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Data Fellowship: Data Analysis Concepts

Revision Session



BCS Exam details

The first exam you will sit is for BCS Data Analysis **Concepts**.

The exam will be one-hour long and is a multiple choice exam.

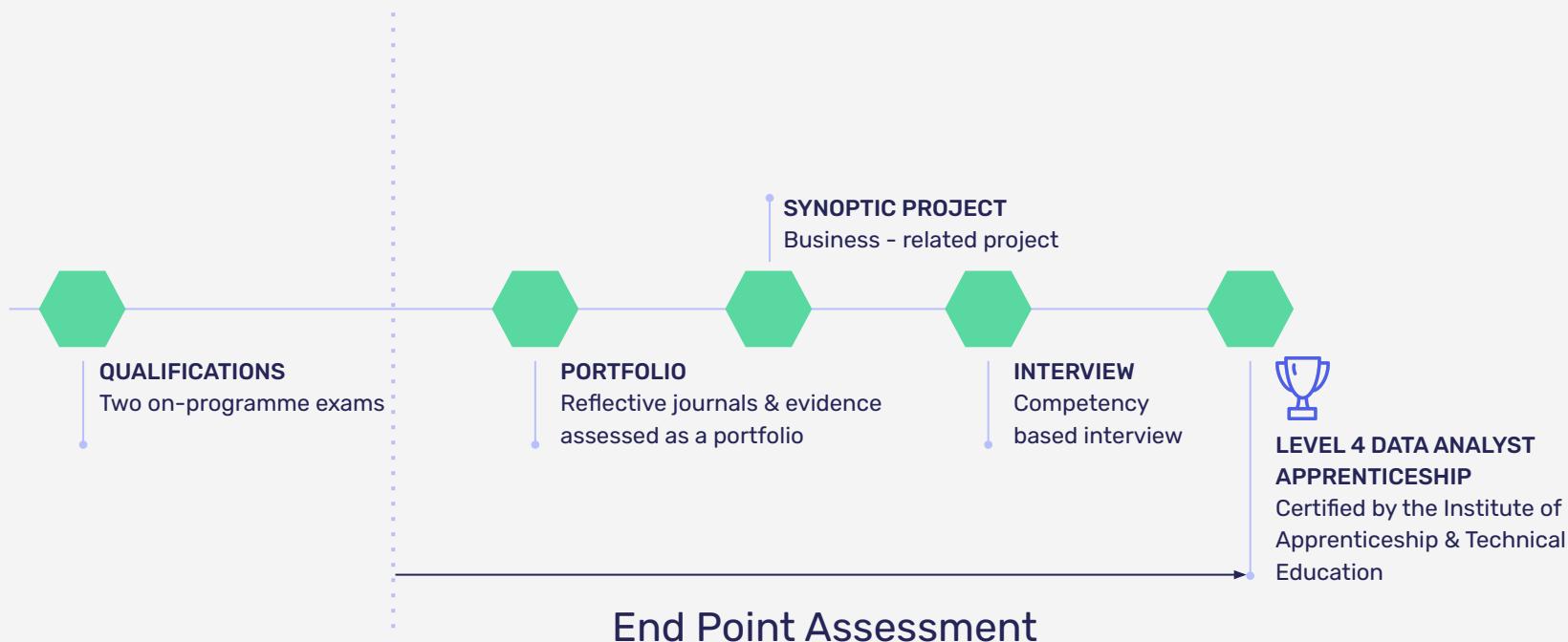
It is a closed book exam, so no materials can be taken in with you. This is why you need QuestionMark secure installed on your computer.

You have 40 questions to answer (1 minute and 30 seconds per question).

Pass mark is 26/40 (65%).



End Point Assessment (EPA)





Data Analysis Concepts Syllabus

All the topics that will come up in the exam covers everything that was taught in Modules 1 and 2.

1.0: Types of data (10%)

2.0: The Data Lifecycle (5%)

3.0: Structured and Unstructured data (10%)

4.0: Requirements for data analysis (15%)

5.0: Quality Issues for data analysis (10%)

6.0: Data analysis tasks (15%)

7.0: Compliance and audit considerations (5%)

8.0: Data structures (10%)

9.0: Database design, Implementation, and maintenance (10%)

10.0: Data architecture (5%)

11.0: The domain context for data analytics (5%)



Order of the day...

1. Types of Data and the Data Lifecycle
2. Structured and Unstructured Data
3. Requirements
4. Quality Issues
5. Data Analysis Tasks
6. Compliance & audit
7. Data Structures
8. Database maintenance and data architecture

...and then a practice test!





Types of Data and The Data Lifecycle





Types of Data

1.1

Data - Raw and unorganised facts

Information - Processed data to make it useful

Knowledge - Understanding information

ETL or 'Organise, Structure & Process'

Organise - where are our files? Which files are included?

Structured - Are our files structure properly?

Process - Take each file and process it



File type? Pros and cons?

YummyFood - Notepad

File Edit Format View Help

name,price,description,calories

Belgian Waffles,\$5.95,Two of our famous Belgian Waffles with plenty of real maple syrup,650

Strawberry Belgian Waffles,\$7.95,Light Belgian waffles covered with strawberries and whipped cream,900

Berry-Berry Belgian Waffles,\$8.95,Light Belgian waffles covered with an assortment of fresh berries and whipped cream,900

French Toast,\$4.50,Thick slices made from our homemade sourdough bread,600

Homestyle Breakfast,\$6.95,"Two eggs, bacon or sausage, toast, and our ever-popular hash browns",950

```
<?xml version="1.0" encoding="UTF-8"?>
<breakfast_menu>
    <food>
        <name>Belgian Waffles</name>
        <price>$5.95</price>
        <description>Two of our famous Belgian Waffles with plenty of real maple syrup</description>
        <calories>650</calories>
    </food>
    <food>
        <name>Strawberry Belgian Waffles</name>
        <price>$7.95</price>
        <description>Light Belgian waffles covered with strawberries and whipped cream</description>
        <calories>900</calories>
    </food>
    <food>
        <name>Berry-Berry Belgian Waffles</name>
        <price>$8.95</price>
        <description>Light Belgian waffles covered with an assortment of fresh berries and whipped cream</description>
        <calories>900</calories>
    </food>
    <food>
        <name>French Toast</name>
        <price>$4.50</price>
        <description>Thick slices made from our homemade sourdough bread</description>
        <calories>600</calories>
    </food>
    <food>
        <name>Homestyle Breakfast</name>
        <price>$6.95</price>
        <description>Two eggs, bacon or sausage, toast, and our ever-popular hash browns</description>
        <calories>950</calories>
    </food>
</breakfast_menu>
```

N

Presentation title here

Private and Confidential



File type? - Answers

YummyFood - Notepad

File Edit Format View Help

name,price,description,calories

Belgian Waffles,\$5.95,Two of our famous Belgian Waffles with plenty of real maple syrup,650
 Strawberry Belgian Waffles,\$7.95,Light Belgian waffles covered with strawberries and whipped cream,900
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 French Toast,\$4.50,Thick slices made from our homemade sourdough bread,600
 Homestyle Breakfast,\$6.95,"Two eggs, bacon or sausage, toast, and our ever-popular hash browns",950

Csv file - this is structured.

Pros: lightweight, easily read

Cons: text qualification needed

```
<breakfast_menu>
  <food>
    <name>Belgian Waffles</name>
    <price>$5.95</price>
    <description>Two of our famous Belgian Waffles with plenty of real maple syrup</description>
    <calories>650</calories>
  </food>
  <food>
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    <calories>900</calories>
  </food>
  <food>
    <name>French Toast</name>
    <price>$4.50</price>
    <description>Thick slices made from our homemade sourdough bread</description>
    <calories>600</calories>
  </food>
  <food>
    <name>Homestyle Breakfast</name>
    <price>$6.95</price>
    <description>Two eggs, bacon or sausage, toast, and our ever-popular hash browns</description>
    <calories>950</calories>
  </food>
</breakfast_menu>
```

XML file - this is also structured.

Pros: easily read by computers, portable across systems

Cons: difficult for humans to read, large file size due to markup tags.

⦿ File type? Pros and cons?

name	price	description	calories
Belgian Waffles	\$5.95	Two of our famous Belgian Waffles with plenty of real maple syrup	650
Strawberry Belgian Waffles	\$7.95	Light Belgian waffles covered with strawberries and whipped cream	900
Berry-Berry Belgian Waffles	\$8.95	Light Belgian waffles covered with an assortment of fresh berries and whipped cream	900
French Toast	\$4.50	Thick slices made from our homemade sourdough bread	600
Homestyle Breakfast	\$6.95	Two eggs, bacon or sausage, toast, and our ever-popular hash browns	950

 YummyFood-tab delimited - Notepad

File Edit Format View Help

name	price	description	calories
Belgian Waffles	\$5.95	Two of our famous Belgian Waffles with plenty of real maple syrup	650
Strawberry Belgian Waffles	\$7.95	Light Belgian waffles covered with strawberries and whipped cream	900
Berry-Berry Belgian Waffles	\$8.95	Light Belgian waffles covered with an assortment of fresh berries and whipped cream	900
French Toast	\$4.50	Thick slices made from our homemade sourdough bread	600
Homestyle Breakfast	\$6.95	Two eggs, bacon or sausage, toast, and our ever-popular hash browns	950

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File type? - Answers

name	price	description	calories
Belgian Waffles	\$5.95	Two of our famous Belgian Waffles with plenty of real maple syrup	650
Strawberry Belgian Waffles	\$7.95	Light Belgian waffles covered with strawberries and whipped cream	900
Berry-Berry Belgian Waffles	\$8.95	Assortment of fresh berries and whipped cream	900
French Toast	\$4.50	Thick slices made from our homemade sourdough bread	600
Homestyle Breakfast	\$6.95	Two eggs, bacon or sausage, toast, and our ever-popular hash browns	950

These are both RTF files (MS word and notepad) - these are unstructured

Pros: lightweight, holds documents not data

Cons: rarely used, hard to read, only for wordpad

YummyFood-tab_delimited - Notepad			
name	price	description	calories
Belgian Waffles	\$5.95	Two of our famous Belgian Waffles with plenty of real maple syrup	650
Strawberry Belgian Waffles	\$7.95	Light Belgian waffles covered with strawberries and whipped cream	900
Berry-Berry Belgian Waffles	\$8.95	Assortment of fresh berries and whipped cream	900
French Toast	\$4.50	Thick slices made from our homemade sourdough bread	600
Homestyle Breakfast	\$6.95	Two eggs, bacon or sausage, toast, and our ever-popular hash browns	950

This is a txt file - this is unstructured.

Pros: flexible, lightweight, easily read

Cons: breaks easily, needs text qualification



File type? Pros and cons?

```

    "breakfast_menu": {
      "food": [
        {
          "name": "Belgian Waffles",
          "price": "$5.95",
          "description": "Two of our famous Belgian Waffles with plenty of real maple syrup",
          "calories": "650"
        },
        {
          "name": "Strawberry Belgian Waffles",
          "price": "$7.95",
          "description": "Light Belgian waffles covered with strawberries and whipped cream",
          "calories": "900"
        },
        {
          "name": "Berry-Berry Belgian Waffles",
          "price": "$8.95",
          "description": "Light Belgian waffles covered with an assortment of fresh berries and whipped cream",
          "calories": "900"
        },
        {
          "name": "French Toast",
          "price": "$4.50",
          "description": "Thick slices made from our homemade sourdough bread",
          "calories": "600"
        },
        {
          "name": "Homestyle Breakfast",
          "price": "$6.95",
          "description": "Two eggs, bacon or sausage, toast, and our ever-popular hash browns",
          "calories": "950"
        }
      ]
    }
  }
}

```

	A	B	C	D	E
1	name	price	description	calories	
2	Belgian Waffles	\$5.95	Two of our famous Belgian Waffles with plenty of real maple syrup	650	
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6	Homestyle Breakfast	\$6.95	Two eggs, bacon or sausage, toast, and our ever-popular hash browns	950	
7					
8					
9					
10					
11					

File type? Pros and cons? - Answers

```

{
  "breakfast_menu": [
    {
      "food": [
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        },
        {
          "name": "Strawberry Belgian Waffles",
          "price": "$7.95",
          "description": "Light Belgian waffles covered with strawberries and whipped cream",
          "calories": "900"
        },
        {
          "name": "Berry-Berry Belgian Waffles",
          "price": "$8.95",
          "description": "Light Belgian waffles covered with an assortment of fresh berries and whipped cream",
          "calories": "900"
        },
        {
          "name": "French Toast",
          "price": "$4.50",
          "description": "Thick slices made from our homemade sourdough bread",
          "calories": "600"
        },
        {
          "name": "Homestyle Breakfast",
          "price": "$6.95",
          "description": "Two eggs, bacon or sausage, toast, and our ever-popular hash browns",
          "calories": "950"
        }
      ]
    }
  ]
}

```

	A	B	C	D	E
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7					
8					
9					
10					
11					

Json - this is unstructured or semi-structured.

Pros: structure easily read by applications,
lightweight.

Cons: No error handling, vulnerable to cyber
attacks.

Xlsx - this is unstructured.

Pros: familiar to all, widely used.

Cons: Large size, need MS excel, hard for
applications to read.



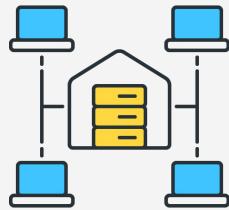
Data sources



Public Data
(open data is a subset)



Internal / Proprietary Data
(operational vs
administrative)



Client Data



Third Party / Purchased Data
(research data)

Quantitative vs. Qualitative Data

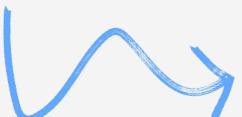
Height of a person

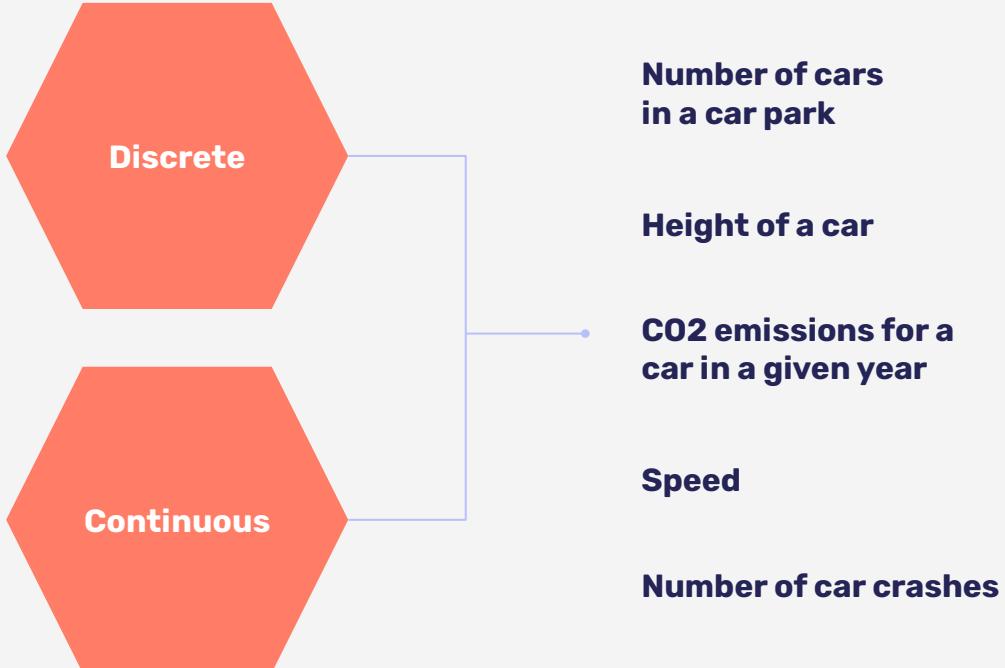
The colour
of the sky

The softness
of a carpet

The amount of money
in your bank account

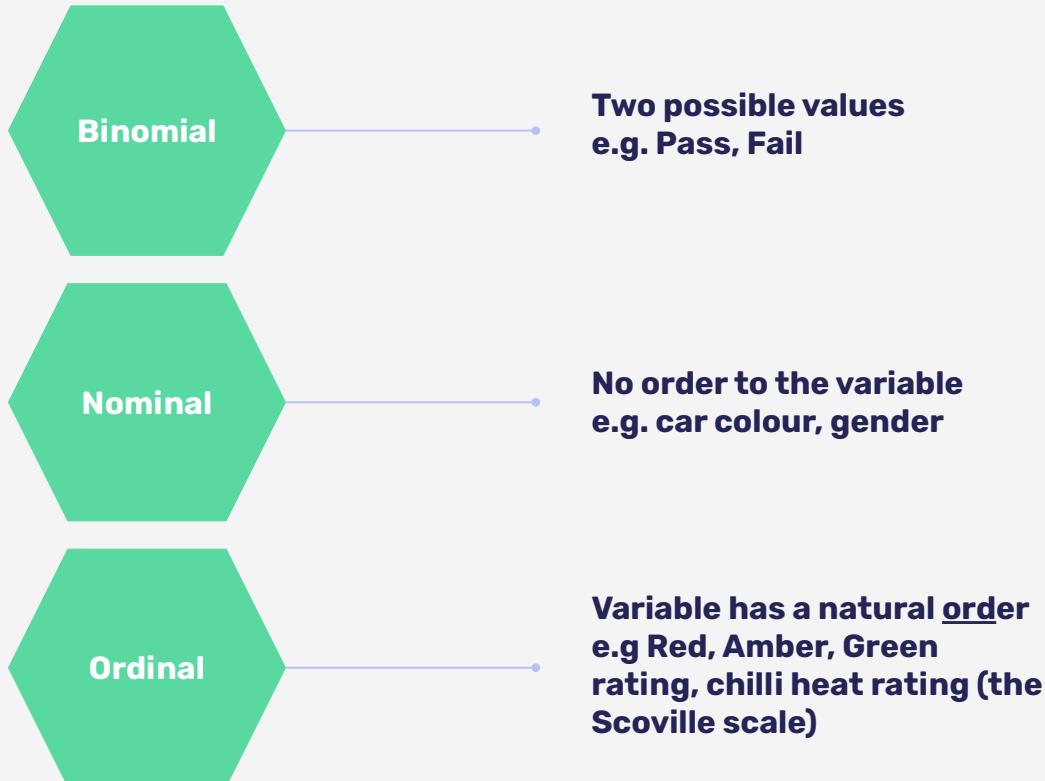
Facial expressions







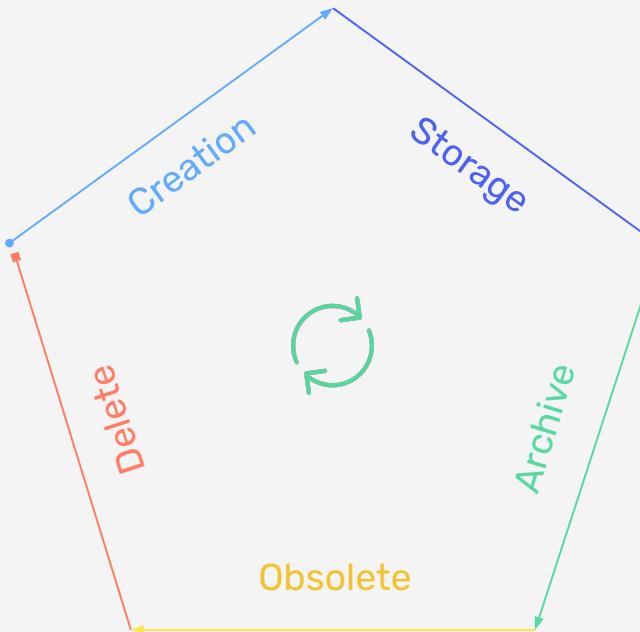
Qualitative Data





The Data Lifecycle

2.1 / 2.2



Note: this is different from the data ***analytics*** lifecycle

An analyst is working with performance data from a new, recently patented product. How would this data be classified?

- A. Proprietary data
- B. Open source data
- C. Public data
- D. Nominally viable

Which of the following is NOT a stage of the data lifecycle?

- A. Archived
- B. Created
- C. Migrated
- D. Deleted

What is the following an example of?

- A. Extensible Markup Language
- B. Data Definition Language
- C. Entity-Relationship Model
- D. Unified Modelling Language

```
<?xml version="1.0"?>
<payment>
<from>Acme Inc</from>
<to>XYZ Ltd</to>
<amount>1234.56</amount>
<currency>GBP</currency>
</payment>
```

Structured and Unstructured Data





Structured

- Can be ordered and processed by analysis tools
- Clearly defined data types
- Extensible markup language (XML)
- Tables stored within a database

Unstructured

- Everything else...
- Video
- Audio
- Sensor data e.g. brightness
- Text data - e.g. twitter feed



Beware spreadsheets!

Spreadsheets (i.e. Excel), may look 'structured' and you may have designed it with structure in mind – but spreadsheets are defined as unstructured (.xlsx).

This is because spreadsheets can not be easily ordered and processed by data analysis tools.

Spreadsheets contain no rules around the usage within the spreadsheet – for example:

- you are under no obligation to define headers
- you could have multiple tables on one sheet
- you do not need to have only one data type in a column
- you might merge cells or use conditional formatting



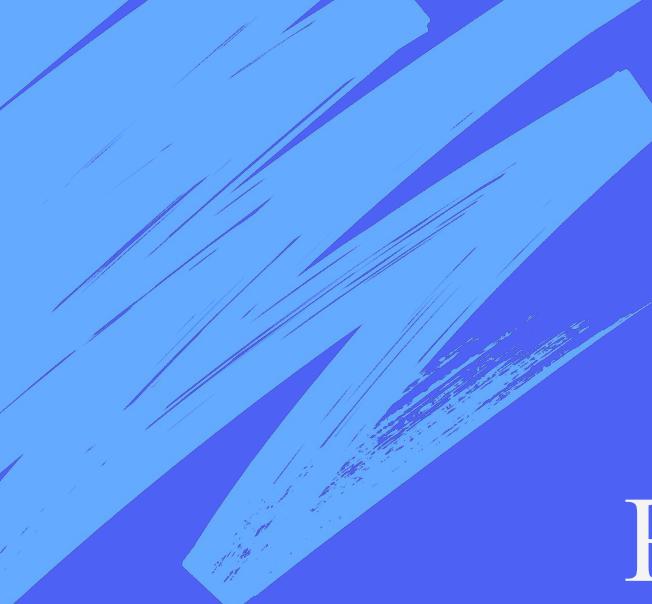
“Structured and Unstructured
data complement each other
to create rich insight”

Which of the following is NOT a common format for structured data?

- A. Sequential data files, e.g. CSV
- B. Extensible markup records, e.g. XML
- C. Data compression archives, e.g. ZIP
- D. Relational database models e.g. Accdb

Which of the following statements is TRUE about structured and unstructured data analysis for businesses?

- A. Statistical analysis is more difficult on structured data than on unstructured data
- B. Unstructured data analysis is easier if a business's requirements are not very clear
- C. Modern statistical analysis tools always struggle with processing well-structured data
- D. Structured and unstructured data can both be used during statistical analysis



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Requirements





Project scoping / different requirements for a project.

Project scoping is an important step where you gather all the project requirements.

Things you need to consider include:

- Business policies & standards (general requirements, such as GDPR)
- Stakeholder requirements
- Technical requirements (e.g. using a specific DBMS or software)
- Budget, resource & scoping constraint



Verification vs. Validation

Verification

“The internal process of evaluating a data project to determine whether the products of a given development phase satisfy the conditions imposed at the start.”

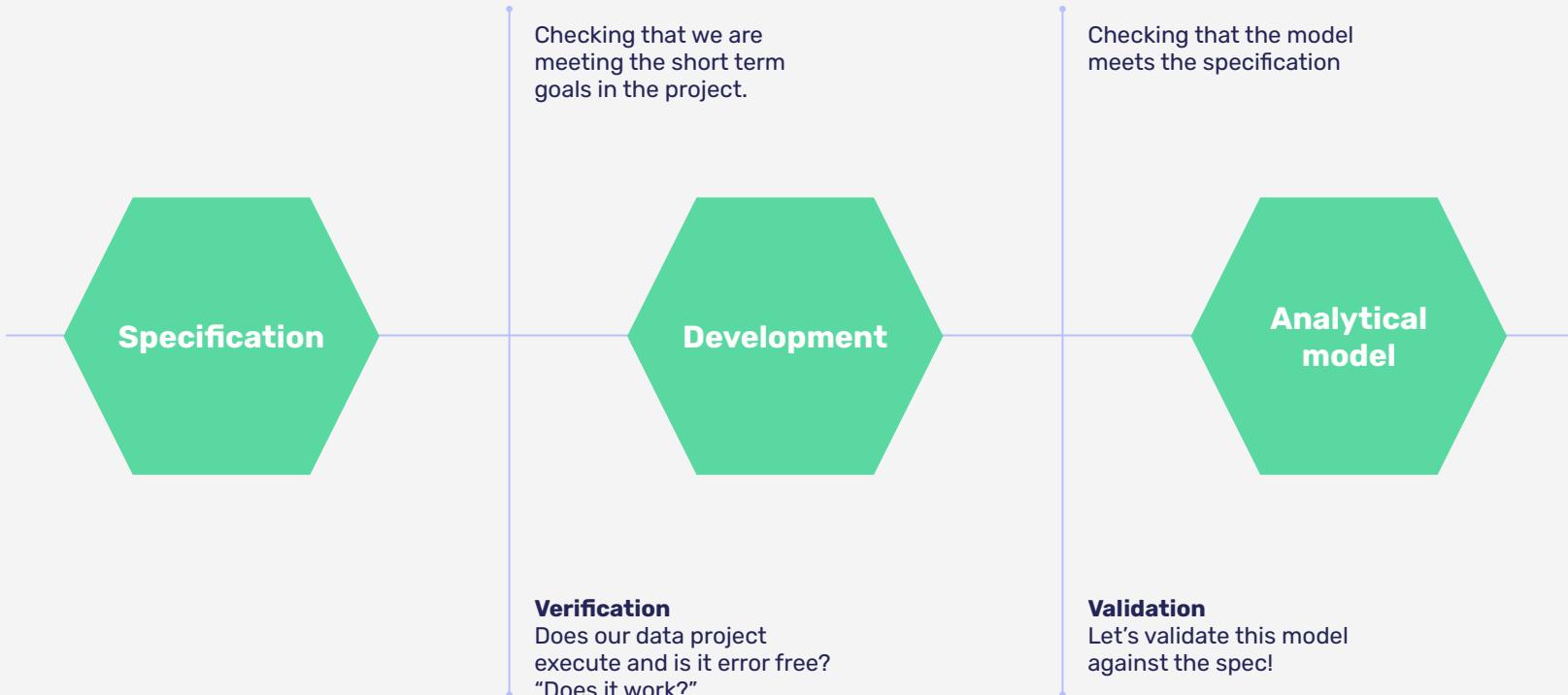
Validation

“The external process of evaluating a data project during or at the end of the development process to determine whether it satisfies the specific external requirements.”



Validation vs. verification - which one is which?

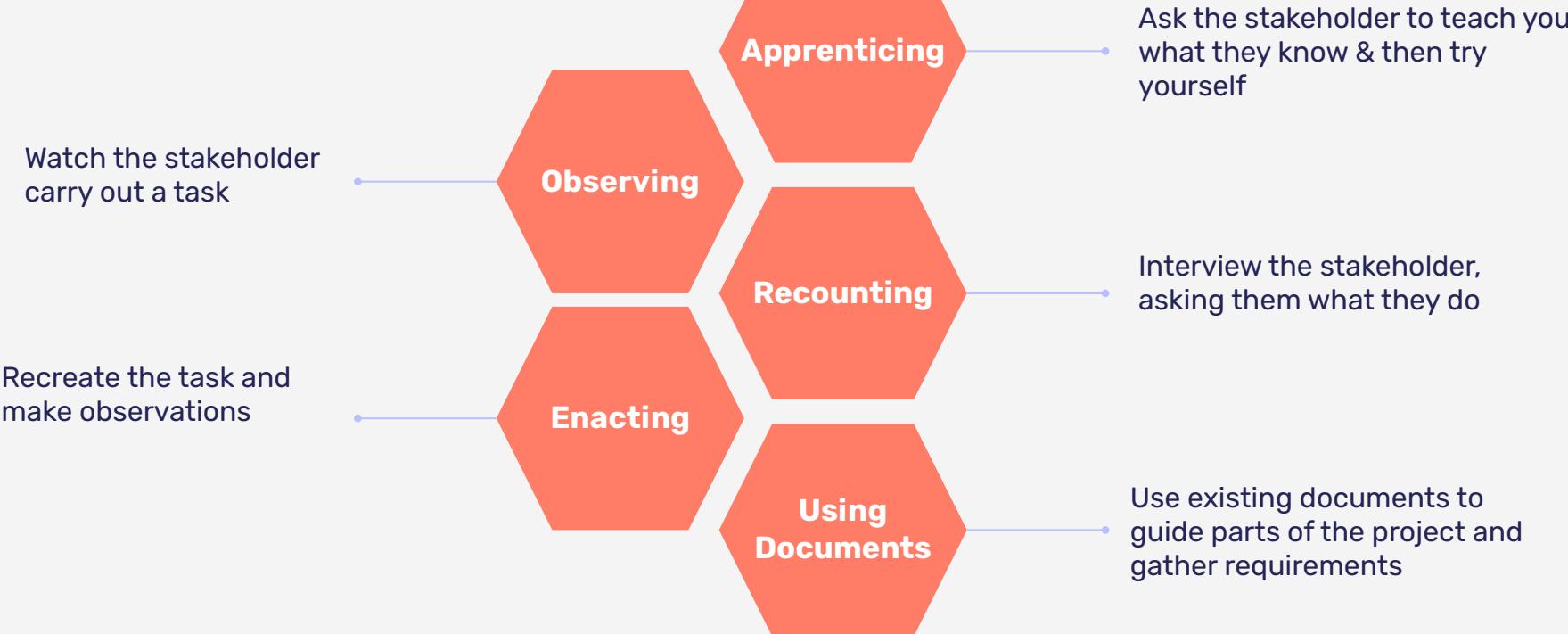
4.2





Elicitation techniques

4.3





Tacit Knowledge

- **Is gained through experience.**
- **It is subjective and harder to communicate and capture.**
- **This includes insights and intuitions.**

Explicit Knowledge

- **Information that is fact and figure based.**
- **Easily codified.**
- **Easily articulated, identified, shared and employed.**

What is a requirements elicitation process?

- A. Gathering requirements for an analysis from stakeholders
- B. Filtering the initial requirements for an analysis
- C. Refining the formal requirements of an analysis
- D. Gathering the data that will be used in an analysis



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Break



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Quality Issues





Quality Control, why is it important?

Legal and regulatory compliance

We have a legal & compliance duty to ensure data is good quality - GDPR and DPA.

Commercial and intellectual property

There is value in data. Ensuring good data quality protects your data assets and business insights.

Confidentiality, integrity and availability

Good data ensures your company operates well. This enables you to use data for business advancement and give you a competitive edge.



The Common Sources of Quality Issues/Errors

Completeness: No missing values

Uniqueness: Data must not be stored in more than one place

Timeliness: Data should not be outdated or old

Validity: Data should conform to the syntax (format, type, range) of its definition

Accuracy: The data point is the right value for that data point

Consistency: Form and content of the data field is always the same



Consequences of errors



Cost



Accuracy



Inconsistency



Cleanliness

Dealing with dirty data can be expensive

Making business decisions based on inaccurate data

Your business operations might fluctuate due to bad data

Dirty data can make a mess, which may lead to issues down the line

The Common Solutions Quality Issues/Errors

Entry/Transcription: The way in which you put the data into the system

Process: What can we do to reduce the likelihood of introducing errors?

Identification: Can we identify data when it is bad? How do we know?

Usage: Running tests on the data can check to see if there are any errors

Structure: Having a defined structure means you can identify problems easier

Improving data quality and having a defined organisation strategy will ultimately improve business decision making.

What results can poor data quality have on a business?

- a) It causes loss of trust in the analytical system
 - b) It makes business continuity planning easier
 - c) It simplifies data modelling
 - d) It increases the time required for reconciliation
-
- A. A, b and c only
 - B. B, c and d only
 - C. A and d only
 - D. C and d only

Why is it VITAL to have good data quality?

- A. To ensure accurate predictions
- B. To meet regulatory requirements
- C. To prove a hypothesis
- D. To make effective visualisations

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Data Analysis Tasks

Hypotheses

Hypothesis

A statement about what might be true. The goal of the project is to find out if the hypothesis is true or not.

Null Hypothesis (H_0)

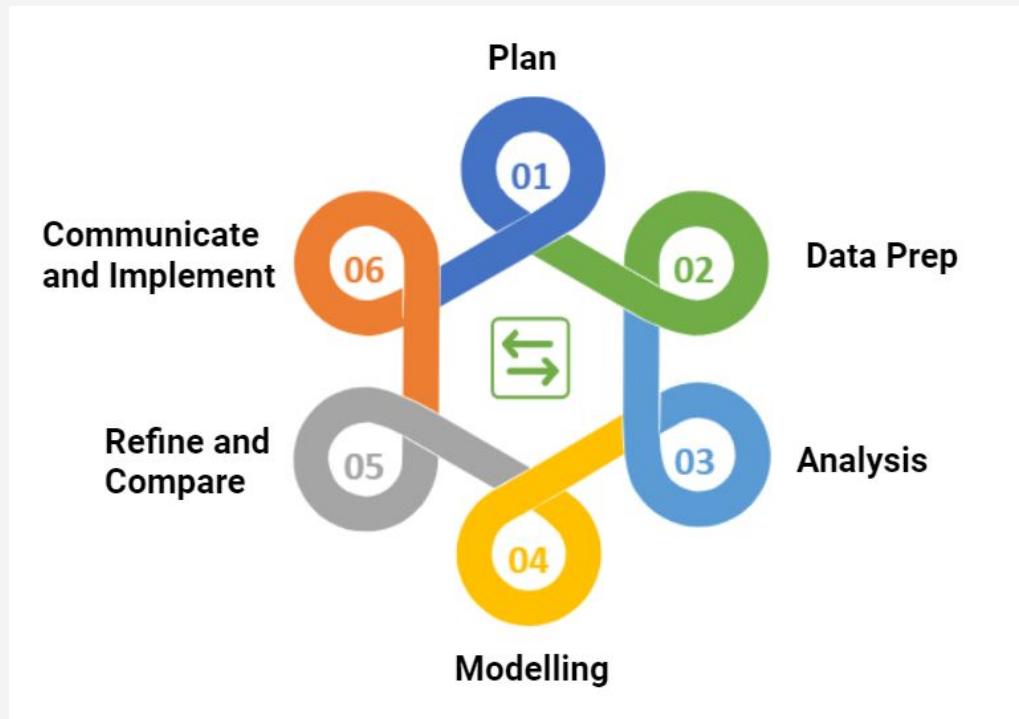
Assumes what you are investigating
is false

Alternate Hypothesis (H_1)

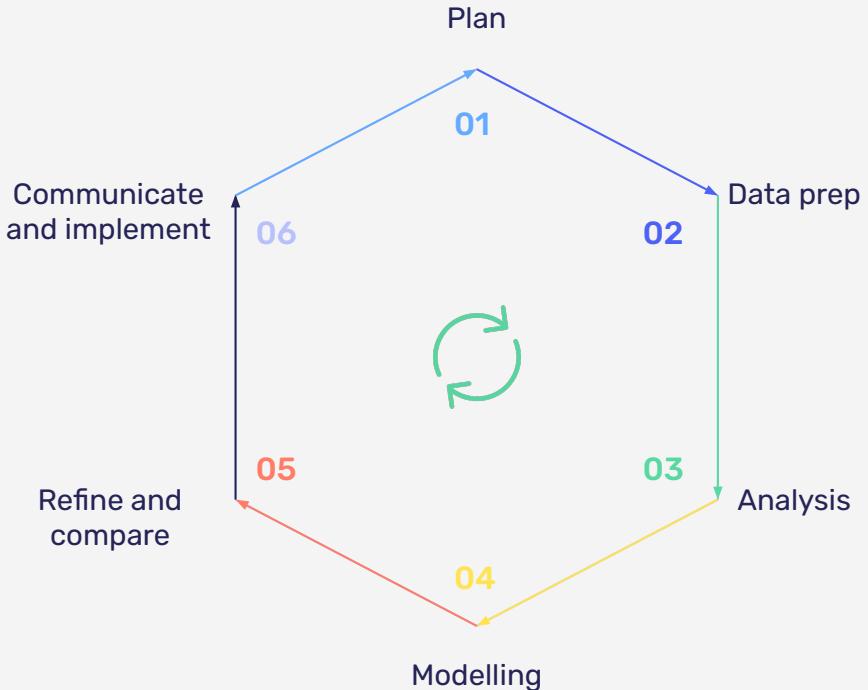
Assumes what you are investigating
is true



'Routine' Data analysis - think Data *Analytics* lifecycle



'Routine' Data analysis - think Data *Analytics* lifecycle



>Data Prep or ‘Cleanse Data’

Filtering – filtering out irrelevant data

Interpolation – finds the missing value when given two known values across each side of the missing value

Transformation – helps convert the data in the appropriate format

Masking – modifies or hides data to protect sensitive information

Blending – used to combine data from multiple sources into a single location

Which of the following statements defines a null hypothesis?

- A. The opposite of the alternative hypothesis
- B. The suggestion that data analysed has been corrupted
- C. The belief that more unstructured data is needed to draw a valid conclusion
- D. The assumption that the data comes from a valid source

Which of the following chart types is MOST suitable for categorical data?

- A. Scatter plot
- B. Radar chart
- C. Line graph
- D. Pie chart



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Compliance & Audit



>Data Protection Act (not GDPR)

Data protection act applies to:

1. **Personally identifiable information** (data that can identify an individual)
2. **Protected health information** (data in a medical record that can identify an individual)

'Sensitive personal data' consists of:

- Racial or ethnic origin of the person
- Political opinions
- Religious beliefs or other beliefs of a similar nature
- Whether they are a member of a trade union
- Physical or mental health conditions
- Sex life
- The commission or alleged commission of any offence
- Any proceedings for any offence

 There are 8 Principles of the DPA

1. Data must be kept **secure**
2. Data stored must be **relevant**
3. Data stored must be **kept no longer than necessary**
4. Data stored must be kept **accurate and up to date**
5. Data must be obtained and processed **lawfully**
6. Data must be processed within the **data subject rights**
7. Data must be obtained and specified for **lawful purposes**
8. Data must **not be transferred** to countries without adequate data protection laws

Which of the following is NOT covered by the Data Protection Act?

- A. Surname
- B. Address
- C. Religious identity
- D. Working history



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Data Structures





Data Structures

8.1 / 8.2

File	Description
Files	A file used to store information. Programs can use files to read the information that needs to be processed. The data within a file is typically organised in smaller packets of information - which are referred to as records or lines.
Lists	A list contains elements of one or multiple data types. A list must be one-dimensional. E.g. ('John', 'Paul', 'George'), or (67, 84, 92) or ('John', 15.3, 78)
Arrays	An array is similar to a list, but can be identified by one or more indicides. An array is similar to a list but can have multiple dimensions. A two-dimensional array looks like a table, or is known as a matrix. A 3D array would be a cube and so forth. Unlike a list, the data types must be the same.
Records	A record is a collection of data relating to one entity. Similar to a row in a table.
Trees	A hierarchical collection of data, expressed with parent and child nodes. Think XML files!
Tables	This is how data is stored within a database, with structured columns and defined data types.

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Database Maintenance & Data Architecture

Conceptual data model



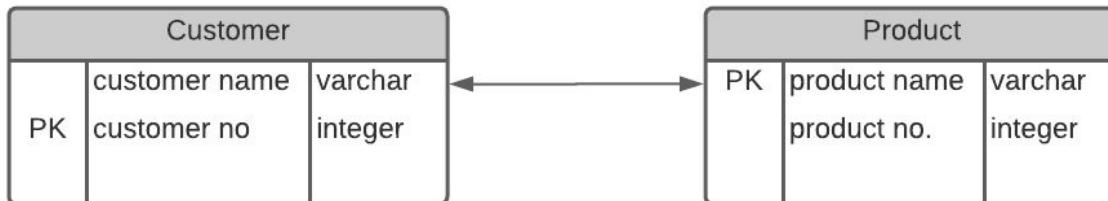
Broad level of detail & tailored for a business audience. This is to develop conceptually, without considering the technical information.

Logical data model



Builds on the conceptual model, still independent of the technical information but normalisation is applied until 3NF.

Physical data model



The final step, designed specifically for a certain DBMS and more detailed information regarding keys, data types, and relationships are added.



Other design features...



Redundancy free & Unambiguous

Normalisation, no duplicate-data, clear labels (documentation?)



Flexible / Extensible

Can it be scaled? Does it accommodate growth or changes in the future.



Derivable data

Introduction of information *after* normalisation to enable quicker querying.



Splitting / combining the data structures

Splitting your data up, e.g. customers table into customers table for *each* region.

Introduce artificial foreign keys so it is easier to join tables.



Normalisation



De-normalisation

Normalisation is a database design technique that **reduces redundancy, eliminates undesirable characteristics** like insertion, update and deletion anomalies. Normalisation divides larger tables into smaller tables and **links them using relationships**.



Types of databases

9.2

Type of DB	Examples	Description
Relational	MsSQL, Postgres, mySQL	This is the most common form of database. It contains tables that can be joined to other tables through their relations. Normalisation* is a key part of relational databases.
Hierarchical	IBM Information Management System (IMS) Windows Registry	Data is stored in a parent-children relationship nodes, in a tree like structure. The data is stored as a collection of fields where each field contains only one value. The records are linked to each other via links into a parent-children relationship. In a hierarchical database model, <i>each child record has only one parent</i> . A parent can have multiple children. To retrieve a field's data, we need to traverse through each tree until the record is found.
Network	Data Store (IDS), IDMS (Integrated Database Management System), Raima Database Manager, TurboIMAGE	Network database management systems (Network DBMSs) use a network structure to create relationship between entities. Network databases are mainly used on large digital computers. Network databases are hierarchical databases but unlike hierarchical databases where one node can have one parent only, a <i>network node can have relationship with multiple entities</i> . A network database looks more like a cobweb or interconnected network of records.



Types of databases

9.2

Type of DB	Examples	Description
Object-oriented	TORNADO, Gemstone, ObjectStore, GBase	Object-oriented databases use small, recyclable separated chunks of data called objects. The objects themselves are stored in the object-oriented database. Each object contains two things: the object itself, and the metadata that explains that object, its purpose, what it is and where it fits in
Multi-dimensional	Essbase, Cognos Powercube	Multi-dimensional databases (MDBs) use the concept of a data cube (or hypercube) to represent the dimensions of data available to users (though physically they are stored as compressed multidimensional arrays with offset positioning). An MDB with three dimensions looks like a cube, whilst an MDB with four or more dimensions is called a hypercube, and becomes more difficult to visualise. They are designed to assist with decision support systems, and to optimise online analytical processing (OLAP) and data warehouse applications.
NoSQL		The 'No' stands for 'Not Only' SQL - these databases seek to improve on standard SQL based DBMS by enhancing the forms of analytics available and changing the way that data is stored (no longer relational.) These databases are ideal for storing unstructured data (past exam question).



Database maintenance

Ensures data is stored in it's most efficient way

Data compaction



A file that contains the previous operations that have happened on a database. These should be trimmed down & checked

Ensuring database rules are followed - ensuring no orphaned data

Integrity check



Reorganising your hard disk in the most efficient way

Data warehousing

Backing up your data!

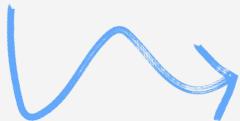


Data Architecture

10.1 / 10.2

Data is usually governed by:

- Rules
- Policies
- Standards
- Models



Storage?

Users?

Managed?

Integration?

Data architecture key terms:

- Migration (moving data across systems)
- Modelling (data structure, location, owner)
- Integration (compatibility across data sources)
- Warehousing (library/archive of all data)

An analyst is using a RDBMS. Which of the following CORRECTLY describes the data source?

- A. Unstructured
 - B. Structured
 - C. External
 - D. Internal
- 

Which of these is a goal of database normalisation?

- A. Prescriptive analytics
- B. Unambiguous observations
- C. Redundant visualisations
- D. Duplicated entries



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Domain Context





Types of analytics

	Tools used	Limitations	When to use
Decision Analytics Systematic, quantitative and visual approach for business decisions	<ul style="list-style-type: none">Variety of toolsPsychology, management, & economics techniquesDecision trees	<ul style="list-style-type: none">Information overload, leading to analysis paralysis	<ul style="list-style-type: none">When risk, capital investments, and strategic business decisions are needed
Descriptive Analytics What happened and why?	<ul style="list-style-type: none">Data aggregationData mining	<ul style="list-style-type: none">Snapshot of the pastLimited ability to guide decisions	<ul style="list-style-type: none">When you want to summarize results for all/part of your business
Predictive Analytics What might happen?	<ul style="list-style-type: none">Statistical modelsSimulation	<ul style="list-style-type: none">Guess at the futureHelps inform low complexity decisions	<ul style="list-style-type: none">When you want to make an educated guess at likely results
Prescriptive Analytics What should we do?	<ul style="list-style-type: none">Optimization modelsHeuristics	<ul style="list-style-type: none">Most effective where you have more control over what is being modeled	<ul style="list-style-type: none">When you have important, complex or time-sensitive decisions to make



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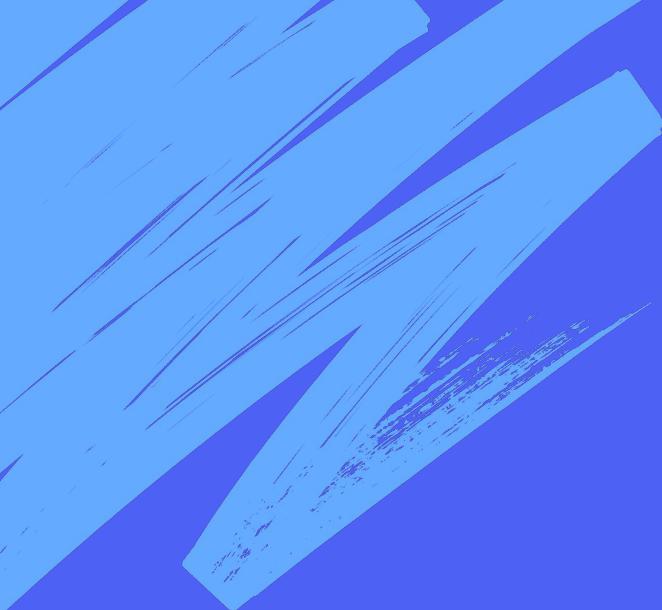
Final MCQ Tips





Final tips

- ANSWER ALL THE QUESTIONS!!
- Don't panic.... Remember you have 1.5 minutes per question AND the answer is in front of you
- Focus on breathing, mindfulness, relaxation techniques to remain calm
- Sleep and rest well
- Good luck!



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Next steps





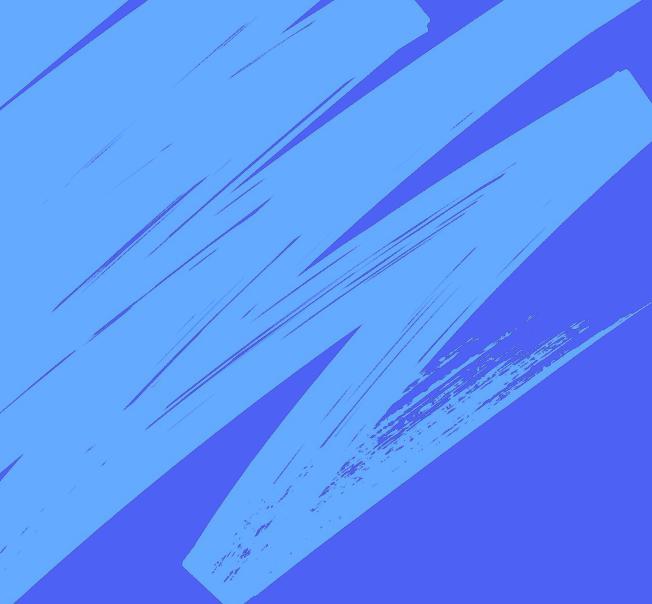
Next steps

- Revise !!
- Look at the [BCS website](#) for the syllabus / specimen paper
- Read through the revision pack
- Re-visit module 1 and module 2

Make sure you download the appropriate tech requirements for the exam.

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Session Attendance Log, + OTJ!



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Questions?





let's play

Kahoot!