UGRC 150
CRITICAL THINKING & PRACTICAL REASONING

Session 11 – INDUCTIVE REASONING IN THE SCIENCES & EVERYDAY LIFE (PART 2)

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Session Overview

- An important way of engaging in inductive reasoning is to provide a **list of evidences** that serves as **the basis** for a **conclusion**. This sort of **induction** is described as **enumerative.** In this session, attention is paid to enumerative induction and accompanying issues.

- **Goals and Objectives**

At the end of the session, the student will

1. Understand ***enumerative induction***.

2. Relate ***enumerative to statistical and law-like hypothesis***

3. Virtue of uncertainty.

Session Outline

The key topics to be covered in the session are as follows:

- Topic One*:* ***(A).*** **ENUMERATIVE INDUCTION**

  (B). **ARGUMENTS BASED ON STATISTICAL HYPOTHESIS**

- Topic Two: ***UNCERTAIANTY AS A VIRTUE IN SCIENCE.***

Reading List

- Log onto the UG Sakai LMS course site: http://sakai.ug.edu.gh/xxxxxxxxx
- Read Unit 7 of Recommended Text –pages 143-153
- Watch ***the Videos for session 11- Inductive Reasoning in the Sciences and Everyday Life (Part 2)***
- Visit the ***Chat Room*** and discuss the ***Forum question*** for ***session 11 (Part 2)***

Topic One

ENUMERATIVE INDUCTION AND ARGUMENTS BASED ON STATISTICAL HYPOTHESIS

INTRODUCTION

- **Just as we looked at the different patterns or logical structures of deductive arguments in session 8, here we look at the different ways in which inductive arguments are constructed.**
- **There are two important issues about induction that will be discussed in this session.**
- **The first one is what we call enumerative induction or induction by enumerative. Enumerative induction is about how hypotheses are supported or constructed out of a list of verifiable statements(evidence)**
- **The second is an inductive arguments that contains statistical hypothesis as part of its premises to draw a conclusion about a particular future case.**

ENUMERATIVE INDUCTION

- **Enumerative induction or induction by enumeration** is the type of **inductive argument** that uses **verifiable statements** or **particular statements** as ***premises*** to support a **general statement(confirmable statement)or hypothesis** as ***conclusion.***
- It is called ***enumerative because the conclusion based on an accumulated number of instances or evidence*** to support it.
- It is **the accumulated number of instances or evidence** that will ***determine*** which type of **hypothesis** will be the ***conclusion***. The conclusion can either be a ***law-like hypothesis or a statistical hypothesis.***

Examples of enumerative induction

Example with a law-like hypothesis as conclusion

- **Five different snakes were fed with live rats in an experiment and the results are as follows,**

1. The first bit its rat and it died.

2. The second bit its rat and it died.

3. The third bit its rat and it died.

4. The fourth bit its rat and it died.

5. The fifth bit its rat and it died.

Summary: The five snakes that were fed all killed their rats by biting them.

Therefore**, ALL SNAKES ARE POISONOUS.**

Example with a statistical hypothesis as a conclusion

- **Five different snakes were fed with live rats in an experiment and the results are as follows,**

1. The first bit its rat and it died.

2. The second bit its rat and it died

3. The third bit its rat and it died

4. The fourth bit its rat and it did not die.

5. The fifth bit its rat and it did not die.

Summary: 3 out of the 5 snakes that were fed killed their rats by biting them.

- Therefore, **60% OF SNAKES ARE POISONOUS.**

CONTINUATION

- When you look the above examples you can see that **all the examples have five statements as premises and all these statements are verifiable statements (particular statements)**. For the **reference class in each statement is particular (finite)**
- But the **conclusion** for each **example is different** even though they are ***both hypothesis with infinite reference class.*** The one on the **left** is ***law-like***, and the one on the **right** is ***statistical.***
- In the example on the left it can be seen that **all the five snakes have something in common in the sense that, they all record the same results for their respective rats.** That is why the ***conclusion is a law-like hypothesis***. It is only in **situations like this** that you **can have a law-like hypothesis as a conclusion.**
- The argument can also be constructed this way; **All the 5 snakes killed their respective rats. Therefore all snakes are poisonous.**

continuation

- If we look at the **statistical example on the right**, we realize that unlike the example on the left, ***not all the snakes recorded the same result***; **2 out of the 5 could not kill their rats** so in such a situation the **favorable hypothesis is a statistical hypothesis.**
- The argument on the right side can also be constructed in this way; **3 out of the 5 snakes that were fed with live rats killed their respective rats. Therefore 60% of snakes are poisonous.**
- **Thus these are the two ways that an enumerative induction can be constructed. An enumerative induction that supports a law-like hypothesis and the other that supports a statistical hypothesis.**
- **They are both inductive arguments because it is possible for the conclusion to be false when the premises are assumed to be true. This is because the premises have finite reference classes whilst the conclusions have infinite reference class.**

INDUCTIVE ARGUMENT WITH A STATISITICAL HYPOTHESIS AS PREMISES

- This is the Second type of **inductive argument which unlike the enumerative moves from general statements as premises to a particular future instance as a conclusion.**
- **Examples:**

(1).Most footballers are models.
Michael Essien is a footballer.
So, Michael Essien is a model.

(2). 50% of students cheat in exams.
Kwame is a student.
So, Kwame cheats in exams.

- These are **inductive arguments** because **it is possible for the conclusion to be false even when the premises are true.**
- This is because **there are exceptions in the first premises** that allow for ***the conclusions to be false when the premises are true***.

Continuation

- However , ***when we change the first premise which is a statistical hypothesis for instance in E.g1 to law-like hypothesis,*** the argument will change from **inductive** to **deductive**.
- **For instance,**

(1). All **footballers** are **models**. All **F**s are **M**s

Essien is a **footballer**. =➔ Essien is **F**

So, Essien is a **model.** **So,** Essien is **M**.

- **If it is true that all footballers are rich, and it is also true that Essien is a footballer, can we conclude by saying that Essien is not a model? The answer is NO, because to draw such a conclusion will result in a contradiction. Therefore, it is a valid deductive argument.**

Continuation

- **NB: Inductive arguments are the type of arguments or reasoning where premises CONFIRM a conclusion. Thus there is always the possibility of the conclusion to be false when the premises are true.**

Topic Two

UNCERTAINTY AS A VIRTUE IN SCIENCE.

UNCERTAINTY

- As mentioned above we cannot be absolutely certain of any claim or conclusion that we arrive at by means of induction.
- This is because **we understand** now that **the premises of our inductive conclusions** only ***confirm*** the conclusion ***(i.e.,*** they indicate the **degree of probability of the conclusion being true depending on how good the reasons are).**
- However this **uncertainty** about **inductive claims or conclusions is of great importance** in science as well as our everyday understanding of the world.

Continuation

- **Uncertainty** is a characteristic of all empirical observations. This means they are not always true, but are sometimes true and sometimes false.

Continuation

- If ***a statement is falsifiable or can be doubted*** then ***it gives us reason to find out the truth about something in the world. Thus it gives us knowledge about the world***. But if **a statement not falsifiable** then such **a statement gives us no knowledge** about the world.

Illustration.

- Let us say you are in an enclosed room. You do not know what is happening outside. Somebody enters the room and you ask the person: **Is it raining outside?** And the person **response**: ***it is raining outside***. If you take his answer as true, you will probably decide not to go out or take an umbrella with you should you decide to go outside. **Thus you are able to make a decision based on the answer you got from the person.**
- If you decide to go out, **you go out having in mind that it is raining**. So you step outside and you realize that every place outside is wet and you can also see rain drops falling, ***then you would have indeed come to know that what you were told is true about the world***.

continuation

- But if you go outside and ***you realize that the ground suggests that it has not rained for a longtime,*** then you now realize that **what you were told was(is) not true about the world**. At that very moment you have come to know, based on your own observation about the outside(world) that it is not raining. **This then becomes a new knowledge which you did not have about the world.**
- Gaining **the new knowledge** and being able to ***make a decision*** became possible because **the answer** that "***it is raining outside is a falsifiable(testable) statement.***"

Continuation

- However, what happens if the person had responded; **Either it is raining outside or it is not raining**.

- With such a response, **it will be difficult to make a decision** about whether or not to take an umbrella should you decide to go out.

- If **you go outside and it is raining**, or **you go outside and it is not raining** the response "**either it is raining outside or it is not raining outside"** will remain ***true***. If ***you go outside and it is raining at a section of the compound but another not raining at another section***, the response "**either it is raining outside or not"** will still remain **true**.

Continuation

- **Examples of statements that are falsifiable are,**

  1. Any **Particular observation statements(falsifiable**).

  2. Any **statistical hypothesis (less falsifiable**).

  3. Any **law-like hypothesis (more or easily falsifiable).**

- ***NB. IF A STATEMENT IS FALSIFIABLE THEN IT GIVES US KNOWLEDGE. Thus THE MORE FALSIFIABLE THE MORE KNOWLEDGE. THE LESS FALSIFIABLE THE LESS KNOWLEDGE***

CONTINUATION

- If a statement is **not falsifiable** then **it does not give us any empirical content or knowledge about the world.**

- **NB: Thus Uncertainty is a virtue in science and our everyday understanding of the world because with uncertainty (falsifiability) comes knowledge.**