Section 1: Logical Reasoning

1.1. What is logical reasoning?

- Logical reasoning supports the attachment of meaning to analyzed information.
- Information is often incomplete and differences in contexts can affect meaning. For example:
  - A gathering by the road side can be due to a number of reasons.
  - A smile can represent some happy gesture or pretense.

1.2. Types of Logical Reasoning

- Three types of logical reasoning - deductive, inductive and abductive - are distinguishable.

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1.2. Types of Logical Reasoning

- Given a precondition or premise, a conclusion or logical consequence and a rule or material conditioning that ensures that the conclusion is achieved, one can explain that:

1.2.1.Deductive reasoning

- The truth of a conclusion can be determined for that rule, based solely on the truth of the premise.
- For example, "smokers are liable to die young”. Gordon is a smoker. He is therefore liable to die young.
- This type of logic is used in mathematical and philosophy.
- Deductive reasoning allows us to draw conclusions that must hold given a set of facts (premises).

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1.2. Types of Logical Reasoning

1.2.2. Inductive reasoning

- A rule after a number of successful trials is taken to be a conclusion that follows from a precondition in terms of such a rule.
- For example, “several smokers have died young”, therefore smokers are liable to die young.

1.2.3. Abductive reasoning

- Given a true conclusion and a rule, a valid premise is abducted to support the conclusion, though not uniquely.
- For example, people who start to smoke early tend to die young.

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1.2.3. Abductive reasoning

- A young man died. Therefore, he may have been a smoker.
- This kind of reasoning is used to develop hypotheses, which in turn can be tested by further reasoning or data analyses.
- Diagnostic and detective investigations adopt this type of reasoning.

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1.3. Fallacies

- Fallacies occur when arguments are not logical either because:
  - the premise is wrong,
  - the rule or material conditioning is incorrect,
  - the conclusion is inappropriate.
- A fallacy is an incorrect argument in logic and rhetoric.
- It undermines an argument's logical validity and soundness.
- Fallacies are either formal or informal.

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1.3. Fallacies

1.3.1. Formal fallacies

- A formal fallacy is an error in logic that is obvious in the argument's form.
- It is either the premise, conditioning or conclusion or a combination of all or any is wrong.
- All formal fallacies are specific types of non-sequiturs (do not follow).
- Some types of formal fallacies include:

Anecdotal fallacy – using an individual's experience or isolated case to draw conclusions on universal issues.

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1.3. Fallacies

1.3.1. Formal fallacies

Argument from fallacy – falsifying a conclusion because an argument leading to it is fallacious.

Masked man fallacy – substituting a different but identical subject in a true statement.

1.3.1.1. Propositional fallacies

- A propositional fallacy is an error in logic that concerns compound propositions.
- For a compound proposition to be true, the constituent parts must logically and relevantly connect.
- Types of Propositional fallacies include:

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1.3.1.1. Propositional fallacies

Affirming a disjunct – concluding that one disjunct of a logical disjunction must be false because the other disjunct is true;

- E.g.. A or B; if A, therefore not B.

Affirming the consequent – concluding that the antecedent in an indicative conditional is true because the consequent is true;

- E.g., if A, then B; B, therefore A.

Denying the antecedent – concluding that the consequent in an indicative conditional is false because the antecedent is false;

- E.g., if A, then B; not A, therefore not B.

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1.3.1. Formal fallacies

1.3.1.2. Quantification fallacies

- A quantification fallacy is an error in logic where the unit of measuring the premise contradicts with that of the conclusion.
- This includes an existential fallacy, wherein an argument that is based on a universal premise leads to a particular conclusion.

1.3.1.3. Syllogistic fallacies

- This involving three propositions; a formal deductive argument made up of a major premise, and minor premise, and a conclusion.
- For example, all cars are driven with petrol, Mazda is a car, therefore Mazda drives with petrol.

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1.3.2. Informal fallacies

- Arguments that are fallacious for reasons other than structural (formal) flaws.
- This usually requires examination of the argument's content. For example:

Appeal to the stone (argumentum ad lapidem) – dismissing a claim as absurd without demonstrating proof of its absurdity.

Argument to moderation (argumentum ad temperantiam) – assuming compromise between two views to be always correct.

Begging the question (petitio principii) – providing what is essentially the conclusion of the argument as a premise.

Equivocation – the misleading use of a term with more than one meaning, by glossing over which meaning is intended at a particular time.

Fallacy of composition – assuming that something true of part of a whole must also be true of the whole.

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1.3.2.1. Faulty Generalization

- A faulty generalization is produced when a conclusion is reached from weak premises.
- The premises may be remotely related to the conclusions but weak or inadequate to buttress the conclusions. Examples include the following:

Cherry picking: highlighting individual cases to support a particular position, while ignoring a significant portion of related cases that may contradict that position.

Hasty generalization : basing a broad conclusion on a small sample due to insufficient statistics or jumping to a conclusion (secundum quid).

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1.3.2.2. Red herring fallacies

- An error in logic where a proposition is, or is intended to be, misleading in order to make irrelevant or false inferences.
- This is an irrelevant argument that is intended to draw attention away from the subject of argument. E.g.;

Ad hominem – attacking the arguer instead of the argument.

Appeal to authority - (argumentum ab auctoritate) – an assertion deemed to be true because of the authority of the person asserting it.

Appeal to emotion - an argument made to manipulate emotions or weep sentiments, instead of being logical.

Association fallacy (guilt by association) – arguing that because two things share a property they are the same.

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1.3.2.3. Conditional or questionable fallacy

- ***Broken window fallacy*** – an argument that disregards lost opportunity costs associated with what appears to be a gain.
- The money paid to a window repairer could have been spent on other things.

Section 2: Conceptualization

2.1. Definitions

2.1.1. Concepts

- Concepts are mental constructs developed to symbolize ideas, persons, things, or events (symbolic interaction).
- A concept helps us to isolate and separate a class of phenomena from the others.

2.1.2. Conceptualization

- Conceptualization is the process of specifying a term (so that others know what it is) and giving it cognitive borders.
- In deductive research, conceptualization helps to translate portions of an abstract theory into specific variables that can be used in testable hypotheses.
- In Inductive research, conceptualization is an important part of the process used to make sense of related observations.

2.1.3. Concepts and Conceptualization

- E.g., if we say that poverty directly correlates to an increase in criminality, then we need to say what is criminality and how it can be measured.
- Conceptual definitions are multi-dimensional.
  - It can be ideological, experiential, ritualistic, consequential or intellectual.
  - We will sometimes need to determine if something is tall or big, black or dirty, clean or white, and so on

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- Conceptualization is the process of specifying what is meant by a term.
- It involves taking portions of an abstract theory and translating them into hypotheses with measurable elements.
- For instance, to work on poverty, a researcher needs to define the context of poverty relevant to the study.
- Four approaches - criterion-related measure, alternative criterion measure, related measure and subjective measure are commonly used.
- Conceptualization is a process of defining the agreed meaning of the terms for a context.
- Indicators are identified to mark the presence or absence of a concept.
- Some concepts have more than one aspect or facet, called dimensions.

2.2. Approaches of Conceptualization

- ***Criterion-Related Measure*** – comparing an occurrence to a standard or criterion. E.g., to measure poverty we can compare family income against the "poverty line."
- ***Alternative Criterion*** – measuring the possibility of an occurrence by an alternative. E.g., assessing the level of poverty by asking how often a family had to do without certain things, such as food or clothing?
- ***Related Measure*** – selecting a baseline level or standard. E.g., for poverty the most common measure is to define the lowest income earners as those living in poverty.

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Subjective Approach

- using a proxy or related and assessable measure.
- E.g., for poverty, what is can be done is to ask individuals how poor they feel relative to their peers.
- The sample population can also be asked if their family received food aid or whether their children received free lunch at school (where such subsidies are only available to families who live below the poverty line).
- The respondents can also be asked how often they went hungry or without another necessity.

2.3. Operationalization

- Conceptualization allows the researcher to define the relevant concepts, thereby giving the study a clear focus.
- Thereafter, operational definitions are required to define the procedures or steps used in measuring a concept and identifying the appropriate performance indicators.
- An operational definition must be specific and unambiguous, and linked directly to the study purpose.

2.3. Operationalization

- Three key elements of operationalization are as follows:
  - What is the necessary range in variation in measuring your concept?
  - How fine must the measure indicate variation between the attributes of a variable?
  - Which dimensions are important to your study?

2.3.1. Measurement Reliability

- The measurement is reliable when an instrument consistently measures the variable of interest.

2.3.1. Measurement Reliability

- Reliability of the measures can be assured through; test-retest method, alternative-form method, internal consistency method, split-half reliability method, item-total reliability method and ensuring inter-observer or inter-coder agreement.
- The reliability coefficients should be at least equal to 70% to demonstrate a reliable measure.

2.3.2. Measurement Validity

- A measurement is considered valid when the empirical measure observes what it purports to observe.
- The key validity question is “does the measure appropriately (adequately and accurately) reflect the meaning of the concept?”

2.3.2. Measurement Validity

- Validity of measurement can be enhanced by ensuring content validity, face validity, expert panel validity, criterion validity, predictive validity
- Concurrent validity, construct validity, convergent validity, discriminant validity and representational validity

2.4. Developing Tests and Measures for Concepts

- The methods that can be used to develop meaningful tests/measures of concepts include:
  - meaning analysis, inclusion analysis, exclusion analysis, and theoretical necessity.

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2.4.1. Meaning analysis

- Firstly review scholars' definitions of the terms and evaluate agreements and disagreements about the terms in the literature.
- Secondly, review the different uses of the terms and the relative successes.
  - Focus more on popular use of the terms, and evaluate dimensions within scales/measures for multiple components.
  - Sticking close to common use of terms makes it easier for others to understand what we are doing.
- Thirdly, identify the sub-concepts. It is often the case that a single word may stand for very different ideas.

2.4.2. Inclusion analysis

- Firstly, identify and articulate actual events or objects or behaviors that exemplify the concept.
- Secondly, test the extent that the concept includes real life situation, and review the concept if considered not all-inclusive.

2.4.3. Exclusion analysis

- Review the content and context of the actual events, objects and behavior that are covered by the concept to determine their relevance.
- This may require checking to see that similar but distinct examples do not get scored as examples of the concept under study.
- The unnecessary aspects are either removed or the definition rewritten for more inclusiveness.

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2.4.4. Theoretical necessity

- It is not always the case that the selected concept fits the context of a theory.
- Where the concept was constructed independently, it may be necessary to adapt it to fit within the theory under study.

2.5. Why Conceptualization is Important

- Theory development and modeling are dependent on concepts.
- Conceptualization is the first step in explication. It is an intellectual process that takes us from vagueness and ambiguity to clearer and more useful ‘constructs’.
- Continual review of conceptual definitions should occur as a result of new research.
- The concepts other researchers use, and their findings should be taken into account in future researches.
- Continuing refinement of concepts is part of scientific progress.

2.6. Conflicts in Measurement Validity

- The fact that concepts are multi-dimensional can render operationalization problematic.
- E.g., to operationalize how in-house training affects productivity, we need to say how “improved productivity” is measured
  - more working hours, more income generated or more output per unit of time, and so on.

2.7. Levels of Measurement

- The mathematical precision that the values of a variable can be expressed.
- The levels of measurement cannot be determined without considering both the concept and the measure.

2.7. Levels of Measurement

- Measurement can be nominal or qualitative.
- Nominal measurement is qualitative and devoid of mathematical interpretation.
- Quantitative levels of measurement are precisely mathematical; ordinal, interval, and ratio.

2.7.1. Nominal Measures

- The nominal measurement varies in kind or quality but not in amount.
- For example, using the variable “types of trousers”, one can say a jean is not equal to a velvet.
- But it will be wrong to say that a jean is more a trouser than a velvet and vise-versa.

2.7.1. Nominal Measures

- Variables only have attributes that are mutually exclusive and exhaustive.
- Names or labels are offered for the attributes characteristics.
- Measurement is by counting the frequencies of each attribute.
- Example: What is your primary source of news? Television, newspapers, radio, magazines, internet or others.

2.7.2. Quantitative Measures

Ordinal Measures

- Here only the order of the cases, in terms of "greater than" and "less than" or "indifferent" are distinguished.
- Given A, B, and C, it is A is preferred to B, B is preferred to A, or there is no difference between A and B.
- These are variables that can be logically rank-ordered.
- The attributes of a variable indicate relatively more or less of that variable.

2.7.2. Quantitative Measures

Ordinal Measures

- The actual distance between the attributes of a variable is imprecise.
- Example: How important are newspapers as your news source compared to the TV?
  - not very important, fairly important, very important, and most important source.

Interval Measures

- Measurement can lie in-between two absolute numbers with no absolute zero point.
- Measure variables that the distance between the attributes is important.

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Interval Measures

- Measure assumes the logical distance between the attributes of the variables through standard intervals.
- E.g., Newspapers are an important source of news information for me.

Strongly Agree Agree Neither Agree nor Disagree

Disagree Strongly Disagree

Ratio Measures

- Fixed measuring units with an absolute zero point.
- On a ratio scale, 10 can be two points higher than 8 or is two times greater than 5.
- Ratio numbers can be added, subtracted, multiplied or divided.
- Measures are based on a true zero point. Example: What is your age?

Section 3: Critical Thinking

3.1. Who is a critical thinker?

- A critical thinker follows reason and evidence wherever they may lead.
- Adopts a systematic approach to problem solving, inquisitiveness, even-handedness, confidence in reasoning, and metacognition.
- Three elements are involved, as follows:
  - Strong disposition towards considering problems thoughtfully, studying and applying past experience.
  - Ability to make inquiries and reason logically.
  - Competencies for logical reasoning and problem solving.

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- Critical thinking supports internalization and construction of basic ideas, principles, and theories inherent in content.
- Critical thinking supports the implementation of ideas, principles, and theories as become necessary.
- The core concepts of critical are problem solving, analyzing information, Interpreting information, recognizing bias, understanding diverse points of view, applying information and learning.
- These core values are embedded in subject-specific content of different disciplines.
- Critical thinking, also called critical analysis, which allows for well-reasoned and thought out ideas.
- Critical thinking involves skillfully conceptualizing, applying, and evaluating information to reach conclusions.

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- Disciplined and reflective thinking informed by evidence.
- It promotes purposeful, self-regulatory and contextual considerations upon which sound judgment is based.

3.2. Critical thinking Skills

- Ability to determine evidence through reality and isolate the problem from context.
- Ability to set up the relevant criteria for making the judgment well, and draw conclusions or form judgment
- Ability to construct theoretical and conceptual models for understanding the problem and question at hand.
- Ability to engage in solving problems and taking decisions.

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3.3. Procedures for Critical Thinking

- ***Problem Identification*** – the thinker should identify the problem and map its environment and ecosystem.
- ***Solution Identification*** – the thinker is able to identify the solutions and prioritize them in the order of precedence.
- ***Information identification*** – the thinker is able to identify, gather and organize the pertinent information.
- ***Risks and Assumptions identification*** – the thinker identifies and assesses the risk and the assumptions (mitigations) for addressing them.
- ***Appropriate Communication*** – the thinker is able to craft and use the correct language to communicate the thoughts with accuracy, clarity, and discernment.
- ***Information interpretation*** – the thinker understands and interprets situations and data, appraise evidence, and evaluates arguments.

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- ***Logical connectivity*** – the thinker is able to recognize the existence (or non-existence) of logical relationships between propositions, events and actions.
- ***Valid conclusions*** – the thinker draws informed conclusions and generalizations
- ***Testing Conclusions*** – the thinker applies the conclusions and generalizations to related or similar situations.
- ***Reconstructing material and non-material reality*** – the thinker is able to alter patterns of beliefs on the basis of new information or wider experience.
- ***Universalization*** – the thinker is able to render defensible and accurate judgments about specific things and qualities in everyday life.

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3.4. Critical thinking and far-mindedness

- Critical thinking promotes fair-mindedness.
- To be fair-minded one needs to have intellectual humility, intellectual integrity, intellectual courage, intellectual autonomy, intellectual empathy, intellectual perseverance, and confidence in reason.

Intellectual humility

- knowing one's ignorance, being aware of one's biases and prejudices, accepting the limitations of one's viewpoint, and wanting to continue knowing.

Intellectual integrity

- To be true to disciplined thinking and holding oneself to the same standards that one expects others to meet.
- It means practicing daily what one advocates for others (walking the talk).
- It implies avoiding all forms of cognitive dissonance (that is, believing one thing and doing another).

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3.4. Critical thinking and far-mindedness

Intellectual courage

- To have confidence in reason, and reach conclusions through rational thinking.
- To support people to think for themselves, form insightful viewpoints, and draw reasonable conclusions.
- Rely on good reason and sound evidence.

Intellectual autonomy

- Thinking for oneself while adhering to standards of rationality.
- Thinking through issues independently rather than just accept the viewpoints of others.
- However, critical thinkers are not willful, stubborn, or unresponsive to the views of others.

Selected Resources

1) Wikipedia (2014) Critical thinking
2) Hardegree (undated), Symbolic Logic Chapter One: Basic Concepts of Logic
3) Walker Center for Academic Excellence (undated)Using Critical Thinking Skills to Be a Better Student
4) Wikipedia (2015) Conceptualization
5) Peter Flach (2007) Simply Logical Intelligent Reasoning by ExampleJohn Wiley & Sons
6) Sharon Bailin, Roland Case, Jerrold R. Coombs and Leroi B. Daniels (1999) Conceptualizing critical thinking j. curriculum studies, 1999, 31(3), 285 – 302
7) Wikipedia (2015) Critical Thinking