technique might be more appropriate, and why, will be expected.
design and use efficient and effective data capture sheets and methods of recording data;	
understand the role, and use of, pilot studies and pre-testing;	The rationale behind pilots and pre-tests will be expected.
understand and account for the problems of design, ambiguity of wording, leading and biased questions, definitions and obtaining truthful responses;	The minimisation of ambiguity and bias will be expected.
understand the advantages and disadvantages of open and closed questions;	Incorporated in questionnaire design.
be aware of and understand the problems related to identifying the appropriate population, the distribution and collection of questionnaires, errors in recorded answers, non-responses and missing data;	Dealing with problems such as non-response and rogue values will be expected.
identify appropriate sources of secondary data;	Newspapers, national statistics, the internet and others.
extract data from secondary sources, including those based on ICT;	The sampling of secondary data from sources such as National Statistics will be expected or data on subjects of students' own interests, including that extracted from the internet.
understand the aspects of accuracy, reliability, relevance and bias as related to secondary data;	Questioning the reliability of secondary sources and data will be expected. Examples of secondary data include the internet, RPI, Key Data and Abstract of Statistics, GCSE results, etc.
design simple statistical experiments to obtain data;	Students will be expected to comment on the design of experiments, eg using controls and random allocation.
understand the meaning of explanatory and response variables;	The identification of explanatory (independent) and response (dependent) variables will be expected.
understand the need for the identification of the variables to be investigated;	Knowledge of redundant variables will be expected.
understand surveys.	Examples from other school subjects (including science) and everyday life.

2 Processing, representing and analysing data

Content	Notes
(*a*) Tabulation	
Students should be taught to:	
construct frequency tables by tallying raw data where appropriate;	The use and interpretation of the standard five point tally will be expected
tabulate using class intervals as appropriate;	For continuous or discrete data.
tabulate using various forms of grouping the data;	Could include qualitative or quantitative categories.
combine categories to simplify tables with an understanding of the problems of over simplification, the effects on readability, the identification or masking of trends and the loss of detail;	Student will be expected to comment on aspects such as loss of detail or masking of trends.
read and interpret data presented in tabular or graphical form;	Tables of data drawn from media and from government and other statistical sources may be used, eg Social Trends.
design suitable tables, including summary tables; design and use appropriate two way tables;	Systematically listing outcomes from single or two successive events.
convert raw data to summary statistics, design, construct and present summary tables.	The difference between raw data and summary statistics is expected.
(*b*) Diagrams and representations	
Students should be taught, as appropriate, to construct, draw, use and understand:	
the need for correct and precise labelling of all forms of diagrams;	The labelling and scaling of axes will be expected.
pictograms, bar charts, multiple or composite bar charts and pie charts for qualitative, quantitative and discrete data;	The reasons for choosing one form of representation will be expected.
vertical line (stick) graphs for discrete data;	Comparative line graphs will be expected.
for continuous data the following: pie charts, grouped frequency diagrams with equal class intervals, frequency diagrams, cumulative frequency diagrams, population pyramids;	No distinction will be made between cumulative frequency polygons and curves whilst frequency polygons could be open or closed.
stem and leaf diagrams for discrete and continuous data;	Students may need to define the stem for themselves. A key will be expected.
scatter diagrams for bivariate data;	Students may be required to define their own scales.
line graphs and time series;	Trend lines by eye and seasonal variation will be expected.

Content	Notes
choropleth maps (shading);	Eg showing temperature across Europe by shading regions.
simple properties of the shape of distributions of data including symmetry, positive and negative skew;	
the distinction between well presented and poorly presented data;	Poorly presented data can be misleading.
the shape and simple properties of frequency distributions; symmetrical positive and negative skew;	
the potential for visual misuse, by omission or misrepresentation;	Knowing about causes such as unrepresentative scales will be expected.
the transformation from one presentation to another;	Bar chart to pie chart, etc.
how to discover errors in data and recognise data that do not fit a general trend or pattern.	Analytical definition of an outlier will not be required.
(*c*) Measures of central tendency	
Students should be taught to:	
work out and use the mean, mode and median of raw data presented as a list;	No more than 30 numbers in the list will be examined.
work out the mean, mode and median for discrete data presented as a frequency distribution;	Graphical and other methods for the median will be expected. Σ notation will be expected.
identify the modal class interval for grouped frequency distributions for discrete or continuous data;	Frequency distributions with equal class intervals only.
work out and use estimates for the mean and median of grouped frequency distributions for discrete or continuous data;	Graphical and other methods for the median will be expected.
understand the appropriateness, advantages and disadvantages of each of the three measures of central tendency;	Explaining why certain measures are inappropriate will be expected.
be able to make a reasoned choice of a measure of central tendency appropriate to a particular line of enquiry.	

Content	Notes
(d) Measures of dispersion	
Students should be taught to:	
work out and use the range for data presented in a list or frequency distribution;	The possible effect of an outlier on range will be expected.
work out the quartiles, percentiles and inter-quartile range for discrete and continuous data presented either as a list, frequency table or grouped frequency table;	Graphical and other methods will be expected.
construct, interpret and use box plots;	The use of box plots could include comparisons.
understand the advantages and disadvantages of each of the measures of dispersion range, quartiles, inter-quartile range, percentiles;	
use an appropriate measure of central tendency together with range, quartiles, inter-quartile range, percentiles to compare distributions of data.	An awareness that a full comparison needs at least both a measure (or measures) of central tendency and of dispersion.
(*e*) Further Summary Statistics	
students should be taught to use:	
simple index numbers.	Price relative = $\frac{\text{price}}{\text{price in base year}} \times 100$
(*f*) Scatter diagrams and correlation	
Students should be taught to:	
plot data as points on a scatter diagram;	The labelling and scaling of axes may be required.
recognise positive, negative and zero correlation by eye;	Terms such as strong or weak will be expected.
understand the distinction between correlation, causality and a non-linear relationship;	The points lying on the circumference of a circle are related but show zero correlation.
fit a line of best fit passing through $(\bar{x}, \bar{y})$ to the points on a scatter diagram, by eye may be required;	Questions will state when $(\bar{x}, \bar{y})$ is required.
understand the pitfalls of interpolation and extrapolation;	Particularly the problem of extrapolating beyond the range.
interpret data presented in the form of a scatter diagram.	

Content	Notes
(*g*) Time series	
Students should be taught to:	
plot points as a time series; draw a trend line by eye and use it to make a prediction;	No more than 20 points will be expected.
calculate and use appropriate moving averages;	Up to and including a seven-point moving average.
identify and discuss the significance of seasonal variation by visual inspection of time series graphs.	
(*h*) Estimation	
Students should be taught to:	
estimate population means from samples;	
estimate of population proportions from samples with application in opinion polls and elsewhere;	
understand the effect of sample size on estimates and the variability of estimates.	

3 Reasoning, interpreting and discussing results

Content	Notes
Students should be taught in the context of real data to:	
apply statistical reasoning, explain and justify inferences, deductions, arguments and solutions;	Cases clearly restricted to the content of the specification at the appropriate level.
explore connections, look for and examine relationships between variables;	Eg height and weight, age and depreciation of a car, GNP and mortality in infants.
consider the limitations of any assumptions;	Simple cases only, eg honest replies to questionnaires, equally likely outcomes in probabilities, representativeness of sample of population, reliability of secondary data.
relate summarised data to any initial questions or observations;	The relevance of measures of central tendency.
interpret all forms of statistical tables, diagrams and graphs;	To include real published tables and graphs.
compare distributions of data and make comparisons using measures of central tendency, measures of dispersion and percentiles;	The shapes of distributions and graphs may be used. Formula for variance and standard deviation to be given.

Content	Notes
check results for reasonableness and modify their approaches if necessary;	Eg the mean must lie between the maximum and minimum, 'the average bicycle speed was 130 km per hour' is not reasonable.
interpret correlation as a measure of the strength of the association between two variables.	The use of words such as weak or strong will be expected.

4 Probability

Content	Notes
Students should be taught to:	
understand the meaning of the words event and outcome;	Tossing a coin is an event with outcomes landing Heads or Tails.
understand words such as impossible, certain, highly likely, likely, unlikely, possible, evens and present these on a likelihood scale;	Interpretation of real-life situations will be expected, eg 'the probability that the horse will win the next race is 0.3'; 'the probability that I will get a grade C or better in my Statistics is 3/4.'
put outcomes in order in terms of probability;	Use of ≤ will be expected.
put probabilities in order on a probability scale;	Labelling of the scale will be expected.
understand the terms 'random' and 'equally likely';	
understand and use measures of probability from a theoretical perspective and from a limiting frequency or experimental approach;	Formal definition and notation of a limit will not be required whilst terminology such as 'as the number of trials increases' will be required.
understand that in some cases the measure of probability based on limiting frequency is the only viable measure;	The probability of a sports team winning can only be measured from a limiting frequency perspective. For example, medical statistics for assessment of health risks.
compare expected frequencies and actual frequencies;	
use probability to assess risk;	Examples may be taken from insurance.
produce, understand and use a sample space;	Listing all outcomes of single events and two successive events, in a systematic way.
understand the terms mutually exclusive and exhaustive and to understand the addition law P(A or B) = P(A) + P(B);	P(A or B) = P(A) + P(B); 'Mutually exclusive' means that the occurrence of one outcome prevents another, $\Sigma p = 1$ when summed over all mutually exclusive outcomes.

Content	Notes
know, for mutually exclusive outcomes, that the sum of the probabilities is one and in particular the probability of something not happening is one minus the probability of it happening;	If P(A) = p then P(not A) = 1 – p.
form and use tree diagrams and probability tree diagrams for independent events;	Listing all possible joint or compound outcomes.
understand, use and apply the addition law for mutually exclusive events and the multiplication law for independent events.	To correctly apply P(A and B) = P(A) × P(B), P(A or B) = P(A) + P(B).

Higher Tier

1 The collection of data

Content	Notes
(*a*) Planning	
Students should be taught to:	
specify a line of enquiry to be investigated; break it down into more manageable parts and sub-questions when necessary;	
specify a hypothesis to be tested;	Terminology such as null hypothesis will not be required. A hypothesis such as 'as motor cycles get older their value is likely to go down' will be expected.
determine the data required for a line of enquiry, selecting an appropriate method of obtaining the data **and justifying the choice of method by comparing it with possible alternatives.**	Use a questionnaire rather than an open-ended interview. Explain the rationale behind a sampling method, **size or type of sample.**
(*b*) Types of data	
Students should be taught to:	
recognise that data can be obtained from primary or secondary sources;	Primary sources could include raw data, surveys, questionnaires which may have more than two categories, investigations and experiments, etc whilst secondary sources could include databases, published statistics, newspapers, internet pages, etc.
recognise the difference between quantitative and qualitative variables;	Number of pets is quantitative, favourite name is qualitative.
recognise the difference between discrete and continuous data;	Number of people is discrete, whilst height is continuous.
recognise, understand and use scales of measurement – categorical, rank, **interval and ratio**;	The registration letter, say P, on a car represents a period of time from 1 August 1996 to 31 July 1997. **An example of interval data is temperature; examples of ratio are area, counts, volumes and weight.**
categorise data through the use of well defined, precise definitions, intervals or class boundaries;	The use of class boundaries such as $0 < a \leq 5$ and terms such as class width and class interval will be expected.
appreciate the implications of grouping for loss of accuracy in both calculations and presentations;	

Content	Notes
understand the meaning of bivariate data which may be discrete, continuous, grouped or ungrouped;	**Plotting and interpreting points in a 2D framework is expected.**
understand, use and define situations for grouped and ungrouped data.	The construction and use of two-way tables obtained from surveys and questionnaires.
(*c*) Population and sampling	
Students should be taught to:	
understand the meaning of the term population;	The definition of 'population' can vary – eg it could be a family or the cars in a car park.
understand the word census, especially with regard to well defined, small scale and large populations, eg National census;	A census obtains information about every member of a population. **The types of questions used and how the collected data is used.**
understand the reasons for sampling and that sample data is used to estimate values in the population;	Reasons to include time and efficiency, and the impossibility of reaching the whole population in many circumstances.
understand the terms random, randomness and random sample;	The relation between 'random' and 'equally likely' may be tested.
generate and use random numbers using a random number table, calculator or computer including the use of a spreadsheet;	
understand, design and use a sampling frame;	Designing a sampling frame might be tested.
be able to select a simple random sample or a stratified sample by **more than** one category as a method of investigating a population;	An appreciation of an appropriate sample size will be expected, as will the ability to make a random selection or sample from a population using tables of random numbers or a calculator. Examples of one category might include male/female or KS2/KS3/KS4.
have a basic idea of the concept of bias, how it might occur in a sampling procedure and how it might be minimised;	Possible bias in sources of secondary data, eg vested interests.
understand and use systematic, quota and cluster sampling;	**With particular reference to large scale lines of enquiry such as quality control or opinion polls.**
understand the strengths and weaknesses of various sampling methods, including bias, influences and convenience.	**An awareness of influences such as gender, social background or geographical area will be expected.**

Content	Notes
(*d*) Collecting data	
Students should be taught to:	
collect or obtain data by observation, surveys, experiments (including controlled experiments), counting, data logging, **convenience sampling**, questionnaires and measurement;	Writing improved or good questions for a questionnaire will be expected.
obtain primary data by questionnaires, experiment **or simulations**.	**Simulations such as the rolling of a die can be obtained using the RAN button on a calculator.**
understand the effects of accuracy on measurements;	Knowing that measured data such as length or time is subject to some error. For example, **recognise** that every measurement is taken to a given level of **accuracy and that measurements given to the nearest whole unit may be inaccurate by up to ±½ unit;**
understand the advantages and disadvantages of using interviews versus questionnaires;	Deciding which technique might be more appropriate, and why, will be expected.
design and use efficient and effective data capture sheets and methods of recording data;	
understand the role, and use of, pilot studies and pre-testing;	The rationale behind pilots and pre-tests will be expected.
understand and account for the problems of design, ambiguity of wording, leading and biased questions, definitions and obtaining truthful responses **with simplest form of random response in sensitive cases**;	The minimisation of ambiguity and bias will be expected. **For example, when emotions, finance, politics or criminal activity are involved**.
understand the advantages and disadvantages of open and closed questions;	Incorporated in questionnaire design.
be aware of and understand the problems related to identifying the appropriate population, the distribution and collection of questionnaires, errors in recorded answers, non-responses and missing data;	Dealing with problems such as non-response and rogue values will be expected.
identify appropriate sources of secondary data;	Newspapers, national statistics, the internet and others.
extract data from secondary sources, including those based on ICT;	The sampling of secondary data from sources such as National Statistics will be expected or data on subjects of students' own interests, including that extracted from the internet.

Content	Notes
understand the aspects of accuracy, reliability, relevance and bias as related to secondary data;	Questioning the reliability of secondary sources and data will be expected. Examples of secondary data include the internet, RPI, Key Data and Abstract of Statistics, GCSE results, etc.
design simple statistical experiments to obtain data;	Students will be expected to comment on the design of experiments, eg using controls and random allocation **including replication, randomisation and matched pairs.**
understand the meaning of explanatory and response variables;	The identification of explanatory (independent) and response (dependent) variables will be expected.
understand the need for the identification of the variables to be investigated;	Knowledge of redundant variables will be expected.
understand surveys; **the appropriateness of the conditions**.	Examples from other school subjects (including Science) and everyday life.

2 Processing, representing and analysing data

Content	Notes
(*a*) Tabulation	
Students should be taught to:	
construct frequency tables by tallying raw data where appropriate;	The use and interpretation of the standard five point tally will be expected
tabulate using class intervals as appropriate, **including open ended classes and classes of varying width**;	For continuous or discrete data.
tabulate using various forms of grouping the data;	Could include qualitative or quantitative categories.
combine categories to simplify tables with an understanding of the problems of over simplification, the effects on readability, the identification or masking of trends and the loss of detail;	Students will be expected to comment on aspects such as loss of detail or masking of trends.
problems associated with under and over simplification through inappropriate number of significant figures or an unsuitable group size;	**An awareness of problems associated with creating categories that are too broad, too narrow or redundant.**
read and interpret data presented in tabular or graphical form;	Tables of data drawn from media and from government and other statistical sources may be used, eg Social Trends

Content	Notes
design suitable tables, including summary tables; design and use appropriate two way tables;	Systematically listing outcomes from single or two successive events.
convert raw data to summary statistics, design, construct and present summary tables.	The difference between raw data and summary statistics is to be expected.
(*b*) Diagrams and representations	
Students should be taught, as appropriate, to construct, draw, use and understand:	
the need for correct and precise labelling of all forms of diagrams;	The labelling and scaling of axes will be expected.
pictograms, bar charts, multiple or composite bar charts and pie charts for qualitative, quantitative and discrete data **and comparative pie charts with area proportional to frequency**;	The reasons for choosing one form of representation will be expected.
vertical line (stick) graphs for discrete data **and cumulative frequency step polygons**;	Comparative line graphs will be expected, **as will comparative step polygons**.
for continuous data the following: pie charts, grouped frequency diagrams with equal class intervals, frequency diagrams, cumulative frequency diagrams, population pyramids, **histograms with unequal class intervals and the concept of frequency density**;	No distinction will be made between cumulative frequency polygons **(other than step polygons)** and curves whilst frequency polygons could be open or closed. **Changes over time, eg population pyramids. Practical consequences applied to all forms of representation**.
stem and leaf diagrams for discrete and continuous data;	Students should be able to define the stem for themselves. A key will be expected.
scatter diagrams for bivariate data;	Students should be able to define their own scales.
line graphs and time series;	Trend lines by eye and seasonal variation will be expected.
choropleth maps (shading);	Eg showing temperature across Europe by shading regions.
simple properties of the shape of distributions of data including symmetry, positive and negative skew;	
the distinction between well presented and poorly presented data;	Poorly presented data can be misleading, **eg 3-D angled pie charts and 3-D pie charts with slices pulled out.**
the shape and simple properties of frequency distributions; symmetrical positive and negative skew;	

Content	Notes
that many populations can be modelled by the Normal distribution;	
the potential for visual misuse, by omission or misrepresentation;	Knowing about causes such as unrepresentative scales **or other measures** will be expected.
the transformation from one presentation to another;	Bar chart to pie chart, etc.
how to discover errors in data and recognising data that do not fit a general trend or pattern, **including outliers**.	Analytical definition of an outlier **will** be required.
(*c*) Measures of central tendency	
Students should be taught to:	
work out and use the mean, mode and median of raw data presented as a list;	No more than 30 numbers in the list will be examined.
work out the mean, mode and median for discrete data presented as a frequency distribution;	Graphical and other methods for the median will be expected. Σ notation will be expected.
identify the modal class interval for grouped frequency distributions for discrete or continuous data;	Frequency distributions with equal class intervals only.
work out and use estimates for the mean and median of grouped frequency distributions for discrete or continuous data;	Graphical and other methods for the median will be expected.
understand the effects of transformations of the data on the mean, mode and median;	**Transformations will be restricted to those of the type $x \rightarrow ax + b$ (ie affine transformations).**
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;	**Inclusion or exclusion of members of a population or sample.**
calculate and use a weighted mean;	**No more than four categories will be expected. Simple index numbers and retail price index.**
work out the geometric mean;	
understand the appropriateness, advantages and disadvantages of each of the three measures of central tendency;	Explaining why certain measures are inappropriate will be expected.
be able to make a reasoned choice of a measure of central tendency appropriate to a particular line of enquiry, **nature of the data and purpose of the analysis.**	**Explaining fully why a particular measure is chosen, including cases where a comparison is to be made, will be expected.**

Content	Notes
(*d*) Measures of dispersion	
Students should be taught to:	
work out and use the range for data presented in a list or frequency distribution;	The possible effect of an outlier on range will be expected.
work out the quartiles, percentiles and inter-quartile range for discrete and continuous data presented either as a list, frequency table or grouped frequency table;	Graphical and other methods will be expected. **Numerical interpolation could be required.**
work out inter-percentile ranges for discrete and continuous data presented as a list, frequency distribution or grouped frequency distribution;	Numerical interpolation could be required.
construct, interpret and use box plots;	The use of box plots could include comparisons.
formally identify outliers;	**Outliers are defined as:** **Less than LQ – 1.5 × IQR and** **Greater than UQ + 1.5 × IQR,** **where LQ and UQ are lower and upper quartiles and IQR is inter-quartile range.** **Effect of anomalous data.**
calculate and use variance and standard deviation;	**Division by *n* will be expected, as will use of Σ notation.**
understand the advantages and disadvantages of each of the measures of dispersion range, quartiles, inter-quartile range, percentiles, **deciles, inter-percentile range, variance and standard deviation**;	
use an appropriate measure of central tendency with range, quartiles, inter-quartile range, percentiles, **deciles, inter-percentile range, variance and standard deviation** to compare distributions of data;	An awareness that a full comparison needs at least both a measure (or measures) of central tendency and of dispersion.
calculate, interpret and use standardised scores to compare values from different frequency distributions.	
(*e*) Further Summary Statistics	
Students should be taught to use:	
simple index numbers;	Price relative = $\frac{\text{price}}{\text{price in base year}} \times 100$
chain base numbers;	**Used to calculate the annual percentage change.**

Content	Notes
weighted index numbers;	**Weighted index number** $= \frac{\Sigma(\text{index number} \times \text{weight})}{\Sigma(\text{weight})}$
Retail Price Index (RPI).	**What items are in the index, how items change over time, how prices are established from survey, how the index is used in assessing real price change and the limitations.**
(*f*) Scatter diagrams and correlation	
Students should be taught to:	
plot data as points on a scatter diagram;	The labelling and scaling of axes may be required.
recognise positive, negative and zero correlation by eye;	Terms such as strong or weak will be expected.
understand the distinction between correlation, causality and a non-linear relationship;	The points lying on the circumference of a circle are related but show zero correlation.
fit a line of best fit passing through $(\bar{x}, \bar{y})$ to the points on a scatter diagram, by eye may be required;	Questions will state when $(\bar{x}, \bar{y})$ is required.
find the equation of a line of best fit in the form $y = ax + b$ and interpret a and b;	**Commenting on whether a straight line is appropriate will be expected.**
fit non-linear models of the forms $y = ax^n + b$ and $y = ka^x$;	**The relationship will be suggested; n could be 2, –1 or ½ only.**
understand the pitfalls of interpolation and extrapolation;	Particularly the problem of extrapolating beyond the range.
interpret data presented in the form of a scatter diagram;	
calculate, in appropriate cases, Spearman's rank correlation coefficient and use it as a measure of agreement or for comparisons of the degree of correlation.	**The formula will be given. Although candidates should have experience of dealing with tied ranks this will not be tested in the examination.**
(*g*) Time series	
Students should be taught to:	
plot points as a time series; draw a trend line by eye and use it to make a prediction;	No more than 20 points will be expected.
calculate and use appropriate moving averages;	Up to and including a seven-point moving average.

Content	Notes
identify and discuss the significance of seasonal variation by visual inspection of time series graphs;	
establish a trend line, with its equation, based on moving averages;	**Trend lines will not be expected to pass through a mean point.**
recognise seasonal effect at a given data point and average seasonal effect.	**Interpretations may be required.**
(*h*) Quality Assurance	
Students should be taught to:	
plot sample means, median and ranges over time.	**To view consistency and accuracy against a target value in cases where a process is off-target. For example, in the manufacture of clothes to test that the variation in waist size is within the allowable limits of production and may continue; in the manufacture of engineering components that certain measurements are within allowable limits.**
(*i*) Estimation	
Students should be taught to:	
estimate population means from samples;	
estimate population proportions from samples with applications in opinion polls and elsewhere;	
estimate population size based on the Petersen capture/recapture method;	**The appropriateness of the assumptions in practice.**
understand the effect of sample size on estimates and the variability of estimates, **with a simple quantitative appreciation of appropriate sample size**.	

3 Reasoning, interpreting and discussing results

Content	Notes
Students should be taught in the context of real data to:	
apply statistical reasoning, explain and justify inferences, deductions, arguments, solutions **and decisions;**	Cases clearly restricted to the content of the specification at the appropriate level
explore connections, look for and examine relationships between variables **including fitting the equation to a line of best fit or trend line**;	Eg height and weight, age and depreciation of a car, GNP and mortality in infants. **Interpretations of gradient and intercept will be expected**.
consider the limitations of any assumptions;	Simple cases only, eg honest replies to questionnaires, equally likely outcomes in probabilities, representativeness of sample of population, reliability of secondary data.
formally identify outliers using quartiles;	**Dealing with outliers will be expected.**
relate summarised data to any initial questions or observations;	The relevance of measures of central tendency.
interpret all forms of statistical tables, diagrams and graphs;	To include real published tables and graphs.
compare distributions of data and make comparisons using measures of central tendency and measures of dispersion, percentiles, **deciles, inter-percentile range, mean deviation, variance and standard deviation**;	The shapes of distributions and graphs may be used. Formula for variance and standard deviation to be given.
check results for reasonableness and modify their approaches if necessary;	Eg the mean must lie between the maximum and minimum, 'the average bicycle speed was 130 km per hour' is not reasonable.
interpret correlation as a measure of the strength of the association between two variables, **including Spearman's rank correlation coefficient for ranked data;**	The use of words such as weak or strong will be expected; **the closer to ± 1 the better the correlation for a given sample size. Beware the use of correlation in small samples.**
make predictions;	**The use of a trend line by eye, drawing or formula will be expected.**
compare or choose by eye between a line of best fit and a model based on $y = ax^n + b$ for $n = 2$, 1 or ½, $y = ax^2 + bx$ or $y = ka^x$.	**Based on an informal awareness of the spread of points around a proposed model.**

4 Probability

Content	Notes
Students should be taught to:	
understand the meaning of the words event and outcome;	Tossing a coin is an event with outcomes landing Heads or Tails.
understand words such as impossible, certain, highly likely, likely, unlikely, possible, evens and present these on a likelihood scale;	Interpretation of real-life situations will be expected, eg 'the probability that the horse will win the next race is 0.3'; 'the probability that I will get a grade C or better in my Statistics in 3/4.'
put outcomes in order in terms of probability;	Use of ≤ will be expected.
put probabilities in order on a probability scale;	Labelling of the scale will be expected.
understand the terms 'random' and 'equally likely';	
understand and use measures of probability from a theoretical perspective and from a limiting frequency or experimental approach;	Formal definition and notation of a limit will not be required whilst terminology such as 'as the number of trials increases' will be required. **Understand that increasing sample size generally leads to better estimates of probability and population parameters.**
the relationship between 'odds' and probability;	**The relationship between $\Sigma p = 1$ and 'odds' may be tested.**
understand that in some cases the measure of probability based on limiting frequency is the only viable measure;	The probability of a sports team winning can only be measured from a limiting frequency perspective. For example, medical statistics for assessment of health risks.
compare expected frequencies and actual frequencies;	
use simple cases of the binomial and discrete uniform distribution;	**The expansion of $(p + q)^2$ will be expected. In all other cases the expansion of $(p + q)^n$ will be given.**
use simulation to estimate more complex probabilities;	
use probability to assess risk;	Examples may be taken from insurance.
produce, understand and use a sample space;	Listing all outcomes of single events and two successive events, in a systematic way.
understand and use Venn diagrams and cartesian grids;	

Content	Notes
understand the terms mutually exclusive and exhaustive and to understand the addition law P(A or B) = P(A) + P(B);	P(A or B) = P(A) + P(B); 'Mutually exclusive' means that the occurrence of one outcome prevents another, Σ = 1 when summed over all mutually exclusive outcomes.
know, for mutually exclusive outcomes, that the sum of the probabilities is one and in particular the probability of something not happening is one minus the probability of it happening;	If P(A) = p then P(not A) = 1 – p.
form and use tree diagrams and probability tree diagrams for independent events **and conditional cases**;	Listing all possible joint or compound outcomes **with and without replacement for up to three outcomes and three sets of branches.**
understand, use and apply the addition, **general addition** and multiplication laws for independent events **and conditional events and outcomes;**	To correctly apply P(A and B) = P(A) × P(B), P(A or B) = P(A) + P(B) **P($A \cup B$) = P(A) × P(B) – P($A \cap B$),** **P(A or B) = P($B \mid A$) × P(A).**
the shape and simple properties of the normal distribution.	**The distribution is symmetrical with mean, mode and median equal; approximately 95% of values are within ± 2 standard deviations of the mean; virtually all values are within ± 3 standard deviations of the mean. Use of the normal distribution to model some populations.** **Use of Normal distribution tables will not be required.**

Edexcel GCSE Statistics

Formulae Sheet

Foundation Tier

Mean of a frequency distribution = $\frac{\sum fx}{\sum f}$.

Mean of a grouped frequency distribution = $\frac{\sum fx}{\sum f}$, where x is the mid-interval value.

Edexcel GCSE Statistics

Formulae Sheet

Higher Tier

Mean of a frequency distribution $= \dfrac{\sum fx}{\sum f}$.

Mean of a grouped frequency distribution $= \dfrac{\sum fx}{\sum f}$, where x is the mid-interval value.

Variance $= \dfrac{\sum (x - \bar{x})^2}{n}$

Standard deviation (set of numbers) $\sqrt{\left[\dfrac{\sum x^2}{n} - \left(\dfrac{\sum x}{n}\right)^2\right]}$

or $\sqrt{\left[\dfrac{\sum (x - \bar{x})^2}{n}\right]}$

where $\bar{x}$ is the mean set of values.

Standard deviation (discrete frequency distribution) $\sqrt{\left[\dfrac{\sum fx^2}{\sum f} - \left(\dfrac{\sum fx}{\sum f}\right)^2\right]}$

or $\sqrt{\left[\dfrac{\sum f(x - \bar{x})^2}{\sum f}\right]}$

Spearman's rank correlation coefficient $1 - \dfrac{6\sum d^2}{n(n^2 - 1)}$

Grade descriptions

The following grade descriptions indicate the level of attainment characteristic of the given grade at GCSE. They give a general indication of the required learning outcomes at each specified grade. The descriptions should be interpreted in relation to the content outlined in the specification; they are not designed to define that content. The grade awarded will depend in practice upon the extent to which the student has met the assessment objectives overall. Shortcomings in some aspects of the examination may be balanced by better performances in others.

Grade F

Candidates recognise the difference between a population and a sample, recognising that a census is the whole and entire population. They use tables of random numbers. They can provide simple reasons for sampling. They design and use simple data capture sheets using tallies and design simple questionnaires which may contain some leading questions or lead to bias.

Candidates record data using inequality signs but with some errors over open and closed intervals. They design and use simple two way tables. They interpret diagrams as composite bar charts and pie charts and construct them with a few errors. They plot and interpret points on a scatter diagram.

Candidates work out the mean for data presented in a list. They identify the mode from a frequency table or diagram. They use a measure of central tendency and range to make comparisons.

Candidates order probabilities, plot probabilities on a probability scale using fractions, decimals and percentages. They work out simple theoretical probabilities in the form $\frac{a}{n}$.

Grade C

Candidates recognise, define and explain the differences between types of data. They select an appropriately sized sample, including a stratified sample with one category. They can offer an explanation as to how bias can be minimized. They appreciate what data to collect and how to collect it.

Candidates appreciate the effects of accuracy on measurement, understand the advantages or otherwise of interviews, questionnaires, pre-tests, pilot study and explain the problems of ambiguity and poor design.

Candidates can, in appropriate circumstances, use all forms of tabulation as defined by the specification. They construct frequency diagrams, including frequency polygons, for continuous grouped data, cumulative frequency diagrams and population pyramids. They recognise the different forms of skewness. They show a basic understanding of visual misuse.

Candidates can identify modal class, work out estimates of mean and median for grouped continuous data, quartiles and inter-quartile range and construct box plots. They make comparisons using a measure of central tendency and inter-quartile range. They can fit and use a line of best fit on a scatter diagram, calculate moving averages and discuss seasonal variations on a time series.

Candidates comment on theoretical probabilities and limiting frequencies and make use of the fact that the sum of the probabilities is 1. They use a tree diagram for systematic listing, and apply the multiplication law for independent cases.

Candidates specify hypotheses and test them, summarising results. They give a reason for their choice of statistical presentation, explaining features they have selected, examining relationships between variables. They justify their arguments or propositions, showing some insight into the structure of the data. They appreciate the difference between the explanation and experimental evidence. They compare distributions and make comparisons using the shape of distributions, graphs with measure of central tendency and measures of dispersion such as range, percentiles, inter-quartile range.

Grade A

Candidates know when to use rank and why. They can take a stratified sample with more than one category, show an appreciation of and use systematic and quota sampling. They show an appreciation of sensitive cases and the use of random response.

Candidates analyse the problems of redundancy, too broad and too narrow categories. They construct and use comparative pie charts and cumulative frequency step polygons. They construct, interpret and compare histograms, based on frequency density, with unequal class intervals.

Candidates can explain the effect of a transformation on measures of central tendency and the addition or withdrawal of a sample member or members. They can reason the choice for a measure of central tendency and discuss the possible effect of outliers.

Candidates work out percentiles and make comparisons using a measure of central tendency and percentiles or inter-percentile range. They formally work out any outliers from a box and whisker diagram or similar.

Candidates comment on the meaning of the gradient and intercept of a line of best fit on a scatter diagram or trend line on a time series. They recognise that a non-linear model, rather than linear, will be needed to fit some data. They calculate Spearman's rank correlation and use it in appropriate cases.

Candidates use Venn diagrams and Cartesian grids in relation to probability. They recognise conditional probability.

Candidates give reasons for the choices they make when investigating within statistics itself or when using statistics to analyse tasks: these reasons explain why particular lines of enquiry or procedures are followed and others rejected. They apply the statistical techniques they know in familiar and unfamiliar contexts. Their reports include statistical justifications, explaining their interpretations and solutions to problems involving a number of features or variables.

The wider curriculum

Key skills

This specification will provide opportunities, as appropriate, to develop the key skills of application of number, communication, improving own learning and performance, information technology, problem solving and working with others.

Application of number

This specification provides numerous opportunities for the development and assessment of this key skill both throughout the course and through the associated project work.

Communication

Through their project work students may have opportunities to discuss their work and make presentations on their findings.

Improving own learning and performance

The project work associated with this specification is a major, piece of work. In order to complete this project students will have to take responsibility for their work and may have opportunities to discuss short-term targets and review these at various stages as they work on their project.

Information and communication technology

Opportunities for developing this key skill are identified below.

Problem solving

Again the project work associated with this specification provides the richest source of opportunities to develop this key skill as the project is, in itself, an exercise in problem solving.

Working with others

During normal classroom interactions students will have the opportunity to develop skills in working with others. Although the project required by this specification is an individual's piece of work there may opportunities to develop this key skill, for example in the collection and pooling of data.

Spiritual, moral, ethical, social, cultural and environmental issues, health and safety considerations and the European dimension

This specification will enable centres to provide courses in statistics that will allow students to discriminate between truth and falsehood. As students explore statistical models of the real world there will be many naturally arising moral and cultural issues, environmental and safety considerations and aspects of European and world development for discussion.

Education for citizenship

The GCSE specification for statistics gives students the opportunity to develop their skills of enquiry and communication in relation to citizenship. In particular, they will be able to develop their ability to analyse information from different sources, including ICT-based sources and explore the use and abuse of statistics. They will also have the opportunity to develop their knowledge and understanding of citizenship. In particular, through their work in handling data, students may have the opportunity to explore the use of statistical information in the media and its role in providing information and affecting opinion. Through their work on statistics students may explore the practical applications of their work in the fields of business and financial services. Other opportunities for developing ideas of citizenship will present themselves depending on contexts in which they explore and develop their statistical knowledge, skills and understanding.

Information and communication technology

At all stages throughout the course, students should be provided with opportunities to develop and apply ICT capability through the use of ICT tools and techniques to support their learning in **all** appropriate subjects at appropriate levels.

The following list provides examples of ICT tools and techniques which could be used to support, develop and enhance students' work.

- word processing software
- internet
- databases
- data logging sequences
- spreadsheets
- calculators, with specific reference to statistical functions
- graph and chart drawing software
- function graph plotters
- simulation software
- miscellaneous statistical packages

All students should be provided with opportunities to support their work by being taught to:

- obtain data and other information from a variety of sources, selecting and synthesising such information as required and developing an ability to question the reliability of such information in terms of accuracy, bias and plausibility
- develop their ideas using ICT and other related tools and techniques to amend, refine and develop their work in terms of quality, accuracy and reliability
- communicate, exchange and share information both directly and through electronic media
- reflect critically on the quality and progress of their work, particularly in terms of its review, modification and evaluation
- provide potential extensions to their work.

Examples of the above might include:

- examining the information about the changes in pass rates at GCSE – who writes about such with vested interest
- questioning the reliability of secondary statistics when the 'goals for' and 'goals against' in printed tables differ
- pooling data electronically
- modifying a 'height v weight' relationship in terms of age/gender
- examining the correlation between age, mileage and value of 'used cars' in greater detail.

Other issues

The study of statistics can, and should, provide opportunities to promote:

- **general thinking skills –** through developing problem solving, communication and deductive reasoning, ie why 'lines of best fit' are limited on a modelling of used car prices or why 'a football team is at its most vulnerable shortly after it scores a goal' is nonsense
- **economic skills** – through using and applying statistics in problems set in economic disciplines, eg the relationship between the Retail Price Index and house prices
- **entrepreneurial and enterprise skills** – developing students' abilities to apply statistical techniques in business, technology, science, economics, etc. For example, what are the implications of a drop in share prices or the causality of smoking and heart disease
- **work-based tasks** – by developing students' abilities to appreciate and apply statistical techniques in a range of 'workplace' situations and analyse related real-life problems, eg the minimum hourly wage as related to production, share prices, profits and potential growth or closure of the company.

Support and training

Training

A programme of INSET courses covering various aspects of Edexcel's specifications and assessment will be arranged by Edexcel each year on a regional basis. Full details may be obtained from:

Professional Development and Training
Edexcel
Stewart House
32 Russell Square
London WC1B 5DN

Tel: 0870 240 8900
Fax: 020 7758 5951
Email: trainingenquiries@edexcel.org.uk

Website

www.edexcel.org.uk

Please visit the Edexcel website, where further information about training and support for all qualifications, including this GCSE, can be found.

The website is regularly updated, and an increasing amount of support material and information will become available through it.

Edexcel Publications

Support materials and further copies of this specification can be obtained from:

Edexcel Publications
Adamsway
Mansfield
Notts NG18 4FN

Tel: 01623 467467
Fax: 01623 450481
Email: publications@linneydirect.com

The following support materials will be available from summer 2003 onwards:

- Specimen papers
- Coursework guide, including ideas for coursework tasks.

Regional offices and Customer Services

Further advice and guidance is available through a national network of regional offices. For general enquiries and for details of your nearest office please call the Edexcel Customer Services on 0870 240 9800.

Appendices

Appendix 1 – Assessment criteria for application of statistical techniques and ideas

The centre-assessed (coursework) component

Nature of coursework

Coursework will consist of one major project. The task chosen and data collected should provide the candidate with opportunities to satisfy all of the coursework assessment objectives.

Candidates may, during the course of study undertake more than one line of enquiry but only one may be presented for assessment, although it may, under exceptional circumstances be possible to combine two extensive projects into one major project.

Setting, administering and supervising coursework

General

The coursework component consists of 25% of the final assessment. The time devoted to the coursework and associated skills should reflect the weighting of the component.

Candidates may choose any area of study or line of enquiry for their project, but it is advised that they do so in consultation with their teacher. The project may reflect personal interests of the candidate or local interests but should be chosen to ensure that the full range of statistical techniques open to the candidate can be demonstrated in the project.

Data collected for the project may come from primary or secondary sources chosen by the candidate. Specific data should not be given to the candidate since this would be restrictive in one of the areas of assessment. It is to be noted that qualitative data can also be restricting.

Whilst providing the basis for an extended piece of work, the project should also involve opportunities for designing the overall strategy, the identification of aims and hypotheses, the identification of appropriate data to be collected and the following parameters or variables to be considered:

- the selection and collection of appropriate data, the use of primary or secondary sources, methods of collection and/or selection and a very clear description of the sampling method and technique
- the recording and tabulation of data, sorting and re-sorting to fit various categories, control of variables, the use of an appropriately wide range of graphical methods of representation to describe, compare or relate the data
- the selection and computation of appropriate measures or summary statistics to describe, compare or relate the variables in order to make as full as possible analysis of the data
- the interpretation of tables, graphs, summary statistics and other measures in the context of the line of enquiry, to show a clear and full understanding of the work undertaken or to confirm or refute hypotheses and draw accurate conclusions.

ICT

The use of ICT is to be both encouraged and promoted at all stages in the project. The encouragement should include the creation and interrogation of databases, the use of the internet as a source of data, computer simulations and packages. The use of the computer to carry out graphical work and calculation should also be encouraged; but it should be recognised that for the coursework the selection of the appropriate graphs or computations is the real emphasis of the assessment; particularly when this is accompanied by reasoning behind the selection.

The use of computer-based statistical packages is to be encouraged at all times since this is very much at the heart of what the statistician of today does in real-life situations.

Cross-curricular projects

There are many applications of statistics in areas such as science, geography, business studies, economics and psychology. For this reason, lines of enquiry and projects which cut across subject boundaries are to be welcomed. The data collected for 'another subject' could often be subjected to a deeper analysis of a statistical nature and thus be the basis for GCSE Statistics coursework.

It must be recognised that a project submitted for assessment in statistics and another area of study will need to satisfy the assessment objectives of both areas of study and be assessed according to the assessment criteria for each subject.

Group work

Statisticians rarely work in isolation so group work in coursework is to be allowed. This is particularly true for the collection of data, which can readily be shared and this can add to the overall efficiency – especially with the collection of a large sample. When group work is undertaken it is important that teachers can recognise the contribution of each individual in order to make reliable assessments.

Coursework advice

Edexcel will provide centres with advice on coursework by:

- providing a collection of approved lines of enquiry
- a programme of INSET provision
- endorsed textbooks.

Administering the coursework

The coursework component can be undertaken at any time during the period of study.

Edexcel will provide centres with information about the closing date for the sending of coursework marks to Edexcel; this date will be a few weeks before the written examinations start.

Centres will be provided with:

- full administrative details in booklet form, including details of how to proceed in special cases such as lost or missing work
- photocopiable coursework record forms
- details of their moderator.

Supervision of coursework

Centres will be required to ensure that the general principles governing the supervision of coursework are applied to statistics coursework. These clearly include the integrity of the work from each candidate.

Teachers will be asked to comment on any 'extra guidance' given to individual candidates and informed of what to do in the case of any occurrences of malpractice.

Both the teacher and the candidate will be required to sign a declaration confirming that the coursework submitted for assessment is that of the candidate.

Assessment criteria

Introduction

Coursework is marked across both tiers of entry on a common mark spine. The maximum mark is 40, which is then converted by Edexcel to a mark out of 25 by a direct scaling factor for each tier of entry.

Each piece of work must be assessed under the following strand headings with the mark for each strand recorded on the Candidate Record Form (CRF) (see *Appendix 2*).

The assessment criteria are subdivided into three strands, these being

- **Strand 1**: Specify the line of enquiry, design and plan the approach the collection of data
- **Strand 2**: Processing and representing data with calculations and summary statistics
- **Strand 3**: Interpretation and discussion of results with conclusions.

Strands 1 and 3 will be on a 10 mark scale and Strand 2 will be on a 20 mark scale but Strands 1 and 2 will be divided into two sub-strands (a) and (b) with the final mark for the strand being the sum of the marks in (a) and (b).

The mark awarded in each strand must reflect the degree of difficulty and sophistication of the line of enquiry. Teachers should recognise the following broad relationship between a mark and the GCSE Statistics grade descriptions.

For strands 1(a) and 1(b),

Mark 2 should encompass the appropriate material from the Grade F descriptors;
Mark 3 should encompass the appropriate material from the Grade C descriptors;
Mark 4 should encompass the appropriate material from the Grade A descriptors;
Mark 5 should encompass appropriate material deemed to be above the Grade A descriptors.

For strands 2(a), 2(b) and 3,

Mark 3 should encompass the appropriate material from the Grade F descriptors;
Mark 5 should encompass the appropriate material from the Grade C descriptors;
Mark 7 should encompass the appropriate material from the Grade A descriptors;
Mark 9 should encompass appropriate material deemed to be above the Grade A descriptors.

The Assessment criteria

Strand 1 (a): Planning

Mark

1 Candidates choose a simple, routine but well defined line of enquiry giving some degree of clarity to their aims.

2 Candidates choose a straightforward line of enquiry which will involve the routine use of simple statistical techniques. They give a clear statement of the purpose of their study.

3 Candidates consider a more complex line of enquiry which will require the use of statistical techniques up to at least those defined in the descriptors at grade C. Their aims, plan and strategy – particularly as related to the statistical techniques – are well described.

4 Candidates consider a line of enquiry which requires careful specification and a degree of creative thinking. They state their aims in clear statistical terms which should include at least one hypothesis to be confirmed, refuted or tested in some statistical manner. The hypothesis may arise from evidence of a pre-test; candidates may also, where appropriate, consider the use of control groups. Their overall design and plan should demand the use of statistical techniques given in the Grade A descriptions.

5 Candidates must consider an advanced line of enquiry which demands very careful specification, creative thinking and detailed planning – particularly in terms of the statistical techniques likely to be employed. Their aims should include a hypothesis or set of hypotheses to be examined. Pre-tests and control groups, where appropriate, should appear and use be made of them if required. Their overall design and plan should demand the use of statistical techniques from some areas deemed to be beyond those defined in the Grade A descriptors.

Strand 1 (b): Collecting

Mark

1 Candidates collect data of a very simple nature which is collected using the very simplest of techniques. The data should have some relevance to the line of enquiry.

2 The data collected must be relevant to the line of enquiry and candidates must give some indication of the source of the data and their method of selection. The data may be of a small sample nature or a census from a small population. Candidates need not use the word census but should indicate that they are considering the whole population.

3 The data collected needs to be relevant to the line of enquiry, mainly reliable and collected efficiently in a way designed to ensure its accurate use, particularly in terms of statistical techniques from at least the Grade C descriptions. The sources of data and reasons for choosing primary or secondary sources or a mixture of the two should be given as should the identification, where appropriate, of any exceptional datum points (outliers). A clear description of methods of selection and collection, using a recognised sampling method, must be given. The size of any sample should be appropriate to the line of enquiry and statistical techniques to be used.

4 Candidates must collect data which is both relevant to the line of enquiry and also reliable. All attempts to eliminate bias must be taken and reported, as should the practical problems of dealing with missing data, random response, non-response or ensuring the reliability of secondary sources. Clear, detailed descriptions of the methods of data collection or selection, including the correct naming of sampling techniques, should be given. Evidence of data collection techniques appropriate for the Grade A descriptors in data collection and statistical techniques must be given. The size of the sample must be appropriate to the line of enquiry and statistical techniques to be used.

5 The data collected must satisfy, where appropriate, all of the conditions for Mark 4 above and be appropriate to meet the demands of the advanced nature of the line of enquiry. In addition, methods for dealing with the problems associated with bias, non-response, missing data, outliers and the reliability of secondary sources should be justified as should the decision to make use of primary sources, secondary sources or a mixture of the two.

Strand 2(a): Analysis, presentation and diagrams

Marks

1 – 2 Some attempt is made to use a suitable method of recording data but with only little thought being given to processing. Information and results are presented in a fairly clear and organised way.

3 – 4 The forms of presentation and calculations should be commensurate with the description grade for at least Grade F. Results of presentations should be generally correct, which for diagrams includes labels and scaling, and supported by appropriate descriptions in terms of statistical concept, words and language to show some understanding of the use of diagrams and tables in terms of the aims of their line of enquiry.

5 – 6 Candidates use a range of more demanding, largely relevant diagrammatic representations that include techniques associated with the description grade at least at Grade C. The diagrams should be generally correct with no obvious omissions. Reasons for the choice of diagram – in terms of their relevance to the aims of the line of enquiry – should be given; with diagrams being supported by correct statistical concepts, words, language and explanations. There should be little redundancy in the presentations.

7 – 8 Candidates use a range of relevant diagrammatic representations that include techniques of a demand at least equivalent to those made in the description grade for Grade A. These diagrams need to be correct, justified in terms of the aims of the line of enquiry and devoid of any serious levels of redundancy or incorrectness. Candidates use statistical concepts, language and symbols in presenting both descriptions and arguments. An appropriate range of diagrams should be used to summarise the data and show how the parameters and variables are related.

9 – 10 Candidates should use a range of diagrammatic representations that include some associated with the description grade at Grade A and above. All choices of method and diagrams need to be justified in terms of the aims and methods of the line of enquiry. Diagrams, concepts and arguments need to be presented correctly, with a high degree of justification and both effectively and efficiently. Diagrams should be used to support a high degree of statistical analysis.

Strand 2(b): Calculations

Marks

1 – 2 Candidates use only the simplest form of calculations in which the results are frequently correct.

3 – 4 The forms of calculations should be commensurate with the GCSE Statistics grade descriptors for at least Grade F. Results of calculations should be generally correct and supported by appropriate descriptions in terms of statistical concept, words and language to show some understanding of the use of tables and calculations, in terms of the aims of their line of enquiry.

5 – 6 Candidates use a range of more demanding, largely relevant calculations that include techniques associated with the GCSE Statistics grade descriptors at least at Grade C. The calculations should be generally correct with no obvious omissions. Reasons for the choice of calculation – in terms of their relevance to the aims of the line of enquiry – should be given; with calculations being supported by correct statistical concepts, words, language and explanations. There should be little redundancy in calculations.

7 – 8 Candidates use a range of relevant calculations that include techniques of a demand at least equivalent to those made in the GCSE Statistics grade descriptors for Grade A. These calculations need to be correct, justified in terms of the aims of the line of enquiry and devoid of any serious levels of redundancy or incorrectness. Candidates use statistical concepts, language and symbols in presenting both descriptions and arguments. Where appropriate, numerical results are rounded correctly. An appropriate technique should be used to summarise the data and show how the parameters and variables are related.

9 – 10 Candidates should use a range of calculations that include some associated with the GCSE Statistics grade descriptors at Grade A and above. All choices of calculations need to be justified in terms of the aims and methods of the line of enquiry. Calculations and symbols need to be presented correctly, with a high degree of justification and both effectively and efficiently. Calculations should be used to support a high degree of statistical analysis.

Strand 3: Interpretation

Marks

1 – 2 Based on the limitations of their line of enquiry and statistical techniques, candidates make a simple comment on patterns in the data and draw a simple conclusion.

3 – 4 Candidates comment on patterns in the data and identify any exceptions. Their comments should be at a level commensurate with the GCSE Statistics grade descriptors for at least Grade F, which could include comparisons. They should provide some form of conclusion which relates their summarised data to the aims of the line of enquiry. In the case of multiple conclusions at least one, but not all of them, need to be correct.

5 – 6 Candidates make detailed explanations of findings with correct interpretations of all measures, summary statistics and graphs and valid comparisons. They summarise and correctly interpret their graphs and calculations and relate summary statistics and data to the line of enquiry and draw correct inferences. They comment on the consequences of any sampling technique used, including how conclusions can be affected by the size of any sample. Their comments, conclusions and inferences should be commensurate with the GCSE Statistics grade descriptors of an equivalence to those of at least Grade C.

7 – 8 Candidates comment on patterns and offer plausible reasons for any exceptions. They relate summary statistics, calculations or graphical descriptions to either support, confirm or refute any hypothesis made. Inferences made need to be both correct and justified in terms of the supporting evidence and may be made in terms of probability or equivalent. In appropriate cases they should comment upon the possible effects of the sampling size, methods of sampling and effectiveness of their overall strategy. All comments, conclusions and inferences should be commensurate with the GCSE Statistics grade descriptors of a level at least equivalent to those at Grade A.

9 – 10 At this level, candidates should make comments, conclusions and inferences of a level which is above that of the GCSE Statistics grade descriptors at Grade A. These inferences, etc should clearly relate to any hypotheses which may be supported, confirmed, refuted or described in terms of probability. All commentaries should be both correct and concisely expressed using effective and efficient statistical language. In cases where evidence refutes a hypothesis candidates should offer an alternative hypothesis and at least describe a full method by which the alternative could be tested. Candidates should evaluate the effectiveness of their methodology, recognise its possible limitations and comment constructively on any practical consequences of their work.

Supporting evidence

Candidates' submissions must be annotated to show where the crucial evidence behind the awarding of a mark in each strand can be found.

When the assessments are complete, the marks awarded under each of the strands and an overall mark out of 40 must be entered on the CRF with, where appropriate, any supporting information being offered in the spaces provided.

Standardisation

Internal standardisation

Each centre is required to standardise across teachers marking the coursework component and teaching groups entering the examination. In cases where more than one teacher has been involved in the marking of the coursework then one teacher must be designated as being responsible for the final mark, signing the CRF and for the standardisation of the candidates' work.

Centres are advised to hold training sessions for internal markers.

Moderation

The sample for moderation

Centres will be informed prior to the examination of the sample they should send for moderation. This sample will be chosen, at random, by the Edexcel computer. However it should always contain both the highest and lowest mark awarded by the centre, so if these are not included in the selected random sample the centre will be asked to add them to the sample.

The moderator

A moderator will be assigned to each centre by Edexcel. The sample for moderation should be sent directly to the moderator by the centre.

Feedback

The centre will receive brief feedback notes from the moderator; these notes will highlight any problem areas in the marking of the coursework.

Appendix 2 – Candidate Record Form

Edexcel
Success through qualifications

GCSE Statistics 1389 Candidate Record Form

Candidate Name: _____ Candidate No: _____

Centre Name: _____ Centre No: _____

Project Title: _____

Total mark (out of 40)

Strand		Mark
1	a	
	b	
2	a	
	b	
3		

Help given over and above normal classroom practice

Date	Nature of Help

Teacher's contribution (if any)

DECLARATION TO BE SIGNED BY THE CANDIDATE

I declare that the work submitted for assessment has been carried out without assistance other than that which is acceptable under the scheme of assessment.

Signed …….. Date ……

DECLARATION TO BE SIGNED BY THE TEACHER-EXAMINER RESPONSIBLE FOR COMPLETING THE CANDIDATE RECORD FORM

I declare that the task and project of the candidate in respect of the marks on this form have been kept under regular supervision and that, to the best of my knowledge, no assistance has been given apart from any which is acceptable under the scheme of assessment and has been identified and recorded.

Signed …….. Date ……

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