Version 1.0 0913

General Certificate of Education

Statistics 6380
2014

Material accompanying this Specification

- Specimen/Past Papers and Mark Schemes
- Reports on the Examination
- A Teacher's Guide

SPECIFICATION

This specification will be published annually on the AQA Website (www.aqa.org.uk). If there are any changes to the specification centres will be notified in print as well as on the Website. The version on the Website is the definitive version of the specification.

Further copies of this specification booklet are available from:

AQA Logistics Centre, Unit 2, Wheel Forge Way, Ashburton Park, Trafford Park, Manchester, M17 1EH.
Telephone: 0870 410 1036 Fax: 0161 953 1177
or
can be downloaded from the AQA Website: www.aqa.org.uk

Set and published by the Assessment and Qualifications Alliance.

The Assessment and Qualifications Alliance (AQA) is a company limited by guarantee registered in England and Wales 3644723 and a registered charity number 1073334. Registered address AQA, Devas Street, Manchester, M15 6EX.

Contents

Background Information

Scheme of Assessment

Subject Content

Key Skills and Other Issues

Centre-assessed Component

Awarding and Reporting

Appendices

Background Information

1 Advanced Subsidiary and Advanced Level Specifications

1.1 Advanced Subsidiary (AS)

Advanced Subsidiary courses were introduced from September 2000 for the award of the first qualification in August 2001. They may be used in one of two ways:

- as a final qualification, allowing candidates to broaden their studies and to defer decisions about specialism;
- as the first half (50%) of an Advanced Level qualification, which must be completed before an Advanced Level award can be made.

Advanced Subsidiary is designed to provide an appropriate assessment of knowledge, understanding and skills expected of candidates who have completed the first half of a full Advanced Level qualification. The level of demand of the AS examination is that expected of candidates half-way through a full A Level course of study.

1.2 Advanced Level (AS+A2)

The Advanced Level examination is in two parts:

- Advanced Subsidiary (AS) – 50% of the total award;
- a second examination, called A2 – 50% of the total award.

Most Advanced Subsidiary and Advanced Level courses will be modular. The AS will comprise three teaching and learning modules and the A2 will comprise a further three teaching and learning modules. Each teaching and learning module will normally be assessed through an associated assessment unit. The specification gives details of the relationship between the modules and assessment units.

With the two-part design of Advanced Level courses, centres may devise an assessment schedule to meet their own and candidates' needs. For example:

- assessment units may be taken at stages throughout the course, at the end of each year or at the end of the total course;
- AS may be completed at the end of one year and A2 by the end of the second year;
- AS and A2 may be completed at the end of the same year.

Details of the availability of the assessment units for each specification are provided in Section 3.1.

2 Specification at a Glance
Statistics

AS Examination 5381

Unit Statistics 1A (SS1A) or **Unit Statistics 1B (SS1B)**

Unit Statistics 1A (SS1A)	Unit Statistics 1B (SS1B)
written paper and coursework	written paper only
1¼ hours and one task	1½ hours
coursework weighted at 8.33% of total AS Marks *(4.17% of total A Level marks)*	

all questions compulsory; graphics calculator allowed

each Unit weighted at

33.3% of the total AS marks

16.7% of the total A Level marks

Unit Statistics 2 (SS02)

1½ hours — 33.3% of the total AS marks *16.7% of the total A Level marks*

all questions compulsory; graphics calculator allowed

Unit Statistics 3 (SS03)

1½ hours — 33.3% of the total AS marks *16.7% of the total A Level marks*

all questions compulsory; graphics calculator allowed

Advanced Subsidiary Award

5381

+

A2 Examination 6381

Unit Statistics 4 (SS04)

1½ hours — 16.7% of the total A Level marks

all questions compulsory; graphics calculator allowed

Unit Statistics 5 (SS05)

1½ hours — 16.7% of the total A Level marks

all questions compulsory; graphics calculator allowed

Unit Statistics 6 (SS06)

1½ hours — 16.7% of the total A Level marks

all questions compulsory; graphics calculator allowed

Advanced Award

6381

3 Availability of Assessment Units and Entry Details

3.1 Availability of Assessment Units

Examinations based on this specification are available as follows:

	Availability of Units		Availability of Qualification	
	AS	**A2**	**AS**	**A Level**
June	All	All	✓	✓

3.2 Sequencing of Modules

Statistics is inherently a sequential subject and, as a consequence, later modules depend on modules earlier in the course. Any prerequisites for a particular module are detailed in the preamble to each module in sections 10–15.

3.3 Entry Codes

The following unit entry codes should be used:

Unit	Level	With or without coursework	Entry code
Statistics 1A	AS	with	SS1A
Statistics 1B	AS	without	SS1B
Statistics 2	AS	without	SS02
Statistics 3	AS	without	SS03
Statistics 4	A2	without	SS04
Statistics 5	A2	without	SS05
Statistics 6	A2	without	SS06

The **Subject Code** for entry to the Statistics AS award is 5381.

The **Subject Code** for entry to the Statistics Advanced Level award is 6381.

3.4 Rules for Combinations of Unit Entries

There are restrictions on combinations of unit entries for this Specification and AQA GCE Mathematics.

Concurrent entries for SS1A and SS1B will not be accepted.

3.5 Classification 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 GCE 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:

Statistics 2260

3.6	Private Candidates	This specification is available to private candidates. Private candidates who have previously entered this specification can enter units with coursework (as well as units without coursework) providing they have a coursework mark which can be carried forward. Private candidates who have not previously entered for this specification can enter units without coursework only. Private candidates should write to AQA for a copy of *'Supplementary Guidance for Private Candidates'*.
3.7	Access Arrangements and Special Consideration	We have taken note of equality and discrimination legislation and the interests of minority groups in developing and administering this specification. We follow the guidelines in the Joint Council for Qualifications (JCQ) document: *Access Arrangements, Reasonable and Special Consideration: General and Vocational Qualifications.* This is published on the JCQ website (**http://www.jcq.org.uk**) or you can follow the link from our website (**http://www.aqa.org.uk**). Applications for access arrangements and special consideration should be submitted to AQA by the Examinations Officer at the centre.
3.8	Language of Examinations	All assessment units in this subject are provided in English only.
3.9	Use of Calculators	For units in which calculators are allowed the rules (http://web.aqa.org.uk/admin/p_conduct.php) regarding what is permitted for GCE Maths and GCE Statistics are the same as for any other GCE examination. Most models of scientific or graphical calculator are allowed. However, calculators that feature a 'Computer Algebra System' (CAS) are **not** allowed. It is usually clear from the manufacturer's specifications whether a model has this feature.

Scheme of Assessment

4 Introduction

AQA offers a GCE specification in Statistics, and a separate GCE specification in Mathematics. This specification, which is in Statistics, offers AS and A Level qualifications. Qualifications at AS and A Level standard in Mathematics, Pure Mathematics and Further Mathematics are available in the Mathematics specification.

The AS and A Level Statistics qualifications in this specification may appeal to the student who wishes to pursue the study of a numerate post-16 subject, but does not want to study Pure Mathematics.

The emphasis is on using and applying statistics. Appropriate interpretation of contexts and the outcomes of statistical procedures will be required.

The content of the AS specification has been selected to include statistical knowledge, skills and techniques which are needed for the study of other subjects, such as Biology, Economics, Geography, Psychology and Business Studies.

The A2 specification is designed to give an understanding of the calculation of statistical measures, as well as their application and interpretation, without requiring knowledge of Pure Mathematics beyond GCSE. For example, no calculus techniques are required and questions which are essentially algebraic problems will not be set.

The AS and A Level qualifications based on this specification are a recognised part of the National Qualifications Framework. As such, AS and A Level provide progression from Key Stage 4, through post-16 studies and form the basis of entry to higher education or employment.

This GCE specification complies with:

- the Common Criteria;
- the GCSE, GCE, Principal Learning and Project Code of Practice April 2013;
- the GCE Advanced Subsidiary and Advanced Level Qualification-Specific Criteria.

Where appropriate, reference has also been made to the requirements of the QCA Subject Criteria for Mathematics.

Prior level of attainment

Statistics is inherently a sequential subject. There is progression of material through all the levels at which the subject can be studied, with each level depending on the knowledge, understanding and skills of earlier ones.

This specification builds on the knowledge, understanding and skills established in GCSE Mathematics (or equivalent).

GCSE Statistics is not a prerequisite.

5 Aims

A course based on this specification should encourage candidates to:

a. develop their understanding of statistics and statistical processes in a way that promotes confidence and fosters enjoyment;

b. develop their abilities to construct a logical statistical argument and recognise incorrect statistical reasoning;

c. extend their range of statistical knowledge, skills and techniques, and use them in both structured and unstructured problems;

d. develop an understanding of coherence and progression in statistics;

e. recognise how a situation may be represented statistically and understand the relationship between 'real world' problems and statistical models, and how the latter can be refined and improved;

f. develop an understanding that a statistical technique can be applied to a variety of contexts and that a variety of statistical techniques can give insight into a given context;

g. use statistics as an effective means of communication;

h. read and comprehend statistical arguments and articles concerning applications of statistics;

i. acquire the skills needed to use technology such as calculators and computers effectively, and be aware of their limitations;

j. develop an awareness of the relevance of statistics to other fields of study, to the world of work and to society in general;

k. take increasing responsibility for their own learning and the evaluation of their own statistical development.

6 Assessment Objectives

The Assessment Objectives (AOs) are common to both AS and A Level. The schemes of assessment will assess candidates' ability to:

AO1 recall, select and use their knowledge of statistical facts, concepts, techniques and methods of data collection in a variety of contexts;

AO2 construct rigorous statistical arguments through use of precise statements or hypotheses, logical deduction and inference, including the construction of extended arguments for the handling of substantial problems presented in unstructured form;

AO3 recall, select and use their knowledge of statistical models to represent situations in the real world; recognise and understand given representations involving statistical models; present and interpret results from such models in terms of the original situation, including discussion of the assumptions made and refinement of such models;

AO4 comprehend translations of common realistic contexts into statistical models; use the results of calculations to make predictions, or to comment on the context; interpret statistical information; and read critically and comprehend statistical arguments or applications;

AO5 use contemporary calculator technology, statistical tables and formulae booklets accurately and efficiently; understand the limitations of such technology and give answers to appropriate accuracy.

7 Scheme of Assessment - *Advanced Subsidiary (AS)*

The Scheme of Assessment has a modular structure. The Advanced Subsidiary (AS) award comprises three assessment units, either SS1A or SS1B, SS02 and SS03. The assessment units, SS1A and SS1B, both assess teaching module Statistics 1 (section 10), but unit SS1A includes coursework. For the written papers, each candidate will require a copy of the AQA Booklet of formulae and statistical tables issued for this specification.

7.1 Assessment Units for AS Statistics

Unit SS1A	Written Paper	1¼ hours
33$^{1}/_{3}$% of the total AS marks	+ Coursework	60 marks

The written paper comprises 25% of the AS marks. All questions are compulsory. A graphics calculator may be used. The coursework comprises 8$^{1}/_{3}$% of the AS marks. One task is required.

Unit SS1B	Written Paper	1½ hours
33$^{1}/_{3}$% of the total AS marks		75 marks

All questions are compulsory. A graphics calculator may be used.

Unit SS02	Written Paper	1½ hours
33$^{1}/_{3}$% of the total AS marks		75 marks

All questions are compulsory. A graphics calculator may be used.

Unit SS03	Written Paper	1½ hours
33$^{1}/_{3}$% of the total AS marks		75 marks

All questions are compulsory. A graphics calculator may be used.

7.2 Weighting of Assessment Objectives for AS Statistics

The approximate relationship between the relative percentage weighting of the Assessment Objectives (AOs) and the overall Scheme of Assessment is shown in the following table.

Assessment Objectives	Unit Weightings (%)				Overall Weighting of AOs (%)
	SS1A	SS1B	SS02	SS03	
AO1	6 – 10	6 – 10	8 – 12	8 – 12	22 – 34
AO2	6 – 10	6 – 10	4 – 8	4 – 8	14 – 26
AO3	8 – 14	8 – 14	4 – 10	4 – 10	16 – 34
AO4	2 – 4	2 – 4	2 – 4	2 – 4	6 – 12
AO5	3 – 5	3 – 5	5 – 9	5 – 9	13 – 23
Overall Weighting of Units (%)	$33^1/_3$	$33^1/_3$	$33^1/_3$	$33^1/_3$	100

Candidates' marks for each assessment unit are scaled to achieve the correct weightings.

8 Scheme of Assessment - *Advanced Level (AS+A2)*

The Scheme of Assessment has a modular structure. The Advanced award comprises six assessment units, either SS1A or SS1B, together with SS02 – SS06. The assessment units, SS1A and SS1B, both assess teaching Statistics 1 (section 10), but unit SS1A includes coursework. For the written papers, each candidate will require a copy of the AQA Booklet of formulae and statistical tables issued for this specification.

8.1 AS Assessment Units Statistics

Unit SS1A — Written Paper — 1¼ hours
$16^2/_3$% of the total A Level marks — + Coursework — 60 marks

The written paper comprises 12½ % of the A Level marks. All questions are compulsory. A graphics calculator may be used.
The coursework comprises $4^1/_6$% of the A Level marks. One task is required.

Unit SS1B — Written Paper — 1½ hours
$16^2/_3$% of the total A Level marks — 75 marks

All questions are compulsory. A graphics calculator may be used.

Unit SS02 — Written Paper — 1½ hours
$16^2/_3$% of the total A Level marks — 75 marks

All questions are compulsory. A graphics calculator may be used.

Unit SS03 — Written Paper — 1½ hours
$16^2/_3$% of the total A Level marks — 75 marks

All questions are compulsory. A graphics calculator may be used.

8.2 A2 Assessment Units Statistics

Unit SS04 — Written Paper — 1½ hours — 75 marks
16²/₃% of the total A Level marks

All questions are compulsory. A graphics calculator may be used.

Unit SS05 — Written Paper — 1½ hours — 75 marks
16²/₃% of the total A Level marks

All questions are compulsory. A graphics calculator may be used.

Unit SS06 — Written Paper — 1½ hours — 75 marks
16²/₃% of the total A Level marks

All questions are compulsory. A graphics calculator may be used.

8.3 Synoptic Assessment

The GCE Advanced Subsidiary and Advanced Level Qualification-Specific Criteria state that A Level specifications must include synoptic assessment representing at least 20% of the total A Level marks. Synoptic assessment in Statistics addresses candidates' understanding of the connections between different elements of the subject. It involves the explicit drawing together of knowledge, understanding and skills learned in different parts of the A level course, focusing on the use and application of methods developed at earlier stages of the course to the solution of problems. Making and understanding connections in this way is intrinsic to learning Statistics.

Synoptic assessment is part of the assessment in the following units in A Level Statistics: Statistics 4, Statistics 5, Statistics 6. There is no restriction on when synoptic units may be taken.

8.4 Weighting of Assessment Objectives for A Level Statistics

The approximate relationship between the relative percentage weighting of the Assessment Objectives (AOs) and the overall Scheme of Assessment is shown in the following table.

Assessment Objectives	**Unit Weightings (%)**			**Overall Weighting of AOs (%)**
	SS1A, SS1B	SS02 – SS03	SS04 – SS06	
AO1	3 – 5	4 – 6	4 – 6	23 – 35
AO2	3 – 5	2 – 4	2 – 4	13 – 25
AO3	4 – 7	2 – 5	2 – 5	14 – 32
AO4	1 – 2	1 – 2	1 – 2	6 – 12
AO5	1½ – 2½	2½ – 4½	2 – 4	12½ – 23½
Overall Weighting of Units (%)	$16^2/_3$			100

Candidates' marks for each assessment unit are scaled to achieve the correct weightings.

Subject Content

9 Summary of Subject Content

9.1 AS Modules

MODULE S1 - Statistics 1

Numerical measures
Probability
Binomial Distribution
Normal Distribution
Estimation
Correlation and Regression

MODULE S2 - Statistics 2

Time Series Analysis
Sampling
Discrete Probability Distributions
Interpretation of Data
Application of Hypothesis Testing

MODULE S3 - Statistics 3

Application of Contingency Tables in Real-world Situations
Distribution Free Methods
Correlation

9.2 A2 Modules

MODULE S4 - Statistics 4

Continuous Probability Distributions
Distributional Approximations
Estimation in a Real-world Context
Application of Hypothesis Testing

MODULE S5 - Statistics 5

Continuous Probability Distributions
Estimation
Application of Hypothesis Testing

MODULE S6 - Statistics 6

Experimental Design
Analysis of Variance
Statistical Process Control
Acceptance Sampling

10 AS Module *Statistics 1*

Candidates may use relevant formulae included in the formulae booklet without proof.

Candidates should learn the following formula, which is **not** included in the formulae booklet, but which may be required to answer questions.

$(\text{residual})_i = y_i - a - bx_i$

10.1 Numerical Measures

Standard deviation and variance calculated on ungrouped and grouped data.

Where raw data are given, candidates will be expected to be able to obtain standard deviation and mean values directly from calculators. Where summarised data are given, candidates may be required to use the formula from the booklet provided for the examination. It is advisable for candidates to know whether to divide by n or $(n-1)$ when calculating the variance; either divisor will be accepted unless a question specifically requests an unbiased estimate of a population variance.

Linear scaling.

Artificial questions requiring linear scaling will not be set, but candidates should be aware of the effect of linear scaling on numerical measures.

Choice of numerical measures.

Candidates will be expected to be able to choose numerical measures, including mean, median, mode, range and interquartile range, appropriate to given contexts. Linear interpolation will not be required.

10.2 Probability

Elementary probability; the concept of a random event and its probability.

Assigning probabilities to events using relative frequencies or equally likely outcomes. Candidates will be expected to understand set notation but its use will not be essential.

Addition law of probability. Mutually exclusive events.

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$; two events only.
$P(A \cup B) = P(A) + P(B)$; two or more events.
$P(A') = 1 - P(A)$.

Multiplication law of probability and conditional probability. Independent events.

$P(A \cap B) = P(A) \times P(B \mid A) = P(B) \times P(A \mid B)$; two or more events.

$P(A \cap B) = P(A) \times P(B)$; two or more events.

Application of probability laws.

Only simple problems will be set that can be solved by direct application of the probability laws, by counting equally likely outcomes and/or the construction and the use of frequency tables or relative frequency (probability) tables. Questions requiring the use of tree diagrams or Venn diagrams will not be set, but their use will be permitted.

10.3 Binomial Distribution

Discrete random variables.	Only an understanding of the concepts; not examined beyond binomial distributions.
Conditions for application of a binomial distribution.	
Calculation of probabilities using formula.	Use of $\binom{n}{x}$ notation.
Use of tables	
Mean, variance and standard deviation of a binomial distribution.	Knowledge, but not derivations, will be required.

10.4 Normal Distribution

Continuous random variables.	Only an understanding of the concepts; not examined beyond normal distributions.
Properties of normal distributions.	Shape, symmetry and area properties. Knowledge that approximately $\frac{2}{3}$ of observations lie within $\mu \pm \sigma$, and equivalent results.
Calculation of probabilities.	Transformation to the standardised normal distribution and use of the supplied tables. Interpolation will not be essential; rounding z-values to two decimal places will be accepted.
Mean, variance and standard deviation of a normal distribution.	To include finding unknown mean and/or standard deviation by making use of the table of percentage points. (Candidates may be required to solve two simultaneous equations.)

10.5 Estimation

Population and sample.	To include the terms 'parameter' and 'statistic'. Candidates will be expected to understand the concept of a simple random sample. Methods for obtaining simple random samples will not be tested directly in the written examination.
Unbiased estimators of a population mean and variance.	$\overline{X}$ and S^2 respectively.
The sampling distribution of the mean of a random sample from a normal distribution.	To include the standard error of the sample mean, $\frac{\sigma}{\sqrt{n}}$, and its estimator, $\frac{S}{\sqrt{n}}$.
A normal distribution as an approximation to the sampling distribution of the mean of a large sample from any distribution.	Knowledge and application of the Central Limit Theorem.
Confidence intervals for the mean of a normal distribution with known variance.	Only confidence intervals symmetrical about the mean will be required.

Confidence intervals for the mean of a distribution using a normal approximation.	Large samples only. Known and unknown variance.
Inferences from confidence intervals.	Based on whether a calculated confidence interval includes or does not include a 'hypothesised' mean value.

10.6 Correlation and Regression

Calculation and interpretation of the product moment correlation coefficient.	Where raw data are given, candidates should be encouraged to obtain correlation coefficient values directly from calculators. Where summarised data are given, candidates may be required to use a formula from the booklet provided for the examination. Calculations from grouped data are excluded. Importance of checking for approximate linear relationship but no hypothesis tests. Understanding that association does not necessarily imply cause and effect.
Identification of response (dependent) and explanatory (independent) variables in regression.	
Calculation of least squares regression lines with one explanatory variable. Scatter diagrams and drawing a regression line thereon.	Where raw data are given, candidates should be encouraged to obtain gradient and intercept values directly from calculators. Where summarised data are given, candidates may be required to use formulae from the booklet provided for the examination. Practical interpretation of values for the gradient and intercept. Use of line for prediction within range of observed values of explanatory variable. Appreciation of the dangers of extrapolation.
Calculation of residuals.	Use of $(\text{residual})_i = y_i - a - bx_i$. Examination of residuals to check plausibility of model and to identify outliers. Appreciation of the possible large influence of outliers on the fitted line.
Linear scaling.	Artificial questions requiring linear scaling will not be set, but candidates should be aware of the effect of linear scaling in correlation and regression.

11 AS Module *Statistics 2*

Candidates will be expected to be familiar with the knowledge, skills and understanding implicit in the module Statistics 1.

The emphasis is on using and applying statistics. Appropriate interpretation of contexts and the outcomes of statistical procedures will be required.

Candidates may use relevant formulae included in the formulae booklet without proof.

Candidates should learn the following formulae, which are **not** included in the formulae booklet, but which may be required to answer questions.

P(Type I error) = P(reject H_0 | H_0 true) and
P(Type II error) = P(accept H_0 | H_0 false)

11.1 Time Series Analysis

Seasonal variation, trend, short-term and random variation.	Questions may require the use of regression to estimate trend. Additive model assumed for seasonal effects.
Use of moving averages to estimate seasonal effects, to deseasonalise series and to make short-term forecasts.	Candidates should appreciate that numerical techniques can only project past patterns into the future and should not be expected to give accurate forecasts.

11.2 Sampling

Simple (without replacement) and unrestricted (with replacement) random samples. Use of random numbers from tables or calculators to obtain random samples.	Variance of sample mean not required for sampling without replacement.
Stratified random sample.	Use of prior information to make sample more representative of population. Calculation of means and variances not required.
Cluster, quota and systematic sampling.	Use to overcome practical problems of sampling. Advantages and disadvantages.

11.3 Discrete Probability Distributions

Expectation and variance.

Use of:

$$\mathrm{E}(X) = \sum x_i p_i$$

$$\mathrm{E}(\mathrm{g}(X)) = \sum \mathrm{g}(x_i) p_i$$

$$\mathrm{Var}(X) = \mathrm{E}\left(\left[X - \mathrm{E}(X)\right]^2\right)$$

$$\mathrm{Var}(X) = \mathrm{E}\left(X^2\right) - \left[\mathrm{E}(X)\right]^2$$

Candidates will be expected to apply these and to interpret the results in real-world situations.

Modelling a real-world situation using a Poisson distribution.

Evaluation of probabilities using formula will not be required.

Use of tables, distribution of the sum of independent Poisson distributions.

Use, but not proof, of mean and variance of Poisson distribution may be tested.

Questions may require knowledge of binomial distribution from module Statistics 1.

Knowledge of the conditions necessary for a Poisson Model to be applicable.

Candidates will be required to determine whether a Poisson distribution is appropriate in a particular real-world situation.

11.4 Interpretation of Data

Data may be presented in the form of diagrams, tables of secondary data, summary statistics and/or associated analysis.

Candidates may be asked to construct and interpret pie charts, line diagrams, box and whisker plots, cumulative frequency diagrams and scatter diagrams. Construction or interpolation of histograms will not be required. (This statement is included now as a histogram question appeared, in error, on the specimen paper.)

11.5 Application of Hypothesis Testing

Null and alternative hypothesis, significance levels, one and two tailed tests.

Questions may require understanding of the concept of Type I errors (reject H_0 | H_0 true) and Type II errors (accept H_0 | H_0 false) but questions requiring the calculation of the risk of Type II errors will not be set.

Tests for means based on:
1. a sample from a normal distribution with known standard deviation;

Appreciation of the need for random samples and of the necessary conditions.

Candidates will be required to identify and apply a suitable test appropriate to a particular context.

2. a large sample from an unspecified distribution.

Interpretation of results in context. Appreciation of the need for random samples.

12 AS Module *Statistics 3*

Candidates will be expected to be familiar with the knowledge, skills and understanding implicit in the modules Statistics 1 and Statistics 2.

The emphasis is on using and applying statistics. Appropriate interpretation of contexts and the outcomes of statistical procedures will be required.

Candidates may use relevant formulae included in the formulae booklet without proof.

Candidates should learn the following formulae, which are **not** included in the formulae booklet, but which may be required to answer questions.

Contingency Tables
E = (row total × column total)/grand total
For an $m \times n$ table the degrees of freedom are $(m-1)(n-1)$

Yates' correction for a 2 × 2 contingency table is
$$\Sigma(|O - E| - 0.5)^2/E$$

12.1 Application of Contingency Tables in Real-world Situations

Use of $\Sigma(O - E)^2/E$ as an approximate χ^2 -statistic. Conditions for approximation to be valid.

Identification and application of the appropriate test and the interpretation of the results in context.

The convention that all Es should be >5 will be expected.

Yates' correction for 2 × 2 contingency tables will be required.

12.2 Distribution Free Methods

1. Tests of Average

Sign test (for medians) and Wilcoxon signed-rank test (for medians/means). Choice of appropriate test in particular circumstances.

The Wilcoxon signed-rank test assumes that the distribution is symmetrical and consequently that the mean and median are identical. Questions may require choice between sign test, Wilcoxon signed-rank test and z-test (from module Statistics 2).

2. Analysis of Paired Comparisons

Use of sign test and Wilcoxon signed-rank test to analyse results of a paired comparison.	Questions may be set which require an appreciation of simple ideas of experimental design – replication, randomisation and paired comparisons.

3. Two Independent Samples

Mann-Whitney U test to test hypothesis that two independent samples come from identical populations.	Although the hypothesis is that the populations are identical in every respect, only a difference in mean is likely to lead to H_0 being rejected. Normal approximations to the critical values of the Wilcoxon and Mann-Whitney tests will not be required.

4. More Than Two Independent Samples

Kruskal-Wallis test to test the hypothesis that more than two independent samples come from identical populations.	Critical values for the Kruskal-Wallis H statistic are obtained from the χ^2 distribution with $k-1$ degrees of freedom where k is the number of samples compared. Candidates will not be expected to rank results from more than 3 samples.

12.3 Correlation

Spearman's rank correlation coefficient. Use of tables to test no association between ranks.	Defined as the product moment correlation coefficient between ranks. For tied ranks, the convention of giving the mean rank to each equal item will be expected.
Use of tables to test $\rho = 0$ for a bivariate normal distribution. Choice of appropriate correlation coefficient in particular cases.	Where ρ is the product moment correlation coefficient.

13 A2 Module *Statistics 4*

Candidates will be expected to be familiar with the knowledge, skills and understanding implicit in the modules Statistics 1, Statistics 2 and Statistics 3.

The emphasis is on using and applying statistics. Appropriate interpretation of contexts and the outcomes of statistical procedures will be required.

Candidates may use relevant formulae included in the formulae booklet without proof.

Candidates should learn the following formulae, which are **not** included in the formulae booklet, but which may be required to answer questions.

When X is $N(\mu_x, \sigma_x^2)$ and Y is independently $N(\mu_y, \sigma_y^2)$ then
$aX \pm bY$ is $N(a\mu_x \pm b\mu_y,\ a^2\sigma_x^2 + b^2\sigma_y^2)$

13.1 Continuous Probability Distributions

Distribution of a linear combination of independent normal random variables.

Applied to practical situations. Interpretation of results in context.

13.2 Distributional Approximations

Poisson approximation to binomial. Normal approximation to binomial and Poisson distributions.

Candidates will be required to recognise that a particular approximation is appropriate in a particular context.

Conditions for approximations to be appropriate.

Continuity corrections required.

Calculations of Poisson probabilities using formula may be required.
Properties of e^x are not required.

13.3 Estimation in a Real-world Context

Application of confidence intervals for mean based on a sample from a normal distribution with unknown standard deviation using the *t*-distribution.

Questions may involve knowledge of confidence intervals from module Statistics 1.

Only confidence intervals symmetrical about the mean will be considered.

Candidates will be required to interpret the meaning of a confidence interval in the context of a problem.

Approximate confidence intervals, using normal approximations, for proportions and for the mean of a Poisson distribution.	Continuity correction not required.

13.4 Application of Hypothesis Testing

Hypothesis tests for mean based on a sample from a normal distribution with unknown standard deviation using the *t*-distribution.	Candidates will be expected to identify and apply a suitable test in context. Questions may involve knowledge of hypothesis tests for mean from module Statistics 2.
Hypothesis tests for proportions and for the mean of a Poisson distribution.	Using exact probabilities or, where appropriate, normal approximations. Continuity correction not required. Interpretation of results in context.

14 A2 Module *Statistics 5*

Candidates will be expected to be familiar with the knowledge, skills and understanding implicit in the modules Statistics 1, Statistics 2, Statistics 3 and Statistics 4.

The emphasis is on using and applying statistics. Appropriate interpretation of contexts and the outcomes of statistical procedures will be required.

Candidates may use relevant formulae included in the formulae booklet without proof.

Candidates should learn the following formulae, which are **not** included in the formulae booklet, but which may be required to answer questions.

For an exponential distribution $\mathrm{P}(X \leqslant x) = 1 - e^{-\lambda x}$

14.1 Continuous Probability Distributions

Rectangular and Exponential distributions.

Candidates will be expected to recognise when these are appropriate models for a given real-world situation.

Use but not proof of mean and variance. Questions on exponential distribution will be solvable using cumulative distribution function only.

Integration will not be required or expected, but may be used by candidates.

14.2 Estimation

Determination of confidence intervals for variance and standard deviation based on a sample from a normal distribution.

Using χ^2.

Knowledge of the necessary conditions for application and deductions in context.

Questions may be set which require the calculation of confidence intervals for the mean using knowledge from modules Statistics 1 and/or Statistics 4.

14.3 Application of Hypothesis Testing

Tests for variance and standard deviation based on a sample from a normal distribution.

Throughout this section, candidates will be required to identify and apply a test appropriate to the context of a real-world situation. Interpretation of the results of such tests in context will be required.

Using χ^2.

Questions may be set which require hypothesis tests for the mean using knowledge from modules Statistics 2 and/or Statistics 4.

Goodness of fit test using $\Sigma(O-E)^2/E$ as an approximate χ^2 -statistic. Conditions for approximation to be valid.	The convention that all Es should be >5 will be expected. Tests may be required for binomial, Poisson, normal, rectangular, exponential or specified discrete distributions. Integration will not be required.
Two independent sample tests:	
1. tests for equality of variance of two normal distributions;	Using *F*.
2. tests for equality (or for a given difference) of means for two normal distributions with known variances or with unknown but equal variances.	Using *z*. Using *t*.

15 A2 Module *Statistics 6*

Candidates will be expected to be familiar with the knowledge, skills and understanding implicit in the modules Statistics 1, Statistics 2, Statistics 3, Statistics 4 and Statistics 5.

The emphasis is on using and applying statistics. Appropriate interpretation of contexts and the outcomes of statistical procedures will be required.

Candidates may use relevant formulae included in the formulae booklet without proof.

Candidates should learn the following formulae, which are **not** included in the formulae booklet, but which may be required to answer questions.

For Latin squares, SS_R and SS_C as for two-factor model with $m = n$ and $SS_L = \sum L_k^{\,2}/n - T^2/n^2$

Warning limits for means chart are $\mu \pm 1.96\sigma/\sqrt{n}$

Action limits for means chart are $\mu \pm 3.09\sigma/\sqrt{n}$

where μ is the target value.

15.1 Experimental Design

Experimental error, randomisation, replication. Control and experimental groups, blind and double blind trials. Use of paired comparisons and blocking to reduce experimental error.

Reduction of experimental error by standardising conditions.

Use of replication to estimate magnitude of experimental error and randomisation to eliminate unconscious bias.

Analysis of paired comparisons using paired *t*-test.

Questions may be set which require the use of the sign test or Wilcoxon signed-rank test from module Statistics 3 to analyse paired comparisons.

15.2 Analysis of Variance

One-way analysis of variance, completely randomised design.

Including an appreciation of the underlying model, i.e. additive effects with experimental errors N(0, σ^2). Interpretation of results in context.

Two-way analysis of variance without replicates, randomised block design.

Motivated by the idea of blocking. Appreciation of the assumption of no interaction. Interpretation of results in context.

Latin squares – purpose, construction and analysis.

Appreciation of assumption of no interactions. Latin squares with replicates excluded. Interpretation of results in context.

15.3 Statistical Process Control

Construction and use of charts for mean, range, standard deviation and proportions.	Where a target value is given, this should be used as the centre-line of the chart for means. Advantages and disadvantages of using attributes or variables.
Estimation of short-term standard deviation from small samples.	
Ability of a process to meet tolerances.	Estimate of proportion not meeting tolerances.

15.4 Acceptance Sampling

Schemes for attributes and variables. Design to meet specific criteria. Construction and use of operating characteristics.	Advantages and disadvantages.
Operating characteristics for double sampling plans.	Comparison with single sampling plans.

Key Skills and Other Issues

16 Key Skills - Teaching, Developing and Providing Opportunities for Generating Evidence

16.1 Introduction

The Key Skills Qualification requires candidates to demonstrate levels of achievement in the Key Skills of *Application of Number*, *Communication* and *Information Technology*.

The units for the 'wider' Key Skills of *Improving own Learning and Performance*, *Working with Others* and *Problem Solving* are also available. The acquisition and demonstration of ability in these 'wider' Key Skills is deemed highly desirable for all candidates, but they do not form part of the National Qualification.

Copies of the Key Skills Units may be downloaded from the QCA Website (www.qca.org.uk/keyskills).

The units for each Key Skill comprise three sections:

A What you need to know.

B What you must do.

C Guidance.

Candidates following a course of study based on this specification for Statistics can be offered opportunities to develop and generate evidence of attainment in aspects of the Key Skills of *Application of Number, Communication, Information Technology, Working with Others*, and *Improving own Learning and Performance*. Areas of study and learning that can be used to encourage the acquisition and use of Key Skills, and to provide opportunities to generate evidence for Part B of the units, are signposted. The study of Statistics does not easily lend itself to developing the Key Skill of Problem Solving. Therefore, this Key Skill is not signposted.

16.2 Key Skills Opportunities in Statistics

The following matrices signpost the opportunities for the acquisition, development and production of evidence for Part B of the Key Skills units of *Application of Number, Communication, Information Technology, Working with Others,* and *Improving own Learning and Performance at Level 3*, in the teaching and learning modules of this specification. The degree of opportunity in any one module will depend on a number of centre-specific factors, including teaching strategies and level of resources.

Communication

What you must do ...	Signposting of Opportunities for Generating Evidence in Modules						
	SS1A	SS1B	SS02	SS03	SS04	SS05	SS06
C3.1a Contribute to discussions	✓	✓	✓	✓	✓	✓	✓
C3.1b Make a presentation	✓	✓	✓	✓	✓	✓	✓
C3.2 Read and synthesise information	✓						
C3.3 Write different types of document	✓						

Application of Number

What you must do ...	Signposting of Opportunities for Generating Evidence in Modules						
	SS1A	SS1B	SS02	SS03	SS04	SS05	SS06
N3.1 Plan and interpret information from different sources	✓	✓	✓	✓	✓	✓	✓
N3.2 Carry out multi-stage calculations	✓	✓	✓	✓	✓	✓	✓
N3.3 Present findings, explain results and justify choice of methods	✓	✓	✓	✓	✓	✓	✓

Information Technology

What you must do ...	Signposting of Opportunities for Generating Evidence in Modules						
	SS1A	SS1B	SS02	SS03	SS04	SS05	SS06
IT3.1 Plan and use different sources to search for and select information	✓	✓	✓	✓	✓	✓	✓
IT3.2 Explore, develop and exchange information and derive new information	✓	✓	✓	✓	✓	✓	✓
IT3.3 Present information including text, numbers and images	✓	✓	✓	✓	✓	✓	✓

Working with Others

What you must do ...	Signposting of Opportunities for Generating Evidence in Modules						
	SS1A	SS1B	SS02	SS03	SS04	SS05	SS06
WO3.1 Plan the activity	✓	✓	✓	✓	✓	✓	✓
WO3.2 Work towards agreed objectives	✓	✓	✓	✓	✓	✓	✓
WO3.3 Review the activity	✓	✓	✓	✓	✓	✓	✓

Improving own Learning and Performance

What you must do ...	Signposting of Opportunities for Generating Evidence in Modules						
	SS1A	SS1B	SS02	SS03	SS04	SS05	SS06
LP3.1 Agree and plan targets	✓	✓	✓	✓	✓	✓	✓
LP3.2 Seek feedback and support	✓	✓	✓	✓	✓	✓	✓
LP3.3 Review progress	✓	✓	✓	✓	✓	✓	✓

Note: The signposting in the tables above represents opportunities to acquire and produce evidence of the Key Skills which are possible through this specification. There may be other opportunities to achieve these and other aspects of Key Skills via this specification, but such opportunities are dependent on the detailed course of study delivered within centres.

16.3	Key Skills in the Assessment of Mathematics	The 'main' Key Skill of *Application of Number* must contribute to the assessment of Statistics. Aspects of *Application of Number* form an intrinsic part of the Assessment Objectives, and hence will form part of the assessment requirements for all units.
16.4.	Further Guidance	More specific guidance and examples of tasks that can provide evidence of single Key Skills or composite tasks that can provide evidence of more than one Key Skill are given in the Teachers' Guides published for AQA Mathematics Specification A (6300) and AQA Mathematics and Statistics Specification B (6320)

17 Spiritual, Moral, Ethical, Social, Cultural and Other Issues

17.1	Spiritual, Moral, Ethical, Social and Cultural Issues	The study of Statistics can contribute to a candidate's understanding of moral and cultural issues. Contexts used during the study of the modules may contribute to candidates' understanding of spiritual, moral and cultural issues.
17.2	European Dimension	AQA has taken account of the 1988 Resolution of the Council of the European Community in preparing this specification and associated specimen papers.
17.3	Environmental Education	AQA has taken account of the 1988 Resolution of the Council of the European Community and the Report '*Environmental Responsibility: An Agenda for Further and Higher Education'* 1993 in preparing this specification and associated specimen units.
17.4	Avoidance of Bias	AQA has taken great care in the preparation of this specification and associated specimen units to avoid bias of any kind.

Centre-assessed Component

18 Nature of Centre-assessed Component

18.1

Candidates will present one task, of approximately 8–10 hours' duration, for unit Statistics 1A (SS1A). It is intended that coursework assessment should be an integral part of the teaching and learning process. As a consequence, candidates should feel that at least some of their ongoing work will contribute to the final result. Coursework thus provides an opportunity for candidates to conduct an extended piece of statistical reasoning that will also enhance their understanding of an area of the specification content.

In coursework, candidates will use a reflective or creative approach to apply their knowledge to a real-world problem. Candidates will make sensible assumptions, formulate and test hypotheses, carry out appropriate statistical analyses and produce reports in which they interpret their results in context and comment on the suitability of their results in terms of the original task.

Coursework also provides an appropriate method for generating evidence for five of the six Key Skills: *Communication*, *Application of Number*, *Information Technology*, *Improving Own Learning*, and *Working with Others*.

18.2 Early Notification

Centres should advise AQA of their intention to enter candidates, using the *Estimated Entries Form* supplied to Examinations Officers so that a Guidance Pack for teachers can be supplied and a Coursework Adviser allocated. This will also enable AQA to send out an order form in September for centres to request the *Candidate Record Forms* appropriate for their intended unit entries.

18.3 Relationship of Coursework to Assessment Objectives

All Assessment Objectives can be met in coursework. The following pages show the *Marking Grid* with the weightings of each Assessment Objective.

19 Guidance on Setting Centre-assessed Component

A list of recommended coursework tasks is provided in the Guidance Pack. The pack provides guidance on appropriate coursework, exemplar materials for reference purposes together with marked pieces of work showing clearly how the criteria are to be applied. Where a centre or a candidate wishes to submit their own task, the centre may submit the task to their allocated Coursework Adviser in order that guidance may be offered on the suitability of the task. Such tasks must be submitted at least six weeks prior to their use by the centre.

20 Assessment Criteria

20.1 Introduction

Coursework tasks will be marked internally by teachers making reference to the *Marking Grid* and *Mark Breakdown* on the *Candidate Record Form*.

The grids will be used to measure **positive** achievement, according to descriptors, within a number of categories.

20.2 Criteria

The *Marking Grid* and *Mark Breakdown* have four strands, each of which represents a different set of criteria.
The criteria within each strand listed on the *Marking Grid* are intended to indicate the essential characteristics that should be identified at various levels of performance to be expected from candidates within that unit.
Teachers must complete the *Marking Grid* section of the *Candidate Record Form* for each candidate.
The *Mark Breakdown* section of the *Candidate Record Form* gives a further detailed breakdown of marks for each strand. This section is optional. Teachers can use it as a guide in reaching the final mark for the assessment of coursework tasks. Completing this section will be useful for centres for internal standardisation procedures, and could be used by AQA as a basis for feedback to centres.
The final mark for the assessment of the coursework task is the sum of the marks for each strand.
If none of the criteria has been met in any strand then zero marks must be awarded in that strand.

20.3 Marking Grid for Statistics Coursework Tasks

Strand	Marks 0 → 8	Marks 9 → 15	Marks 16 → 20	Assessment Objective mark allocation
Design	Problem defined and understood. Aims and objectives discussed. Some discussion of how the sample was obtained.	The approach to the task is coherent. The strategies to be employed are appropriate. Clear explanation of how sample was obtained. Some discussion of the statistical theories or distributions used.	A well-balanced and coherent approach. Clear discussion and justification of the statistical theories or distributions used in relation to the task.	AO1 6 AO2 9 AO3 3 AO4 2 AO5 0
Data Collection and Statistical Analysis	Adequate data collected. Raw data clearly set out. Some relevant calculations are correct.	A range of relevant statistical calculations are used. Most calculations are correct, and quoted to an appropriate degree of accuracy.	A full range of calculations are used. The calculations are correct and appropriate to the task.	AO1 10 AO2 4 AO3 0 AO4 0 AO5 6
Interpretation / Validation	A reasoned attempt is made to interpret the results. Some discussion of how realistic the results are. Some discussion of possible modifications.	Results are interpreted. Attempt to relate the task to the original problem. Clear discussion of possible modifications/ improvements which could have been made.	Results are fully interpreted within a statistical context. Outcomes are clearly related to the original task. Clear discussion of the effects of the sampling and data collection methods used.	AO1 2 AO2 0 AO3 12 AO4 6 AO5 0
Communication	The report is presented clearly and organised with some explanation. Diagrams are effective and appropriate. Conclusions are stated.	The report is clear and well organised. Other areas of work which could have been investigated are discussed. The report is consistent with a piece of work of 8–10 hours.	Appropriate language and notations used throughout. The report is clear and concise and of sufficient depth and difficulty.	AO1 6 AO2 10 AO3 2 AO4 0 AO5 2

Total marks for each Assessment Objective:

AO1	24
AO2	23
AO3	17
AO4	8
AO5	8
	80

20.4 Evidence to Support the Award of Marks

The coursework task for each candidate must show clear, annotated evidence of having been marked under the four strands. Calculations must be checked for accuracy and annotated accordingly.

It is perfectly acceptable for parts of a candidate's coursework to be taken from other sources as long as all such cases are clearly identified in the text and fully acknowledged either on the *Candidate Record Form* or in supporting evidence. Where phrases, sentences or longer passages are quoted directly from a source, candidates should use quotation marks.

Teachers should keep records of their assessments during the course, in a form which facilitates the complete and accurate submission of the final assessments at the end of the course.

When the assessments are complete, the marks awarded under each of the strands must be entered on the *Candidate Record Form*. The *Marking Grid* section must be completed; the *Mark Breakdown* section is optional. Supporting information should also be recorded in the section provided on the last page of the form.

21 Supervision and Authentication

21.1 Supervision of Candidates' Work

Candidates' work for assessment must be undertaken under conditions which allow the teacher to supervise the work and enable the work to be authenticated. As it is necessary for some assessed work to be done outside the centre, sufficient work must take place under direct supervision to allow the teacher to authenticate each candidate's whole work with confidence.

21.2 Guidance by the Teacher

The work assessed must be solely that of the candidate concerned. Any assistance given to an individual candidate which is beyond that given to the group as a whole must be recorded on the *Candidate Record Form*.

It is expected that candidates will start their coursework after consultation with their teacher. It is important that discussion should take place between the teacher and the candidate at all stages of the work involved; the coursework is not being carried out solely for the purpose of assessment; it is part of the teaching/learning process and the teacher will need to be involved in the work of the candidate if he or she is to be able to use this approach as part of the course of study. When a candidate has need of assistance in completing a piece of work, such assistance should be given but the teacher must take the degree of assistance into account when making the assessment and, where necessary, should add appropriate comments on the *Candidate Record Form*. Assistance in learning a new area of statistics for use in a problem is acceptable, and no deduction of marks should be made for such assistance.

It is accepted that candidates may wish to conduct initial data collection in groups. Where candidates work as a group, it must be possible to identify the individual contribution of each candidate so that the requirements of the specification are met.

21.3 Unfair Practice

At the start of the course, the supervising teacher is responsible for informing candidates of the AQA Regulations concerning malpractice. Candidates must not take part in any unfair practice in the preparation of coursework to be submitted for assessment, and must understand that to present material copied directly from books or other sources without acknowledgement will be regarded as deliberate deception. Centres must report suspected malpractice to AQA. The penalties for malpractice are set out in the AQA Regulations.

21.4 Authentication of Candidates' Work

Both the candidate and the teacher are required to sign declarations on the *Candidate Record Form*, confirming that the work submitted for assessment is the candidate's own. The form declares that the work was conducted under the specified conditions, and requires the teacher to record details of any additional assistance.

22 Standardisation

22.1 Annual Standardising Meetings

Annual standardisation meetings will usually be held in the autumn term. Centres entering candidates for the first time must send a representative to the meetings. Attendance is also mandatory in the following cases:

- where there has been a serious misinterpretation of the specification requirements;
- where the nature of coursework tasks set by a centre has been inappropriate;
- where a significant adjustment has been made to a centre's marks in the previous year's examination.

Otherwise attendance is at the discretion of centres. At these meetings, support will be provided for centres in the development of appropriate coursework tasks and assessment procedures.

22.2 Internal Standardisation of Marking

The centre is required to standardise the assessments across different teachers and teaching groups to ensure that all candidates at the centre have been judged against the same standards. If two or more teachers are involved in marking a component, one teacher must be designated as responsible for internal standardisation. Common pieces of work must be marked on a trial basis and differences between assessments discussed at a training session in which all teachers involved must participate. The teacher responsible for standardising the marking must ensure that the training includes the use of reference and archive materials such as work from a previous year or examples provided by AQA. The centre is required to send to the moderator a signed form *Centre Declaration Sheet* confirming that the marking of coursework at the centre has been standardised. If only one teacher has undertaken the marking, that person must sign this form.

23 Administrative Procedures

23.1 Recording Assessments

The candidates' work must be marked according to the assessment criteria set out in Section 20.2. The marks and supporting information must be recorded on the *Candidate Record Form* in accordance with the instructions in Section 20.4.

Details of any additional assistance must be given, and the teacher must sign the *Candidate Record Form*. The candidate must also complete and sign the first page of the Form. The completed *Candidate Record Form* for each candidate must be attached to the work and made available to AQA on request.

23.2 Submitting Marks and Sample Work for Moderation

The total coursework mark for each candidate must be submitted to AQA on the mark sheets provided or by Electronic Data Interchange (EDI) by the specified date. Centres will be informed which candidates' work is required in the samples to be submitted to their moderator.

23.3 Factors Affecting Individual Candidates

Teachers should be able to accommodate the occasional absence of candidates by ensuring that the opportunity is given for them to make up missed assessments.

Special consideration should be requested for candidates whose work has been affected by illness or other exceptional circumstances. Information about the procedure is issued separately. Centres should ask for a copy of '*Regulations and Guidance relating to Candidates with Particular Requirements*'.

If work is lost, AQA should be notified immediately of the date of the loss, how it occurred and who was responsible for the loss. AQA will advise on the procedures to be followed in such cases.

Where special help which goes beyond normal learning support is given, AQA must be informed so that such help can be taken into account when assessment and moderation take place.

Candidates who move from one centre to another during the course sometimes present a problem for a scheme of internal assessment. Possible courses of action depend on the stage at which the move takes place. If the move occurs early in the course, the new centre should take responsibility for assessment. If it occurs late in the course, it may be possible to accept the assessments made at the previous centre. Centres should contact AQA at the earliest possible stage for advice about appropriate arrangements in individual cases.

23.4 Retaining Evidence and Re-using Marks

The centre must retain the work of all candidates, with *Candidate Record Forms* attached, under secure conditions from the time it is assessed; this is to allow for the possibility of an enquiry-about-results. The work may be returned to candidates after the issue of results provided that no enquiry-about-result is to be made which will include re-moderation of the coursework component. If an enquiry-about-result is to be made, the work must remain under secure conditions until requested by AQA.

Candidates wishing to improve the result of any unit containing coursework may carry forward their moderated coursework mark from a previous series.

24 Moderation

24.1 Moderation Procedures

Moderation of the coursework is by inspection of a sample of candidates' work, sent by post from the centre for scrutiny by a moderator appointed by AQA. The centre marks must be submitted to AQA by the specified date.

Following the re-marking of the sample work, the moderator's marks are compared with the centre's marks to determine whether any adjustment is needed in order to bring the centre's assessments into line with standards generally. In some cases, it may be necessary for the moderator to call for the work of other candidates. In order to meet this possible request, centres must have available the coursework and *Candidate Record Form* of every candidate entered for the examination and be prepared to submit it on demand. Mark adjustments will normally preserve the centre's order of merit, but where major discrepancies are found, AQA reserves the right to alter the order of merit.

24.2 Post-moderation Procedures

On publication of the GCE results, the centre is supplied with details of the final marks for the coursework component.

The candidates' work is returned to the centre after the examination. The centre receives a report form from their moderator giving feedback on the appropriateness of the tasks set, the accuracy of the assessments made, and the reasons for any adjustments to the marks.

Some candidates' work may be retained by AQA for archive purposes.

Awarding and Reporting

25 Grading, Shelf-Life and Re-Sits

25.1 Qualification Titles

The qualifications based on these specifications have the following titles:

AQA Advanced Subsidiary GCE in Statistics;
AQA Advanced GCE in Statistics.

25.2 Grading System

The AS qualification will be graded on a five-point scale: A, B, C, D and E. The full A level qualification will be graded on a six-point scale: A*, A, B, C, D and E. To be awarded an A*, candidates will need to achieve a grade A on the full A level qualification and 90 % of the maximum uniform mark on the aggregate of the A2 units. For both qualifications candidates who fail to reach the minimum standard for grade E will be recorded as U (unclassified) and will not receive a qualification certificate. Individual assessment unit results will be certificated.

25.3 Shelf-Life of Unit Results

The shelf-life of individual unit results, prior to the award of the qualification, is limited only by the shelf-life of the specification.

25.4 Assessment Unit Re-Sits

Each assessment unit may be re-taken an unlimited number of times within the shelf-life of the specification. The best result will count towards the final award. Candidates who wish to repeat an award must enter for at least one of the contributing units and also enter for certification (cash in). There is no facility to decline an award once it has been issued.

25.5 Carrying Forward of Coursework Marks

Candidates re-taking a unit with coursework may carry forward their moderated coursework marks. These marks have a shelf-life which is limited only by the shelf-life of the specification, and they may be carried forward an unlimited number of times within this shelf-life.

25.6 Minimum Requirements

Candidates will be graded on the basis of work submitted for the award of the qualification.

25.7 Awarding and Reporting

This specification complies with the grading, awarding and certification requirements of the current GCSE, GCE, Principal Learning and Project Code of Practice April 2013, and will be revised in the light of any subsequent change for future years.

Appendices

A Grade Descriptions

The following grade descriptions indicate the level of attainment characteristic of the given grade at A Level. They give a general indication of the required learning outcomes at each specific 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, on the extent to which the candidate has met the Assessment Objectives (as in Section 6) overall. Shortcomings in some aspects of the examination may be balanced by better performances in others.

Grade A Candidates recall or recognise almost all the statistical facts, concepts and techniques that are needed, and select appropriate ones to use in a wide variety of contexts.

Candidates manipulate statistical expressions and use graphs, sketches and diagrams, all with high accuracy and skill. They use statistical language correctly and proceed logically and rigorously through extended arguments. When confronted with unstructured problems, they can often devise and implement an effective solution strategy. If errors are made in their calculations or logic, these are sometimes noticed and corrected.

Candidates recall or recognise almost all the standard models that are needed, and select appropriate ones to represent a wide variety of situations in the real world. They correctly refer results from calculations using the model to the original situation; they give sensible interpretations of their results in the context of the original realistic situation. They make intelligent comments on the modelling assumptions and possible refinements to the model.

Candidates comprehend or understand the meaning of almost all translations into statistics of common realistic contexts. They correctly refer the results of calculations back to the given context and usually make sensible comments or predictions. They can distil the essential statistical information from extracts of prose having statistical content. They comment meaningfully on the statistical information.

Candidates make appropriate and efficient use of contemporary calculator technology and other permitted resources, and are aware of any limitations to their use. They present results to an appropriate degree of accuracy.

Grade C Candidates recall or recognise most of the statistical facts, concepts and techniques that are needed, and usually select appropriate ones to use in a variety of contexts.

Candidates manipulate statistical expressions and use graphs, sketches and diagrams, all with a reasonable level of accuracy and skill. They use statistical language with some skill and sometimes proceed logically through extended arguments. When confronted with unstructured problems, they sometimes devise and implement an effective and efficient solution strategy. They occasionally notice and correct errors in their calculations.

Candidates recall or recognise most of the standard models that are needed and usually select appropriate ones to represent a variety of situations in the real world. They often correctly refer results from calculations using the model to the original situation; they sometimes give sensible interpretations of their results in the context of the original realistic situation. They sometimes make intelligent comments on the modelling assumptions and possible refinements to the model.

Candidates comprehend or understand the meaning of most translations into statistics of common realistic contexts. They often correctly refer the results of calculations back to the given context and sometimes make sensible comments or predictions. They distil much of the essential statistical information from extracts of prose having statistical content. They give some useful comments on this statistical information.

Candidates usually make appropriate and effective use of contemporary calculator technology and other permitted resources, and are sometimes aware of any limitations to their use. They usually present results to an appropriate degree of accuracy.

Grade E Candidates recall or recognise some of the statistical facts, concepts and techniques that are needed, and sometimes select appropriate ones to use in some contexts.

Candidates manipulate statistical expressions and use graphs, sketches and diagrams, all with some accuracy and skill. They sometimes use statistical language correctly and occasionally proceed logically through extended arguments.

Candidates recall or recognise some of the standard models that are needed and sometimes select appropriate ones to represent a variety of situations in the real world. They sometimes correctly refer results from calculations using the model to the original situation; they try to interpret their results in the context of the original realistic situation.

Candidates sometimes comprehend or understand the meaning of translations in statistics of common realistic contexts. They sometimes correctly refer the results of calculations back to the given context and attempt to give comments or predications. They distil some of the essential statistical information from extracts of prose having statistical content. They attempt to comment on this statistical information.

Candidates often make appropriate and efficient use of contemporary calculator technology and other permitted resources. They sometimes present results to an appropriate degree of accuracy.

B Statistical Notation

Probability and Statistics

A, B, C, etc.	events
$A \cup B$	union of the events A and B
$A \cap B$	intersection of the events A and B
$\mathrm{P}(A)$	probability of the event A
A'	complement of the event A
$\mathrm{P}(A \mid B)$	probability of the event A conditional on the event B
X, Y, R, etc.	random variables
x, y, r, etc.	values of the random variables X, Y, R, etc.
$x_1, x_2, \ldots$	observations
$f_1, f_2, \ldots$	frequencies with which the observations $x_1, x_2, \ldots$ occur
$\mathrm{p}(x)$	probability function $\mathrm{P}(X = x)$ of the discrete random variable X
$p_1, p_2, \ldots$	probabilities of the values $x_1, x_2, \ldots$ of the discrete random variable X
$\mathrm{f}(x), \mathrm{g}(x), \ldots$	the value of the probability density function of a continuous random variable X
$\mathrm{F}(x), \mathrm{G}(x), \ldots$	the value of the (cumulative) distribution function $\mathrm{P}(X \leqslant x)$ of a continuous random variable X
$\mathrm{E}(X)$	expectation of the random variable X
$\mathrm{E}[\mathrm{g}(X)]$	expectation of $\mathrm{g}(X)$
$\mathrm{Var}(X)$	variance of the random variable X
$\mathrm{B}(n, p)$	binomial distribution with parameters n and p
$\mathrm{N}(\mu, \sigma^2)$	normal distribution with mean μ and variance σ^2
$\mathrm{Po}(\lambda)$	Poisson distribution with parameter λ
μ	population mean
η	population median
σ^2	population variance
σ	population standard deviation
$\bar{x}$	sample mean
s^2	unbiased estimate of population variance from a sample, $s^2 = \frac{1}{n-1}\sum (x_i - \bar{x})^2$
Φ	cumulative distribution function for standardised normal

ρ	product moment correlation coefficient for a population
r	product moment correlation coefficient for a sample
ρ_s	Spearman's rank correlation coefficient for a population
r_s	Spearman's rank correlation coefficient for a sample
a	intercept with the vertical axis in the linear regression equation
b	gradient in the linear regression equation

Miscellaneous Symbols

$=$	is equal to
$\neq$	is not equal to
$\approx$	is approximately equal to
$<$	is less than
$\leqslant$	is less than or equal to, is not greater than
$>$	is greater than
$\geqslant$	is greater than or equal to, is not less than
∞	infinity

Operations

$a+b$	a plus b
$a-b$	a minus b
$a\times b,\ ab,\ a.b$	a multiplied b
$a\div b,\ \frac{a}{b},\ a/b$	a divided by b
$\sum_{i=1}^{n} a_i$	$a_1+a_2+\ \ldots\ +a_n$
$\sqrt{a}$	the positive square root of a
$\lvert a \rvert$	the modulus of a
$x!$	x factorial
$\binom{n}{x}$	the binomial coefficient $\frac{n!}{x!(n-x)!}$

Exponential and Logarithmic Functions

e	base of natural logarithms
e^x	exponential function of x

C Record Forms

Candidate Record Forms, Centre Declaration Sheets and GCE Statistics specific forms are available on the AQA website in the Administration area. They can be accessed via the following link http://www.aqa.org.uk/admin/p_course.php

D Overlaps with other Qualifications

Subject awards in other AQA specifications, including the AQA GCE Mathematics specification are not prohibited combinations with subject awards in this AQA GCE Statistics specification. However, there are overlaps in the subject content between this specification and the Statistics units within the AQA GCE Mathematics specification. Qualifications from other awarding bodies with the same or similar titles can be expected to have a similar degree of overlap.

E Relationship to other AQA GCE Mathematics and Statistics Specifications

Further details of these relationships are given in the Teachers' Guide.

Relationship to AQA GCE Mathematics and Statistics B (6320)

This specification is a development from the AQA GCE Mathematics and Statistics B specification (6320). Each of the modules SS1B and SS02 – SS06 in this specification has an equivalent module with similar content in AQA Mathematics and Statistics B. The nearest equivalent modules/units are shown below.

New unit	Old unit
SS1B	MBS1
SS02	MBS2
SS03	MBS3
SS04	MBS4
SS05	MBS7
SS06	MBS8

Relationship to AQA GCE Mathematics A (6300)

In addition, the content of module SS1A is principally drawn from the content of two units in AQA GCE Mathematics A (6300). These modules are MAME and MAS1. Like MAS1, coursework forms part of the assessment for SS1A, but unlike MAS1, unit SS1A is assessed at AS standard.

Relationship to AQA GCE Mathematics (6360)

The subject content for the Statistitcs 1 module in this specification is the same as that for GCE Mathematics (6360). However, the assessment units in this specification are separate and independent of those in GCE Mathematics (6360).

This is to allow flexibility for candidates who are not sure whether they want to study AS Mathematics or AS Statistics.