



Higher National Unit specification

General information

Unit title: Statistics for Science 2 (SCQF level 7)

Unit code: H8XV 34

Superclass: RB

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Version: 03

Unit purpose

This Unit is designed to enable learners to utilise advanced statistical techniques used in scientific analysis. This Unit leads on from H8XT 33 *Statistics for Science 1*. Learners will develop an insight into where and when these statistical techniques should be employed, and will apply this knowledge in the context of scientific problems.

Outcomes

On successful completion of the Unit the learner will be able to:

- 1 Explain and demonstrate an understanding of appropriate sampling techniques.
- 2 Determine confidence intervals and test hypothesis.
- 3 Interpret and apply non-parametric tests.

Credit points and level

1 Higher National Unit credit at SCQF level 7: (8 SCQF credit points at SCQF level 7)

Recommended entry to the Unit

Entry to this Unit is at the discretion of the centre, but learners would normally be expected to have achieved the H8XT 33 *Statistics for Science 1* Unit, or hold a qualification in statistics at SCQF level 6.

Higher National Unit Specification: General information (cont)

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Core Skills

Achievement of this Unit gives automatic certification of the following Core Skills component:

Complete Core Skill	None
Core Skill component	Using Number at SCQF level 6 Critical Thinking at SCQF Level 6

Context for delivery

If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

The Assessment Support Pack (ASP) for this Unit provides assessment and marking guidelines that exemplify the national standard for achievement. It is a valid, reliable and practicable assessment. Centres wishing to develop their own assessments should refer to the ASP to ensure a comparable standard. A list of existing ASPs is available to download from SQA's website (<http://www.sqa.org.uk/sqa/46233.2769.html>).

Equality and inclusion

This Unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

Higher National Unit specification: Statement of standards

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Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the Knowledge and/or Skills section must be taught and available for assessment. Learners should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Explain and demonstrate an understanding of appropriate sampling techniques.

Knowledge and/or Skills

- ◆ Explain and demonstrate an understanding of appropriate sampling techniques:
 - Random Sampling
 - Systematic Sampling
 - Stratified Sampling
 - Multi Stage Sampling

Outcome 2

Determine confidence intervals and test hypothesis.

Knowledge and/or Skills

- ◆ Confidence limits and intervals
- ◆ Hypothesis Testing: z-test, f-test, t-test

Outcome 3

Interpret and apply non-parametric tests.

Knowledge and/or Skills

- ◆ Wilcoxon test
- ◆ Mann-Whitney test
- ◆ Chi-squared test

Higher National Unit specification: Statement of standards (cont)

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Evidence Requirements for this Unit

Learners will need to provide evidence to demonstrate their knowledge and/or skills across all Outcomes by showing that they can:

Outcome 1

Explain and demonstrate an understanding of appropriate sampling techniques.

- ◆ Provide definitions, explanations and examples of two of these four statistical concepts:
 - Random Sampling
 - Systematic Sampling
 - Stratified Sampling
 - Multi Stage Sampling

Outcome 2

Determine confidence intervals and test hypothesis.

- ◆ Perform one calculation involving confidence limits and intervals
- ◆ Perform calculations involving two of the following three hypothesis tests (stating the null and alternative hypothesis)
 - z-test
 - f-test
 - t-test

Outcome 3

Interpret and apply non-parametric tests.

- ◆ Test two of the following three knowledge and skills:
 - Wilcoxon test
 - Mann-Whitney test
 - Chi-squared test

Assessment should be conducted under closed-book, controlled and invigilated conditions.

Learners should not have information in advance about the content of the assessment.

Learners should be provided with a formulae sheet appropriate to the content of this Unit when undertaking their assessment (this could include data tables and definitions of probability distributions).

It is recommended that this assessment be conducted in a single, holistic, end of Unit test, although assessment may be conducted Outcome by Outcome, or in groups of Outcomes. The questions in the examination should not be grouped by Outcome or be labelled in terms of the Outcomes they relate to when a single end of Unit holistic examination is used.



Higher National Unit Support Notes

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Unit Support Notes are offered as guidance and are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

This Unit is one of a suite of four Units in Mathematics and Statistics developed for Higher National Qualifications across a range of Science disciplines. The four Units are:

- ◆ *Statistics for Science 1*
- ◆ *Statistics for Science 2*
- ◆ *Mathematics for Science 1*
- ◆ *Mathematics for Science 2*

This Unit leads on from the Statistics for Science 2 Unit.

Consideration of this list of topics alongside the Assessment Support Pack developed for this Unit will provide clear indication of the standard expected in this Unit.

Outcome 1

Explain and demonstrate an understanding of appropriate sampling techniques.

Examine different sampling techniques, and explore when each approach would be appropriate, considering their advantages and disadvantages in different circumstances. Consideration should be given to objectives and research design, sampling frame, sample sizes, sample planning, data collection, and review of sampling. Post stratification and Oversampling could be discussed.

Outcome 2

Determine confidence intervals and test hypothesis.

Explore desired confidence levels, desired confidence intervals, and how they relate to sample sizes. Consider confidence interval for the mean, and confidence interval for the difference between two means.

Consider the meaning of hypothesis testing, construction of null and alternative hypotheses, type I and type II errors, the selection of parametric test statistics (t-test, z-test, and f-test), significance level, the critical region, and decision.

Higher National Unit Support Notes (cont)

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Outcome 3

Interpret and apply non-parametric tests.

Consider tests used when parametric tests are not appropriate, and why. Examine situations where the Wilcoxon test (same population for multiple tests), and Mann-Whitney test (different population for multiple tests) are appropriate, and perform tests using these methods. Explore the Chi-squared test and its use for determining goodness of fit and independence, and perform tests using this method.

Guidance on approaches to delivery of this Unit

This Unit provides knowledge and understanding of advanced statistical principles and processes which underpin the studies undertaken in a number of Higher National Qualifications across a range of scientific disciplines.

Centres may deliver the Outcomes in any order they wish, but it is recommended that Outcome 1 is delivered first followed by Outcome 2, and then Outcome 3.

All teaching input should be supplemented by formative assessment in which learners are provided with opportunities to develop their knowledge, understanding and skills.

Computer software and computer algebra may be used to support learning.

Guidance on approaches to assessment of this Unit

Evidence can be generated using different types of assessment. A recommended approach is the use of an examination question paper. The question paper could be composed of an appropriate balance of short answer, restricted response and structured questions.

The summative assessment of all Outcomes — whether individually or at a single assessment event — should not exceed 3 hours. An appropriate threshold score may be set for the assessment of this Unit. A threshold score should be used for each assessment if Outcome level assessment is used.

Centres are reminded that submitting centre-devised assessments for prior verification would help to ensure that the national standard is being met.

Opportunities for e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by Information and Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at www.sqa.org.uk/e-assessment.

Higher National Unit Support Notes (cont)

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Opportunities for developing Core and other essential skills

Candidates gain an understanding of the principles involved in research design and statistical analysis of data, as well as development of their mathematical and computer software skills. This knowledge acts as a base as well as supplementing other Higher National Qualifications candidates undertake both at the current, and higher level.

Skills gained, i.e, data collection, and analysis should be looked at favourably by employers seeking employees who can accurately and systematically observe, record and analyse numerous types of data.

Opportunities for developing Core and other essential skills

This Unit has the Using Number component of Numeracy embedded in it. This means that when candidates achieve the Unit, their Core Skills profile will also be updated to show they have achieved Using Number and Critical Thinking at SCQF level 6.

History of changes to Unit

Version	Description of change	Date
02	Core Skills Component Using Number and Critical Thinking at SCQF level 6 embedded.	September 2015
03	Addition of opportunities for developing core and other essential skills. Addition of general information for learners.	16/09/2015

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General information for learners

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This section will help you decide whether this is the Unit for you by explaining what the Unit is about, what you should know or be able to do before you start, what you will need to do during the Unit and opportunities for further learning and employment.

The Statistics for Science 2 Unit is one of a suite of Mathematics and Statistics Units developed for Higher National Certificates across a range of Science disciplines. These Units help develop the mathematical skills required for workplace roles and for more advanced studies in Science.

This Unit is designed to develop or consolidate the basic level of statistical skills required of learners across a range of Science disciplines. The Unit is at the level equivalent to Higher Mathematics.

In this unit, you will learn :

- 1 Explain and demonstrate an understanding of appropriate Sampling Techniques
 - ◆ Explain and demonstrate an understanding of appropriate sampling techniques:
 - Random Sampling
 - Systematic Sampling
 - Stratified Sampling
 - Multi Stage Sampling
- 2 Determine confidence Intervals and Test Hypothesis
 - ◆ Perform one calculation involving confidence limits and intervals
 - ◆ Perform calculations involving two of the following three hypothesis tests (stating the null and alternative hypothesis)
 - z-test
 - f-test
 - t-test
- 3 Interpret and apply non-parametric tests.
 - ◆ Test two of the following three knowledge and skills:
 - Wilcoxon test
 - Mann-Whitney test
 - Chi-squared test

It is likely that Unit delivery will comprise of a significant teaching input from your lecturer. This will be supplemented by tutorial exercises which will allow you to develop the knowledge, understanding and skill to apply the statistical principles covered in the Unit to a range of Scientific problems.

Depending on which centre you attend, formal assessment may be conducted on an Outcome by Outcome basis or by one single assessment. Assessment will be conducted under closed-book, controlled and invigilated conditions.

Entry to this Unit is at the discretion of the centre, but learners would normally be expected to have achieved the H8XT 33 *Statistics for Science 1* Unit, or hold a qualification in statistics at SCQF level 6