Introduction

Study objectives are formulated to direct implementation of research study. Objectives directly emanate from the problem statement of the identified researchable issues. The objectives reflect the cause-effect identified in the problem tree and therefore inform the formulation of hypothesis and research questions for the study. Clarity in objectives enhances clarity of hypothesis and research questions, subsequently the conceptual model and data collection needed to address the research issue of concern. The objectives define the limits of the research and describe the expected outputs when the objectives are achieved. The objectives define the needed data and form the links the problem statement with data collection procedure in the research design.

Learning Objectives

Upon completion of this topic, the learner should be able to:

a. Distinguish null hypothesis from alternative hypothesis
b. Distinguish research question from research hypothesis
c. Write well understood research (SMART) objectives
d. Write well understood research questions and hypothesis
e. Critique objectives, research questions and hypotheses in research reports.

Key Concepts

- Research objective
- Research hypothesis
- Research questions
- Developmental hypothesis

4.1. Research Objectives

Research objectives are the achievements a researcher can point out to show success made in implementing the research project. Objectives describe the endpoints that a researcher will be accountable for.

The characteristics of well stated statements of objectives are:

- Logical consequence of the background and problem statement
• Are achievable with data to be collected from surveys, observations and experiments

• Have active verbs such as:
  o Determining…
  o Measuring how much…
  o Identifying…
  o Establishing…
  o Evaluating…
  o Assessing…

• Are not statement of the methods:
  To carry out a survey…
  To compare treatments…
  because the methods are developed to meet the objectives, not the other way around.

• Declare the relationships to be investigated, identifying independent and dependent variables

• Make sense to an informed reader without additional information

4.2. Research Hypothesis and Research Questions
Hypothesis is a statement of the expectation that a researcher states about the population characteristics for making statistical decisions on the basis of sample data. Statistical decisions to make is rejecting or accepting the hypothesis within a specified level of certainty. Hypothesis formulation is done at the stage of developing the proposal to guide collection of appropriate data.

There are two approaches of formulating hypothesis:

• The Statistical approach

• The developmental approach

Statistical hypothesis and population parameters
Statistical hypothesis approach is inferential; based on estimation of population parameters from a random sample to describe population characteristics. It is stated in mathematical/statistical terms that make it possible to calculate the probability of possible samples assuming the hypothesis is correct. It is comparative in nature for factor effects of interest. The hypothesis testing may be for one or more of the population parameter:

• Mean \( \mu \)

• Median \( M \)
Statistical hypothesis can be stated in the Null or Alternative forms, and Non directional or directional form.

The Null hypothesis expects equality:  \( H_0: \mu_1 - \mu_2 = 0 \)  or  \( H_0: \mu_1 = \mu_2 \)

The Alternative expects non equality:  \( H_a: \mu_1 - \mu_2 \neq 0 \)  or  \( H_0: \mu_1 \neq \mu_2 \)

Directional and non-directional form of hypothesis is about the area of rejection of the hypothesis in the distribution function. Directional hypothesis has rejection area to one tail of the distribution:

\[ H_0: \mu_1 > 5 \text{ a specified value: } H_a: \mu_1 > 5 \text{ or } H_a: \mu_1 < 5 \]

While Non directional hypothesis has rejection area to either of the tail of the distribution

\[ H_0: \mu_1 - \mu_2 = 0 ; \quad H_0: \mu_1 = \mu_2 \]
\[ H_a: \mu_1 - \mu_2 \neq 0 ; \quad H_0: \mu_1 \neq \mu_2 \]

An example of hypothesis for testing single mean in non directional form is stated as:

Null \( H_0: \mu_1 - \mu_0 = 0 \)  Alternative \( H_a: \mu_1 - \mu_0 \neq 0 \)

In the distribution function, rejection area is to either of the tail, hence the term two sided or two tailed test. In directional form, the rejection is within one specified tail area, hence the term one sided or one tailed test.

\[ H_0: \mu_1 > \mu_0 \quad H_a: \mu_1 < \mu_0 \]

Stating hypothesis for testing two means in non directional form:

\[ H_0: \mu_1 = \mu_2 \quad H_a: \mu_1 \neq \mu_2 \]

Stating hypothesis for testing two means in the directional form:

\[ H_0: \mu_1 \leq \mu_2 \quad H_a: \mu_1 > \mu_2 \]

The statistical approaches used to test hypothesis are addressed in AICM 702: Statistical methods and includes:
1. **Confidence Interval (CI)** which define the range of values within which the true population mean (μ, π) lies with a certain probability (99%, 95%, 90%), and may be estimated for large or small sample size with the formula:

**Large population size:** \( \text{CI} = \bar{y} \pm Z_{\alpha} \times \text{SE} \)

**Small sample size:**
\[
\text{CI} = \bar{y} \pm t_{\alpha} \times \frac{S}{\sqrt{n}}
\]

The decision to reject or not to reject the null hypothesis is based area where the CI estimate falls, which is illustrated in here.

![Diagram](image)

The illustration shows the area where the estimated CI is rejected when falling outside or is not rejected when falling within the area of expectation/assumption if the null hypothesis were true.

2. **Test statistics** is based on statistical procedures appropriate for the sample data distribution function to test the stated hypothesis. A general formula for test statistics is:

\[
\text{Test} = \frac{\text{Estimate} - \text{Hypothesis}}{\text{SE}}
\]

Commonly used test statistics for testing hypothesis include:

a. \( z \)-test
b. \( t \)-test, the student t test
c. \( F \)-test
d. \( \chi^2 \)-chi square test
e. Sign rank test
f. Other specialized tests statistics

**Developmental hypothesis**

Developmental hypothesis may not be statistically tested. The hypotheses are on objectives relating to macro development goals such as the Millennium Development Goals or national
development goals. These are the higher level goals in the logical framework. The definition can be developed through participatory problem analysis with the primary beneficiaries in identifying entry points for development intervention, analysis of the objectives and activities and analysis of important assumptions that is likely to be barriers to the attainment of the stated objectives. Therefore developmental hypothesis is more relevant to development projects rather than academic projects such as thesis.

Summary of Topic

Hypothesis is formulated in comparative statements that:

- Compare the value of parameter estimates
- Compare the effects of factors/treatments
- Compare the association between factors

Hypothesis is stated at the time of developing the research concept in order to:

- Aid design of questionnaire
- Guide planning of data collection process
- Aid choice of appropriate analytical procedures

Learning Activities

Case study for the problem of low milk sale price earlier introduced in the previous chapter to illustrate stating of hypothesis:

<table>
<thead>
<tr>
<th>Case study I: Formulating statement of the problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Molo peri-urban area, many smallholders sell milk at low prices despite stiff competition for milk between the formal and informal market outlets. Consequently, farmers have low returns to external inputs, which they use to support intensive milk production. The access, timeliness, reliability and use of market information between producers and traders could explain why some producers are sell milk competitively while others are not. Knowledge of the flow and use of market information on milk prices would be useful in designing effective price information dissemination strategies to help farmers sell their milk at profitable prices and realize positive returns to their investment for improved income and food security from dairy production.</td>
</tr>
<tr>
<td>Overall objective: To enable milk producers access competitive market price in order to produce milk profitably and increase income and food security for the households</td>
</tr>
<tr>
<td>Specific objectives: To determine the influence of market information sourcing on the milk sale price</td>
</tr>
</tbody>
</table>
Research question: Do producers sourcing market information sell their milk at more competitive prices than those who do not?

Hypothesis Ha: Milk producers that source market information about milk price sell milk at more competitive prices than those not sourcing for market information

Hypothesis Ho: Market milk sale price is not different between producers sourcing market information and those not sourcing

Exercise

Applying the knowledge and skills gained on the above case, present the overall study objective, the specific objectives and their corresponding research questions and hypotheses stated in both Null and Alternative form for the assignment 1 in the last chapter. The first case was about unsuccessful application of an integrated pest management (IPM) scheme and crop rotation by some farmers in western Kenya to increase incomes and maintain soil fertility. The second case was about failure by many smallholder milk producers in Molo peri-urban area to sell milk at competitive price despite the competition for their milk

Assignments

1. An ICT Company has been experiencing revenue decline for the last two years. The company has identified that the problem is emanating from the declining number of people using their ICT products. Their analysis points to negative perception of the company by the public. Based on this brief, in groups, define the research objective and research question for this case.

2. In groups, review at least five MSc and PhD proposals and theses to evaluate the stated objectives, hypothesis and research questions if these are clear on what is being tested and measurements. Identify the relationships hypothesised between dependent and independent variables

3. Individually conduct a web search and identify three journals that publish ICM research. Scan to identify 3 titles published within the last five years that are closest to a topic of research you are interested in for your MSc thesis. From among the three paper titles you selected, choose one and from its contents, extract the excerpts on:

   a) The researchable issue addressed
   b) The objectives of the study
   c) The research questions answered
   d) The hypotheses tested
e) The conceptual framework
f) The data collection approaches used
g) The statistical methods used

References and Additional Reading Materials

- MSc and PhD research proposals and theses.
- GEAR CD supplied by RUFORM
- Journals of communication and information management

Useful links

On-line research methods resource materials; Biometrics and Research Methods Teaching Resource"

Covering both theoretical and policy research; this is a practical overview of the central issues involved in the design of social and economic research.