

UGRC 150: CRITICAL THINKING AND PRACTICAL REASONING

LECTURE 6 : *Inductive Reasoning in the Sciences and Everyday Life (UNIT 7)*

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OUTLINE

- Basic principles of *Inductive* Reasoning.
- *Verifiable* and *confirmable* statements.
- ***Enumerative* Induction:**
- Law-like and Statistical Hypothesis

Recall Induction

Unlike deduction, in inductive arguments...

- the premises provide some reasons or evidence to *believe* the conclusion will be *probably* true (Not certain).
- the premises do **not** prove or guarantee the truth of conclusion; (i.e., no logical relationship between premises and the conclusion)
- the conclusion does not *necessarily* follow from the premises
- The meanings of the *content or information* provided matters in *confirming the degree of likelihood* of truth of conclusion based on the **strength of evidence** presented
- **Note:** conclusion may be false even if it is assumed that the premises are true, and no contradiction will be created

Induction **cont'd**

- The more evidence you have that *corroborate* (support) the conclusion, the higher the *degree* of confirmation.
- **But confirmation is not proof!**
- **Types** of inductive arguments: arguments based on *sampling, analogy, causal reasoning, enumerative induction*.

Examples of inductive arguments

1. 80% of politicians are lawyers.

Mr. Kofi is a politician

So, he is a lawyer

2. Few Ghanaians are hostile to foreigners.

Dede is a Ghanaian.

Thus, she is not hostile to foreigners.

3. Yaa is a woman and she cheated.

Ajo is a woman and she cheated.

Mansa is also a woman and she cheated.

Therefore, believe me when I tell you that women are cheats.

4. Two out of five women like rich men.

So, women like rich men.

5. The security man was the last person who left the building last night.

So, he is responsible for the theft.

Practice: Activity 1.5 (pp. 148-149) distinguishing deduction from induction. Discuss at tutorial!

Example of an enumerative induction

*Premises: I dated Ama and she cheated
I dated Yaa, she also cheated
I dated Mansa, she cheated
I dated Afi, she cheated
I have just dated Zainab and she cheated
All the women I have dated cheated*

Conclusion: So, all women are cheats

Premises (verifiable statements) are listed or **enumerated** to show the several instances that support the generalized conclusion or hypothesis (which is not verifiable but is only confirmable).

Two kinds of enumerative inductive

- **Enumerative induction 1**: argument with many *verifiable premises* (enumerating the premises like a list) and a ***law-like hypothesis*** as conclusion.
- **Enumerative induction 2**: argument with many *verifiable premises* (enumerating the premises like a list) and a ***statistical hypothesis*** as conclusion.

...with a **law-like hypothesis as conclusion** (Unit 7, section 3)

Premise 1: Gold expanded when heated.

Premise 2: Silver expanded when heated.

Premise 3: Bronze expanded when heated.

Premise 4: Copper expanded when heated.

Premise 5: Aluminum expanded when heated.

Premise 6: Platinum expanded when heated.

Premise 7: Brass expanded when heated.

Premise 8: Lead expanded when heated.

Premise 9: Iron expanded when heated.

Premise 10: Zinc expanded when heated.

Summary of premises: All the metals tested so far expanded when heated.

- **Conclusion: All metals expand when heated.**

...with a **statistical hypothesis as conclusion** (Unit 7, section 3)

Premises: I dated Ama and she cheated

I dated Yaa, she also cheated

I dated Mansa, she cheated

I dated Afi, she cheated

I have just dated Zainab & she cheated

All the women I have dated cheated

Conclusion: So, most women are cheats

CONFIRMATION IS NOT PROOF!!

Note:

- Inductive arguments aim at **confirming** the given hypothesis, while
 - Deductive arguments aim at **proving** the given conclusion
- The evidence of an inductive argument only confirms but it does not prove the truth of the hypothesis.

Confirmation is not proof!

Hypothesis is the same as the conclusion of inductive arguments whether statistical or law-like

Verifiable vs. confirmable statements

- ❖ A statement is **verifiable** if it has a *finite* (specific, countable) **reference class** (particular statement) and is therefore **directly testable**. E.g., That man is a bully.
- ❖ A statement is **confirmable** if it has an *infinite* (non-specific, uncountable) **reference class** (general statement) and is therefore **indirectly testable**. E.g., Men are bullies.

Recall particular vs general statements

Every statement (proposition) has two parts : the reference class and the attribute class.

e.g. That man is a bully.

- 'That man' is the reference class

(since 'that man' is specific, countable and finite, we describe this statement as a **particular statement**)

e.g. Men are bullies.

- 'Men' is the reference class

(since 'men' is not specific, not countable and infinite, we describe this statement as a **generalization**)

Recall! Types of generalizations

universal and statistical

Universal/lawlike generalization: The attribute applies to all members of that infinite reference class. (No one is exempted!) *E.g. Men are bullies.*

Statistical generalization: The attribute applies only to a subset of the infinite reference class. (some are exempted but the class is still infinite, therefore a generalization). *E.g. Some men are bullies.*

NOTE: The reference class tells you whether a statement is general or particular; as well as the type of generalization

verifiable **evidence** & confirmable **hypothesis**

- Particular statements have *finite reference class*, they are *directly testable* and therefore **useful as evidence(premise)**. We describe such statements as verifiable statements.
- Generalizations or general statements have *infinite reference class*, they are *indirectly testable* and therefore **useful as hypothesis (conclusion)**. We describe such statements as confirmable statements.
- **Note:** It's all about **the reference class!!**

Practice! **verifiable** vs. **confirmable** statements:

See pg. 191

1. **The disease** is contagious . **verifiable**
2. **Few Ghanaians** are allergic to pineapples. **confirmable**
3. **The liquid** in that bowl is poisonous. **verifiable**
4. **Green tables** are scarce these days. **confirmable**
5. **Kofi** is the new SRC president. **verifiable**
6. **All voters** prefer a recount of ballots. **confirmable**
7. **All *the* voters** interviewed said they will prefer a recount of the ballot. **verifiable**
8. **No student** registers unless forced. **confirmable**
9. None of ***the* students** in that class registered for the course. **verifiable**
10. **80% of all retailed** stones are not real diamonds. **confirmable**

Degrees of confirmability: statistical vs. law-like hypothesis

- **Examples of statistical hypotheses**

1. Some Americans are allergic to pineapples.
2. 80% of all retailed stones are not real diamonds.
3. Most Christians worship on Sundays.
4. Few Africans approve of same-sex marriage
5. Two out of every ten men are egoistic.

- **Examples of law-like hypotheses**

1. No cat is a dog
2. All voters prefer a recount of ballots.
3. No student registers unless forced.
4. Ghanaians are hospitable
5. Alcoholics are womanizers

Note:
statistical
hypotheses
are ***easier to
confirm
therefore
less
valuable*** to
the empirical
scientist
compared to
law-like
hypothesis

Note: degrees of confirmability

- Statistical hypotheses are *easier to confirm* than law-like hypothesis. That makes *statistical hypothesis less valuable* to the empirical scientist.
- Law-like hypotheses are **easier to falsify**, therefore they are *more valuable* to the empirical scientist!

Why falsifiability is valuable to the empirical scientist

- When a theory is falsified then the empirical scientist can be certain that it is not true.
- But when a theory is confirmed, it only means there is currently evidence that corroborates the likelihood of the theory being true.
- But the empirical scientist cannot be certain that a confirmed theory is certainly true because there is always the possibility that we may encounter a counter-factual.
- So, law-like generalizations are more valuable, next is statistical generalization, then verifiable statements

Scientific statements as: (testable, falsifiable)

- To be scientific is to be capable of being true or false. That is to say, to be **testable**.
(it makes sense to re-search only if what we found earlier could turn out to be false). **So uncertainty is a virtue in science!**
- Therefore, a statement that ***cannot be false is a pseudo-scientific statement*** (it is not a genuine scientific statement). E.g. **Tautologous** statements like “*Tomorrow it will rain or it will not rain*” and “she is pregnant or she is not pregnant” are always true, therefore pseudo-scientific!
- **Falsifiability** (able to be false) is a sign that the statement is scientific. It is valued by the scientist!!!
- **Verifiable or confirmable statements are testable/scientific**

Empirical content, degrees of falsifiability and predictive power

- The *more general* a statement is the *more empirical content* it has;
- The more empirical content a statement has, *the higher its predictive power*;
- The more predictive power a statement has, *the easier it is to falsify*;
- The easier it is to falsify a statement, the *more valuable* it is to the scientist!

Some conclusions on unit 7!

- Therefore,
 - universal generalizations have more empirical content,
 - followed by statistical generalization,
 - then particular statements.

(Pseudo scientific statements do not have empirical content or predictive power and are not falsifiable).

Practice exercises in text!! Unit 5.1 and 5.2

Cont'd

- A valuable empirical information must be *falsifiable* to be scientific.
- A statement that is not falsifiable cannot be a verifiable or confirmable statement.
- A statement that is absolutely true has no empirical content (pseudo-scientific statement).

Compare degrees of falsifiability, empirical content, predictive power, scientific value

TRY!!

1. The earth's orbit around the sun is elliptical.
2. All the planets that were discovered by Kepler before 1620 AD have elliptical orbits.
3. All planets have elliptical orbits.

TRY!

- a) Heavy smokers are prone to cancer
 - b) Most heavy smokers are prone to cancer
 - c) That heavy smoker is prone to cancer.
 - d) Either that heavy smoker is prone to cancer or he is not.
1. Which has the least predictive power?.....
 2. Which has the most empirical content?.....
 3. Which is/are pseudo-scientific?.....
 4. Which is easiest to falsify?.....
 5. Which is/are directly testable?.....
 6. Which would you call verifiable?.....
 7. Which is absolutely true regardless?.....
 8. Which is tautologous and therefore empty of empirical content?.....
 9. Which would you call hypothetical or confirmable?.....
 10. Which would you use as evidence/data or observation statement?.....

BREATHE!!!!

- END OF LECTURE 6 (UNIT 7)
 - Next topic UNIT 9, Causal Reasoning

Interim Assessment preparation!

- Units for **Interim Assessment**:
Units **1, 2, 3, 5, 6 and 7** (30%)
1. Study lecture resources (i.e., slides, videos, Q & A sessions etc.) *along with the **prescribed text-book***.
 2. Practice exercises in the text-book at tutorial and among yourselves.

All best wishes!!