

Lecture Six: Research Questions and Hypotheses

1. Introduction

Deciding the research questions and hypothesis of a study is an essential aspect of conducting a quantitative study. This section explains both these components and explores the process of identifying them. A research question presents the problem(s) to be addressed in the research study, and the hypothesis is the predicted answer to the research question, based on the literature reviewed.

2. Learning Outcomes By the end of this lesson, You will be able to:

- Understand the types of research questions, the key elements of good research questions and the possible sources and the process of identifying research questions.
- Understand the types of hypothesis, the process of developing a hypothesis and the errors associated with hypothesis testing.

3. What is a Research Question?

A research question is a carefully worded question that addresses an aspect or concept of a hypothesis. It is a key element of a research study because it defines the main purpose or direction of the study. A researcher may have a clear idea of the main theme of the research but defining this idea in terms of a testable research question is an essential part of the research process. Quantitative research questions usually explore relationships between variables in a research study. However, they may also address the magnitude of a single variable as in “What is the level of participation of college youth in the Hepatitis B awareness campaign” where the focus is not exploring relationship, instead it centers on finding out the magnitude of a single variable, ‘participation in campaign’. Research question/s should focus of the following:

- ✓ What are you trying to find through this research? What are the question/s for which you seek answers?
- ✓ What is the geographic area for the research? Where will you draw your sample from?
- ✓ What is the time frame for your research? The answers to the above will help you frame your research question.

For example:

- ✓ What is the extent of burnout amongst counsellors involved in HIV/AIDS counselling in Mumbai? (this focuses on magnitude of burnout amongst counsellors)
- ✓ Do supervisory practices help counsellors involved in HIV/AIDS counselling in Mumbai cope with burnout? (this deals with understanding the relationship between supervisory practices and coping capacities of counsellors)

3.1 Identification of research questions

Researchers do not simply make up research questions, but rather identify research questions from a number of different sources. Some of these sources are as follows:

- ❖ Practical experience: Practitioners working in the different settings may be inspired to take up research on a particular issue or problem that concerns them; the research questions may emerge from their daily work. For example, a teacher or social worker working in a preschool setting may decide to study the impact of the preschool program on children's primary school achievement. Alternatively, another social worker working on vocational training programs may want to check if the program was successful in ensuring that the trained youth found employment. Therefore, real life work situations can be an excellent source for identifying research questions.
- ❖ Literature review: Literature reviews can also be a good source for research questions. As we learned in a previous module, a literature review involves a critical appraisal of the concerned literature on a said topic. While reviewing the literature, a researcher has a good opportunity to examine previously conducted researches on a given subject in order to understand the findings, the limitations and any emerging trends. This process can give the researcher a good idea of what questions or issues remain unanswered or unexplored.

For example, while reading the literature, a reviewer may find that little research exists about children's perceptions of domestic violence. The researcher can then choose this topic for a research study and draft a research question. A review of literature may also help uncover untested theories which provide a good opportunity to identify research questions. Researchers may use existing theories to test their applicability in various situations. For example, the "Broken Window" theory asserts that crime rates increase in neighbourhoods that are in a poor and shabby condition. A researcher may be interested in applying this theory to school settings, to see if the theory is verifiable in that context.

Brainstorming with colleagues, friends or faculty members is a good technique to generate and refine ideas for research questions. Make a list of all the possible questions you can think of (related to your interest area) and then evaluate these questions using the criteria defined in Sections 3.3 and 3.4. Narrow your list down up to five questions. Read additional material on these questions to explore if they have been investigated before, and if so, what results were found. Use your reading to refine the questions and finalize them.

3.2. Types of research questions

There are three types of research questions, each of which reflect the type of research study. These types are as follows:

- i. **Descriptive questions:** these questions generally look at descriptions of a particular issue or situation. Descriptive questions usually have just one variable, but in cases where there are multiple variables, the direction of the relationship is not specified in descriptive studies. An example of a descriptive question is “What percentage of low income children complete primary school in communities of Mumbai?”
- ii. **Exploratory questions:** these questions explore a particular issue or phenomenon and usually involve two or more variables. Example: “Is there a relationship between maternal education and children’s school completion in rural Bihar?”
- iii. **Explanatory questions:** these questions seek to establish causal effects between two or more variables. Example: “Do parents who have completed their bachelor’s degree have the same aspirations for their daughters as parents with education levels less than SSC? The type of question you ask will determine the type of study you are conducting, and will relate to the methods you will use during your study.

3.3 Elements of good research questions

Any good research question has four elements which are:

- The research question must be significant: It must have the potential to contribute to and extend significant learning on an issue. In other words, the study results should address a knowledge gap, and the new knowledge generated will be theoretically valid and/or practically relevant. If a particular question has been answered before, it is pertinent to ask if it is worth exploring again, and if so, in

what contexts. When explaining the significance of your project, connect your research to larger issues in order to demonstrate its relevance to larger contexts.

- The research question must be feasible. In other words, it takes into account the availability of required resources such as money, time, and research subjects. Therefore, consider your resource limitations when defining and finalizing your questions. If the question is exploratory or explanatory, the researcher would also need to take into account whether it is possible to manipulate the desired variables.
- The research question must be clear and concise. It must be grounded in updated theoretical or empirical knowledge. This will make your research study relevant, and will connect your study to existing knowledge. Use simple language to frame your question because questions that are abstract or overly complex can make it difficult to assess significance or relevance.
- The research question must be ethically sound. The researcher needs to consider whether the research question could cause any potential harm to the research subjects. Further, researchers also need to make sure that questions do not inadvertently lead to a breach in confidentiality procedures.

3.4. Tips for writing good research questions

1. Remember the research question is a question. Therefore, do not draft it as a statement.
2. Ensure that your question is specific. If the question is too broad, it may confuse and may contain other questions within it. If the question is too narrow, it can be answered in a simple sentence. Both these types of questions are not appropriate research questions.
3. Make sure the question is practical and can be investigated empirically. It may not be possible to investigate some questions.
4. Make sure your questions relate one variable to another because that is what your study will test.
5. Be sure to conduct a thorough literature review because this process can help you in deciding and framing good research question/s.
6. Articulate your question clearly and make sure the terms are well defined. For example, instead of saying “How does teacher training influence students?” it might be better to say “How does teacher training influence student performance in annual exams?”

7. Be sure to specify the population of your study in your research question. For example, instead of saying “preschoolers” it would be more appropriate to be specific and state “3-5 year old children.”
8. Make your question as interesting as possible!
9. Frame your question in a provocative way. For example: “Why has the incidence of smoking increased even though the frequency of anti-smoking campaigns has increased?”
10. Limit your variables. Too many variables may result in a study that is too large or too complicated.
11. Keep your research questions objective – your questions should avoid value judgments. For example, it would be wrong to state a question like “Does the bad habit of smoking cause lung cancer?”
12. Make sure your questions are ethical. For example, it might be feasible to do a study with child abuse victims but it may not be ethical to do so if the study is going to raise painful memories and experiences.

Clear, concise and well framed research questions will make it easier to conduct an effective study that results precise and accurate knowledge. Research questions link to other parts of a research proposal such as defining the hypothesis and selecting the methods for the study. The research questions also serve to keep you focused during the process of research; it is a good idea to refer back to them periodically (or even when you are confused) to make sure you are on the right track.

4. What is a Hypothesis?

A hypothesis (plural form: hypotheses) is a statement that explains the relationship between two or more variables. This statement is tested during a research study, and the predicted relationship can be proved to be either valid or invalid within the framework or particular context of the study. It is important to note that a hypothesis is validated (or proved to be invalid) within the specified time frame of the study. A hypothesis can be regarded as the proposed (or tentative) answer to a research question. For example, if the research question is “Do supervisory practices help counsellors involved in HIV/AIDS counselling in Mumbai cope with burnout?”, the hypothesis could be “Supervisory practices assist in reducing burnout amongst counsellors involved in HIV/AIDS counselling in Mumbai”. Reducing a problem to a hypothesis format makes it possible to scientifically solve the problem.

In quantitative studies, a hypothesis is usually stated in advance of the study, and then is tested during the study. Stating a hypothesis in advance helps researchers to keep the study focused and also helps them interpret the results of a study against an established framework. A hypothesis is formulated based on existing knowledge, and by the process of being tested during a research study, serves as a tool to advance knowledge on a particular subject. Even if a given hypothesis is proved to be false during a study, the result is regarded as an advancement of knowledge because we know that within the context of the study, the stated variables do/do not share a relationship. This knowledge is useful to other researchers who may want to test that relationship in other contexts.

Hypotheses are usually derived from theory and may be based on already conducted research on the subject. Thus, the development of a hypothesis is closely linked to the literature review conducted for the study. For example, in a study on child labour, the research question could be: What is the link between dropout rates in primary school and children being involved in labour and the hypothesis could be: As dropout rates in primary schools increase, the rate of child labour among 6-10 year old children also increases.

Hypotheses usually include the independent variable, the dependent variable, the predicted outcome and the population of a study. In the above example, school dropout is the independent variable, child labour is the dependent variable, and 6-10-year-old children are the population. The predicted outcome is that child labour will increase if school abandonment increases.

Hypotheses usually indicate the direction of the relationship between the independent and dependent variable. These relationships are usually presented as below:

- **Positive association (+):** Two or more variables are said to be positively associated when they change in the same direction as each other. Thus, if one variable increases, the other also increases OR if one decreases, the other also decreases. For example, the higher the levels of stress faced by students, the greater the chances of their chances of scoring good marks.
- **Negative association (-):** Two or more variables are said to be negatively associated when they change in opposite directions from each other. Thus, as one variable increases, the other decreases. For example, the more sleep deprived a person is, the higher the chances of their making mistakes in tests.

In order to phrase the correct relationship between the Independent and the Dependent variable, it is often helpful to think of the hypothesis in terms of an IF-THEN statement. Since the Independent variable is the variable that is influencing the dependent variable, an IF-THEN statement can help express this relationship correctly in a hypothesis. For example, if we consider our earlier example of the child labour hypothesis, we can say: “IF school abandonment increases, THEN the rate of child labour also increases.” This gives us a clear indication that school abandonment influences child labour, and therefore, school abandonment is the Independent variable.

A hypothesis has the following characteristics:

- ❖ It is phrased as a statement not as a question.
- ❖ A hypothesis is not a moral or ethical question, but rather a testable statement.
- ❖ In quantitative research, a hypothesis is stated prior to conducting a study.
- ❖ It predicts the relationship between two or more variables.
- ❖ A hypothesis can be tested and verified (either validated meaning proved as true or invalidated meaning proved as false).
- ❖ It is not too general and not too specific.
- ❖ Must be stated in clear and unambiguous terms.
- ❖ Hypotheses are derived from theory.
- ❖ Hypotheses usually state the relationship between two or more variables.

4.1. Process of Generating a Hypothesis

As mentioned earlier, we generate hypotheses from existing theory. The process of generating a hypothesis in quantitative research can be described as follows:

Theory → Hypothesis → Observation → Confirmation

From the diagram, we see that Theory is the starting point of the process. A theory systematically defines how certain variables and/or concepts relate with each other. We can identify theories during the literature review process when we review existing research on a subject and identify a theory on how certain principles or concepts relate to each other. We then use these theories to define a hypothesis which predicts the relationship between the variables being considered the study. The hypothesis is then tested through a process of observation during the study. Based on the observations, the hypothesis is then either confirmed or rejected.

4.2. Types of hypotheses

There are primarily two types of hypotheses –

a) Null hypothesis and b) Alternative hypothesis. We will explore each of these categories further.

a) Null Hypothesis:

Also known as the Statistical Hypothesis, the Null Hypothesis is often noted as H_0 (H zero) or H_N (H null). This type of hypothesis expresses a variable relationship that has either been proved true or has not yet been tested but is being used as the basis for an argument. A Null Hypothesis usually states there is no relationship between two or more variables, as stated in the research hypothesis.

The conclusion of a quantitative study is usually expressed in terms of the Null hypothesis. A study can either conclude that “the Null Hypothesis was rejected in favor of the Alternative Hypothesis” (see below) or “the Null Hypothesis was not rejected.” It is important to note that just because a Null Hypothesis was not rejected, this does not mean that the Null Hypothesis is valid. It only means that in the context of a particular study, there was not enough evidence to reject the Null Hypothesis or prove that it was invalid.

b) Alternative Hypothesis:

Also known as the Research or Scientific Hypothesis, the Alternative Hypothesis is noted as H_1 (H one) or H_A (H alternative). This type of hypothesis is a statement for what the test seeks to establish. This type of hypothesis is considered the opposite of the Null hypothesis and is usually arrived at when the Null hypothesis is rejected. Examples of the different types of hypotheses are as follows:

Let us assume that we need to conduct a study to explore the relationship between teacher training and student performance. Here are the possible hypotheses:

Null Hypothesis: There is no relationship between teacher training and student performance.

Alternative Hypothesis: IF there is an increase in training programs for teachers, THEN there is an increase in student performance.

A hypothesis is thus an important element of a research study, because it responds to the research question. By stating a hypothesis in advance, a researcher can connect his/her study to existing research,

and also helps in interpreting study results within the context of a predefined framework. Even if a study proves a given hypothesis as false, this is still considered a valuable contribution to knowledge.

We have now completed our review of two key elements of quantitative research – research question and hypothesis. These two elements are considered foundational in quantitative research. The importance of these elements is visible in the fact that quantitative studies are focused on responding to the research question or testing the hypothesis.

5. Variables in a Hypothesis

There are five types of variables. These are: (1) Independent Variables, (2) Dependent Variables, (3) Moderator Variables, (4) Control Variables, (5) Intervening Variables.

1. The Independent Variable: It is a stimulus variable. It is an input which operates either within a person or within environment to affect his/her behaviour. It is that factor which is measured, manipulated, or selected by the researcher to determine its relationship to an observed phenomenon.

2. The Dependent variable: it is a response variable or output. It is an observed aspect of the behaviour of an organism that has been stimulated. The dependent variable is that factor which is observed and measured to determine the effect of the independent variable. It is the variable that will change as a result of variation in the independent variable. It is considered dependent because its value depends upon the value of the independent variable. It represents the consequence of change in the person or situation studied.

3. The Moderator Variable: It is defined as that factor which is measured, manipulated, or selected by the researcher to discover whether it modifies the relationship of independent variable to an observed phenomenon. The sex generally functions as a moderator variable.

4. The Control variable: It is defined as that variable whose effect must be mentalised or cancelled by the researcher. In general, while the effects of the control variables are neutralized, the effects of the moderator variables are studied. Examples of control variables are: sex, intelligence, and socio-economic status.

5. The Intervening Variable: Each independent variable, moderator and control variables can be manipulated by the researcher and each variation can be observed by him/her as it affects the

dependent variable. Often these variables are not concrete but hypothetical, the relationship between a hypothetical underlying or intervening variable and dependent variable.

An intervening variable is that factor which affects the observed phenomenon, but cannot be seen and measured or manipulated. Its effects must be inferred from the effects of the independent and moderator variables on the observed phenomena. Examples of intervening variables are: the attitude, learning process, habit, and interest.

EFL Teaching Example: Effects of Feedback on Writing Accuracy

Here's an example using variables in EFL (English as a Foreign Language) teaching research:

Independent Variable: Type of Feedback (written vs. oral)

- **Explanation:** Researchers want to see if providing written feedback on student essays has a different effect compared to giving oral feedback.

Dependent Variable: Writing Accuracy (measured by the number of grammatical errors in a post-intervention essay)

- **Explanation:** Researchers are interested in how the type of feedback affects the number of grammatical mistakes students make in their writing.

Controlled Variables:

- **Topic:** Students write essays on the same topic to ensure everyone focuses on similar grammar points.
- **Class Level:** The study is conducted with students of the same proficiency level to avoid baseline differences.
- **Teacher:** The same teacher delivers the feedback to control for individual teaching styles.

Moderating Variable: Learning Style (visual vs. auditory)

- **Explanation:** Some students might learn better from written feedback (visual learners), while others might benefit more from oral explanations (auditory learners). This could affect how much their writing accuracy improves from each feedback type.

Intervening Variable: Student Engagement with Feedback

- **Explanation:** Students who actively engage with the feedback they receive (reading written comments or asking questions about oral feedback) are more likely to understand and apply the corrections, leading to greater improvement in writing accuracy.

6. Summary

- ❖ Quantitative research questions explore the relationships between variables in a research study.
- ❖ Research questions are identified through practical experience, literature reviews or untested theories.
- ❖ There are three types of research questions – descriptive, exploratory and explanatory.
- ❖ Research questions need to be Significant, Feasible, Clear and Ethical.
- ❖ A hypothesis (plural form: hypotheses) is a statement that explains the relationship between two or more variables.
- ❖ A hypothesis is derived from theory.
- ❖ A hypothesis usually indicates the direction of the association of the independent and dependent variable. The association between the variables can either be positive or negative.
- ❖ There are two types of hypothesis – Null Hypothesis and Alternative Hypothesis.
- ❖ Two types of errors are associated with Hypothesis Testing. Type 1 errors happen when the Null Hypothesis is wrongly rejected. Type 2 errors happen when the Null Hypothesis is not rejected even when it is false.