

Accredited



Specification

AS Level

Quantitative Methods (MEI)

H133

September 2013

Developed by OCR and MEI, this highly practical new qualification supports post-16 learners with their mathematical needs in other subjects, as well as for employment and everyday life.

It's designed for post-16 students who have achieved grade C or better at GCSE Maths and don't want to take the subject at A Level but do use maths in other subjects such as Biology, Business Studies, Chemistry, Computer Science, Economics, Geography, IT or Psychology.

Who was involved in developing the course?

Quantitative Methods has been developed jointly by MEI and OCR. We consulted widely with teachers and higher education lecturers in a range of subjects including Biology, Business Studies, Chemistry, Computer Science, Economics, Geography, IT, Mathematics, Medicine and Psychology.

Two practical choices

Students can follow a 60-guided learning hour unit, Introduction to Quantitative Methods (IQM), and obtain a Level 3 Certificate. If they wish, they can continue by taking Decision 1 and Statistics 1 from the A Level Maths (MEI) suite and obtain an AS Level in Quantitative Methods. ('Mathematics' doesn't appear in these titles because this course shouldn't be seen as a suitable preparation for Maths, Engineering or Physical Sciences at university). The AS in Quantitative Methods requires 180 guided learning hours in total.



= Level 3 Certificate in Quantitative Methods (MEI)

IQM + Decision 1 + Statistics 1 = AS in Quantitative Methods (MEI)

What resources and support will be available?

Dedicated support materials will be available from MEI (www.mei.org.uk) who have a track record of providing excellent resources and support for teachers and students. These will include case studies related to different subjects as well as support with problem solving and use of ICT.



Accredited version September 2013

Key Features

- Unrivalled levels of support and advice.
- Web-based resources covering the units.
- Together with the MEI Structured Mathematics scheme, offers clear and appropriate progression routes from GCSE Mathematics for all students.
- Offers the support in mathematics and statistics needed in other subjects.
- Teaches problem-solving skills and techniques needed to solve real and realistic problems.

This specification was devised by Mathematics in Education and Industry (MEI) and is administered by OCR.

A separate specification contains the requirements for H863 Level 3 Certificate in Quantitative Methods (MEI).

Support and Advice

The specification is accompanied by a complete support package provided by MEI and OCR. The two organisations work closely together with MEI taking responsibility for the curriculum and teaching aspects of the course, and OCR the assessment.

- Advice is always available at the end of the telephone or by email; contact details can be found at www.mei.org.uk and www.ocr.org.uk.
- INSET provided by MEI.
- The MEI annual three-day conference.
- MEI branch meetings.
- Regular newsletters from MEI.
- Specimen and past examination papers, mark schemes and examiners' reports.
- Coursework resource materials and exemplar marked tasks.

Web-based Support

The units in this specification are supported by a very large purpose-built website designed to help students and teachers.

Routes of Progression

This specification is designed to provide support for students with grade C or better in GCSE Mathematics who need some mathematics or statistics in their other subjects or in employment. A new unit has been written, Introduction to Quantitative Methods (*IQM*) (G244); this may be taken as a standalone qualification – see the separate specification for the Level 3 Certificate in Quantitative Methods (MEI). Candidates may decide to take two further units, Statistics 1 (*S1*) (G245) and Decision 1 (*D1*) (G246), and the three units can then make up an AS in Quantitative Methods (MEI) (H133). The two units Statistics 1 and Decision 1 are identical in content and assessment to the two units in the MEI Structured Mathematics specification, which contains the requirements for AS and Advanced Level Mathematics and Further Mathematics.

It should be noted that this Quantitative Methods qualification contains no calculus, and that an AS or Advanced Level Mathematics (and possibly Further Mathematics) course is more suitable for students hoping to follow HE courses in Mathematics, Engineering or the Physical Sciences. Some other HE courses might prefer students to have achieved a Mathematics qualification rather than a Quantitative Methods qualification.

For first teaching in September 2014.

For first assessment in June 2015.



Contents

SECTION A: SPECIFICATION SUMMARY 6

SECTION B: USER SUMMARY 7

Using this specification 7

SECTION C: GENERAL INFORMATION 8

1 Introduction 8

1.1 Rationale 8

1.2 Certification Title 9

1.3 Language Availability 9

1.4 Exclusions 10

1.5 Code of Practice Requirements 10

1.6 Spiritual, Moral, Ethical, Social and Cultural Issues 10

1.7 Environmental, Education and Health and Safety Issues 10

1.8 Avoidance of Bias 11

1.9 Calculators and Computers 11

2 Specification Aims 12

2.1 Aims of MEI 12

2.2 Aims of this Specification 12

3 Assessment Objectives 13

3.1 Assessment Objectives 13

3.2 Specification Grid 13

4 Scheme of Assessment 14

4.1 Unit Assessment 14

4.2 Structure 14

4.3 Rules of Combination 14

4.4 Final Certification 15

4.5 Availability 15

4.6 Re-sits 16

4.7 Question Papers 16

4.8 Coursework 17

4.9 Special Arrangements 19

4.10 Differentiation 19

4.11 Grade Descriptions 19

5 Subject Content 21

5.1 Assumed Knowledge 21

5.2 Modelling 22

6 AS Unit Specifications 22

6.1 Main Introduction 23

6.2 Introduction to Quantitative Methods (*IQM*) (G244) 25

6.3 Statistics 1 (*S1*) (G245) 51

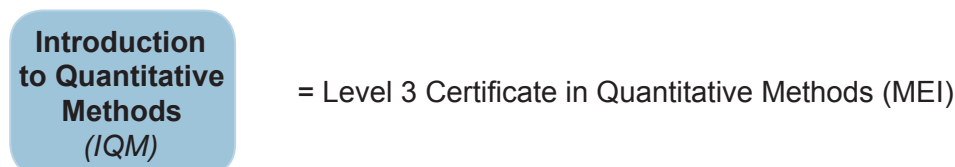
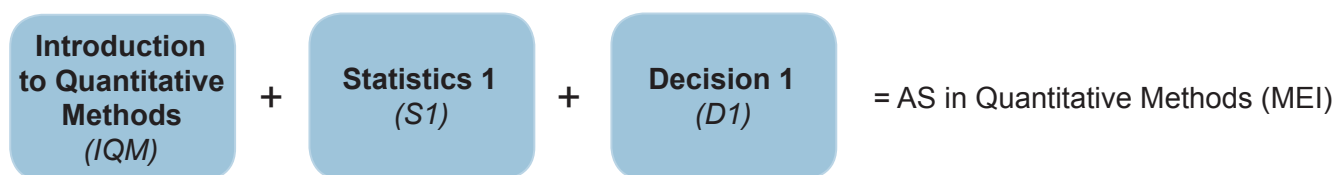
6.4 Decision Mathematics 1 (*D1*) (G246) 61

7 Further Information and Training for Teachers 66

Appendix A: Mathematical Notation 67

SECTION A: SPECIFICATION SUMMARY

This specification allows for two routes which lead to qualifications.



Details of the Level 3 Certificate in Quantitative Methods (MEI) can be found in a separate specification.

Candidates may decide to take just one unit, Introduction to Quantitative Methods (*IQM*), and achieve a Level 3 Certificate in Quantitative Methods (MEI). Candidates may decide to take two further units, Statistics 1 (*S1*) (G245) and Decision 1 (*D1*) (G246), and the three units can then make up an AS in Quantitative Methods (MEI) (H133).

The two units, Statistics 1 and Decision 1, are identical in content and assessment to the two units in the MEI Structured Mathematics specification, which contains the requirements for AS and Advanced Level Mathematics and Further Mathematics. This enables students who start on a course leading to the AS in Quantitative Methods to change to a course leading to AS Mathematics. However, a unit result from Statistics 1 or Decision 1 cannot count towards both of these AS qualifications. Centres are advised to contact OCR for advice on transferring from one course to the other.

Each unit in this specification requires 60 guided learning hours. The AS in Quantitative Methods requires 180 guided learning hours in total.

The three units in this specification are each assessed by a 1½ hour unit examination, available each June. In addition, the Introduction to Quantitative Methods unit has a coursework requirement.

SECTION B: USER SUMMARY

Using this specification

This specification, as well as the specification for the Level 3 Certificate in Quantitative Methods, provides courses that support the mathematical needs of students in their other subjects. Students can choose to tackle different numbers of units to match their needs, and gain recognition for what they have done.

- Candidates who sit the unit Introduction to Quantitative Methods (*IQM*), may, in the same series or later, certificate for a Level 3 Certificate in Quantitative Methods (MEI).
- The result from the *IQM* unit can contribute to a Level 3 Certificate as well as an AS GCE in Quantitative Methods (MEI).
- Candidates sitting the three units *IQM*, *S1* and *D1*, in any order and in any series, are eligible for an AS GCE in Quantitative Methods (MEI).
- There are no A2 units nor is there an Advanced Level qualification in Quantitative Methods in this specification.
- Examinations are available in June only.
- Unit results are notified in the form of a grade and a Uniform Mark. The total of a candidate's Uniform Marks on the three modules determines the grade awarded at AS GCE.
- To obtain an AS award a 'certification entry' must be made to OCR.

SECTION C: GENERAL INFORMATION

1 Introduction

1.1 Rationale

1.1.1 This Specification

This booklet contains the specification for Advanced Subsidiary GCE (AS) in Quantitative Methods (MEI) for teaching from September 2014. A separate booklet contains the specification for the Level 3 Certificate in Quantitative Methods (MEI) for teaching from September 2014.

This specification was developed by Mathematics in Education and Industry (MEI) and is assessed by OCR. Support for those delivering the specification comes from both bodies and this is one of its particular strengths.

This specification is designed to support post-16 students with their mathematical needs in other subjects, as well as for employment and everyday life. In particular, it provides support for subjects such as Biology, Business Studies, Chemistry, Computer Science, Economics, Geography, ICT and Psychology. This specification does not contain any calculus and is not adequate, on its own, to support the mathematical needs of students going on to study Mathematics, Engineering or the Physical Sciences.

This specification gives students the mathematical skills to tackle problems in a variety of different real and realistic contexts. Students are taught to use a modelling cycle, a statistical problem-solving cycle and a financial problem-solving cycle. The use of technology – in particular, spreadsheets – is an integral part of the course.

MEI is a curriculum development body and, in devising this specification, the long-term needs of students have been its paramount concern.

1.1.2 MEI and OCR

MEI is a long established, independent curriculum development body. MEI provides advice and INSET relating to all the curriculum and teaching aspects of the course. It also provides teaching resources, which for this specification can be found on the website (www.mei.org.uk). Textbooks are also available for the Statistics 1 and Decision 1 units, the product of a partnership between MEI and a major publishing house. A particular feature of MEI's provision is the very substantial website (see Section 7), covering all the various units. Students can access this at school or college, or when working at home. Not only does this help them with their immediate course; it also develops the skills they will need for independent learning throughout their lives.

OCR's involvement is primarily centred on the assessment, awarding and issuing of results. However, members of the Qualification Team are available to give advice, receive feedback and give general support.

OCR also provides online training and materials such as Examiners' Reports, mark schemes and past papers.

It is thus a feature of this specification that an exceptional level of help is always available to teachers and students, at the end of the telephone or online; contact details can be found at www.mei.org.uk and www.ocr.org.uk.

1.1.3 Background

There has been a growing national consensus that more post-16 students need to be tackling more mathematics. For many of these students, although they have obtained grade C or better in GCSE Mathematics, their needs are not met by GCE Mathematics courses.

Other subjects, at GCE and undergraduate level, are becoming increasingly quantitative and the same is true of many forms of employment. This specification aims to meet some of the mathematical needs of other subjects and employment, as well as provide skills that students will need in everyday life.

There is also growing concern that students are not able to apply the skills they acquired in GCSE Mathematics to other contexts. This course tries to remedy some of this, by focusing on using mathematical methods in different contexts, familiar and unfamiliar. Students are given three frameworks for solving problems: a modelling cycle; a statistical problem-solving cycle and a financial problem-solving cycle. The use of pre-release material to prepare for the written examination allows candidates to learn enough about a new context to be able to answer questions in it, or to make use of a large quantity of data.

Technology is playing an increasingly important role in a data-driven world, and so it is highly appropriate that the use of a spreadsheet will be taught and assessed in this specification. The use of other statistical software is to be encouraged in the course.

Considerable thought has gone into the design of this specification. It is based on several pieces of research into the mathematical needs of students in post-16 education and at undergraduate level, and in employment. There has been wide consultation with colleagues in Higher Education, post-16 education, employers and learned societies in a range of subjects, including Biology, Business Studies, Chemistry, Computer Science, Economics, Geography, IT, Mathematics and Psychology.

1.1.4 A Route of Progression

This specification is designed to be accessible to students who have achieved a grade C, or better, in GCSE Mathematics. Students with grade C are often denied access to GCE Mathematics courses and so are unable to continue with mathematics beyond 16. This course is designed both to be accessible to such students and to provide the sort of mathematics that they need.

1.2 Certification Title

This specification will be shown on a certificate as the following:

- OCR Advanced Subsidiary GCE in Quantitative Methods (MEI)

1.3 Language Availability

This specification, and all associated assessment materials, are available only in English. The language used in all question papers will be plain, clear, free from bias and appropriate to the qualification.

1.4 Exclusions

Advanced Subsidiary GCE in Quantitative Methods may **not** be taken with any Advanced Subsidiary GCE Mathematics or Statistics qualification in the same series.

The Advanced Subsidiary GCE in Quantitative Methods may not be taken at the same time as any other Advanced Subsidiary GCE having the same title nor with OCR Free Standing Mathematics Qualification (Advanced): Additional Mathematics (6993).

Candidates may not obtain certification from this specification, based on units from other mathematics specifications.

Candidates may not enter a unit from this specification and a unit with the same title from other mathematics specifications.

1.5 Code of Practice Requirements

The qualification covered by this specification complies in all aspects with the GCE Code of Practice.

1.6 Spiritual, Moral, Ethical, Social and Cultural Issues

Students are required to examine arguments critically and so to distinguish between truth and falsehood. They are also expected to interpret the results of modelling exercises and there are times when this inevitably raises moral and cultural issues. Such issues will not be assessed in the examination questions; nor do they feature, *per se*, in the assessment criteria for any coursework tasks. Ethical issues may arise in the statistical and financial problem-solving cycles in *IQM*.

1.7 Environmental, Education and Health and Safety Issues

While the work developed in teaching this specification may use examples, particularly involving modelling and statistics, that raise environmental issues, these issues do not in themselves form part of the specification.

The work developed in teaching this specification may at times involve examples that raise health and safety issues. These issues do not in themselves form part of this specification.

Teachers should be aware that candidates may be exposed to risks when doing coursework. They should apply usual precautions. Candidates should not be expected to collect data on their own when outside their Centre.

Teachers should be aware of the dangers of repetitive strain injury for any student who spends a long time working on a computer.

1.8 Avoidance of Bias

MEI and OCR have taken great care in the preparation of this specification and assessment materials to avoid bias of any kind.

1.9 Calculators and Computers

Students are expected to make appropriate use of calculators and computers. The JCQ document *Instructions for conducting examinations*, published annually, contains the regulations regarding the use of calculators in examinations.

The use of computer software is an assessed part of the *IQM* unit. Candidates should use a spreadsheet to analyse and represent data in their coursework, and examination questions may be set which assume that candidates have experience of using a spreadsheet to do the things itemised in the unit specification.

2.1 Aims of MEI

‘To promote the links between education and industry in Mathematics, and to produce relevant examination and teaching specifications and support material.’

2.2 Aims of this Specification

This course should encourage students to:

- develop their understanding of mathematics and mathematical processes in a way that promotes confidence and fosters enjoyment
- develop abilities to reason logically, recognise incorrect reasoning and to generalise
- extend their range of mathematical skills and techniques and use them in more difficult, unstructured problems
- develop an understanding of coherence and progression in mathematics and of how different areas of mathematics can be connected
- recognise how a situation may be represented mathematically and understand the relationship between ‘real world’ problems and standard and other mathematical models and how these can be refined and improved
- use mathematics as an effective means of communication
- read and comprehend mathematical arguments and articles concerning applications of mathematics
- acquire the skills needed to use technology such as calculators and computers effectively, recognise when such use may be inappropriate and be aware of limitations
- develop an awareness of the relevance of mathematics to other fields of study, to the world of work and to society in general
- take increasing responsibility for their own learning and the evaluation of their own mathematical development
- develop the skills to engage with mathematical problems arising in other subjects, employment and everyday life
- develop the confidence to undertake further study of mathematics.

These aims are based on those for GCE Mathematics; the final two are specific to this specification.

3.1 Assessment Objectives

This specification requires candidates to demonstrate the following assessment objectives in the context of the knowledge, understanding and skills prescribed. These assessment objectives are based on those for GCE Mathematics.

Candidates should be able to demonstrate that they can:

AO1	<ul style="list-style-type: none"> recall, select and use their knowledge of mathematical facts, concepts and techniques in a variety of contexts.
AO2	<ul style="list-style-type: none"> construct rigorous mathematical arguments through use of precise statements, logical deduction and inference and by the manipulation of mathematical expressions, including the construction of extended arguments for handling substantial problems presented in unstructured form.
AO3	<ul style="list-style-type: none"> recall, select and use their knowledge of standard mathematical models to represent situations in the real world recognise and understand given representations involving standard models present and interpret results from such models in terms of the original situation, including discussion of assumptions made and refinement of such models.
AO4	<ul style="list-style-type: none"> comprehend translations of common realistic contexts into mathematics use the results of calculations to make predictions, or comment on the context where appropriate, read critically and comprehend longer mathematical arguments or examples of applications.
AO5	<ul style="list-style-type: none"> use contemporary calculator and computer technology and other permitted resources (such as formulae booklets or statistical tables) accurately and efficiently understand when not to use such technology, and its limitations give answers to appropriate accuracy.

3.2 Specification Grid

The table below gives the permitted allocation of marks to assessment objectives for the unit. The figures given are percentages.

Entry Code	Unit Code	Unit Name	Level	Weighting of Assessment Objective (%)				
				AO1	AO2	AO3	AO4	AO5
G244	IQM	Introduction to Quantitative Methods	AS	20–30	20–30	25–35	10–20	5–15
G245	S1	Statistics 1	AS	20–30	20–30	25–35	10–20	5–15
G246	D1	Decision Mathematics 1	AS	20–30	20–30	25–35	10–20	5–15

4.1 Units of Assessment

4.1.1 Summary Table

Entry Code	Unit Code	Level	Unit Name	Examination Questions* (approximate mark allocation)	Time (hours)
G244	IQM	AS	Introduction to Quantitative Methods	6–9 questions, total 72 marks Coursework: 18 marks	1½
G245	S1	AS	Statistics 1	A: $5 - 7 \times \leq 8 = 36$; B: $2 \times 18 = 36$	1½
G246	D1	AS	Decision Mathematics 1	A: $3 \times 8 = 24$; B: $3 \times 16 = 48$	1½

* number of questions \times number of marks for each = total mark

For Unit G244, centres have the option of submitting new coursework (entry code Option A) or carrying forward a coursework mark from a previous series (Option B).

4.1.2 Weighting

Each unit carries $33\frac{1}{3}\%$ of the total marks for the Advanced Subsidiary certification in Quantitative Methods.

4.1.3 Awarding of Grades

Advanced Subsidiary GCE units are awarded on a scale of a to e or u (unclassified). Uniform marks correspond to unit grades as follows:

Maximum Unit Uniform Mark	Unit Grade					u
	a	b	c	d	e	
100	100–80	79–70	69–60	59–50	49–40	39–0

4.2 Structure

4.2.1 Recommended Order

The assumed knowledge required to start any unit is stated on the title page of its specification. It is recommended that *IQM* is studied before unit *S1*.

There are, however, no formal restrictions on the order in which units may be taken.

4.3 Rules of Combination

The only permissible combination of units for Advanced Subsidiary GCE Quantitative Methods (H133) is *IQM*, *S1* and *D1*.

4.4 Final Certification

Each unit is given a grade and a Uniform Mark, using procedures laid down by Ofqual in the document *GCE A and AS Code of Practice*.

4.4.1 Certification of Quantitative Methods

Candidates enter for three units of assessment at Advanced Subsidiary GCE.

To claim an award at the end of the course, candidates' unit results must be aggregated. This does not happen automatically and Centres must make separate 'certification entries'.

4.4.2 Awarding of Grades

Advanced Subsidiary GCE qualifications are awarded on the scale A to E or U (unclassified). OCR adds together the unit *uniform* marks and compares these to pre-set boundaries (see the table below) to arrive at qualification grades.

Qualification	Qualification Grade					U
	A	B	C	D	E	
AS GCE	300–240	239–210	209–180	179–150	149–120	119–0

4.4.3 Enquiries on Results

Candidates will receive their final unit results at the same time as their subject results. In common with other Advanced GCE results, the subject results are at that stage provisional to allow enquiries on results. Enquiries concerning marking are made at the unit level and so only those units taken at the last sitting may be the subject of such appeals. Enquiries are subject to OCR's general regulations.

4.5 Availability

4.5.1 Unit Availability

There is one examination series each year, in June, in which all units are assessed.

4.5.2 Certification Availability

Certification is available in the June series only.

4.5.3 Shelf-life of Units

Individual unit results, prior to certification of the qualification, have a shelf-life limited only by that of the specification.

4.6 Re-sits

4.6.1 Re-sits of Units

A candidate may re-sit any unit. The best result will count.

4.6.2 Re-sits of Advanced Subsidiary GCE

Candidates may take the whole qualification more than once.

4.7 Question Papers

4.7.1 Style of Question Papers

The assessment requirements of the various units are summarised in the table in Section 4.1.1.

IQM is assessed by a question paper lasting 1½ hours, and also has a coursework requirement which accounts for 20% of the total mark for the unit. The question paper for *IQM* contains between 6 and 9 questions.

S1 and *D1* are each assessed by a single question paper lasting 1½ hours. The question papers for *S1* and *D1* have two sections, A and B. The questions in Section A are short and test techniques. The questions in Section B are longer and also test candidates' ability to follow a more extended piece of mathematics.

There is no choice of questions in any of the papers.

4.7.2 Use of Language

Candidates are expected to use clear, precise and appropriate mathematical language, as described in Assessment Objective 2 (see Section 3.1).

4.7.3 Thresholds

At the time of setting, each examination paper will be designed so that 50% of the marks are available to grade E candidates, 75% to grade C and 100% to grade A. Typically candidates are expected to achieve about four fifths of the marks available to achieve a grade, giving design grades of: A 80%, B 70%, C 60%, D 50% and E 40%. The actual grading is carried out by the Awarding Committee. They make allowance for the difficulty of the paper and for any other features that only become apparent after the paper has been taken. Thus some variation from the design grades can be expected in the award.

4.7.4 Calculators

For all units, a scientific or graphical calculator is allowed. Computers, and calculators with computer algebra functions, are not permitted in the examination papers for any of the units. The JCQ document *Instructions for conducting examinations*, published annually, contains the regulations regarding the use of calculators in examinations.

4.7.5 Mathematical Formulae and Statistical Tables

A booklet (MF2) containing Mathematical Formulae and Statistical Tables is available for the use of candidates in the examinations for units *S1* and *D1*. Any formulae beyond GCSE will be given in the question paper for *IQM*.

Details of the mathematical notation that will be used in question papers is contained in Appendix A.

4.8 Coursework

4.8.1 Rationale

The units *S1* and *D1* do not require any coursework.

The requirements of the *IQM* unit include a single piece of coursework, which will count for 20% of the assessment of the unit.

The coursework covers particular skills or topics that are, by their nature, unsuitable for assessment within a timed examination but are nonetheless important aspects of the unit.

The work undertaken in coursework is thus of a different kind from that experienced in examinations. As a result of the coursework students should gain a better understanding of how mathematics is applied in real-life situations.

4.8.2 Use of Language

Candidates are expected to use clear, precise and appropriate mathematical language, as described in Assessment Objective 2 (see Section 3.1).

4.8.3 Guidance

Teachers should give candidates such guidance and instruction as is necessary to ensure that they understand their coursework task, and know how to set about it. They should explain the basis on which it will be assessed. Teachers should feel free to answer reasonable questions and to discuss candidates' work with them, until the point where they are working on their final write-up.

A candidate who takes up and develops advice offered by the teacher should not be penalised for doing so. If, however, a candidate needs to be led all the way through the work, this should be taken into account in the marking, and a note of explanation written on the assessment sheet. Teachers should appreciate that a moderator can usually detect when a candidate has been given substantial help and that it is to the candidate's disadvantage if no mention is made of this on the assessment sheet.

Coursework may be based on work for another subject (e.g. Geography or Economics), where this is appropriate, but the final write-up must be submitted in a form appropriate for Quantitative Methods.

In order to obtain marks for the assessment domain Oral Communication, candidates must either give a presentation to the rest of the class, have an interview with the assessor or be engaged in on-going discussion.

4.8.4 Coursework Tasks

Candidates should choose their own task, and explain why it is a worthwhile problem to tackle. The specification for *IQM* gives details of how candidates should select a task: see Section 6.2.

4.8.5 Moderation

Coursework is assessed by the teacher responsible for the unit or by someone else approved by the Centre. It should be completed and submitted within a time interval appropriate to the task.

Consequently, the teacher has two roles. While the candidate is working on coursework, the teacher may give guidance as described earlier. However, once the candidate has handed in the final write-up, the teacher becomes the assessor and no further help may be given. Only one assessment of a piece of coursework is permitted; it may **not** be handed back for improvement or alteration.

The coursework is assessed over a number of domains according to the criteria laid down in the unit specification. The method of assessment of Oral Communication should be stated and a brief report on the outcome written in the space provided on the assessment sheet.

4.8.6 Internal Standardisation

Centres that have more than one teaching group for the *IQM* unit must carry out internal standardisation of the coursework produced to ensure that a consistent standard is being maintained across the different groups. This must be carried out in accordance with guidelines from OCR. An important outcome of the internal standardisation process will be the production of a rank order of all candidates.

4.8.7 External Moderation

After coursework is marked by the teacher and internally standardised by the Centre, the marks are then submitted to OCR by the specified date, after which postal moderation takes place in accordance with OCR procedures. Centres must ensure that the work of all the candidates is available for moderation.

As a result of external moderation, the coursework marks of a Centre may be changed, in order to ensure consistent standards between Centres.

4.8.8 Re-sits

If a unit is re-taken, candidates are offered the option of submitting new coursework (Entry Code Option A) or carrying over the coursework mark from a previous series (Option B).

4.8.9 Minimum Coursework Requirements

If a candidate submits no work for the coursework component, then the candidate should be indicated as being absent from that component on the coursework Mark Sheet submitted to OCR. If a candidate completes any work at all for the coursework component then the work should be assessed according to the criteria and marking instructions and the appropriate mark awarded, which may be 0 (zero).

4.8.10 Authentication

As with all coursework, Centres must be able to verify that the work submitted for assessment is the candidate's own work.

4.9 Special Arrangements

For candidates who are unable to complete the full assessment or whose performance may be unduly affected through no fault of their own, teachers should consult the JCQ booklet *Access Arrangements, Reasonable Adjustments and Special Consideration*. In such cases advice should be sought from OCR as early as possible during the course.

4.10 Differentiation

In the question papers differentiation is achieved by setting questions which are designed to assess candidates at their appropriate levels of ability and which are intended to allow candidates to demonstrate what they know, understand and can do.

In coursework, differentiation is by task and by outcome. Candidates undertake assignments which enable them to display positive achievement.

4.11 Grade Descriptions

The following grade descriptions indicate the level of attainment characteristic of the given grade at Advanced Subsidiary GCE. They are based on the grade descriptions for GCE Mathematics. 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 candidate has met the assessment objectives 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 mathematical facts, concepts and techniques that are needed, and select appropriate ones to use in a wide variety of contexts.

Candidates manipulate mathematical expressions and use graphs, sketches and diagrams, all with high accuracy and skill. They use mathematical 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 mathematics 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 mathematical information from extended pieces of prose having mathematical content. They can comment meaningfully on the mathematical information.

Candidates make appropriate and efficient use of contemporary calculator and computer 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 mathematical facts, concepts and techniques that are needed, and usually select appropriate ones to use in a variety of contexts.

Candidates manipulate mathematical expressions and use graphs, sketches and diagrams, all with a reasonable level of accuracy and skill. They use mathematical 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 mathematics 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 mathematical information from extended pieces of prose having mathematical content. They give some useful comments on this mathematical information.

Candidates usually make appropriate and efficient use of contemporary calculator and computer 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 mathematical facts, concepts and techniques that are needed, and sometimes select appropriate ones to use in some contexts.

Candidates manipulate mathematical expressions and use graphs, sketches and diagrams, all with some accuracy and skill. They sometimes use mathematical 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 mathematics of common realistic contexts. They sometimes correctly refer the results of calculations back to the given context and attempt to give comments or predictions. They distil some of the essential mathematical information from extended pieces of prose having mathematical content. They attempt to comment on this mathematical information.

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

5.1 Assumed Knowledge

The unit specifications are written with the same assumption about prior knowledge as that used for the GCE Mathematics subject criteria, that students embarking on AS and Advanced GCE study in Mathematics are expected to have achieved at least grade C in GCSE Mathematics, or its equivalent, and to have covered all the material in the Intermediate Tier*. Consequently everything which is in the National Curriculum up to and including that level is also implicit in this specification. In a number of cases such material is included in the specification for clarity and completeness and is indicated by an asterisk; such material will not form the focus of an examination question.

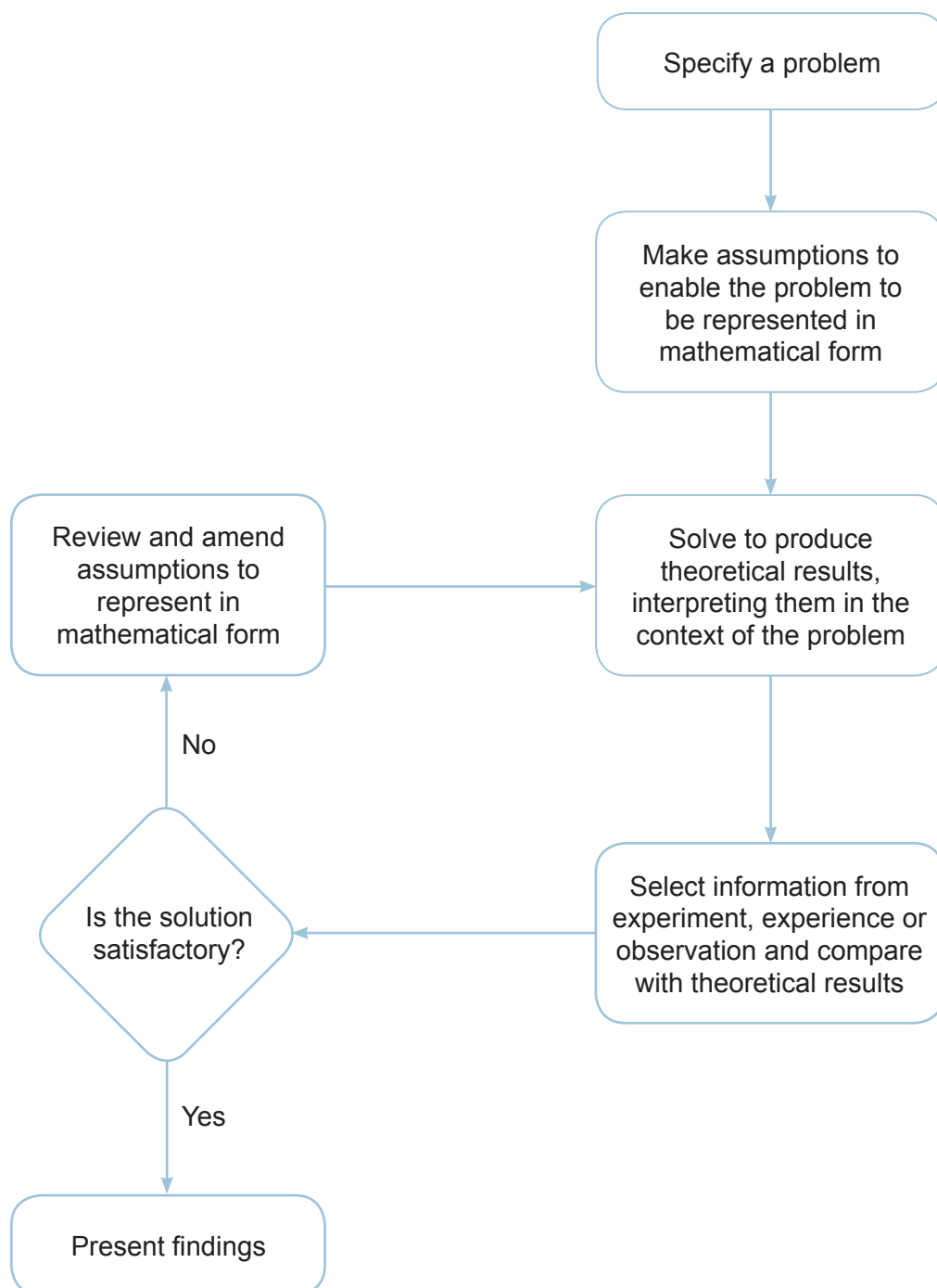
There is no formal prerequisite for a student wishing to embark on this course.

*This refers to the Intermediate tier of GCSE Mathematics at the time when the Maths subject criteria were written. See the document *Assumed Knowledge for Level 3 and AS Quantitative Methods* on the Quantitative Methods pages of the OCR website (www.ocr.org.uk) for more details.

5.2 Modelling

The process of modelling used in all three units is illustrated by the flow chart below.

Mathematics can be used to solve a wide variety of **problems** arising from real situations. But real life is complicated, and can be unpredictable, so some **assumptions** need to be made to allow mathematics to be used. Once answers have been obtained, we need to **compare with experience** to make sure that the answers are useful. For example, the government might want to know how many primary school children there will be in the future so that they can make sure that there are enough teachers and school places. To find a reasonable estimate, they might **assume** that the birth rate over the next five years will be similar to that for the last five years and that students will go to school in the area they were born in. They would **check** that these assumptions fit in with **new data** and **review** the estimate to see whether it is still reasonable.



6.1 Main Introduction

Sections 6.2, 6.3 and 6.4 contain the specifications for the units IQM, S1 and D1 respectively.

After an introduction, the content for each unit is shown in a sequence of double-page spreads. The content is divided into a number of broad headings, given as titles at the top of each section. Each section is then further divided into subsections, with headings in the first column of each double page. These subsections are divided into a list of competence statements.

Competence statements are designed to help users by clarifying the requirements, but the following three points need to be noted:

- work that is covered by a competence statement may be asked in an examination question without further assistance being given
- examination questions may require candidates to use two or more competence statements at the same time without further assistance being given
- where an examination question requires work that is not covered by a competence statement, sufficient guidance will be given within the question.

Competence statements have an implied prefix of the words: 'A candidate should ...'

Each competence statement has a unique reference code. For example, in the code IQMQ1, IQM refers to the unit, Q refers to 'Use of technology' (see below) and 1 means that it is the first such competence statement in the list.

The letters used in assigning reference numbers to competence statements are as follows.

a	algebra	A	Algorithms
f	functions	D	Data presentation
g	geometry, graphs	E	Estimation
l	large and small numbers	F	Financial problem-solving
p	mathematical processes (e.g. modelling)	H	Hypothesis testing
u	probability (uncertainty)	L	Linear programming
		N	Networks
		Q	Use of technology
		R	Random variables
		S	Statistical problem-solving
		X	Critical path analysis
		Z	Simulation

On the right-hand page each competence statement may have an explanatory note and a comment about the notation that may be used in the examination. The final column may contain 'exclusions', items that are not covered by the specification for this unit and will not be examined in the question paper for this unit.

BLANK PAGE

6.2 Introduction to Quantitative Methods (IQM) (G244)

Objectives

Candidates should:

- consolidate and extend the mathematics they have learnt at GCSE
- develop transferable skills in mathematics
- be able to work fluently in a variety of contexts
- use problem-solving cycles in modelling, statistics and financial mathematics
- apply common sense to check the outcomes of calculations
- use appropriate technology in their work.

Assessment

Examination	72 marks 80% of the total marks for this unit 1 hour 30 minutes All questions are compulsory. One paper with six to nine questions
Coursework	18 marks 20% of the total marks for this unit Candidates are required to undertake a piece of coursework, solving a statistical problem with the assistance of a spreadsheet.

Assumed Knowledge

Candidates are expected to know the content for Intermediate Tier GCSE*.

*See note in Section 5.1.

Calculators

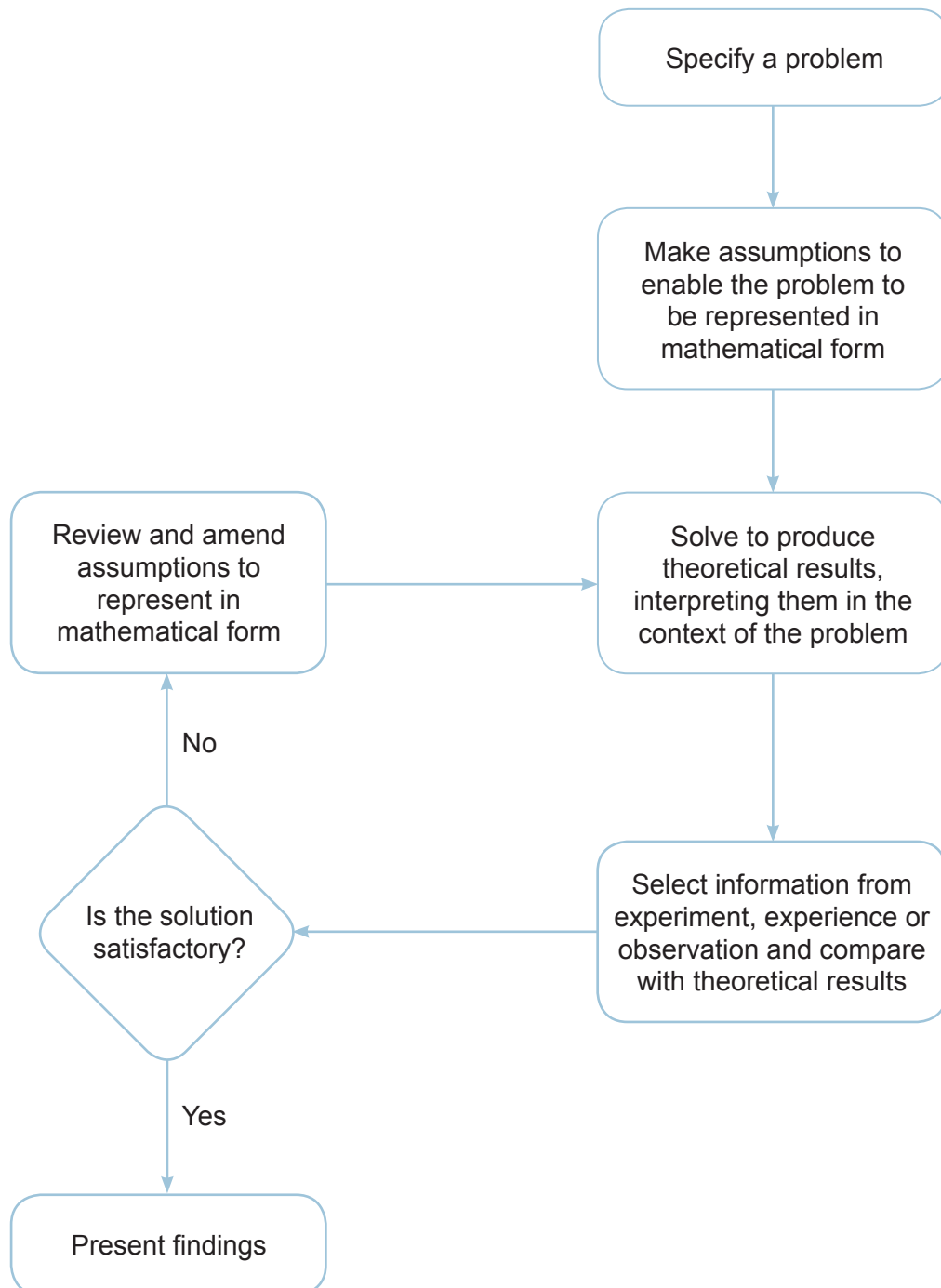
Candidates are expected to use a calculator (scientific or graphical) in the examination. However some questions may ask candidates to work without a calculator; in such cases no credit will be given for answers with insufficient working. Questions may include printouts from spreadsheets which candidates will need to complete or interpret.

Pre-release material

Pre-release material relevant to at least one of the questions will be provided in mid-March each year. Questions may use contexts or data introduced in the pre-release material. A copy of the pre-release material will be provided in the examination.

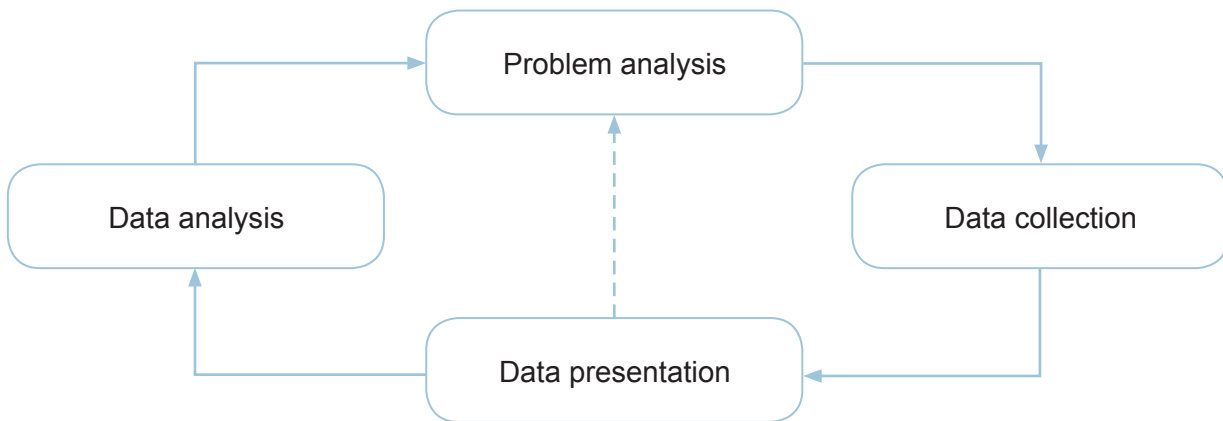
The modelling cycle

Mathematics can be used to solve a wide variety of **problems** arising from real situations but real life is complicated, and can be unpredictable, so some **assumptions** need to be made to allow mathematics to be used. Once answers have been obtained, we need to **compare with experience** to make sure that the answers are useful. For example, the government might want to know how many primary school children there will be in the future so that they can make sure that there are enough teachers and school places. To find a reasonable estimate, they might **assume** that the birth rate over the next five years will be similar to that for the last five years and that students will go to school in the area they were born in. They would **check** that these assumptions fit in with **new data** and **review** the estimate to see whether it is still reasonable.



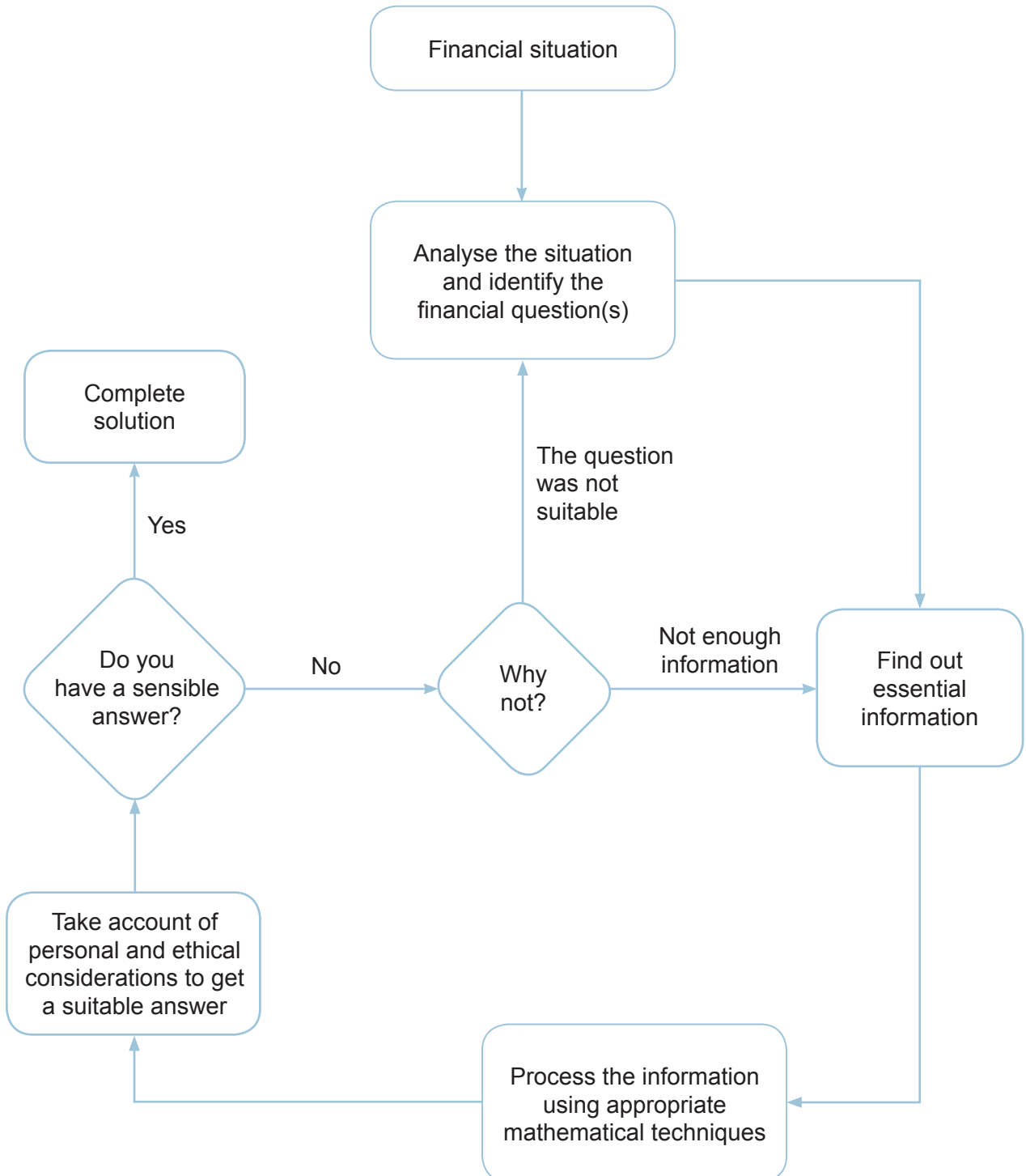
The Statistical Problem-Solving Cycle

This version of the statistical problem-solving cycle, along with the associated notes, is an adaptation of that produced for the Royal Statistical Society report *The Future of Statistics in our Schools and Colleges* and is used by kind permission.



Process	Description	Topics
Problem analysis	This process involves the work at both the start and the end of statistical problem solving. It begins with the analysis of a problem; essential decisions are needed about what data need to be collected and how they will be used. In the subsequent stages the data are collected, presented and analysed. Finally the outcomes are considered in relation to the original problem analysis, and the modelling involved. The conclusion may be that a satisfactory solution to the problem has been found, or it may be a recognition that the approach taken has not been satisfactory; the interpretation may not make sense, or it may not provide sufficient discrimination to be useful. In cases where the problem has not been solved satisfactorily, it will usually be necessary to repeat the whole cycle.	Modelling Errors Risk
Data collection	This process covers the work undertaken when students collect their own (primary) data. Decisions have already been made as to what data need to be collected. It includes deciding how the data will be collected (taking account of practical and ethical considerations), and then carrying it out. The outcome of this stage is a set of original data.	Experimental design Sampling techniques
Data presentation	This stage begins with data, which may be primary or secondary, and involves the application of a variety of descriptive techniques and their informal interpretation. Typical examples are grouping and tabulation, statistical diagrams, simple statistical measures (such as mean and measures of spread).	Tabulation Data display Statistical measures
Data analysis	The work in this stage involves mathematical analysis, leading to some inference that is relevant to the problem. Such work often requires an understanding of probability. This stage ends with results that can be applied to the original problem. In simple situations, the data presentation may be sufficient to allow the problem to be solved. In such cases it may be possible to bypass this stage.	Use of distributions Probability

The Financial Problem-Solving Cycle



Notes on the Financial Problem-Solving Cycle

Financial situation

Examples of financial situations include the following.

- Deciding what to do with income
- Needing to find somewhere to live
- Planning for the future

Financial question

Examples of financial questions include the following.

- How much will that coat cost in the sale?
- How much will I earn after my wage rise?
- I am making earrings to sell; how much should I charge for them?
- Where should I borrow money to buy a car?
- Where should I invest my money?
- How much should I put aside for my pension each month?

Essential information

Examples of information which could be needed to answer the question include the following.

- The percentage reduction for a sale
- If someone wants to sell something they need to know what it cost and how much someone else might be willing to pay
- Asking an adviser about options for loans or investments

Process the information

This could include the following.

- Using a spreadsheet
- Doing a calculation
- Putting information into a table or chart

Personal and ethical considerations

Examples include the following.

- One shop might be cheaper than another but pay its workers low wages so people may prefer to shop at the more expensive shop.
- I may want to buy a car but I need to think about how much spare money I have to repay a loan.
- It may be cheaper to buy a larger pack of fruit than a smaller one but someone may get the smaller one to avoid waste.

Being unable to answer the question

There are various reasons why it may not be possible to give a satisfactory answer to the original question.

Here are some examples.

- The original question was too vague so it is not possible to tell whether it has been answered or not – the question should be made more specific in a second circuit of the cycle.
- It is not possible to find a satisfactory answer. For example, someone wants to buy a large house but cannot afford to repay the mortgage. The question should be amended: perhaps looking for a smaller house or considering shared ownership.
- It may not have been possible to find enough information to answer the question. Advice should be sought in a second circuit of the cycle.

INTRODUCTION TO QUANTITATIVE METHODS (IQM)

Specification	Ref.	Competence Statements
USE OF ICT		
Calculators.	IQMQ1	Be able to use a standard calculator (scientific or graphical).
Spreadsheets.	2	Be able to read information from a standard spreadsheet.
	3	Be able to enter formulae and data into a spreadsheet.
	4	Be able to interpret simple formulae on a spreadsheet given in terms of cell references.
	5	Be able to copy a formula and to ensure that only the required cell addresses increment.
	6	Be able to use a spreadsheet to find a numerical solution of an equation.
	7	Be able to use a spreadsheet to draw graphs and standard statistical diagrams.

INTRODUCTION TO QUANTITATIVE METHODS (IQM)

Ref.	Notes	Notation	Exclusions
USE OF ICT			
IQMQ1			
2			
3	Formulae based on the 4 rules of arithmetic and other standard functions required by the rest of this specification, e.g. to the power of, square root.	e.g. =B2*(C2+D2)	
4	Including financial contexts but also exploring number patterns and simple sequences with a spreadsheet.	e.g. =SUM(A1:A9)	
5		e.g. \$A1, \$A\$1, A\$1	
6	Equations in one variable, involving powers and/or roots.		
7	Including awareness of when graphs produced by a spreadsheet are misleading or incorrect.		

INTRODUCTION TO QUANTITATIVE METHODS (IQM)

Specification	Ref.	Competence Statements
MODELLING		
The modelling cycle.	IQMp1	Be able to identify simplifying assumptions that allow a problem to be modelled.
	2	Develop or choose a simple mathematical model for a real-world situation.
	3	Be able to use a model to make predictions.
	4	Be able to compare the outcomes from a model with actual data, information, experience or common sense.
	5	Be able to critically appraise the assumptions underlying a model.
	6	Understand that a simple model can give useful answers but may need to be improved.
	7	Be able to communicate mathematical results clearly and effectively.
Estimation.	IQME1	Be able to make a rough estimate of a quantity.
	2	Be able to use estimates when checking calculations.
	3	Be able to make and justify upper and lower bounds for a calculation.
	4	Be able to present error bounds on diagrams and in writing.
Algebra.	IQMa1	Be able to represent a situation mathematically using a formula or equation.
	2	Be able to solve equations and change the subject of a formula.

INTRODUCTION TO QUANTITATIVE METHODS (IQM)

Ref.	Notes	Notation	Exclusions
MODELLING			
IQMp1			
2			
3	For example, use a simple demand curve (e.g. a linear model) to predict the change in revenue following a given change in price.		
4	For example, compare an exponential growth model with actual population figures. The information may be given in diagrammatic or graphical form.		
5			
6	Compare outcomes from two models.		
7			
IQME1	For example, estimate how many cars are in a traffic jam. This includes financial estimates such as conversion from a foreign currency to pounds while in a shop.		
2			
3	Includes selecting and/or justifying an appropriate level of accuracy for an answer to a calculation.	Maximum, minimum, upper bound, lower bound	
4	Error bounds may be required in percentage form.	12 ± 0.5 $340 \pm 10\%$	
IQMa1	Candidates should be prepared to use both traditional algebra and spreadsheet notation.		
2	In simple cases using the four operations, powers and roots. Solve more complex equations using trial and improvement or a graphical method.		Changing the subject of an exponential formula.

INTRODUCTION TO QUANTITATIVE METHODS (IQM)

Specification	Ref.	Competence Statements
STATISTICS		
The statistics cycle.	IQMS1	Be able to decide what data need to be collected in order to answer a question requiring statistical evidence.
	2	Be able to use a suitable method for collecting data, taking ethical considerations into account, and judge whether data are of sufficient quality.
	3	Be able to present and analyse the data and so provide an answer to the original question.
	4	Be able to interpret the answer to the question and decide whether it is realistic.
The language of statistics.	5	Understand and use the language describing types of data.
	6	Be able to recognise values in primary or secondary data which are unlikely to be accurate.
	7	Understand the meaning of the terms 'sample' and 'population'.
	8	Be able to interpret sample data in terms of possible properties of the parent population.
	9	Understand about the variability of data and be able to describe the main features of a distribution.
Statistical diagrams and measures.	10	Be able to use and interpret statistical diagrams appropriate to a variety of types of data.
	11	Be able to identify when a statistical diagram is misleading or inadequately labelled.
	12	Be able to identify skewness from a histogram or box and whisker plot.
	13	Be able to interpret a scatter diagram for bivariate data.
	14	Be able to select and calculate appropriate measures of central tendency and to interpret them.
	15	Be able to use appropriate measures of spread and to interpret them.
	16	Be able to calculate an appropriate weighted mean and recognise when it is appropriate to do so.
	17	Be able to relate statistical measures to statistical diagrams.

INTRODUCTION TO QUANTITATIVE METHODS (IQM)

Ref.	Notes	Notation	Exclusions
STATISTICS			
IQMS1			
2	The data may be primary or secondary, and may be read off a graph or diagram.		
3			
4			
5	Primary, secondary; categorical, numerical; continuous, discrete.		
6		Outlier	Knowing formal rules for identifying outliers.
7	The idea of random sampling.		The names of particular sampling methods will not be examined.
8			
9	The main features include the central tendency (average) and spread.		
10	Diagrams include: box and whisker plots, dot plots, scatter diagrams, bar charts, pie charts, histograms, cumulative frequency diagrams. Candidates may need to produce diagrams like these as part of their coursework but drawing them will not be the focus of any examination question; candidates may be asked to interpret them in the examination.		
11			
12	In appropriate contexts. Positive and negative skewness.		Measures of skewness.
13	Including the terms association, correlation, line of best fit.		
14	Mean, median, mode. Includes grouped data. Candidates should use statistical functions on their calculators when appropriate.		
15	Calculate range, inter-quartile range, semi inter-quartile range. Includes grouped data. Candidates should use statistical functions on their calculators when appropriate. Know that standard deviation is a measure of spread.		Calculation of standard deviation.
16			
17	For example, being able to put scatter diagrams in order of correlation, being able to find a median from a dot plot.		Calculation of correlation coefficient.

INTRODUCTION TO QUANTITATIVE METHODS (IQM)

Specification	Ref.	Competence Statements
STATISTICS		
The Normal distribution.	S18	Know that the Normal distribution is a model which can be used for real data and recognise a Normal curve.
	19	Know that, for a Normal distribution, values more than 3 standard deviations from the mean are very unusual and that approximately 95% of the data lie within 2 standard deviations of the mean.
	20	Be able to interpret a Normal probability plot from statistical software.

INTRODUCTION TO QUANTITATIVE METHODS (IQM)

Ref.	Notes	Notation	Exclusions
STATISTICS			
S18	Know that the distribution is symmetrical about the mean for the population but understand that histograms for samples will usually not be exactly symmetrical.		
19	Candidates may be asked to estimate mean and standard deviation from a Normal curve.	μ for population mean σ for population standard deviation	Calculation of Normal probabilities.
20			

INTRODUCTION TO QUANTITATIVE METHODS (IQM)

Specification	Ref.	Competence Statements
FINANCE		
The financial cycle.	IQMF1	Be able to decide what information is needed to address a financial situation.
	2	Know how to obtain the necessary information.
	3	Be able to carry out calculations based on the information to provide one or more possible solutions to the situation.
	4	Be able to decide which, if any, of the solutions are appropriate.
Percentages.	5	Be able to do calculations involving percentages in context.
	6	Know how to use percentages to work with appreciation or depreciation.
	7	Be able to work out an average annual percentage growth (or reduction) rate for a given change over a period.
Foreign exchange.	8	Be able to use foreign exchange rate information to make calculations, including calculations for currency exchange with commission or a fee.
Costing.	9	Be able to work out the regular outgoing cost for a large financial decision.
	10	Be able to find relevant information from tables.
	11	Be able to use a spreadsheet to cost a project or business proposal, recognising that some costs are more variable than others over time.
	12	Be able to use a demand curve as a model for the relationship between price and demand.
	13	Understand and use the language of finance.

INTRODUCTION TO QUANTITATIVE METHODS (IQM)

Ref.	Notes	Notation	Exclusions
FINANCE			
IQMF1			
2	The information may be available on a graph or diagram.		
3			
4			
5	The use of a spreadsheet or calculator may be required. Examples of contexts include VAT and compound interest for savings or loans. Expected calculations include forward and reverse percentage increase and decrease, repeated percentage change and finding a percentage change.		
6	Including comparison of an annual percentage depreciation (or appreciation) model with actual values over time.		
7	Contexts include those outside finance.		
8	In the UK, 'We sell at 1.54, we buy at 1.69' means that when converting from pounds to the currency, a customer gets 1.54 of the currency for £1, but when changing the currency to pounds, 1.69 of the currency is needed for £1.		
9	Examples include the monthly cost of buying and running a car or renting and running a home.		
10			
11	Candidates may be asked to monitor whether a budget is being followed over time, and to calculate projected costs from the budget.		
12		Demand curves will have demand on the horizontal axis and price on the vertical axis.	
13	Words such as income, expenditure, budget, profit, loss, investment, tax.		

INTRODUCTION TO QUANTITATIVE METHODS (IQM)

Specification	Ref.	Competence Statements
WORKING WITH EXPONENTIALS		
Standard form.	IQMI1	Be able to read and write large or small numbers in standard form, including the use of a spreadsheet or calculator.
	2	Be able to calculate with numbers in standard form.
Exponentials.	3	Be able to explore exponential growth and decay, including interpreting output from a spreadsheet.
	4	Be able to represent and interpret exponential growth or decay in a graph.
	5	Be able to solve equations of the forms $x^5 = 35$ and $1.05^x = 8.2$.
Logarithmic scales.	6	Be able to use and interpret a logarithmic scale on a graph.

INTRODUCTION TO QUANTITATIVE METHODS (IQM)

Ref.	Notes	Notation	Exclusions
WORKING WITH EXPONENTIALS			
IQM11	Standard form is sometimes called scientific notation.	3.1×10^8 3.1 E +08 3.1 E +008 3.1 EXP 08	
2	E.g. contexts such as astronomy, wavelengths, atoms or cells.		
3	Contexts include borrowing and saving money, bacterial growth and radioactive decay.	APR, AER	
4	Includes knowing that for exponential growth and decay over time, the amount is multiplied (or divided) by a constant factor for fixed time. Candidates may be asked to plot or sketch graphs.	Half life $y = ka^x$ with k and a constant	
5			Use of logarithms to solve equations of the form $1.05^x = 8.2$.
6	Candidates should know that the value equidistant between a and b on a linear scale is the arithmetic mean $\left(\frac{a+b}{2}\right)$ but for a logarithmic scale it is the geometric mean (\sqrt{ab}) .		

INTRODUCTION TO QUANTITATIVE METHODS (IQM)

Specification	Ref.	Competence Statements
WORKING WITH GRAPHS AND GRADIENTS		
Graphs.	IQMf1	Know that the independent variable is plotted on the horizontal axis of a graph.
	2	Be able to construct a table of values for a graph from a simple formula and use it to plot the graph.
	3	Be able to use a graph to construct a table of values.
	4	Be able to work with graphs drawn from a variety of contexts.
	5	Understand the terms displacement, distance, velocity, speed, acceleration.
	6	Be able to convert between commonly used units.
Gradients.	7	Be able to find the gradient of a straight line graph and interpret it in context, taking account of the scales on the axes
	8	Be able to find the gradient of a curve at a point by drawing a tangent and interpret it as a rate of change.

INTRODUCTION TO QUANTITATIVE METHODS (IQM)

Ref.	Notes	Notation	Exclusions
WORKING WITH GRAPHS AND GRADIENTS			
IQMf1		Dependent variable, response variable, independent variable, explanatory variable.	
2			Formulae with more than four terms.
3			
4	E.g. graphs representing motion along a straight line. E.g. time series graphs.		
5			
6	E.g. units of time, speed.		Knowing conversion factors between metric and imperial units.
7	Includes finding units for the gradient from units on the axes.		
8	Includes e.g. kinematics graphs and growth curves.		

INTRODUCTION TO QUANTITATIVE METHODS (IQM)

Specification	Ref.	Competence Statements
RISK		
Probability.	IQMu1	Be able to identify relevant equally likely outcomes in appropriate contexts.
	2	Be able to count equally likely outcomes in appropriate contexts and hence estimate a probability.
	3	Be able to estimate probability as long-run relative frequency.
	4	Be able to interpret two-way tables and use them to calculate or estimate probability.
	5	Understand the difference between dependent and independent events and be able to calculate probability in simple cases.
	6	Be able to work with a tree diagram when calculating or estimating a probability, including conditional probability.
Risk.	7	Understand risk given as either a probability or as 1 in n .
	8	Be able to interpret a risk assessment, understanding that it involves measures of both likelihood and impact.

INTRODUCTION TO QUANTITATIVE METHODS (IQM)

Ref.	Notes	Notation	Exclusions
RISK			
IQMu1	Includes understanding when outcomes are not equally likely.		
2	Includes listing and use of tree diagrams to find number of outcomes.		Formal understanding of factorials, permutations and combinations.
3			
4			
5	Contexts include gambling and risk of suffering from diseases.		
6	Candidates can choose to work with either frequencies or probabilities in tree diagrams.		Notation $P(A)$, $P(A B)$ etc.
7	Include moving between these forms.		
8			

Introduction to Quantitative Methods (IQM) Coursework: Using the statistical problem-solving cycle with the aid of a spreadsheet

Rationale

The aim of this coursework is that candidates should gain a better understanding of the statistical problem-solving cycle, sampling procedures and the use of ICT in real-life situations.

The objectives are that candidates should:

- undertake the various steps in the statistical problem-solving cycle, using the techniques in this unit,
- use a spreadsheet to help with calculations and diagrams
- write a report on their investigation.

The investigation should cover skills and topics which are, by their nature, unsuitable for assessment within a timed examination. In particular, the report on the investigation should demonstrate an ability to use a spreadsheet to complete calculations and to facilitate the drawing of diagrams. As a result of this piece of coursework, candidates should gain a better understanding of the statistical problem-solving cycle, sampling procedures and the use of ICT in real-life situations.

Requirements

- Candidates will each carry out their own statistical investigation, explaining why it is worth doing.
- They will analyse their chosen problem and plan how to proceed.
- They will collect their own primary data or find and use secondary data.
- They will choose and produce appropriate statistical diagrams and calculations with the aid of a spreadsheet, and explain their choice.
- They will interpret their outcomes, relating them to the original problem.
- They will reflect on their conclusions.

The data and investigation may be related to one of the candidate's other subjects, but the final write-up must be submitted in a form appropriate for Quantitative Methods. It is not permitted to hand in a coursework report written for another subject as the coursework report for this unit. This mirrors the real world, where the same research often leads to different papers written for different audiences.

Either primary or secondary data may be used.

- Primary data may be collected in pairs or small groups, but each candidate must explain independently the decisions made about how the data were collected and checked. Candidates should be made aware of safety issues when collecting data.
- Secondary data should be found by each candidate independently. The teacher should not provide secondary data.

A small number of candidates may work on the same problem if it involves collecting primary data. This might occur, for example, if the problem arises from a field trip or experiment in another subject. They may work together on collecting data. Subsequent to the data being collected they must work independently. Their reports must be independently written.

Candidates will produce appropriate statistical graphs and calculations with the aid of a spreadsheet. Tables of data and calculations should be cut and pasted into the report with annotations to explain what formulae have been used. Graphs should also be cut and pasted into the report. However, if a candidate needs to use a type of graph which is not drawn correctly by the spreadsheet being used then the graph can be drawn with the aid of other available software or by hand; the reason for this should be noted in the report.

It is not expected that candidates will use statistical techniques beyond those in this unit specification in their coursework. In particular, candidates are not expected to conduct a formal statistical hypothesis test.

Choice of problem to investigate

OCR does not supply a bank of tasks for this coursework, and neither should the teacher. It is for each candidate to choose a problem to engage with that he or she feels is worthwhile. Selecting a problem based on a candidate's other subjects, or on a real-world issue, is to be strongly encouraged.

It is appropriate for candidates to check with their teacher whether the problem they wish to investigate will allow them to show all aspects of the problem-solving cycle, but teachers must be careful not to give undue help at the planning stage.

The coursework task represents 20% of the assessment and the work involved should be consistent with that figure, both in quantity and level of sophistication. The length of the final report submitted will depend on a number of factors, including the number and size of diagrams included but it is unlikely that a candidate will be able to cover all the essentials in fewer than four pages. Conversely, anything over twenty pages is likely to be either repetitive or too detailed.

Although more than one candidate may choose to work on the same problem, it is expected that candidates will usually choose to work on different problems.

Use of language

Candidates are expected to use clear, precise and appropriate mathematical language as described in Assessment Objective 2 (see Section 3.1).

Oral Communication

Each candidate must talk about the task; this may take the form of a class presentation at the end of the coursework period, an interview with the assessor or ongoing discussion with the assessor while the work is in progress. This oral communication will be assessed.

Assessment

Each task must be assessed on one of the coursework assessment sheets, A or B, depending on whether the candidate has mainly used primary or secondary data. It is the assessor's decision which sheet should be used; only one sheet may be used and the external moderator will judge the marking against the sheet chosen by the assessor.

Assessing the oral communication domain will assist the assessor in being able to sign with confidence the declaration that each candidate's work is his or her own.

Introduction to Quantitative Methods (IQM) Coursework: Assessment Sheet A

Investigation Using Primary Data

Task: Candidates will carry out an investigation of their own choice, collecting a suitable sample of data which they will describe and interpret in a written report. Diagrams and calculations will be done with the aid of a spreadsheet.

Coursework Title											
Candidate Name						Candidate Number					
Centre Number						Date					
Domain	Mark	Description					Comment	Mark			
Aim	1	The aim of the investigation is stated in clear English and there is a convincing explanation of why the investigation is worth doing.									
Plan	1	The population is defined and there is an explanation of what sample size will be used and why.									
	1	There is a clear justification of why the sampling method to be used was chosen.									
Data Collection	1	There is a clear explanation of the use of the sampling method and how efforts were made to ensure that the data are of good quality.									
	1	The data are neatly and concisely presented.									
Displays	1	The diagrams are appropriate for the data, and there are no undue duplications or omissions.									
	1	There is a clear and correct explanation of why the diagram(s) are appropriate for the data and investigation.									
	1	The diagrams are produced with the aid of a spreadsheet and are labelled correctly and clearly with suitable scales and titles.									
Calculations	1	Calculations are attempted that are suitable for analysing the data, with no obvious omissions. The calculations are shown via annotated print outs from the spreadsheet of formulae and of values.									
	1	There is a clear and correct explanation of why the calculation(s) are appropriate for the data and investigation.									
	1	The calculations are substantially correct. Answers are rounded appropriately.									
Interpretation	1	Conclusions are drawn which relate to the aim of the investigation.									
	1	The candidate indicates clearly what has been discovered and the implications of the conclusion in relation to the population.									
Accuracy and refinements	1	The report includes a sensible discussion of the possible sources of error and the restrictions imposed by the source of the data and the method of collection.									
	1	The report includes a discussion of questions which are raised by the work.									
Written communication	1	The report is clearly written and can be understood by a non-specialist.									
Oral communication	2	Presentation		Please tick at least one box and give a brief report.							
		Interview									
		Discussion									
Half marks may be awarded but the overall total must be an integer. Please report overleaf on any help that the candidate has received beyond the guidelines							TOTAL	18			

Coursework must be available for moderation by OCR

Introduction to Quantitative Methods (IQM) Coursework: Assessment Sheet B

Investigation Using Secondary Data

Task: Candidates will carry out an investigation of their own choice, finding and using a suitable sample of data which they will describe and interpret in a written report. Diagrams and calculations will be done with the aid of a spreadsheet.

Coursework Title									
Candidate Name				Candidate Number					
Centre Number						Date			
Domain	Mark	Description				Comment	Mark		
Aim	1	The aim of the investigation is stated in clear English and there is a convincing explanation of why the investigation is worth doing.							
Plan	1	The population is defined and there is an explanation of what source of secondary data will be used and why.							
	1	There is a clear and concise explanation of the sampling method which was used by the providers of the secondary data or, if this information is not available, an explanation of why the sampling method matters.							
Data Collection	1	There is a clear explanation of efforts that were made to ensure that the data are of good quality and steps taken to check the validity of the data.							
	1	The data are neatly and concisely presented.							
Displays	1	The diagrams are appropriate for the data, and there are no undue duplications or omissions.							
	1	There is a clear and correct explanation of why the diagram(s) are appropriate for the data and investigation.							
	1	The diagrams are produced with the aid of a spreadsheet and are labelled correctly and clearly with suitable scales and titles.							
Calculations	1	Calculations are attempted that are suitable for analysing the data, with no obvious omissions. The calculations are shown via annotated print outs from the spreadsheet of formulae and of values.							
	1	There is a clear and correct explanation of why the calculation(s) are appropriate for the data and investigation.							
	1	The calculations are substantially correct. Answers are rounded appropriately.							
Interpretation	1	Conclusions are drawn which relate to the aim of the investigation.							
	1	The candidate indicates clearly what has been discovered and the implications of the conclusion in relation to the population.							
Accuracy and refinements	1	The report includes a sensible discussion of the possible sources of error and the restrictions imposed by the source of the data and the method of collection.							
	1	The report includes a discussion of questions which are raised by the work.							
Written communication	1	The report is clearly written and can be understood by a non-specialist.							
Oral communication	2	Presentation		Please tick at least one box and give a brief report.					
		Interview							
		Discussion							
Half marks may be awarded but the overall total must be an integer. Please report overleaf on any help that the candidate has received beyond the guidelines						TOTAL	18		

Coursework must be available for moderation by OCR

BLANK PAGE

6.3 Statistics 1 (S1) (G245)

Objectives

To enable students to build on and extend the data handling and sampling techniques they have learnt at GCSE.

To enable students to apply theoretical knowledge to practical situations using simple probability models.

To give students insight into the ideas and techniques underlying hypothesis testing.

Assessment

Examination

72 marks
100% of the total marks for this unit
1 hour 30 minutes

The examination paper has two sections:

Section A: 5 – 7 questions, each worth at most 8 marks.
Section total: 36 marks

Section B: two questions, each worth about 18 marks.
Section total: 36 marks

Assumed Knowledge

Candidates are expected to know the content for Intermediate Tier GCSE*. In addition, they need to know the binomial expansion for positive integer exponents.

*See note in Section 5.1.

Calculators

For all units in the AS Quantitative Methods (MEI) specification, including this one, a graphical or scientific calculator is allowed.

The use of an asterisk* in a competence statement indicates assumed knowledge. These items will not be the focus of examination questions and are included for clarity and completeness. However, they may be used within questions on more advanced statistics.

STATISTICS 1 (S1)		
Specification	Ref.	Competence Statements
PROCESSES		
<i>This section is fundamental to statistics, and is introduced in IQM. In this unit, the ideas may be used in examination questions but will not be their main subject.</i>		
Statistical modelling.	S1p1	Be able to abstract from a real world situation to a statistical description (model).
	2	Be able to apply an appropriate analysis to a statistical model.
	3	Be able to interpret and communicate results.
	4	Appreciate that a model may need to be progressively refined.
Sampling.	5	* Understand the meanings of the terms population and sample.
	6	* Be aware of the concept of random sampling.
DATA PRESENTATION		
Classification and visual presentation of data.	S1D1	* Know how to classify data as categorical, discrete or continuous.
	2	* Understand the meaning of and be able to construct frequency tables for ungrouped data and grouped data.
	3	* Know how to display categorical data using a pie chart or a bar chart.
	4	Know how to display discrete data using a vertical line chart.
	5	Know how to display continuous data using a histogram for both unequal and equal class intervals.
	6	* Know how to display and interpret data on a stem and leaf diagram.
	7	* Know how to display and interpret data on a box and whisker plot.
	8	Know how to display and interpret a cumulative frequency distribution.
	9	Know how to classify frequency distributions showing skewness.

STATISTICS 1 (S1)

Ref.	Notes	Notation	Exclusions
PROCESSES			
<i>This section is fundamental to statistics, and is introduced in IQM. In this unit, the ideas may be used in examination questions but will not be their main subject.</i>			
S1p1	Approximation and simplification involving appropriate distributions and probability models.		Formal definitions.
2			
3	Their implications in real-world terms.		
4	Check against reality.		
5			
6			
DATA PRESENTATION			
S1D1			
2	Define class intervals and class boundaries.		
3			
4			
5	Area proportional to frequency. Use of the term frequency density will be expected.		
6	The term stemplot is also widely used. Stem and leaf diagrams will be expected to be sorted.		
7	The term boxplot is also widely used. The term outlier can be applied to data which are at least $1.5 \times \text{IQR}$ beyond the nearer quartile.		
8			
9	Positive and negative skewness.		Measures of skewness.

STATISTICS 1 (S1)

Specification	Ref.	Competence Statements
DATA PRESENTATION (continued)		
Measures of central tendency and dispersion.	10	Know how to find median*, mean*, mode* and midrange.
	11	Know the usefulness of each of the above measures of central tendency.
	12	Know how to find range*, percentiles, quartiles* and interquartile range*.
	13	Know how to calculate and interpret mean squared deviation, root mean squared deviation, variance and standard deviation.
	14	Be able to use the statistical functions of a calculator to find mean, root mean square deviation and standard deviation.
	15	Know how the mean and standard deviation are affected by linear coding.
	16	Understand the term outlier.

STATISTICS 1 (S1)

Ref.	Notes	Notation	Exclusions
DATA PRESENTATION			
10	For raw data, frequency distributions, grouped frequency distributions.	Mean = \bar{x}	
11			
12			
13	For raw data, frequency distributions, grouped frequency distributions. The term outlier can be applied to data which are at least 2 standard deviations from the mean. $msd = \frac{S_{xx}}{n} = \frac{1}{n} \sum_{i=1}^n (x_i - \bar{x})^2, rmsd = \sqrt{msd}.$ Sample variance: $s^2 = \frac{S_{xx}}{n-1} = \frac{1}{(n-1)} \sum_{i=1}^n (x_i - \bar{x})^2.$ (†) Sample standard deviation: $s = \sqrt{\text{variance}}.$ (§)	$msd, rmsd$ s^2 s	Corrections for class interval in these calculations.
14			
15	$y_1 = a + bx_i \Rightarrow \bar{y} = a + b\bar{x}, s_y^2 = b^2 s_x^2$		Proof of equivalence will not be tested.
16	The term outlier can be applied to data which are: (a) at least 2 standard deviations from the mean; (b) at least $1.5 \times \text{IQR}$ beyond the nearer quartile.		

DATA PRESENTATION

Notation for sample variance and sample standard deviation

The notations s^2 and s for sample variance and sample standard deviation, respectively, are written into both British Standards (BS3534-1, 1993) and International Standards (ISO 3534).

The definitions are those given above in equations (†) and (§). The calculations are carried out using divisor $(n-1)$.

In this specification, the usage will be consistent with these definitions. Thus the meanings of 'sample variance', denoted by s^2 , and 'sample standard deviation', denoted by s , are uniquely defined, as calculated with divisor $(n-1)$.

In early work in statistics it is common practice to introduce these concepts with divisor n rather than $(n-1)$. However there is no recognised notation to denote the quantities so derived.

In this specification, in order to ensure unambiguity of meaning, these quantities will be referred to by the functional names of 'mean square deviation' and 'root mean square deviation'. The letters msd and $rmsd$ will be used to denote their values.

Candidates should be aware of the variations in notation used by manufacturers on calculators and know what the symbols on their particular models represent.

STATISTICS 1 (S1)

Specification	Ref.	Competence Statements
PROBABILITY		
Probability of events in a finite sample space.	S1u1	Know how to calculate the probability of one event.
	2	Understand the concept of a complementary event and know that the probability of an event may be found by finding that of its complementary event.
Probability of two or more events which are: (i) mutually exclusive; (ii) not mutually exclusive.	3	Know how to draw sample space diagrams to help calculate probabilities.
	4	Know how to calculate the expected frequency of an event given its probability.
	5	Understand the concepts of mutually exclusive events and independent events.
	6	Know to add probabilities for mutually exclusive events.
	7	Know to multiply probabilities for independent events.
	8	Know how to use tree diagrams to assist in the calculation of probabilities.
	9	Know how to calculate probabilities for two events which are not mutually exclusive.
Conditional probability.	10	Be able to use Venn diagrams to help calculations of probabilities for up to three events.
	11	Know how to calculate conditional probabilities by formula, from tree diagrams or sample space diagrams.
	12	Know that $P(B A) = P(B) \Leftrightarrow B$ and A are independent.
DISCRETE RANDOM VARIABLES		
Probability distributions.	S1R1	Be able to use probability functions, given algebraically or in tables.
Calculation of probability, expectation (mean) and variance.	2	Be able to calculate the numerical probabilities for a simple distribution.
	3	Be able to calculate the expectation (mean), $E(X)$, in simple cases and understand its meaning.
	4	Be able to calculate the variance, $\text{Var}(X)$, in simple cases.

STATISTICS 1 (S1)			
Ref.	Notes	Notation	Exclusions
PROBABILITY			
S1u1			
2		$P(A)$ A' is the event 'Not A '.	
3			
4		Expected frequency: $n P(A)$.	
5			Formal notation and definitions.
6	To find $P(A \text{ or } B)$.		
7	To find $P(A \text{ and } B)$ Including the use of complementary events. e.g. finding the probability of at least one 6 in five throws of a die.		
8			
9			
10	Candidates should understand, though not necessarily in this form, the relation: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$.		Probability of a general or infinite number of events. Formal proofs.
11	$P(A \cap B) = P(A) \cdot P(B A)$	$P(B A)$	
12	In this case $P(A \cap B) = P(A) \cdot P(B)$.		
DISCRETE RANDOM VARIABLES			
S1R1	In S1 questions will only be set on simple finite distributions.		
2		$P(X = x)$	
3		$E(X) = \mu$	
4	Knowledge of $\text{Var}(X) = E(X^2) - \mu^2$.	$\text{Var}(X) = E[(X - \mu)^2]$	

STATISTICS 1 (S1)

Specification	Ref.	Competence Statements
THE BINOMIAL DISTRIBUTION AND ITS USE IN HYPOTHESIS TESTING		
Situations leading to a binomial distribution.	S1H1	Recognise situations which give rise to a binomial distribution.
	2	Be able to identify the binomial parameter p , the probability of success.
Calculations relating to binomial distribution.	3	Be able to calculate probabilities using the binomial distribution.
	4	Know that ${}^n C_r$ is the number of ways of selecting r objects from n .
	5	Know that $n!$ is the number of ways of arranging n objects in line.
Knowledge of mean.	6	Understand and apply mean = np .
Calculation of expected frequencies.	7	Be able to calculate the expected frequencies of the various possible outcomes from a series of binomial trials.
Hypothesis testing for a binomial probability p .	8	Understand the process of hypothesis testing and the associated vocabulary.
	9	Be able to identify Null and Alternative Hypotheses (H_0 and H_1) when setting up a hypothesis test on a binomial probability model.
	10	Be able to conduct hypothesis tests at various levels of significance.
	11	Be able to identify the critical and acceptance regions.
	12	Be able to draw a correct conclusion from the results of a hypothesis test on a binomial probability model.
	13	Understand when to apply 1-tail and 2-tail tests.

STATISTICS 1 (S1)

Ref.	Notes	Notation	Exclusions
THE BINOMIAL DISTRIBUTION AND ITS USE IN HYPOTHESIS TESTING			
S1H1			
2	As a model for observed data.	$B(n, p), q = 1 - p$ ~ means 'has the distribution'.	
3	Including use of tables of cumulative binomial probabilities.		
4		${}^n C_r = \binom{n}{r} = \frac{n!}{(n-r)!r!}$	
5			
6			Formal proof of variance of the binomial distribution.
7			
8	Null hypothesis, alternative hypothesis. Significance level, 1-tail test, 2-tail test. Critical value, critical region, acceptance region.		
9		H_0, H_1	
10			Normal approximation.
11			
12			
13			

BLANK PAGE

6.4 Decision Mathematics 1 (D1) (G246)

Objectives

To give students experience of modelling and of the use of algorithms in a variety of situations.

To develop modelling skills.

The problems presented are diverse and require flexibility of approach. Students are expected to consider the success of their modelling, and to appreciate the limitations of their solutions.

Assessment

Examination

72 marks
100% of the total marks for this unit
1 hour 30 minutes

The examination paper has two sections:

Section A: three questions, each worth about 8 marks.
Section Total: 24 marks

Section B: three questions, each worth about 16 marks.
Section Total: 48 marks

Assumed Knowledge

Candidates are expected to know the content for Intermediate Tier GCSE*.

*See note in Section 5.1.

Calculators

For all units in the AS Quantitative Methods (MEI) specification, including this one, a graphical or scientific calculator is allowed.

DECISION MATHEMATICS 1 (D1)

Specification	Ref.	Competence Statements
MODELLING		
<i>This unit in Decision Mathematics is based on the use of the modelling cycle in solving problems.</i>		
The modelling cycle applied to real-world problems.	D1p1	Be able to abstract from a real-world problem to a mathematical model.
	2	Be able to analyse the model appropriately.
	3	Be able to interpret and communicate results.
	4	Be able progressively to refine a model as appropriate.
ALGORITHMS		
Background and definition.	D1A1	Be able to interpret and apply algorithms presented in a variety of formats.
	2	Be able to develop and adapt simple algorithms.
Basic ideas of complexity.	3	Understand the basic ideas of algorithmic complexity.
	4	Be able to analyse the complexity of some of the algorithms covered in this specification.
GRAPHS		
Background and definitions.	D1g1	Understand notation and terminology.
Use in problem solving.	2	Be able to model appropriate problems by using graphs.
NETWORKS		
Definition.	D1N1	Understand that a network is a graph with weighted arcs.
Use in problem solving.	2	Be able to model appropriate problems by using networks.
The minimum connector problem.	3	Know and be able to use Kruskal's and Prim's algorithms.
The shortest path from a given node to other nodes.	4	Know and be able to apply Dijkstra's algorithm.

DECISION MATHEMATICS 1 (D1)

Ref.	Notes	Notation	Exclusions
MODELLING			
<i>This unit in Decision Mathematics is based on the use of the modelling cycle in solving problems.</i>			
D1p1	Approximation and simplification.		
2	Solution using an appropriate algorithm.		
3	Implications in real-world terms.		
4	Check against reality; adapt standard algorithms.		
ALGORITHMS			
D1A1	Flowcharts; written English; pseudo-code.		
2	To include sorting and packing algorithms. Sorting: Bubble, Shuttle, insertion, quick sort. Packing: Full-bin, first-fit, first-fit decreasing. Candidates will be expected to know these packing algorithms.		Candidates will not be required to memorise sorting algorithms.
3	Worst case; size of problem; that for quadratic algorithms doubling the size of a large problem can quadruple the solution time, etc.	Order notation, e.g. $O(n^2)$ for quadratic complexity	
4	Kruskal; Prim (network and tabular forms); Dijkstra.		
GRAPHS			
D1g1	Nodes/vertices; arcs/edges; trees; node order; simple, complete, connected and bipartite graphs; walks, trails, cycles and Hamilton cycles; trees; digraphs; planarity.	Pictures (i.e. graphs), incidence matrices.	
2	e.g. Königsberg bridges; various river crossing problems; the tower of cubes problem; filing systems.		
NETWORKS			
D1N1			
2	Use in modelling 'geographical' problems and other problems e.g. translating a book into different languages, e.g. the knapsack problem.		
3	Kruskal's algorithm in graphical form only. Prim's algorithm in graphical or tabular form.		
4			

DECISION MATHEMATICS 1 (D1)

Specification	Ref.	Competence Statements
LINEAR PROGRAMMING		
Linear inequalities in two or more variables.	D1L1	Be able to manipulate inequalities algebraically.
	2	Be able to illustrate linear inequalities in two variables graphically.
Formulation of constrained optimisation problems.	3	Be able to formulate simple maximisation of profit and minimisation of cost problems.
Solution of constrained optimisation problems.	4	Be able to use graphs to solve 2-D problems, including integer valued problems.
Algebraic interpretation of the graphical solution in 2 dimensions.	5	Be able to interpret solutions, including spare capacities.
CRITICAL PATH ANALYSIS		
Using networks in project management.	D1X1	Be able to construct and use a precedence network.
	2	Be able to construct and interpret a cascade chart.
	3	Be able to construct and interpret a resource histogram.
	4	Understand the use of alternative criteria in project optimisation.
	5	Be able to crash a network.
SIMULATION		
Random variables.	D1Z1	Know how to generate realisations of a discrete uniformly distributed random variable.
	2	Be able to use random variables to model discrete non-uniform random variables.
Simulation modelling.	3	Be able to build and use simple models.
	4	Be able to interpret results.
	5	Understand the need for repetition.

DECISION MATHEMATICS 1 (D1)

Ref.	Notes	Notation	Exclusions
LINEAR PROGRAMMING			
D1L1			
2			Non-linear problems.
3		$\begin{aligned} \text{Max } & 2x + 3y \\ \text{s.t. } & x + y \leq 6 \\ & 5x + 2y \leq 12 \\ & x \geq 0, y \leq 0 \end{aligned}$	Non-linear problems.
4	Showing alternating feasible points and their associated costs/profits.		Solving problems in more than 2 dimensions.
5			
CRITICAL PATH ANALYSIS			
D1X1	Including forward and backward passes, the identification of critical activities and the calculation of float (total and independent).	Activity on arc.	Knowledge of an algorithm for constructing a precedence network from a precedence table. Knowledge of an algorithm for numbering activities. Knowledge of an algorithm for resource smoothing.
2			
3			
4	Time; cost; use of resources.		
5	Checking critical activities and for activities becoming critical.		
SIMULATION			
D1Z1	Drawing numbers from a hat; coins; dice; pseudo-random numbers from a calculator; simple pseudo-random number generators; random number tables.		Continuous random variables.
2	Cumulative frequency methods, including rejecting values where necessary.		
3	Hand simulations, including queuing situations.		
4			
5			

The specification is supported by a complete package provided by MEI and OCR.

Online Support

- Web-based resources covering all the units in this specification
www.mei.org.uk and www.ocr.org.uk

Teaching Materials

- Textbooks, one each for *S1* and *D1*.

INSET and Teacher Support

- INSET courses provided by MEI.
- The MEI annual three-day conference.
- MEI branch meetings.
- Help from both MEI and OCR at the end of the telephone or by email.
- Regular newsletters from MEI.

Examinations

- Specimen examination papers and mark schemes.
- Past examination papers and mark schemes.
- Examiners' reports.
- Practice papers for new units.

Coursework

- Exemplar marked coursework.
- Reports to Centres from coursework moderators.

Contact details

MEI: contact details can be found at www.mei.org.uk

OCR: contact details can be found at www.ocr.org.uk

1 Set Notation

\in	is an element of
\notin	is not an element of
$\{x_1, x_2, \dots\}$	the set with elements x_1, x_2, \dots
$\{x: \dots\}$	the set of all x such that ...
$n(A)$	the number of elements in set A
\emptyset	the empty set
E	the universal set
A'	the complement of the set A
(x, y)	the ordered pair x, y
\cup	union
\cap	intersection
$[a, b]$	the closed interval $\{x \in \mathbb{R}: a \leq x \leq b\}$
$[a, b)$	the interval $\{x \in \mathbb{R}: a \leq x < b\}$
$(a, b]$	the interval $\{x \in \mathbb{R}: a < x \leq b\}$
(a, b)	the open interval $\{x \in \mathbb{R}: a < x < b\}$

2 Miscellaneous Symbols

$=$	is equal to
\neq	is not equal to
\equiv	is identical to or is congruent to
\approx	is approximately equal to
\cong	is isomorphic to
\propto	is proportional to
$<$	is less than
\leq	is less than or equal to, is not greater than
$>$	is greater than
\geq	is greater than or equal to, is not less than
∞	infinity

3 Operations

$a + b$	a plus b
$a - b$	a minus b
$a \times b, ab, a.b$	a multiplied by b
$a \div b, \frac{a}{b}, a/b$	a divided by b
$\sum_{i=1}^n a_i$	$a_1 + a_2 + \dots + a_n$
$\prod_{i=1}^n a_i$	$a_1 \times a_2 \times \dots \times a_n$
\sqrt{a}	the positive square root of a
$ a $	the modulus of a
$n!$	n factorial
$\binom{n}{r}, {}^n C_r$	the binomial coefficient $\frac{n!}{r!(n-r)!}$ for $n \in \mathbb{Z}^+$ or $\frac{n(n-1)\dots(n-r+1)}{r!}$ for $n \in \mathbb{Q}$

4 Functions

$f(x)$	the value of the function f at x
--------	--------------------------------------

5 Probability and Statistics

$A, B, C, \text{ etc}$	events
$A \cup B$	union of the events A and B
$A \cap B$	intersection of the events A and B
$P(A)$	probability of the event A
A'	complement of the event A
$P(A B)$	probability of the event A conditional on the event B
$X, Y, R, \text{ etc.}$	random variables
$x, y, r, \text{ etc.}$	values of the random variables X, Y, R etc.
x_1, x_2, \dots	observations
f_1, f_2, \dots	frequencies with which the observations x_1, x_2, \dots occur
$p(x)$	probability function $P(X=x)$ of the discrete random variable X
p_1, p_2, \dots	probabilities of the values x_1, x_2, \dots of the discrete random variable X
$E(X)$	expectation of the random variable X
$E(g(X))$	expectation of $g(X)$
$\text{Var}(X)$	variance of the random variable X
$B(n, p)$	binomial distribution with parameters n and p
μ	population mean
σ^2	population variance
σ	population standard deviation
\bar{x}, m	sample mean
$s^2, \hat{\sigma}^2$	unbiased estimate of population variance from a sample, $s^2 = \frac{1}{n-1} \sum (x_1 - \bar{x})^2$







AS Level in Quantitative Methods (MEI) – an overview

This highly relevant specification gives students the mathematical skills to tackle problems in a variety of different real and realistic contexts. They're taught to use a modelling cycle, a statistical problem-solving cycle and a financial problem-solving cycle. The use of technology – in particular, spreadsheets – is an integral part of the course.

Introduction to Quantitative Methods (IQM)

This motivating unit encourages students to tackle problems in real or realistic contexts, using tools such as a spreadsheet where appropriate. They'll also see how maths is relevant to their other subjects.

In taking this unit, students can develop their ability to:

- Consolidate and extend the mathematics they've learnt at GCSE
- Develop transferable skills in maths
- Work fluently in a variety of contexts
- Use problem-solving cycles in modelling, statistics and financial mathematics
- Apply common sense to check the outcomes of calculations
- Use appropriate technology in their work.

Statistics 1 (S1)

In taking this unit, students can:

- Build on and extend the data handling and sampling techniques they've learnt at GCSE
- Apply theoretical knowledge to practical situations using simple probability models
- Gain insight into the ideas and techniques underlying hypothesis testing.

Decision Mathematics 1 (D1)

In taking this unit, students can:

- Gain experience of modelling and the use of algorithms in a variety of situations
- Develop modelling skills.

The problems presented are diverse and require flexibility of approach. Students are expected to consider the success of their modelling, and to appreciate the limitations of their solutions.

Your Checklist

Our aim is to provide you with all the information and support you need to deliver our specifications.



Bookmark ocr.org.uk/asqm



Be among the first to hear about support materials and resources as they become available. Register for email updates at ocr.org.uk/updates



Join our social network community for teachers at social.ocr.org.uk

If you want to find out more about the Level 3 Certificate in Quantitative Methods (MEI) visit ocr.org.uk/iqm

Staff at the OCR Customer Contact Centre are available to take your call between office hours.

Telephone 01223 553998

Facsimile 01223 552627

Email general.qualifications@ocr.org.uk

Post Customer Contact Centre, OCR,
Progress House, Westwood Business Park,
Coventry CV4 8JQ

