UGRC 150
CRITICAL THINKING & PRACTICAL REASONING

Session 10 – INDUCTIVE REASONING IN THE SCIENCES & EVERYDAY LIFE (PART 1)

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Session Overview

• This session is dedicated to **inductive reasoning** (as found in the sciences and everyday life). It is to enable students know the **methods of scientific or empirical research**—how data are presented and conclusions drawn. And the quality of reasoning contained in scientific or empirical claims.

• **Goals and Objectives**

  At the end of the session, the student will

  1. Will be able to distinguish between **verifiable** and **confirmable** statements.

  2. Types of **hypothesis**.

  3. Account for the **predictive power of hypotheses**.
The key topics to be covered in the session are as follows:

• Topic One: **INDUCTIVE REASONING**

• Topic Two: **CONTRASTING VERIFIABLE AND CONFIRMABLE STATEMENTS.**
  
  (a). Verifiable statement (particular statement)
  (b). Confirmable statement (general statement)

• Topic Three: **THE TYPES OF HYPOTHESIS**
  
  (a). law-like Hypothesis.
  (b). Statistical Hypothesis.

• Topic Four: **PREDICTIVE POWER OF HYPOTHESES**
Reading List

• Log onto the UG Sakai LMS course site: http://sakai.ug.edu.gh/xxxxxxxxxx
• Read Unit 7 of Recommended Text – pages 134-143
• Watch the Videos for session 10- Inductive reasoning in the sciences & Everyday life (Part 1)
• Visit the Chat Room and discuss the Forum question for session 10 (Part 1)
Topic One

INDUCTIVE REASONING
In session 8 we discussed the two types of arguments; “deductive” and “inductive”. In this session we look at inductive argument again.

We defined inductive argument as an argument where the premises provide good reasons or evidence to support the probability of the conclusion being true and thus it is possible for the premises to be true and the conclusion to be false without any contradiction (unlike a deductive argument).

The premises of inductive argument are treated as evidence, data, or observation reports or research findings that support the conclusion.
The quality and quantity or how good the evidence provided by the premises are will determine the degree of probability of the conclusion being true, believable or acceptable.

Examples:

1. For the past twenty years of my life it has been raining every Friday. Tomorrow is Friday. Therefore, tomorrow it will rain.

2. For the past three weeks it has been raining every Friday. Tomorrow is Friday. So tomorrow, it will rain.
(3). Every **Friday** it rains.  

Every **Fs** is **Rs**

Tomorrow is **Friday**. =⇒ Tomorrow is **F**

So, tomorrow it will **rain**.  So, Tomorrow is **R**.

- If we look at the above examples, E.g1 and E.g2 are inductive arguments because it is possible for the conclusion to be false even when the premises are true. However, based on the evidence provided in the premises the conclusion of E.g1 is more likely to be true than that of E.g2. This is because an evidence of “raining on every Friday for the past twenty years” is stronger than an evidence of “raining on every Friday for the past three weeks”. So E.g1 is a good inductive reasoning whilst E.g2 is weak inductive reasoning. In fact, the probability of the conclusion of E.g2 being false is higher than that of E.g1 but both examples are inductive.
However, if we look at E.g3, we realize that it is **not possible for the conclusion to be false when we assume the premises to be true**, so **E.g3 is a valid DEDUCTIVE argument** and for that matter has the LOGICAL STRUCTURE or PATTERN of MODUS PONENS.

This means that an inductive argument does not provide the structure or pattern of logical proof like **MODUS PONENS, MODUS TOLLENS, HYPOTHETICAL SYLLOGISM AND DISJUNCTIVE SYLLOGISM** as it is in the case of deductive argument. (refer to session 9)

But rather it’s premises provide evidence that confirms the likelihood or degree of probability of the conclusion being True. There is no certainty with inductive reasoning. **This is because no matter how good the evidence or reasons are, it is still possible for the conclusion drawn to turn out to be false.**
Topic Two

CONTRASTING VERIFIABLE STATEMENT AND CONFIRMABLE STATEMENT
What are verifiable statements and confirmable statements

• Because we treat the premises of inductive arguments as evidence or observation reports out which conclusions are drawn, the statements that make up inductive arguments from the premises to the conclusion are understood or examined in terms of verifiable statements and confirmable statements.

• VERIFIABLE STATEMENTS are the same as PARTICULAR STATEMENTS. They are also called evidence, data, test results, observation reports or research findings.

• They are called verifiable statements because as particular statements their reference classes are finite. That is the subject is fixed or countable.
We can know the total number of the subject and because of that we can *always cross check to determine whether they are true or false.*

- **Examples:**
  1. *Next week Friday* it will rain.
  2. *The students in this class* are from the distance education school.
  3. *Accra* is filthy.

- All the above examples can be determined to be true or false. For instance, in *E.g1*, we wait to see if it will rain next week Friday. In *E.g2*, we can get the students in that particular class and inquire if they are all from distance education school.
We can also embark on a survey in Accra to see whether there is no filth can be found in any part of Accra, because the statement refers to only one city (Accra).

- **Thus** when it comes to *verifiable statements*, because *their reference classes or subjects are finite (particular statements)*, a *test* or an *experiment* or *observation* can be done to establish *directly* in one, two or few times, *to determine whether they are true or false*.

- **We therefore define verifiable statement** as a statement that is *directly testable through experience* because *its reference class or subject is finite (countable)*.

- **NB:** *All verifiable statements are particular statements*. 
CONFIRMABLE STATEMENTS on the other hand are the same as GENERAL STATEMENTS. They are also call hypotheses.

EXAMPLES:
1. Every Friday it rains.
2. All students are from distance education school.
3. Some taxi drivers in Accra can speak Chinese.
4. Some students cheat in exams.
5. All snakes are poisonous.

All the above statements are CONFIRMABLE STATEMENTS because their reference classes or subjects are infinite (uncountable).
Because their subjects are **uncountable** we cannot **test or observe directly** to determine fully whether they are **true** or **false**.

- For instance, there are **uncountable number of Fridays**. So we cannot get access **empirically to all Fridays** to determine if it rains on each Friday. So the best we can do is **monitor all the Fridays for a period to see if it rained or will rain**. However that will **not exhaust all the Fridays that E.g1 refers to**. Thus even if it rains on all the Fridays for the period of **10 years**, in the 11th, 12th, or 13th year it is possible that it will **not rain on one particular Friday** and that will make the statement, **“every Friday it rains”** false. The same for **E.g2 & E.g5**.
If we take the E.g3, we realize that the reference class “some taxi drivers in Accra” is infinite as well, because if we do a survey we might gather a sample of 50 taxi drivers, but there could be others who can also speak Chinese but we might not include them in our sample so in effect the actual reference class may be more than 50. They may be 100, 200, 1000, etc. So here again we cannot get the total reference class so we only select just a sample to test the statement and that sample will not exhaust the reference class of the statement in E.g3 on page 14. The same analysis can be done on the E.g4 as well.

Thus CONFIRMABLE statements are testable indirectly because their reference class are infinite. That is the subject is limitless in number to ascertain or count them all.
• We only gather a **sample or evidence to test them**, however what ever may be the **results of our observation or sample or evidence**, we project to be the **result of the confirmable statement**.

• Thus **confirmable statements** are **testable indirectly** based on the **results of verifiable statements**.

• We therefore **define confirmable statement** as statements that are **indirectly testable through experience** because their **reference classes or subjects** are infinite(countable).

• **NB:** All **confirmable statements are general statements and they are also called hypotheses**.
Topic Three

TYPES OF HYPOTHESES OR CONFIRMABLE STATEMENT
We know from the previous discussions that hypotheses are also called confirmable statements. However, there are two types of confirmable statements or hypotheses.

- The first type is called law-like statement or law-like hypothesis.
- The second type is called statistical statement or statistical hypothesis.

NB. TAKE NOTE THAT BEFORE A STATEMENT CAN BE LAW-LIKE OR STATISTICAL IT MUST FIRST BE A GENERAL STATEMENT OR CONFIRMABLE STATEMENT.
A law-like hypothesis is a confirmable statement or general statement that has no exception. It is always expressed in the form. All As are Bs. or No As are Bs.

Examples:
1. All metals expand when heated.
2. All living things require oxygen to live.
3. No student register unless forced.
4. All voters hate the New Democratic Congress Party.

A law-like statement makes attribute a property to every individual in its reference class without exception whatsoever. A property that every individual or thing in its reference class will have.
A statistical hypothesis on the other hand is confirmable statement that *has an exception*. It is always expressed in the form, **Some As are Bs. or Most As are not Bs.**

**Examples:**
1. Most metals expand when heated.(not all metals)
2. Some students register when they are forced.(not all students)
3. 80% of Ghanaian voters do not like the New Democratic Congress Party. (20% exception)
4. Almost all Ghanaians are afraid of the Ebola virus. (not all)

**Vague terms like, some, occasionally, few, most, many, typically etc, begin majority of statistical hypothesis.**
Topic Four

PREDICTIVE POWER OF HYPOTHESES.
Predictive power is the ability of a statement to say something about the future.

However some statements have higher predictive power than others. In this case we compare law-like hypotheses and statistical hypotheses.

A Law-like hypothesis makes no exception about its reference classes and because of that, it has higher predictive powers.

A Statistical hypothesis on the other hand makes exception about its reference classes and because of that, it has low predictive power.
Law-like hypotheses illustration

• Consider this example of a law-like statement.

1. Every Friday it rains.

• As a law-like statement, it has no exception because it talks about all Fridays, those that have passed, as well as Fridays in the future.

• If at least it happens that just one Friday it does not rain the above statement will be false. Thus it is easily or more falsifiable.

• If the above statement is true then it gives us information or knowledge about all the Fridays to the end of the world and because of that it gives us the power to predict that the next Friday it will rain, and the Friday after and on and on till the end of the world no matter where we find ourselves.
Statistical hypotheses illustration

- Consider this example of a statistical hypothesis,
  
  1. *Most Fridays it rains.*

- As a **statistical statement** it has an **exception**, because it is implied in the statement that there are **few Fridays** where it **does not rain**.

- If at least one Friday comes and **it does not rain**, the above statement will still be true. Also if **it is true that most Fridays it rain**, the statement, “**every Friday it rains**”(page 24) will be **false**. Thus it is clear that a statement such as “**most Fridays it rain**” is **hardly or less falsifiable by evidence**.

- If **the above statement is true** it gives us **only information** about just majority of Fridays but not all. And also if **I know that a particular day is Friday**, I cannot with **certainty** say that it will rain on that day because **there is an exception that it might not rain**.
• So, the statement “most Fridays it rains” does not give us knowledge or information about all Fridays and for that matter does not give us stronger predictive power.

• Thus law-like hypotheses have more predictive power because they have no exceptions which make them more or easily falsifiable.

• But statistical hypotheses on the other hand have less predictive power because they have exceptions which make them less or hardly falsifiable.