Higher National Unit Specification

General information

Unit title: Communicating with Data (SCQF level 8)

Unit code: J4Y7 35

Superclass: CA

Publication date: December 2020

Source: Scottish Qualifications Authority

Version: 02

Unit purpose

This is a **specialist** unit suitable for learners who wish to develop their skills in the communication and visualisation of data in their data-related role, as well as those who wish to pursue a career in data analysis. It will benefit any learner who wishes to understand how to effectively communicate the results of data analysis to facilitate data-driven decision-making. It is complimentary to J4Y5 35 *Working with Data* at SCQF level 8.

Learners will develop practical skills in the design and creation of a range of data visualisations. They will learn techniques for communicating data effectively and accurately.

On completion of this unit, learners will be able to describe how organisations, in a range of sectors, use data communication to inform decision-making (including Key Performance Indicators (KPIs) and metrics), prepare data for visualisation, and design and create a range of data visualisations, including more advanced types of visualisations such as interactive dashboards. The unit also explores data ethics as they relate to the visualisation and communication of data.

This unit may be taken alongside, or after, J4Y5 34 *Working with Data* at SCQF level 8. At the completion of this unit, learners may progress to a variety of related units, such as *Programming for Data* and J4Y8 35 *Statistics for Data* at SCQF level 8.

Outcomes

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

1 Prepare data for visualisation.
2 Create a range of data visualisations to provide business intelligence.
3 Communicate insights using data visualisation.

Higher National Unit Specification: General information (cont)

Unit title: Communicating with Data (SCQF level 7)

Credit points and level

1 Higher National Unit credit at Scottish Credit and Qualifications Framework (SCQF) level 8: (8 SCQF credit points at SCQF level 8)

Recommended entry to the unit

Although entry is at the discretion of the centre, learners should have experience of data preparation, analysis and visualisation and be familiar with analysis software prior to undertaking this unit.

Core Skills

Achievement of this Unit gives automatic certification of the following:

Complete Core Skill Information and Communication Technology at SCQF level 6

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

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.

This unit may be taken alongside, or after, J4Y6 35 *Working with Data* at SCQF level 8. At the completion of this unit, learners may progress to a variety of related units, such as J4YB 35 *Programming for Data* SCQF level 8 and J4Y8 35 *Statistics for Data* at SCQF level 8.

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

Unit title: Communicating with Data (SCQF level 8)

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

Prepare data for visualisation.

Knowledge and/or skills

- Domain knowledge
- Business requirements
- Business processes and concept of data flow
- Data visualisation as a tool for decision-making
- Data types
- Data quality and data bias
- Preparing data for visualisation

Outcome 2

Create a range of data visualisations to provide business intelligence.

Knowledge and/or skills

- Data visualisation workflow
- Data visualisation as a tool for decision-making
- Types of data visualisation
- Selection of visualisation
- Key elements of a data visualisation
- Key Performance Indicators (KPIs)
- Design of data visualisations
- Creating visualisations using software
- Misleading visualisations

Higher National Unit Specification: Statement of standards (cont)

Unit title: Communicating with Data (SCQF level 8)

Outcome 3

Communicate insights using data visualisation.

Knowledge and/or skills

- Reports and dashboards
- Storytelling using data
- Characteristics of effective communication
- Presentation skills
- Ethical considerations in the communication, visualisation and presentation of data

Evidence requirements for this unit

The evidence requirements for this unit will take **two** forms:

1 Product evidence
2 Performance evidence

The product evidence will relate to outcome 1 and outcome 2. The product evidence will take the form of a number of visualisations of a large, complex, unfamiliar dataset, comprising real data, which will be supplied in analysed form although some data preparation is required. The visualisations must collectively satisfy the following criteria.

1 The visualisations must illustrate relationships and patterns in the data.
2 The visualisations must be well designed and aesthetically pleasing.
3 The visualisations must have high information content.
4 The visualisations must provide accurate insights into the dataset.
5 The visualisation must adhere to graphical conventions.
6 The visualisations must include geospatial and time series visualisations.

The product evidence may be generated in supervised or unsupervised conditions with access to learning materials. When evidence is produced in loosely controlled conditions, it must be authenticated. The *Guide to assessment* provides further advice on methods of authentication.

The performance evidence will relate to outcome 3. It will take the form of a presentation of their visualisations in the form of a dashboard or report. The presentation may be done in person or remotely. The presentation must satisfy the following criteria.

1 The presentation must be appropriate for a non-technical audience.
2 The presentation must tell a story in data that addresses specific business questions.
3 The presentation must minimise complexity.
4 The presentation must have high information content.
5 The presentation must identify key performance indicators
6 The presentation must provide insights into the dataset.
7 The presentation must provide data-driven conclusions or recommendations.
8 The presentation must demonstrate that data ethics has been considered.

Higher National Unit Specification: Statement of standards (cont)

Unit title: Communicating with Data (SCQF level 8)

The performance evidence must be observed and recorded. An observation checklist is required to ensure that the above criteria are satisfied.

There are no time limitations on the production of evidence. The evidence may be produced at any time during the life of the unit.

The SCQF level of this unit provides additional context on the nature of the required evidence and the associated standards. The level descriptors should be used (explicitly or implicitly) when making judgements about the evidence.

The *Guidelines on approaches to assessment* (see the support notes section of this specification) provides specific examples of instruments of assessment.

Higher National Unit Support Notes

Unit title: Communicating with Data (SCQF level 8)

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 intended for learners with experience of interpreting and creating data visualisations who wish to progress their skills in preparing data for visualisation (including transforming the data), creating more advanced visualisations (both with regard to the type of visualisation and the complexity of the underlying data), and using these visualisations to communicate insights to others.

Its focus is on how to create more advanced data visualisations and use them to communicate insights to others in a way which informs their decision-making. The unit is centred on data visualisation as a tool to communicate to others. Therefore, data visualisation as used by analysts (ie to better understand the data in a personal capacity during Exploratory Data Analysis) will not be covered in this unit.

The range of data visualisations used across the outcomes should go beyond the fundamental types (ie bar charts, histograms, scatter plots and line charts) and could, for example, include bubble charts, side-by-side box plots, time-series charts and maps. Additionally, faceting/small multiples should be introduced for some of these visualisation types as a way of comparing different partitions within a dataset. The range of types of visualisations chosen should include those from **more than two** of the following categories:

- Charts which support the comparison of categories, eg donut chart
- Charts which enable correlations to be explored, eg scatter plot
- Charts relating to hierarchies and part-to-whole relationships, eg a waffle chart
- Charts which show trends over time, eg a time-series line graph
- Charts which show spatial patterns, eg a dot map

It is expected that, for outcome 1, learners will be provided with suitable datasets from which to create data visualisations. These datasets:

- should be in a ‘tidy’ (ie normalised) format
- should be easily-accessible, ie it should be easy for the learner to extract the data
- may contain variables of more complex types, eg dates or geospatial data
- may require **some** data cleaning
- should require some of the data to be transformed
- should be accompanied with relevant information which is required to understand them, eg titles, labels, etc.

Higher National Unit Support Notes (cont)

Unit title: Communicating with Data (SCQF level 8)

Outcome 1 — Prepare data for visualisation.

Learners will be introduced to how data visualisation is used as a tool to enable individuals and organisations make informed decisions in a variety of domains such as business, science and sport. It may be possible to find examples that match the interests and/or experience of the learners. For a variety of domains, examples should be given of the kinds of questions that can be answered by using data visualisations, eg what is it telling you? Additionally, examples should be given of how data visualisations can *prompt* questions which can inform decision-making.

Learners should be exposed to a number of good examples from each of the following forms of data communication:

- **Dashboards** — at the time of writing, dashboards are a popular means to communicate data in a business context, particularly for data which relates to Key Performance Indicators (KPIs) and other business metrics. Learners should be exposed to examples of dashboards used within different business functions, including interactive dashboards. The role of interactive dashboards as a means of enabling end-users to *explore* data rather than simply *consume* it should be explored.
- **Charts**
- **Storytelling** — 'storytelling' refers to the construction of a verbal/written narrative structure which complements one or more data visualisations in order to make the 'message' conveyed by the visualisation(s) more compelling.

Learners should be made aware of the implications of transforming data in terms of reporting it, ie that they are no longer visualising 'raw' data, that this may need to be communicated to the audience for the resultant data visualisation, and that this can add a level of complexity into the communication as it may require an explanation of how the data has been transformed.

For each type of transformation, learners should learn the situations in which it can be applied and why the transformation is useful, as well as having an opportunity to practice applying the transformation to data. For example, if the data contains a timestamp and a time-series line chart is being created, it could be demonstrated how aggregating the data at different levels of granularity for this variable (ie second/minute/hour/day, etc) will reveal different trends.

For this outcome, learners should be made aware that, in addition to cleaning, data may require additional types of transformation to prepare it for visualisation. The following types of transformations may be appropriate for inclusion:

- Conversion, eg converting numbers to percentages and vice versa, or changing a numeric variable to a nominal variable (such as an age to 'adult' or 'child')
- Rescaling, ie normalisation or standardisation
- Aggregation, eg aggregation of observations containing a date variable by day/week/month/year, or aggregation of observations prior to applying a summary function such as *mean*, *max* or *sum*
- Extraction, eg extracting the 'year' component of a date
- Mapping, eg geocoding or converting grid references to latitude and longitude
- Transforming continuous data to a normal distribution by applying a *log*, *square, square root* or other function in order to see a relationship 'hidden' in the data

Dates and geospatial variables should be included as these are commonly-occurring data types which frequently need transformed, but where doing so can often be challenging.

Learners should be able to assess a normalised dataset and identify the steps necessary to prepare it for visualisation. Some of the skills required to do this are covered in J4Y6 35 *Working with Data* at SCQF level 8, namely data cleaning, converting between 'longer' and 'wider' formats, and string manipulation. Other transformation skills, which are of a less general nature and more directly applicable to data visualisation, are described above.

Outcome 2 — Create a range of data visualisations to provide business intelligence.

Learners should be able to follow an appropriate data visualisation workflow in order to help them structure their thinking, from an initial problem statement or brief, through to communication of a final solution to stakeholders. A number of workflows have been proposed, including ones by Ben Fry and Andy Kirk. For the purposes of this unit, the key aspects of the process are that it:

- Provides a structure that guides thinking
- Begins with a question/brief/problem-statement/goal
- Ends with communication to stakeholders
- Includes data collection and preparation
- Includes making design choices about data representation (ie choice of chart to be used) and data presentation (eg choice of structure, colour and annotations)
- Involves evaluation at each step
- Is not meant to be slavishly followed

Learners should be able to select an appropriate visualisation to be created, based on the goals and purpose of the communication, the audience and the data, and make appropriate design choices about this visualisation. It would be beneficial if a variety of contexts and purposes were contrived for the creation of the visualisations.

Using a software package, learners could create the following charts from a variety of simple datasets: **side-by-side box plots, donut charts, scatter plots, waffle charts, time-series line graphs** and **dot maps**. This list is intended to be indicative rather than prescriptive. The criteria for selection are that the charts should be ones which are commonly used and that they should be of a level of complexity greater than those that were introduced in J4Y4 34 *Communicating with Data* at SCQF level 7 (ie **bar charts** and their sub-types, **histograms**, **scatter plots** and **line charts**).

Small multiples/faceting should be covered as a method of comparison between similar charts.

Using a software package, learners should create at least one interactive dashboard. Any **one** of the following features would be suitable for the learner to make interactive:

- filtering
- sorting, or
- enabling the user to increase/decrease the level of detail for the data visualised

The range of interactive features available will be determined by the visualisation software selected to create the dashboard. At the time of writing, Tableau™, PowerBI™ and Google Data Studio™, amongst other software tools, provide these features.

At the time of writing, Tableau is the market-leading data visualisation software package, and offer free one-year licences to students at accredited academic institutions. Other popular packages include FusionCharts, Datawrapper and Excel™. Tableau™, FusionCharts™ and Datawrapper™ can be used to create dashboards as well as charts. None of these software tools require programming.

For learners with proficiency in programming in Python or R, both of these programming languages provide very good data visualisation packages and are the most commonly used programming languages in data science, making them the most suitable languages for data visualisation.

The key data visualisation packages for Python are:

- matplotlib
- ggplot
- plotly

The key data visualisation packages for R are:

- ggplot2
- shiny (for creating dashboards)

It is *not* suggested that any programming is taught as part of this unit.

Outcome 3 — Communicate insights using data visualisation.

The purpose of this outcome is to develop learners' presentation skills using data visualisations that they or others have created to communicate to others the relevant insights revealed via the visualisations.

Learners should have the opportunity to, using data storytelling techniques, create a 'story' about the data and the visualisation(s) which will resonate with the intended audience. This is most easily achieved by including some temporal dimension to the data. For those charts which already have a temporal dimension, such as time-series line graphs, the storytelling element could consist of a narrative built around how and why the line changes over time. For charts which do not have a temporal dimension, a 'before' and 'after' visualisation of a dataset could be used, with the 'storytelling' element being a narrative constructed about the change between the two visualisations.

Learners should be able to make a recommendation or propose a course of action based upon their analysis and be able to justify this with reference to the data.

An important part of this outcome is the acquisition of presentation skills — both generic presentation skills and specific skills in the presentation of numerical data and its associated visualisations.

Higher National Unit Support Notes (cont)

Unit title: Communicating with Data (SCQF level 8)

Guidance on approaches to delivery of this unit

Where this unit is delivered alongside J4Y6 34
Working with Data at SCQF level 8 learners should have demonstrated the ability to extract, clean and transform data in the *Working with Data* unit prior to starting activities relating to outcome 2 and outcome 3 in this unit.

A suggested order of delivery is as follows. Outcome 1 should be undertaken first as it provides the foundations upon which the other outcomes will be built and demonstrates the range of data visualisations that will be created in outcome 2 and the key elements of these visualisations. This would enable learners to apply their data transformation skills when preparing data in readiness for visualising it.

Outcome 2 should be delivered after outcome 1. Alternatively, outcome 1 and outcome 2 could be delivered in parallel. For example, a data transformation technique could be taught followed by a data visualisation technique which uses the transformed data. 'Pairing' data transformation with visualisation would allow the data transformations to be practised in a meaningful context (ie in preparing data to be ready for visualising).

Outcome 3 should be delivered last as it is naturally the last step in a data communication process (ie undertaken after data analysis and data visualisation) and requires the knowledge of data visualisations developed in outcome 2 to be effective.

A suggested distribution of time across the outcomes is:

Outcome 1: 10 hours
Outcome 2: 20 hours
Outcome 3: 10 hours

Both the preparation of data for visualisation and creation of data visualisations lend themselves to practical activities so it's therefore suggested that as much of the delivery as possible is of a practical nature. For the preparation of data (outcome 1) it would be beneficial if a large proportion of visualisations were derived from real data. There are many visualisations openly available across a large number of domains which could be used for this purpose, as well as open datasets which could be used to create visualisations.

Guidance on approaches to assessment of this unit

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

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

Higher National Unit Support Notes (cont)

Unit title: Communicating with Data (SCQF level 8)

Outcome 1 — Prepare data for visualisation, and Outcome 2 — Create a range of data visualisations to provide business intelligence.

The assessment of both outcomes could be combined using a case study. This would provide a realistic context in which the learner has the opportunity to produce data visualisations to solve a problem.

If a case study is used, a clear brief must be provided. This should relate to a specific data communication task faced by a team within a particular organisation, have a specific objective, and be targeted at a particular audience. It should include background information on the organisation, the task, the team and the audience.

A checklist must be developed that defines the standards to be achieved. This checklist should include, **as a minimum**, the following knowledge/skills:

- Awareness of business requirements
- Awareness of business processes and the concept of data flow
- Selection of an appropriate form of visualisation for the intended purpose and audience, and the data
- Selection of key elements of a data visualisation
- Preparation of data, including data transformation
- Application of appropriate design features, eg structure, aesthetics and annotations
- Application of graphical conventions
- Creation of visualisations using software

The data visualisations produced should collectively meet the following criteria:

1 The visualisations must illustrate relationships and patterns in the data.
2 The visualisations must be well designed and aesthetically pleasing.
3 The visualisations must have high information content.
4 The visualisations must provide accurate insights into the dataset.
5 The visualisation must adhere to graphical conventions.
6 The visualisations must include geospatial and time series visualisations.

Tabular datasets should be provided which meet the criteria set out in *Guidance on the content and context for this unit*. Such datasets provide an additional level of complexity when preparing data in comparison to those provided at J4Y5 34 *Communicating with Data* at SCQF level 7.

Learners should use software to produce the visualisations. The choice of software used to create the visualisations is left to the discretion of the centre or learner. There is no requirement for them to use software which requires programming but where the student is proficient in programming, a suitable programming language such as Python or R could be used.

Higher National Unit Support Notes (cont)

Unit title: Communicating with Data (SCQF level 8)

Outcome 3 — Communicate insights using data visualisation.

For the performance evidence for this outcome, learners will have to present the data visualisations they produce. This could be done, for example, by embedding them in a written report or creating a presentation of their visualisations in a dashboard.
it is suggested that the visualisations developed for outcome 2 are used, for which the learner will provide one or more data-driven recommendations or courses of action, based on their data visualisations.

The data visualisations to be used for this assignment must have been created by the learner themselves (eg as part of outcome 2). The presentation must:

1 be appropriate for a non-technical audience.
2 tell a story in data that addresses specific business questions.
3 minimise complexity.
4 have high information content.
5 identify key performance indicators.
6 provide insights into the dataset.
7 provide data-driven conclusions or recommendations.
8 demonstrate that data ethics has been considered.

Evidence for this outcome must be observed and recorded. An observation checklist must be developed to ensure the standards are achieved. This should be used to verify that learners have satisfied the criteria above.

The presentation could be done in person, eg in front of their peers or the assessor. Alternatively, where required, this could be done remotely.

Evidence could be gathered through questioning by the tutor and/or the learner's peers. It should also be used to confirm that the learner has used some of the elements of data storytelling to convey their conclusions and/or recommendations. It should be noted that storytelling of this sort is difficult, and that evidence is being sought for the learner applying some storytelling skills to their chosen form of communication, and not that the learner is proficient in this skill.

There are no time limitations on the production of evidence. The evidence may be produced at any time during the life of the unit.

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)

Unit title: Communicating with Data (SCQF level 8)

Opportunities for developing Core and other essential skills

This unit will develop the following Core Skills at SCQF level 6:

- *Numeracy:* Apply a wide range of graphical skills to interpret and present complex information in everyday situations
- *ICT:* Use ICT independently to carry out a range of processing tasks
- *Problem Solving:* Analyse a complex situation or issue; plan, organise, and complete a complex task; review and evaluate a complex problem-solving activity

Depending on the nature of the learning activities adopted, this unit may also help develop the following Core Skills at SCQF level 6:

- *Communication*: Produce and respond to oral communication on a complex topic
- *Working with Others*: In complex interactions, work with others co-operatively on an activity and/or activities

The Core Skill of Information and Communication Technology at SCQF level 6 is embedded in this unit. When a learner achieves the unit, their Core Skills profile will also be updated to include this Core Skill.

History of changes to unit

Version	Description of change	Date
02	Core Skill Information and Communication Technology at SCQF level 6 embedded.	09/12/20

Additional copies of this unit specification can be purchased from the Scottish Qualifications Authority. Please contact the Business Development and Customer Support team, telephone 0303 333 0330.

Unit template: June 2017

General information for learners

Unit title: Communicating with Data (SCQF level 8)

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.

This unit is designed to help you develop the knowledge and skills needed to prepare data for visualisation and create a range of types of data visualisations; to communicate insights from the visualisations you create; and to use your visualisations to make recommendations to others in order to help them make informed decisions.

It is suitable for those who wish to pursue a career in data analysis or for those who already work in data analysis and wish to improve their data visualisation skills.

Some experience of interpreting and creating the fundamental types of data visualisations, such as bar graphs or line charts, is required for this unit. No experience of programming is required.

The unit covers the following topics, amongst others:

- Data visualisation as a tool to decision-making
- Representing types of data beyond discrete and continuous
- Preparing data for visualisation
- Following a workflow to help you organise your data visualisation projects
- Selecting the right type of visualisation to use
- Designing and creating advanced data visualisations, including time-series and geospatial charts and interactive dashboards
- Making recommendations to others using data visualisations
- Using data storytelling to communicate your data in an engaging way

Assessment will likely be through a range of assessment methods, all of which will be practical in nature, including assignments and case studies.

This unit may be taken alongside, or after, J4Y7 35 *Working with Data* at SCQF level 8. After completing the unit, you will be able to create data visualisations and communicate the results of data analysis you have undertaken to others. At the completion of this unit, you may progress to a variety of related units, such as J4YB 35 *Programming for Data* and J4Y8 35 *Statistics for Data* at SCQF level 8.

The Core Skill of Information and Communication Technology SCQF at level 6 is embedded in this unit. When a learner achieves the unit, their Core Skills profile will also be updated to include this Core Skill.