Actuaries Institute
Australia

COMMUNICATION, MODELLING AND PROFESSIONALISM

MODULE 11: CRITICAL THINKING

Education Program
ACTUARIES INSTITUTE

Education that Counts

Actuary Program

Module 11

CRITICAL THINKING

Education that Counts

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11. Critical thinking

This module covers the following learning objectives:

Item	Learning Objective
3	**Apply professionalism and ethics in decision making processes**
3.7	**Apply critical thinking and judgement to actuarial problem solving**
3.7.1	Explain the four main stages in the process of critical thinking
3.7.2	Describe the logical fallacies which are sometimes used to make arguments look stronger than they are

11.1. Introduction

As stated in Module 1 (Introduction), this subject aims to enable students to apply their technical and theoretical knowledge in an effective and professional manner. Previous modules have concentrated on effective writing and presentation skills and introduced how professional and ethical frameworks apply to all aspects of actuarial work.

The final aim of this subject is to develop students' ability to think critically and apply judgement. Critical thinking and judgement skills are expected from actuaries in the workplace and form the basis of many examination questions in Fellowship subjects.

You may be familiar with the principles and methods outlined in this module as universities promote themselves as creating critical thinking scholars. Many universities offer freely available tips and techniques on how to develop critical thinking skills and many of those tips have influenced the structure of this module[1].

[1] This module is significantly influenced by the Monash University's online critical thinking course.

Actuarial advice

An actuary often acts as an advisor to a business. The recipients of the advice want to see a well-constructed and logical argument that supports the conclusions drawn. The output of an actuarial critical thinking exercise usually informs management on the consequences of adopting a position. There is an expectation that the advice will be carefully and broadly considered rather than solely technically based. Section 11.4 (Responding to management) provides a guide on how to frame a response to a position put forward by management and includes a stylised example from a past Fellowship-level examination.

11.2. What is critical thinking?

There are multiple definitions of critical thinking, although the definitions appear to be sufficiently similar. This module defines critical thinking as a process of obtaining true information from data and using that information to form judgements. Objectivity is a key part of the process as one should act disinterested in the output by providing unbiased judgements based on logical reasoning and supporting evidence. Critical thinking is thus aligned with expected behaviours of actuaries, as set out in the Actuaries Institute's Code of Conduct.

While it is expected that it takes practice and experience to apply judgement, this also applies to creating logically valid arguments that are supported by evidence. A key actuarial skill is to demonstrate that you have thought about the entirety of possible material outcomes from a chosen course of action. This module provides a framework to help you develop your thinking and judgement skills.

11.3. The process of thinking critically

Figure 11.1 illustrates the four main stages in the process of critical thinking. Embedded within each stage is the concept of reasoning.

Figure 11.1 – The critical thinking cycle

The critical thinking cycle is analogous to the actuarial control cycle with '*define the problem*' replaced by '*identification*', '*develop the solution*' replaced by '*analysis*' and '*monitor results*' replaced by '*evaluation*'.

While the text in the following sections describes the components of the critical thinking cycle in more detail, a high-level summary of the cycle is:

- **identification** of information – obtain relevant facts, data and evidence;
- **analysis** – clarify whether the information supports any hypotheses;
- **evaluation** – determine appropriate judgements; and
- **communication** – present the judgements in a logical manner, ensuring the evidence supports the points you are making.

Embedded throughout the critical thinking process is the concept of **reasoning**. This is described in Section 11.3.1. The identification, analysis and evaluation stages are covered in Sections 11.3.2, 11.3.3 and 11.3.4, respectively. Communication skills were covered in Modules 2 (Effective communication), 3 (Writing), 4 (Presenting) and 5 (Relationships).

11.3.1. Reasoning

Reasoning is the ability to think logically to formulate fair judgements and justify a position. It should be applied when identifying information and when analysing and evaluating arguments, and thus is a theme throughout the critical thinking cycle.

An **argument** is a logically sound set of reasons that support or refute a claim. Much of your professional life will be spent developing and presenting arguments to others. You may be advocating a position, and thus using an argument to influence others to agree with you. Alternatively, you may be asked to make a formal investigation (inquiry) of an argument to understand the business issue and logical reasoning and query the evidence before making a judgement on the validity of the argument.

Arguments are often classified as either deductive or inductive.

A deductive argument is an argument where if the premises are true, then it would logically follow that the argument is true. If the premises are true, then it would be impossible for the conclusion to be false.

An inductive argument is one where there is a belief that the premises provide reasons supporting the probable truth of the conclusion. If the premises are true, then it is unlikely that the conclusion is false.

It is unlikely that one can be certain that a premise in actuarial work is true. This does not automatically refute any argumentation, but it suggests that actuarial work uses inductive arguments. That is, there is a probability that if the premise is true, then the conclusion is likely to be true. Inductive arguments typically arise where observations from a sample population are generalised to apply to a wider population. For example, using a morbidity experience investigation to determine parameter values is using an inductive argument.

Constructing an argument involves three stages:

- first, you need to understand the central claim or business issue;
- second, gather evidence and supporting reasons or objections; and
- finally, the argument requires a structure:
  - focus on key themes suggested by the evidence and claim; and
  - determine a logical flow for each argument.

A tool that can help in developing a logical flow is known as an argument map.

Argument map[2]

Argument mapping is a way to visually show the logical structure of an argument. An argument map helps you ascertain the validity of an argument by breaking it up into its constituent claims. It uses lines, boxes, colours and location to indicate the relationships between the various parts of an argument. The resulting map allows you to see exactly how each part of an argument is related to every other part.

Video 11.1 provides an introduction to argument mapping.

Video 11.1 – Argument mapping

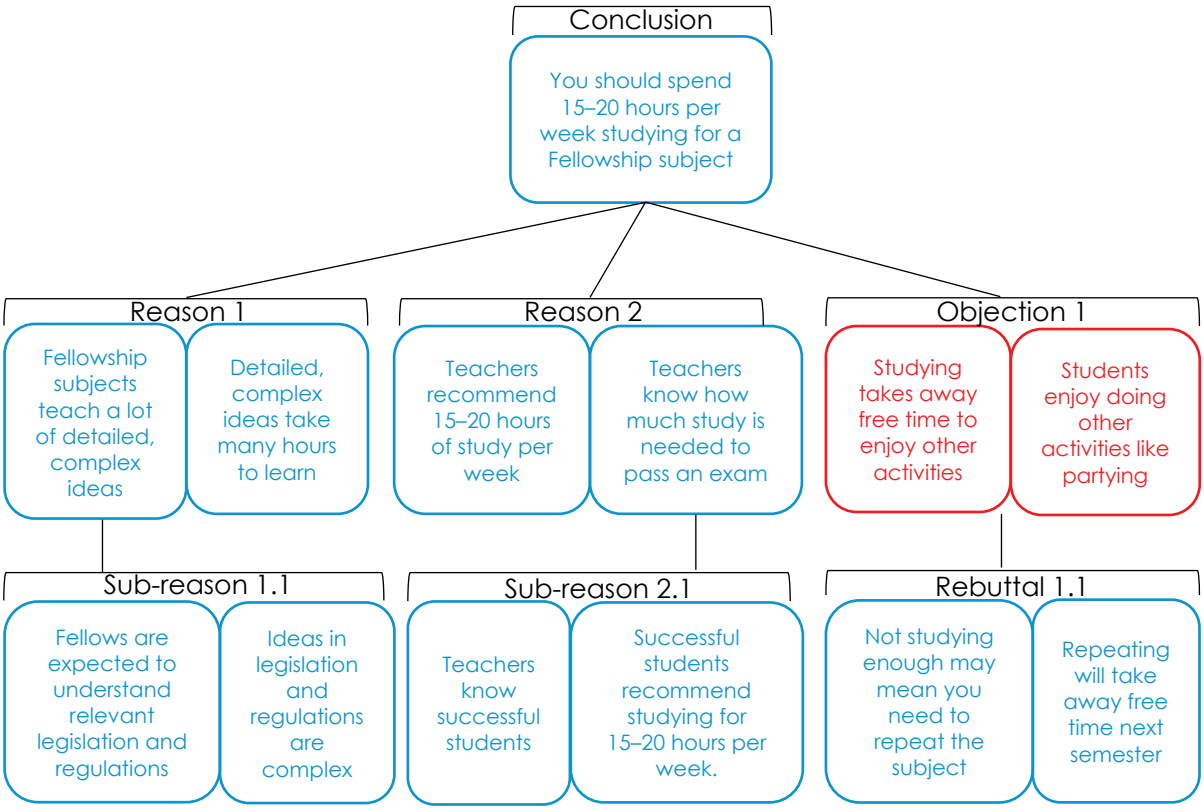
https://www.youtube.com/watch?v=qeS1toMvtoA (5 mins)

Record your video notes here

[2] This material was sourced from http://www.jostwald.com/ArgumentMapping/ARGUMENT%20MAPPING.pdf

Figure 11.2 shows an example of an argument map that concludes you should spend 15 to 20 hours per week studying for your Fellowship subjects. This argument is broken down into its various components in the argument map.

Figure 11.2 – Example of an argument map



Every argument is made up of one or more simple arguments. A simple argument is the building block of all arguments, consisting of one claim and one reason. The claim is the conclusion to an argument. The reason is the evidence to support the claim.

For example, in Figure 11.2, one claim is that 'Fellowship subjects teach a lot of detailed, complex ideas'. A reason provided for that claim is shown as 'Sub-reason 1.1', which is made up of two co-premises: 'Fellows are expected to understand relevant legislation and regulations' and 'Ideas in legislation and regulations are complex'. Collectively, this claim and its reason form one simple argument within the main argument presented in Figure 11.2.

Note that a reason must comprise a premise and at least one co-premise, although sometimes the co-premise is not stated. For example, within the simple argument 'All men are mortal, thus Socrates is mortal', the co-premise 'Socrates is a man' is missing. A more complete argument that includes the missing co-premise would be: 'All men are mortal, **Socrates is a man**, thus Socrates is mortal'. An objection is a reason that counters a claim and thus should also have a premise and a co-premise.

The structure of an argument map has the conclusion at the apex of the diagram. An argument has only one conclusion, or main claim, but can have many reasons, objections (i.e. a counter-argument to the conclusion) and rebuttals (i.e. an objection to an objection). Some of the reasons may be supported by other reasons and thus act both as a reason, supporting a claim above, and a claim, supported by reasons below.

The argument in Figure 11.2 has one conclusion at the apex that is supported by several simple arguments linked together:

- the conclusion is supported by two reasons (each with two co-premises);
- two sub-reasons that support the reasons;
- one objection or counter-claim (with two co-premises); and
- one rebuttal (with two co-premises) of the objection.

Formally, this collection of simple arguments forms a debate.

An argument map can represent a debate by showing exactly where two sides disagree on the issue. In the above example, there is an opposing view that spending more time studying will take away time from enjoying other activities. Thus, the proponent of the opposing view (Objection 1) suggests the conclusion is not warranted but does not necessarily object to the reasons offered to have to study for 15 to 20 hours per week. The person arguing *for* 15 to 20 hours of study time rebuts the argument for not studying as much by suggesting that Objection 1 is not valid—if you don't complete 15 to 20 hours of study, you may need to repeat the subject next semester, which will have an even greater impact on your free time. Of course, you may disagree with the rebuttal.

Carefully constructed argument maps assist the understanding of where two parties agree or disagree, and aid decision makers in balancing competing arguments. For example, if one side has two good reasons to conclude something and their opponent thinks one of those reasons is invalid, then the proposed conclusion may still be warranted if the remaining reason is convincing to the decision makers.

Note that reports to management may have many conclusions, but each one should be supported by argumentation.

Rules for building argument maps

Below are some simple rules that need to be obeyed when constructing argument maps.

Three rules apply to each box in an argument map:

- **declarative sentences:** the text in a box must be a full sentence and should be declaring or claiming something or taking a position (whether it is true or false);
- **no reasoning:** only one claim per box is permissible. Reasoning through the use of multiple claims is represented by the arrows and locations of each box in the map; and
- **single ideas:** the claim made in each box must either be true or false, not both. For example, the claim 'student fail rates are increasing and student study hours are falling' should be split into two boxes before using it in an argument map. This is because it is possible that student fail rates are increasing but student study hours are also increasing, making one part of the claim true but the other part false.

As a beginner's guide, the following three rules are useful to adopt when constructing argument maps:

- assertible;
- holding hands; and
- rabbit rule.

The **assertible** rule requires that all reasons for claims must answer the question: 'How do we know that the claim is true/warranted?' You are asking what evidence allows you to assert that the claim is true. Every claim box should have a reason box below it that answers this question. In Figure 11.2, the claim that 'Fellowship subjects teach a lot of detailed, complex ideas' is supported by the evidence presented in Sub-reason 1.1.

The **holding hands** rule applies horizontally within each simple argument. Within each reason, a term stated in one co-premise must be mentioned in one of the other co-premises in that same reason. The terms must 'hold hands' within a single reason if they are not already accounted for by the rabbit rule (see next paragraph). An example is in Reason 1 where the expression 'detailed, complex ideas' is in each co-premise.

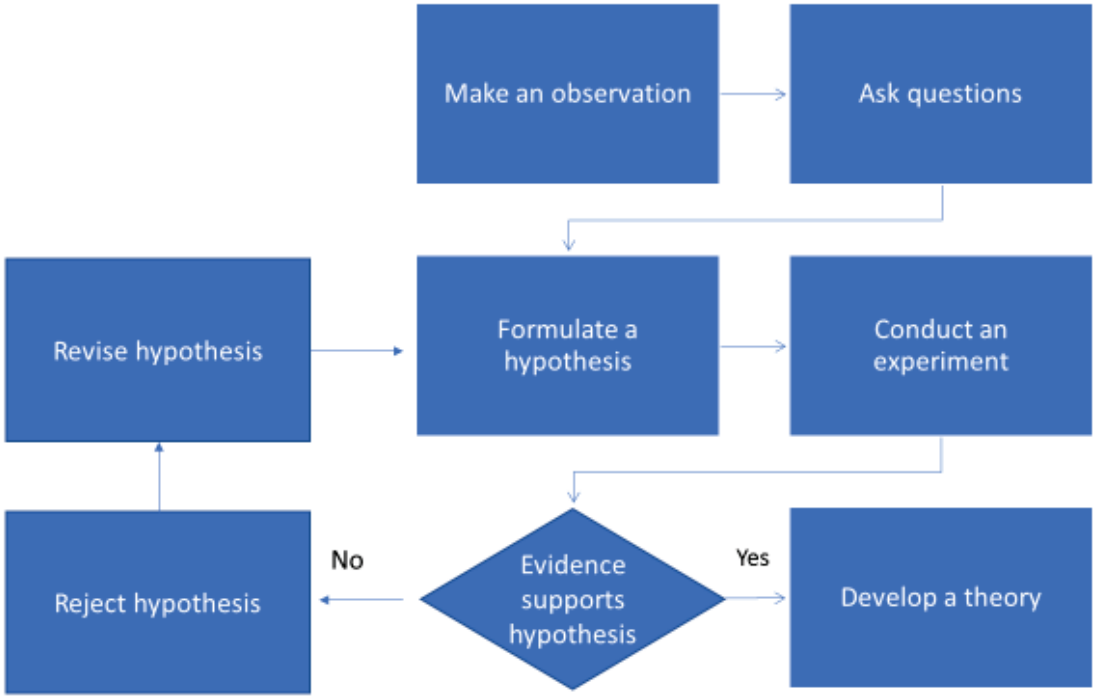
The **rabbit rule** is the vertical equivalent of the holding hands rule. If the holding hands rule is not applicable, then the words in the claim must be in the reasoning boxes below the claim. For example, Reason 1 and Sub-reason 1.1 both use the expressions 'Fellowship/Fellows' and 'complex'.

Using the holding hands rule and the rabbit rule for each simple argument ensures that every term mentioned in each box can be found in one of the other boxes.

The scientific method

The scientific method of reasoning is outlined in Figure 11.3.

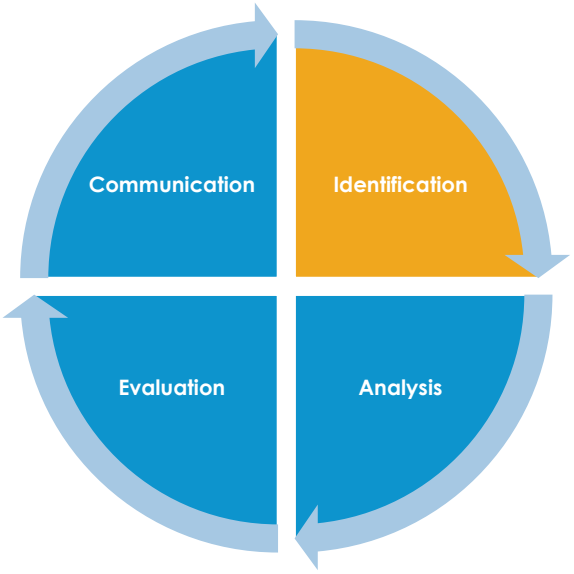
Figure 11.3 – Scientific method of reasoning



Our experience, or observations, lead us to formulate hypotheses regarding future events. In the scientific method of reasoning, we are only interested in hypotheses that can be falsified as more data is collected. For example, the statement that equities outperform bonds in the long-run is not a falsifiable hypothesis as it is not clear what 'long-run' means. However, the statement that equities outperform bonds over periods of at least 10 years is falsifiable.

In actuarial practice, 'develop a theory' is replaced by 'accept a model'. There are many approaches to selecting a model, but these are outside the scope of this subject. Approaches to selecting a model in particular practice areas or contexts are discussed in the relevant Fellowship subjects.

11.3.2. Identification



A key skill that is developed over time is to identify information in data. Video 11.2 contains insights from Ian Laughlin, an experienced actuary, on seeking to extract information from data. The video forms part of a Fellowship subject module but is directly relevant to this subject.

Video 11.2 – Actuarial judgement

https://vimeo.com/314589908/796bc48cc5 (12 mins)

Record your video notes here

The process of identification reduces to asking a set of questions about the credibility and relevance of the data. The items shown in Table 11.1 are general questions[3] that are used by researchers when investigating problems but are useful to consider when assessing information developed by others.

Table 11.1 – Identification questions

Category	Questions
Credibility	• When was the information produced or published? • How up-to-date with current thinking is the information? • Is the information based on outdated methods or evidence?
Relevance	• Does this information assist in answering the question? • Does this information add to your understanding of the topic? • Where was the information produced or published? • Does it apply in your context? • Was the information produced using methods, definitions and interpretations appropriate for actuarial work?
Credibility of the author	• Does the author have the expertise in the relevant field of knowledge? • Is the author qualified in this area? Or is the author an amateur enthusiast or professional generalist with limited expertise? • What affiliation does the author have? Is this affiliation reputable?
Accuracy	• Can information be verified with reliable facts and evidence? • Is the information published in a peer reviewed journal? • Is the evidence based on reliable methods?
Purpose	• Why was the information produced? For example, to explore, persuade, inform, sell, entertain or teach? • Who is the intended audience for this information? • Is the information produced or funded by a person or organisation with particular political or commercial goals?

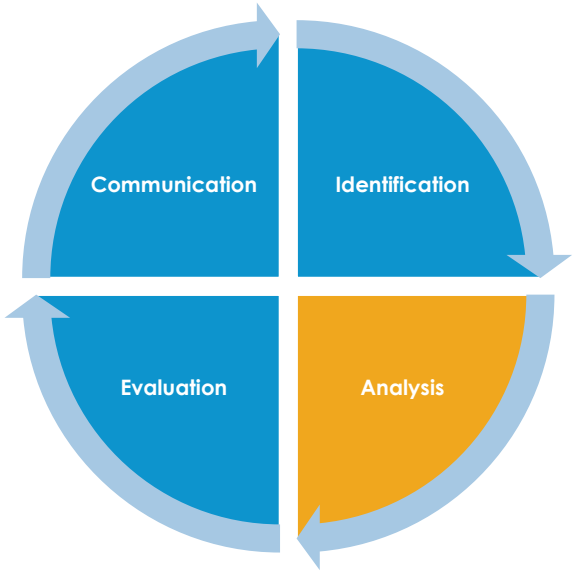
[3] https://www.monash.edu/rlo/research-writing-assignments/critical-thinking/identifying

Although consideration of 'Purpose' was left until the last row in Table 11.1, it is a very important test to apply to any data you are trying to extract information from. There is plenty of 'data' presented in blogs, websites, social media and elsewhere that may pass the initial tests of credibility, relevance and accuracy but fail the purpose test due to inherent biases, conflicts or agendas associated with the 'information' being presented.

For example, many of you will have seen posters on your dentist's wall, such as in Figure 11.4, advertising the importance of eating lots of milk, cheese and yoghurt to keep your teeth strong and healthy. These posters often show lots of seemingly credible facts and figures and are likely highly relevant to you given you are looking at them from the dentist's chair. However, if you noticed that the poster was sponsored by your local dairy industry, how would this change your perception of the reliability and unbiased nature of the advertising?

Figure 11.4 – What is the purpose of this poster?

11.3.3. Analysis



Information needs to be placed in a relevant context. Analysis is the detailed **objective** process of examining information to understand the information and explain its meaning. It thus extends the identification stage by thinking in detail about information and whether claims are supported by evidence or reason.

The analysis involves a close examination of any claims made and ascertaining whether the argumentation is valid or if there are gaps. A key element of the process is identifying key assumptions and any inter-relationships. Careful analysis will prepare you to complete the evaluation stage described in Section 11.3.4.

Asking questions

Asking questions is the primary way to analyse information. Thinking carefully about the evidence and logical structure may be demonstrated by asking suitable questions. Similarly, when you present an argument, you should anticipate the types of questions that might be raised by the recipient of your report.

It is important to attempt to determine whether there are any logical flaws or biases in a report. Again, acting disinterested in the issue will help guide you to raise suitable questions.

For example, suppose you have been asked to support the launch of a new product by agreeing to the conclusions in a pricing report. You would want to receive a copy of the report and some natural questions that would arise as you read the report would include:

- What business issue does the launch of the product solve?
  - Is it to increase sales, spread overheads over a wider base or tap into a new market?
  - What are the consequences of not launching the product?
- Are the data sources reasonable in the context of the proposed product?
  - Is the data relevant to the future experience of the proposed new customers?
- Are there any assumptions that are missing?
  - Will a customer always be able to afford the product?
- Is the evidence to support the proposal biased in any way?
  - This may be tricky as you are not asked to view reports on products that do not progress to the pricing stage.
  - Is the reasoning valid?
  - Can you think about the issue from a different perspective than the author?
- Does the evidence support the conclusions?
  - Are the potential sales volumes supported by the evidence?

- Is there a clear logical argument?
  - 'We must have 25 extras on this product, otherwise brokers will not put us on their panel of preferred companies'—brokers may be more interested in other factors such as ease of completing application forms, smooth dealing with an organisation, and efficient and fast payment of claims—potentially invalidating the argument for adding too many product extras.
- Are there any conflicts of interest?
  - What are the implications of spending money to launch a product that does not sell?
- What drove the choices of the sensitivity analysis?
  - Is this a repetition of a standard formula or are the choices directly relevant to the proposed product?
- Are all material risks considered?
  - Are management actions to mitigate risks discussed adequately?
- Are there items omitted that need further clarification?
  - Does the product comply with the company's Risk Management Framework?

Implicit and explicit arguments

It is necessary to consider not just what is written down but also what has not been stated.

An explicit argument spells out the steps in an argument. An implicit argument occurs when the argument is not stated in a text, and thus the reader must infer that there is some unwritten argument that needs consideration. These can be hard to spot, especially if the implicit argument relates to a field of study that you are not overly familiar with.

Sometimes, the implicit argument is not stated as it is understood by convention. For example, life insurance actuaries write q(x) as the probability of death over the following year for a life aged x exact. By convention, they ignore an implicit argument that the expression is contingent on a life reaching aged x and the probability is a contingent probability as some lives will not reach age x.

Analysing methodologies

The purpose of an investigation should be the main factor defining the use of a methodology. Understanding the appropriateness of a methodology and how it influences the findings is a key part of the analysis.

The following list of possible questions provides a means of determining whether a chosen methodology is valid. The sub-bullet points are examples that depend on unstated contexts.

- Why was this methodology chosen?
  - Is a deterministic model appropriate?
  - Should reserves be calculated using a prospective method rather than an accumulation method?
- What are the core assumptions for this methodology to be valid?
  - Should you use an inflation-adjusted chain ladder method?
- What are the advantages or disadvantages of this methodology?
- Are there explicit or implicit assumptions that have influenced the methodology?
- How might this methodology favour certain types of data, social groups or conclusions?
  - Are there issues of indirect discrimination?
  - Does the product implicitly favour wealthy individuals?

Analysing evidence

To provide examples of the types of questions you might ask when analysing evidence, consider the topic of setting premium rates for workers' compensation insurance. Premiums for this type of insurance typically cover one year's worth of workplace injuries, but claims can be made many years (or even decades) after the injury. In addition, payments under these claims can span multiple decades for injured workers who are unable to return to work as a result of their injury.

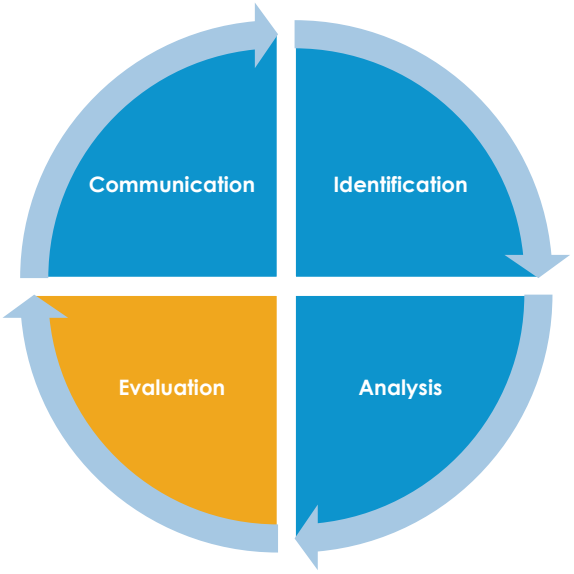
Assume evidence has been presented in a report to support the recommended average premium rate for the next year. The evidence presented is an analysis of the claims, payment and case estimate experience for all employers covered under this insurance from the last four years.

Questions you might ask to analyse the evidence presented in the report include:

- How is this evidence shaped by the context in which it was created?
  - The evidence is based on the legislative and economic environments over the last four years. This may be relevant to the immediate future environment, although there is much uncertainty about future changes in the legislative and economic environments in which this insurance is offered.
  - There is also considerable uncertainty about how claims experience will change over time (both in how many claims are made and how long benefits will be paid after the claim has been accepted).
- What tools or concepts must be applied to properly understand this evidence? Have they been applied in this analysis?
  - Claim experience differs by industry and individual employer. Has the analysis allowed for this differing experience for groups of employers? Has it considered and allowed for increasing trends for some employer groups that have been offset at the aggregate level by decreasing trends for other groups? How has the analysis allowed for changes in the mix of employers in the next year?

- Does the analysis use the best type of evidence available?
  - Is it reasonable to rely on only the last four years of experience?
  - Can the evidence be supplemented using a larger body of claims experience e.g. experience for other comparable workers' compensation schemes?
  - Does the analysis consider other evidence such as expected changes to the cost of medical treatments?
- Has the evidence been gathered properly?
  - What checks have been made on the estimated premium rates and have they been peer reviewed?
- Has data been cleaned with notes available?
  - Does adequate documentation and storage of the data exist?
  - Would the recommended premium rates change if a different analyst completed the exercise i.e. is the approach robust?
- Does the evidence really support the claims being made?
  - The report might claim that the recommended premium rates are adequate to cover all future costs of the scheme.
  - What level of confidence does the report provide that premium rates will be adequate?

11.3.4. Evaluation



Following the stages of identification and analysis, the critical thinking process moves to the evaluation stage.

The objective of this stage is to judge the evidence and argumentation to make a conclusion and propose justifiable actions. The evaluation stage is more subjective than the analysis stage. It aims to assess the quality of something and that involves formulating a judgement.

In applying this step, it is essential that you do not form an opinion too early, but remain open to a range of possible explanations. This mindset will enhance your objectivity and the quality of your conclusion or judgement.

Continuing the theme from the analysis section, the process of evaluation involves the consideration of the answers to relevant questions. Broadly, you should be answering questions on:

- validity – your analysis supports or rejects the argument;
- materiality – whether the argument or information bear any relationship with the business issue that you are considering i.e. consider its relevance;
- the 'so what' question, which considers how the analysis influences what you are undertaking; and
- the 'what else' question, which considers whether more information or investigations are necessary before you can propose actions.

Arguments aim to support or challenge contentions, drawing on evidence to do so. Asking questions is a technique to ascertain whether an argument is valid. Ideas from Section 0 (argument mapping) will help in generating evaluation questions as follows:

- An argument must have one contention: is it stated clearly and does it make sense within the business context?
- Reasons must be backed by evidence: do you consider the evidence supplied to be reasonable and reliable?
- Valid argumentation requires logical connections between the reasons and the conclusion: do you agree that the evidence and reasoning support the conclusion?
- Other stakeholders may have differing views to the protagonist: does the argumentation use evidence and clear reasoning to rebut any objections to the contention?
- Can you identify any logical fallacies in the argumentation?

Judgements are based on the information available at the time. For example, when setting best estimate bases for a valuation, an actuary is basing their judgements on suitable parameters on the currently available knowledge. It is understood that their opinion will likely change when more information is available—for example, at the next valuation.

11.4. Responding to management

Actuaries have a significant role in many firms as advisors to the business. In some jurisdictions, decisions by company boards must take into consideration actuarial advice. For example, management must consult with the Appointed Actuary in Australian life, general and health insurance companies before product terms are changed, reinsurance treaties are signed, bonuses are paid to participating policyholders, and so on.

You should always start from the premise that readers of your reports will be able to critically analyse your argumentation. They may not have the detailed domain knowledge that you will learn through your studies and post-qualification experience but will be able to spot logical flaws in reports.

A typical situation is that someone senior in an organisation has put forward an idea and you have been asked to offer a professional opinion. As discussed throughout this subject, as best you can, you need to be disinterested in the problem and provide a report that considers all sides of the argument.

This concept is also tested frequently in the Fellowship examinations. Examination questions often provide a scenario and then contain a statement from a senior manager or other colleague that the company should take a certain course of action.

The following is a formulaic approach that may be used to structure your answer to these sorts of questions:

- demonstrate that you understand their proposed course of action by providing a brief summary;
- state ways in which their view is valid;
- transition away from their argument;
- state your opposing view; and
- provide evidence that supports your view.

Exercise 11.1

A life insurance company sells income protection contracts to individuals through independent advisors. These contracts pay a regular benefit to the life insured if they become sick and unable to work for a period of time.

The proposal form for this contract has been designed to assist in the underwriting process. The form contains questions that attempt to determine the health of the potential life insured. This helps the insurance company determine the relative riskiness of the insurance applicant and therefore the price they should be charged for insurance cover. For most proposals, there is no need to ask further health-related questions beyond those contained in the standard form or request a medical examination. However, more information is sought if the answers to the medical questions on the standard form warrant a more detailed explanation or if the benefit being applied for exceeds $10,000 per month.

The Head of Sales has suggested that profits would increase if the company stopped asking further questions or requesting further medical examinations.

Draft your response to the suggestion that underwriting should rely solely on the information on the proposal form.

11.5. Using statistics in arguments

Our training as actuaries naturally helps us understand how statistics should be used but we should understand that statistics can be misleading. A key part of being professional is providing a clear explanation so that your reader will not be misled by statistics that are used in your argumentation.

Much of your working life will involve handling data and determining assumptions for input into models that produce output such as expected cash flows. A significant part of this work is applying judgement to manage the conflict between credibility and relevance of source data.

Some tips for good practice when using statistics that support your arguments are:

- adequately disclose the data sources;
- provide sufficient information on how statistics are derived;
- adhere to the principle of correspondence when deriving rates and describe the correspondence between the numerator and denominator;
- explain how rates based on past data are relevant to the future;
- discuss whether trends in the data have been recognised;
- describe, where possible, the underlying statistical distribution:
  - be clear which average is used, and why;
  - explain the variability of results; and
  - if the distribution depends on other factors, then describe those factors; and
- be clear on how much uncertainty there is in your answers.

The final bullet point above is probably the most important take-out. Reports should contain sufficient information to allow your reader to know how confident you are in your statistical estimates.

The detail underlying some of the above items is often not appropriate to include in the main report but could be included in appendices for interested readers to reference. However, this balance between what to include in the main report and appendices also requires careful judgement, as relevant information must not be 'hidden' in appendices, which may be missed by many audiences.

In addition to avoiding misleading others in your use of statistics to support an argument, you should employ a healthy amount of scepticism when being presented with statistics by others.

Video 11.3 provides an example of how statistics can be used to mislead an audience.

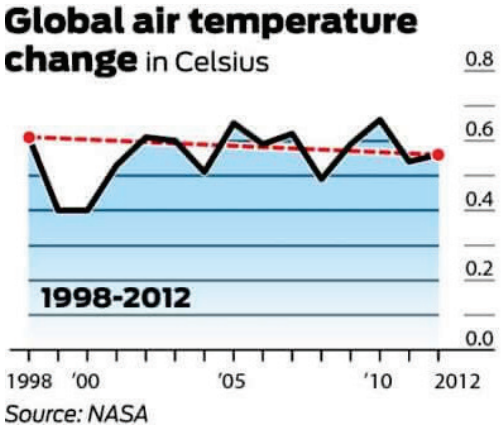
Video 11.3 – Misleading statistics

https://www.youtube.com/watch?v=sxYrzzy3cq8 (4 mins)

Record your video notes here

Exercise 11.2

Consider the information conveyed in the following graph[4]:



What might you conclude about the change in global air temperature over time based on this graph?

What other information would you like to see before predicting future global air temperature changes?

[4] Source: https://www.datapine.com/blog/misleading-statistics-and-data/

11.6. Fallacies of reasoning[5]

Part of the evaluation process is the consideration of an argument's logical structure. Weak or poor arguments are sometimes made to look stronger than they are because the author has employed the use of logical fallacies. Invalid arguments are common in newspapers but do occur in professional and academic writing. It is useful to understand common fallacies and avoid these in your argumentation.

There are many types of fallacies and this section discusses some common examples. The rest of this section will expand on the following list, which is certainly not exhaustive:

- ad hominem ('against the man');
- strawman fallacy;
- appeal to ignorance;
- false dichotomy (also known as the fallacy of the excluded middle);
- slippery slope;
- circular arguments;
- generalisations;
- off-topic distraction;
- appeal to authority;
- appeal to tradition; and
- correlation does not imply causality.

Ad hominem fallacies occur when the counter-claim against proposition X, say, does not address the argument but directly attacks the person making the claim. For example, a sales person may claim that adopting a new policy condition will increase sales, but the initial response to this claim may be to dismiss the argument because the sales person does not have the domain knowledge to understand the financial implications of the claim. This type of response has not addressed the argument but has attacked the character of the sales person.

[5] Marsen S. (2013). Professional Writing, Palgrave Macmillan. There are also many descriptions online of these fallacies—see e.g. https://thebestschools.org/magazine/15-logical-fallacies-know/

The **strawman fallacy** occurs when someone's original argument is simplified or misrepresented and is then claimed to be false. The structure is Person A claims that proposition X is true. Person B incorrectly summarises Person A's proposition as proposition Y. Person B dismantles proposition Y and then claims they have demonstrated the falseness of proposition X.

While politicians often deliberately misdirect responses to questions using strawman fallacy arguments, it is possible to inadvertently create a strawman fallacy argument if you misunderstood the other side's argument. This can happen in project meetings when, for example, complicated topics such as policy responses to changes in legislation or interpreting tax laws are being discussed. It is better practice, as well as demonstrating integrity, to work through the views of others so that you fully understand their argument before making a mistake of introducing a strawman fallacy argument.

Appeal to ignorance occurs when it is claimed that since something has not been proven, then it is not the case or if something has not been disproven, then it must be true. It is the lack of evidence that is the fallacy; absence of evidence is not evidence of absence[6].

For example, suppose you and your actuarial colleagues are discussing crediting rates for a retirement fund with your marketing colleagues. You make a statement that crediting rates should be cut because of the current economic conditions. The marketing manager replies that crediting rates should increase because of current economic conditions. Your original statement has not been backed up with evidence and hence allows the marketing person to cite the same 'reasoning' as you and arrive at the opposite conclusion. Avoid making these mistakes by ensuring you have evidence to back up your statements.

A **false dichotomy** occurs when the argument is presented that there are only two choices when, in reality, there are multiples choices. Many issues that actuaries advise on are complex and it is rare for the outcome to be an either/or situation.

[6] Carl Sagan (1995). The demon-haunted world. Chicago: Chicago University Press.

For example, suppose a competitor makes a change to its health insurance products to include cover for a range of new alternative therapies. Someone may claim that either your company also includes cover for these new therapies or new business sales will stop altogether. Such a claim is easily refuted by asking questions about, for example, the popularity of these new therapies, the amount of cover provided by your competitor and the premium they will charge to introduce this additional cover. The reality is that coverage of these therapies may only affect purchase decisions for a subset of future new policyholders.

The **slippery slope** fallacy occurs when a sequence of future events is linked to a premise and assumes that all the future events will occur leading to an improbable conclusion. The sequence of events may not be explicitly mentioned and then the presenter appears paranoid.

For example, suppose you argue that:

- we should increase the fees we charge to our customers this year because of the significant increases in our operating costs;
- if we don't increase our fees this year, then that sets the precedent not to increase fees in future years, assuming our operating costs continue to increase; thus
- not increasing fees this year will lead to insolvency.

The above argument is false as future operating costs may not necessarily increase at the same rate, fees can still be increased in future years and measures could be taken to tighten operating costs to ensure they don't continue to grow.

Circular arguments are essentially a restatement of the premise as the conclusion. Claiming the output from a model is a best estimate because the assumptions are best estimates does not answer the question of why the output is a best estimate. You need to explain why the assumptions aggregate to give a best estimate output from a model. Thus, you need to explain both the derivation of the individual best estimate assumptions and how the parameter values are valid when aggregated.

Generalisations occur when insufficient evidence exists to support a general claim. For example, if you hear a claim that fellows of actuarial societies should be able to complete the examination in two hours rather than the allocated three hours, then you should question how the evidence was obtained to back the statement. The statement appears plausible, but would you support such a statement if you were being cross-examined by an aggressive barrister in a court of law?

Off-topic distractions happen when someone interjects in a discussion with a statement that is not directly relevant and is only tangentially related to what is being discussed. The comments distract from concluding on the issue at hand and redirect the discussion onto other topics. For example, if you are in a group discussion on reducing lapse rates for home insurance policies, then interjecting with an idea to increase sales of home contents insurance is a distraction. It is tangentially related to the issue but not directly relevant.

A fallacy involving an **appeal to authority** may be difficult to spot as it is usually good practice to use independent experts when validating your claims. The fallacy usually involves a misuse of the authority or, potentially, the authority having less validity than presumed.

For example, suppose you work in a country where the prudential regulator specifies a set of rules to calculate risk-based capital. These rules specify potential stresses that test the ability of companies to remain solvent in adverse scenarios. Suppose you are pricing a product and part of your pricing report is to consider profitability in adverse scenarios. Assume that your new product is subject to one of the stresses. Should you accept the parameters of the stress set by the regulator? You may appeal to their authority, but you should ask whether you are misusing the prudential regulator's rule that was not set in isolation of other tests.

Suppose you use the regulator's rule and then a senior manager asks you for the evidence supporting the rule set by the regulator. The evidence may not be publicly available and may not even exist as the purpose of the regulation is often a balance between having well-capitalised companies and providing attractive returns to shareholders. While in this example you may not have committed a logical fallacy, you should be careful using unverifiable information.

Appealing to tradition justifies actions based on continuing what has occurred in the past. However, what has occurred in the past may not always be correct or ideal. Also, societal changes may invalidate past actions or outcomes. For example, insurance companies in many jurisdictions can rate members of a population differently provided there is actuarial justification for doing so. However, from late December 2012, insurance companies in the European Union could not use gender as a rating factor. Actuaries, therefore, need to have a clear understanding of local rules and should check they are not breaching legislation when continuing with past practice

The phrase **correlation does not imply causality** is likely obvious to you in its intent but sometimes it can be tricky to identify causal relationships.

If two random variables A and B, say, are (linearly) correlated, then possible relationships include:

- A causes B;
- B causes A;
- A and B are consequences of a common cause, but do not cause each other;
- A causes B and B causes A; and
- there is no connection between A and B; the correlation is a coincidence.

If **A causes B** then three conditions must be satisfied:

1. A must precede B;
2. B occurs if and only if A occurs; and
3. There are no other causes or effects.

B causes A is often a fallacy (assuming that A precedes B). A simple example is concluding from the fact that the faster windmills rotate, then one observes stronger wind and, hence, windmills create wind.

A and B are consequences of a common cause, but do not cause each other suggests there are lurking hidden variables. An oft repeated example of this is noticing that not taking shoes off to go to bed is strongly correlated with a headache in the morning. Alcohol is the lurking variable and it would be fallacious to conclude shoes cause the headache.

A causes B and B causes A may be instantaneous such as the relationship between two physical quantities linked via an equation or may occur over time such as the relationship between predators and prey.

To improve your persuasiveness, it's important to avoid these fallacies when constructing your arguments. It is also very useful to look out for these fallacies when reviewing and critiquing the arguments presented to you by others.

11.7. Key learning points

- Critical thinking is a process of obtaining true information from data and using that information to form judgements.
- Critical thinking and judgement skills are expected from actuaries in the workplace and are needed to successfully complete your Fellowship examinations.
- The four main stages in the process of critical thinking are identification, analysis, evaluation and communication. Embedded within each stage is the concept of reasoning.
- Reasoning is the ability to think logically to formulate fair judgements and justify a position.
- Argument maps are a useful tool for ascertaining the validity of an argument, by breaking it up into its constituent claims.
- Identification is the process of asking a set of questions about the credibility and relevance of the data.
- Analysis is the detailed objective process of examining information to understand the information and explain its meaning.
- Evaluation involves judging the evidence and argumentation to make a conclusion and propose justifiable actions.
- A formulaic approach can be used to respond to a statement you do not agree with. This approach involves demonstrating that you understand the other person's position, stating ways in which their view is valid and then transitioning to opposing views with evidence to support them, before reaching your conclusion.
- When using statistics in arguments, a key part of being professional is providing clear explanations so that your audience will not be misled by the statistics.
- Weak or poor arguments are sometimes made to look stronger than they are because the author has employed the use of logical fallacies.

11.8. Answers to exercises

Exercise 11.1

Dear Head of Sales

{Step 1: outline their idea}

You have suggested that we may increase profits by relying solely on the information on the proposal form to underwrite our income protection products. Thus, you propose that we should not ask for further information or seek the applicant to undertake a medical examination.

{Step 2: state ways in which their view is valid}

There are various benefits to this approach. First, asking for further information requires us to incur costs and your proposal eliminates these costs. This reduction in our costs could be used to increase profits or even cut premium rates, which may lead to further sales as our premium rates become more competitive.

Second, sales may increase as our time to acceptance will decrease. This faster processing time will be welcomed by the independent advisors and prospective policyholders.

{Step 3: transition away from their view}

However, there are implications for your suggested approach that may outweigh the potential benefits.

{Step 4: state your view}

More analysis is required to determine whether the benefits of your proposal outweigh the following negative consequences:

(Step 5: provide evidence supporting your claim)

- both the expense savings and reduced time to offer contracts may not occur. With information limited to the proposal form, then we may need to upskill our underwriting staff to undertake a more careful analysis:
  - increasing the skill set of staff increases costs;
  - spending more time on proposals increases the time taken to offer the contract; and
  - increasing the number of contracts that are not accepted will lead to dissatisfaction by the advisors and potential complaints from those who were rejected;
- there may be a need to strengthen the proposal form by including additional questions:
  - this will be disliked by the independent advisors and may discourage prospective policyholders from applying for cover;
- if the proposal form is not altered, then we may adversely change the future morbidity experience:
  - this will make it more difficult to place policyholders in a suitable risk category;
- without additional information, we may:
  - impose special terms on some policyholders that are too high for the actual additional risk and they may decline the cover; or
  - attract lives that would be rated higher by other companies, leading to a deterioration in our claims experience; and
- delays and additional costs may be incurred if our reinsurers alter their terms or request involvement in cases with relatively large benefits.

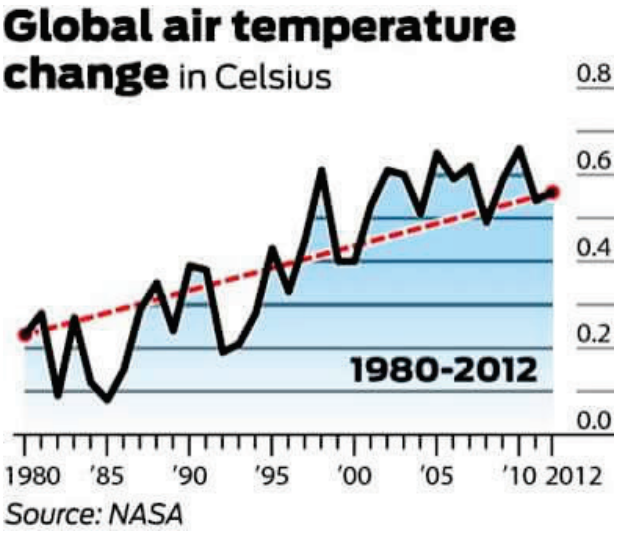
I look forward to discussing the next steps with you at our next project meeting.

Exercise 11.2

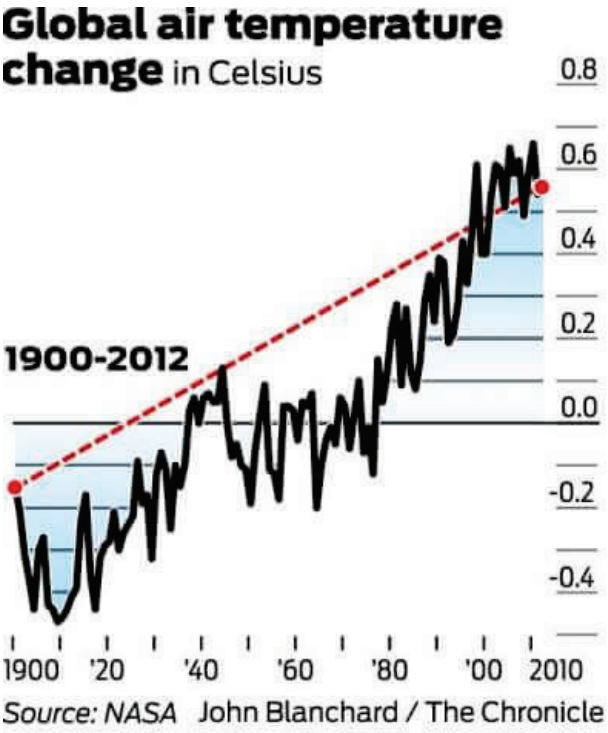
The graph shows global air temperatures from 1998 to 2012. Before drawing any conclusions about what future global air temperatures might do, you might want to seek answers to the following questions:

- How has change in global air temperature been measured in this graph?
  - Are the temperatures shown calculated as averages, minimums, maximums or median temperatures?
  - What does 'global' mean?
  - How has 'change' been calculated? Change relative to what?
- Has the measurement of temperature remained constant over this time?
  - Have the same tools been used to measure temperature?
  - Do the statistics calculate the single point for each year on a consistent basis (i.e. measured at the same time of year, for the same countries)?
- Were there any significant weather events in any of the years shown in the graph that might distort the trend shown?
  - 1998 was one of the hottest years on record due to abnormally strong El Niño wind currents.
- What does the longer-term trend of this measure show?

The picture changes when a longer time horizon for change in global air temperature is shown. The following graph shows the change over a 30-year period:



The trend over a 100-year period tells a different picture again:



The source of these graphs (https://www.datapine.com/blog/misleading-statistics-and-data/) provides several other examples of statistics that can be misleading. It also discusses a range of ways that statistics can be used to mislead and provides advice about how to read statistics critically to avoid being misled by them.

https://www.statisticshowto.datasciencecentral.com/misleading-graphs/ provides further examples of real-life statistics that have been used to mislead audiences.

About the Actuaries Institute

The Actuaries Institute is the sole professional body for actuaries in Australia. The Institute provides expert comment on public policy issues where there is uncertainty of future financial outcomes. Actuaries have a reputation for a high level of technical financial skills and integrity. They apply their risk management expertise to allocate capital efficiently, identify and mitigate emerging risks and to help maintain system integrity across multiple segments of the financial and other sectors. This expertise enables the profession to comment on a wide range of issues including life insurance, health insurance, general insurance, climate change, retirement income policy, enterprise risk and prudential regulation, finance and investment and health financing.

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