National Unit Specification

General information

Unit title: Statistics for Science (SCQF level 5)

Unit code: HP9Y 45

Superclass:	RB
Publication date:	September 2017
Source:	Scottish Qualifications Authority
Version:	2

Unit purpose

The unit is intended for those learners who wish to gain the foundations of the Mathematics underpinning studies in all branches of Science. The unit develops basic skills in calculation, algebra, graph reading and drawing.

Outcomes

The unit is a single outcome. On successful completion of the unit the learner will be able to:

1   Perform statistical and probability calculations.

Credit points and level

1 National Unit credit at SCQF level 5: (6 SCQF credit points at SCQF level 5)

Recommended entry to the unit

Entry to the course is at the discretion of the centre, although a background in Numeracy and Mathematics at SCQF level 5 would be advantageous. This unit is designed to follow on from NC Mathematics for Science unit 5.1

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   *Numeracy* at SCQF level 5

Core Skill component   *Critical Thinking* at SCQF level 5

There are also opportunities to develop aspects of Core Skills which are highlighted in the Support Notes of this unit specification.

Context for delivery

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**.

National Unit Specification: Statement of standards

Unit title: Statistics for Science (SCQF level 5)

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.

Outcome 1

Perform statistical and probability calculations

Performance criteria

(a) Understand types of data and collection of data.
(b) Construct a back to back stem and leaf diagram.
(c) Calculate median, range, quartiles, IQR, SIQR.
(d) Compare two sets of data using comparative box plots.
(e) Draw a scatter plot and estimate the line of best fit graphically.
(f) Determine the best fit line equation and make a prediction from it.
(g) Describe the correlation between two variables from the scatter plot.
(h) Create a frequency table from raw data and illustrate it.
(i) Calculate the arithmetic mean and standard deviation from a frequency table.
(j) Compare two sets of data using mean and standard deviation.
(k) Perform probability calculations
    (i) Explore the laws of probability
    (ii) Combine probabilities using tree diagrams

Evidence requirements for this unit

Evidence is required to demonstrate that learners have achieved the unit.

Evidence should be produced under closed-book, supervised conditions.

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

Scientific calculators may be used, but computer algebra packages, graphical calculators or programmable calculators should not be used.

Sufficient working must be shown to demonstrate the method of solution.

Where reassessment is needed, an alternative instrument of assessment must be used.

Total assessment time should not exceed 2 hours.

National Unit Specification: Statement of standards

Unit title: Statistics for Science (SCQF level 5)

Outcome 1

♦ Understand types of data and collection of data:
— Identify qualitative, quantitative continuous and quantitative discrete data types from a short list of options.
— Identify, describe or compare the most appropriate of three methods of gathering data (cluster, simple random, and systematic).

♦ Construct a back to back stem and leaf diagram:
— Draw one back to back stem and leaf diagram (with key) to compare two distributions.

♦ Calculate median, range, quartiles, IQR, SIQR:
— Calculate median, range, quartiles, IQR and SIQR for one set of data.

♦ Compare two sets of data using comparative box plots:
— Construct two boxplots from two sets of data, and present them on the same diagram and make comments on the comparison.

♦ Determine the best fit line equation and make a prediction from it:
— Determine the best fit line equation from a given scatter plot without being able to read c from the y-axis.

♦ Describe the correlation between two variables from the scatter plot:
— Make a prediction from the equation of the line of best fit, and state whether this prediction is reliable based on the value of r and explain why.

♦ Create a frequency table from raw data and illustrate it:
— Create a frequency table from raw data.
— Prepare a line graph, dot plot or bar chart to illustrate this data.

♦ Calculate the arithmetic mean and standard deviation from the frequency table.

♦ Compare two sets of data using mean and standard deviation (weak/strong, positive/negative).

♦ Perform probability calculations:
— Explore the laws of probability.
— Calculate the probability of a given event using $\frac{number\ of\ outcomes}{number\ of\ possible\ outcomes}$.
— Combine probabilities using tree diagrams:
- Construct a tree diagram with two levels and two branches.
- Interpret a tree diagram with two levels and two branches.
- Interpret a tree diagram with three levels and three branches.

National Unit Support Notes

Unit title: Statistics for Science (SCQF level 5)

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 part of the National Certificate Group Awards in Applied Science, but can also be a free-standing unit. This unit aims to build on and extend the learner's knowledge of statistics and probability.

It is envisaged that the content of this unit is delivered in scientific contexts appropriate to the learner, whether as a unit of the group award or as a free-standing unit.

Applying the mathematical skills of the unit in meaningful scientific scenarios will enable the learner to appreciate that those skills are essential tools for scientific analysis.

Consideration of this list of topics alongside the assessment support pack for this unit will provide clear indication of the standard expected.

Outcome 1

Perform statistical and probability calculations

♦ Understand types of data and collection of data:
  — Identify qualitative, quantitative continuous and quantitative discrete data types.
  — Consider methods of gathering data (cluster, simple random, and systematic).

♦ Explore Stem and leaf diagrams, including using back to back stem and leaf diagram to compare two distributions.

♦ Calculate and explore the meaning of median, range, quartiles, IQR and SIQR.

♦ Compare examples of scientific data using comparative box plots:
  — Pharmaceutical testing is a field of research where multiple box plots are used commonly.

National Unit Support Notes (cont)

Unit title: Statistics for Science (SCQF level 5)

Outcome 1 (cont)

♦ Look at scientific data where a straight line of best fit can be drawn. Determine the best fit line equation, and consider the correlation of this data (looking at cases of strong and weak correlation, positive and negative). If time allows, calculate the correlation coefficient (select various data sets where this will have both large and small values). Make predictions from the line of best fit, and consider how reliable these predictions are based on the correlation of the data sets.

♦ Create a frequency table from raw data and illustrate this in a line graph, dot plot or bar chart.

♦ Calculate the arithmetic mean and standard deviation from the frequency table.

♦ Compare two sets of data using means and standard deviations.

♦ Perform probability calculations:
  — Explore the laws of probability:
    - If time allows, consider the difference between population and sample distributions (although this unit uses sample distributions).
    - Calculate the probability of a given event using $\frac{number\ of\ outcomes}{number\ of\ possible\ outcomes}$.
  — Explore the use of probability trees, both reading and drawing up to three levels with three branches.

Guidance on approaches to delivery of this unit

This unit provides skills, techniques and processes underpinning studies undertaken in Science, and as such, opportunities should be taken to contextualise delivery where possible.

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, computer algebra, and graphical calculators may be used to support learning (eg to confirm the solutions of mathematical problems).

Guidance on approaches to assessment of this unit

Evidence may be generated using different types of assessment. The following are suggestions only and there may be other methods that would be more suitable to learners.

The assessment papers could be composed of an appropriate balance of short answer, restricted response and structured questions. Most parts of this unit lend themselves to assessment using straightforward scientific contexts, and questions should be contextualised where appropriate.

Care should be taken to avoid excessively elaborate contexts or language.

National Unit Support Notes (cont)

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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**.

Opportunities for developing Core and other essential skills

This unit has the Core Skill of *Numeracy* embedded in it, so when learners achieve this unit their Core Skills profile will be updated to show that they have achieved *Numeracy* at SCQF Level 5.

This unit also has the *Critical Thinking* component of *Problem Solving* embedded in it. This means that when learners achieve the Unit, their Core Skills profile will also be updated to show they have achieved *Critical Thinking* at SCQF level 5.

Unit title: Statistics for Science (SCQF level 5)

History of changes to unit

Version	Description of change	Date
2	Core Skill Numeracy at SCQF level 5 embedded. Core Skills Component Critical Thinking at SCQF level 5 embedded.	12/09/2017

General information for learners

Unit title: Statistics for Science (SCQF level 5)

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 unit is intended to help you consolidate and develop you knowledge of the statistics underpinning studies in science. The unit develops basic skills in handling data using statistical methods and performing calculations suing probability.

The unit covers the following topics:

♦ Perform statistical and probability calculations:
  — You will learn how to collect and interpret data in the context of Science. You will look at basic data types, and look at different approaches to collection data, and when they might be appropriate. You will look at methods of collating and comparing data, as well as looking at methods to relate one set of data with another.
  — You will look at probability and its basic rules, as well as probability trees to combine probabilities.

Assessment

The assessment for this unit will be at the end of the unit, and will be closed-book (that is, you cannot take notes into the assessment). You will be allowed to use a scientific calculator, but not an advanced programmable or graphing calculator. Total assessment time will be a maximum of 2 hours.

Core Skills

This unit has the Core Skill of *Numeracy* embedded in it, so when you achieve this unit your Core Skills profile will be updated to show that you have achieved *Numeracy* at SCQF level 5.

This unit also has the *Critical Thinking* component of *Problem Solving* embedded in it. This means that when you achieve the unit, your Core Skills profile will also be updated to show you have achieved *Critical Thinking* at SCQF level 5.