Research Methods

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Research methods is simply an application of common sense

Introduction

Research methods refer to the systematic procedures, techniques, and approaches that researchers use to collect, analyze, and interpret data to answer a research question or test a hypothesis. The choice of research methods depends on the nature of the research question, the type of data needed, and the overall goals of the study. Here are some common research methods:

Surveys and Questionnaires

Surveys and Questionnaires: Researchers collect data by asking participants to respond to a set of questions. This method is often used to gather information about attitudes, beliefs, and behaviors.

Experiments

Researchers manipulate variables to observe their effect on an outcome. This method is often used to establish cause-and-effect relationships.

Observational Studies:

Researchers observe and record behavior without intervening or manipulating variables. This method is common in fields like anthropology and psychology.

Interviews

Researchers conduct one-on-one or group interviews to gather detailed information from participants. This method allows for in-depth exploration of topics.

Observational Studies:

Researchers observe and record behavior without intervening or manipulating variables. This method is common in fields like anthropology and psychology.

Content Analysis

Researchers analyze the content of texts, such as written or visual materials, to identify patterns, themes, or trends.

Cross-Sectional and Longitudinal Studies:

Cross-sectional studies collect data from participants at a single point in time, while longitudinal studies collect data over an extended period to observe changes over time.

The choice of research method depends on factors such as the research question, the type of data needed, ethical considerations, and practical constraints. Researchers often use a combination of methods to gain a more comprehensive understanding of their topic.

General research process

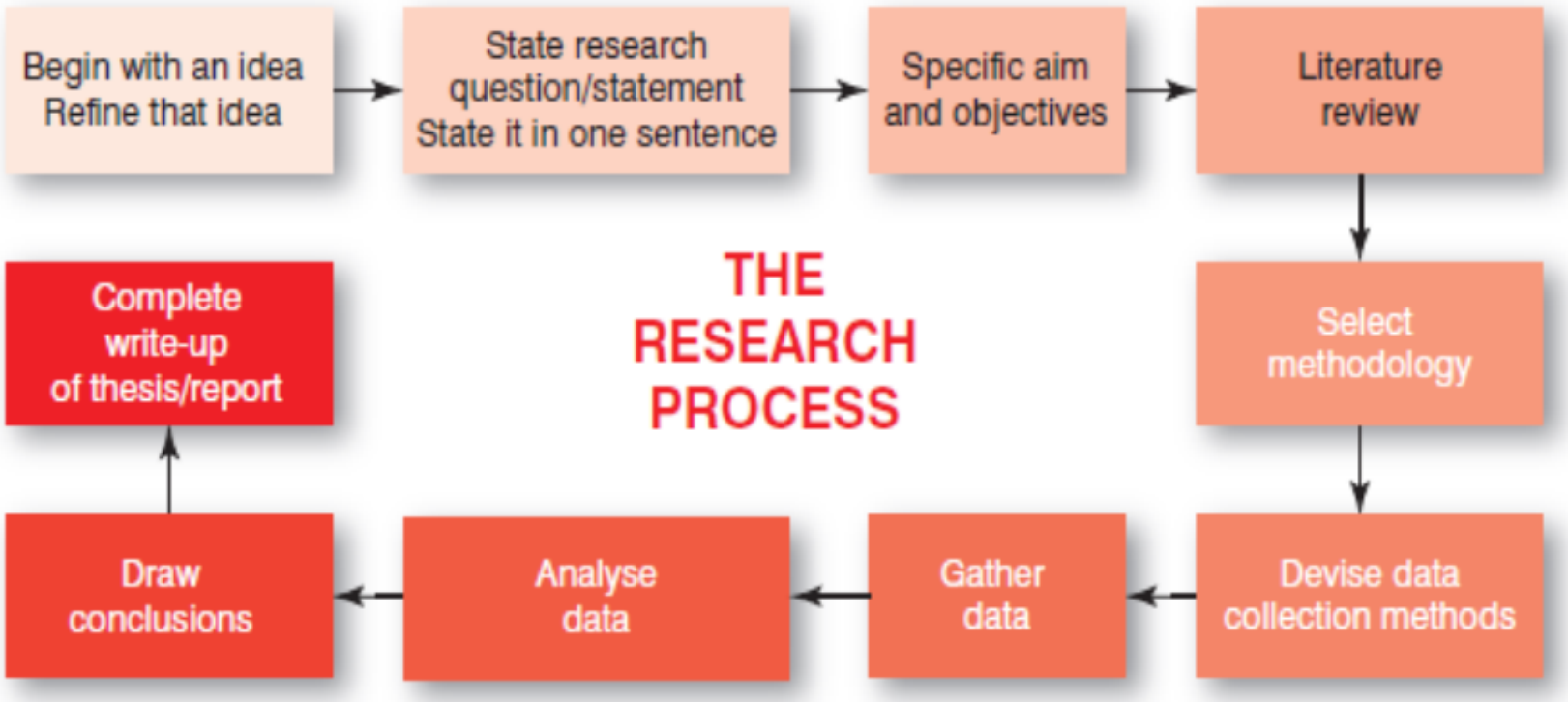

Figure 1: Flow diagram of the Research process

Four Frameworks

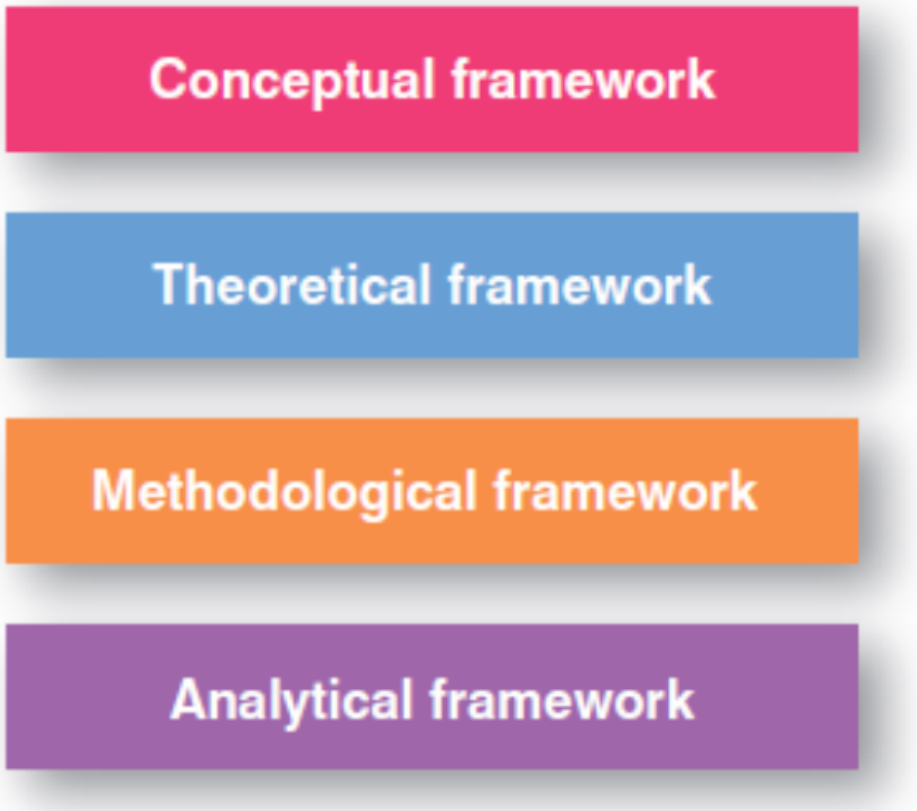

Figure 2: Transition diagram

Research question

Research questions are fundamental to the research process, guiding the inquiry and shaping the study. They should be clear, specific, and focused to help researchers achieve meaningful results. Here are a few examples

1). How can machine learning algorithms be optimized for fraud detection in financial transactions?

2). What are the security implications of emerging technologies in Internet of Things (IoT) devices?

3). How do different programming languages affect software development productivity?

These examples illustrate the diversity of research questions, showcasing the importance of tailoring inquiries to the specific context and objectives of the study.

Hypothesis testing

Hypothesis testing is a statistical method used to make inferences about a population based on a sample of data. In hypothesis testing, researchers formulate a null hypothesis H_o and an alternative hypothesis H_1 to determine whether there is enough evidence in the sample data to reject the null hypothesis in favor of the alternative hypothesis. Here are some examples of hypothesis testing scenarios:

Example

Null Hypothesis H_O: There is no difference in test scores between students who received tutoring and those who did not.

Alternative Hypothesis H_1: Students who received tutoring have higher test scores.

Methodolgy Framework

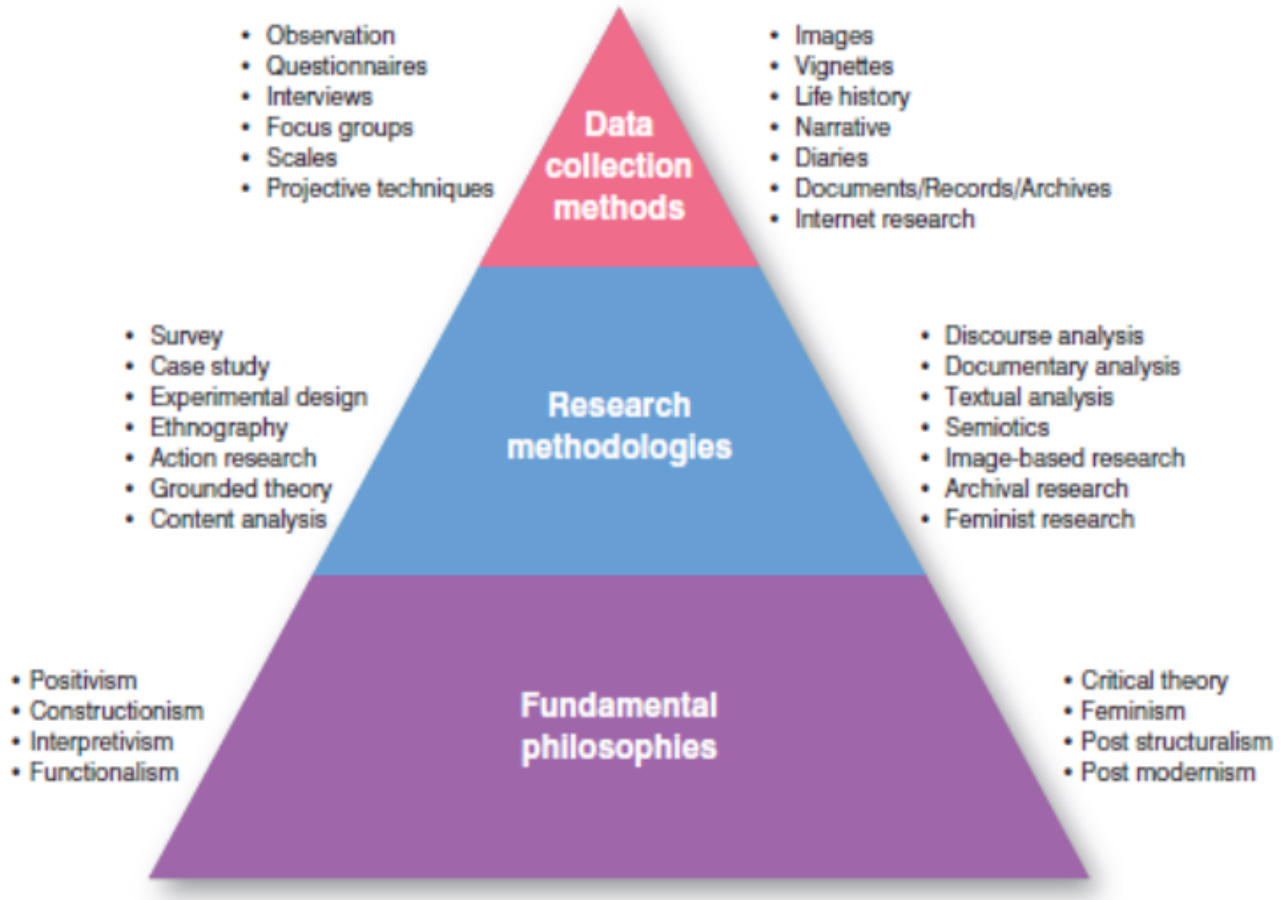

Figure 3: Pyramid

Data types and scales of measurements

1). Two types of data exist namely: qualitative and quantitative data

2). There are four scales of measurement: Nominal, ordinal(order is important), ratio, and interval(Assigning a score of zero indicates an absence of the variable being measured)

3). Primary source of data: Data one collects himself and secondary data is available data relevant to one's research

4). Compare your conclusions with those in your literature review

Stages of Data analysis

1). Describe the data & what you see in your data

2). Interpreting its meaning & significance

3). Draw a conclusion from your interpretation

4). Compare your conclusions with those in your literature review

Samples

Sampling from a population is a common research practice, and it involves selecting a subset of individuals or elements from a larger group (the population) to gather information and make inferences about that entire population. There are several reasons why researchers use sampling:

Resource Constraints:

Time and Cost: It may be impractical or too expensive to study an entire population. Sampling allows researchers to collect data more efficiently and within budget constraints.

Feasibility:

Logistics: It may be logistically challenging or even impossible to study an entire population, especially if the population is large, dispersed, or difficult to access.

Time Efficiency:

Time Sensitivity: Researchers may have time constraints, and sampling allows them to collect and analyze data more quickly than attempting to study the entire population.

Destructive Testing:

Destructive Processes: In situations where testing or measuring destroys the subject (e.g., medical trials), sampling is essential to conserve resources and minimize harm.

Sampling technique

• There are two types of sampling techniques namely probability sampling and non-probability sampling.
In non-probability sampling, the sample is selected to represent the population, but it cannot be said to be representative of the population, in any statistical sense
• It often happens with social science research projects that it is not possible to produce a complete list of the population; when this is the case, it is not possible to develop a sampling frame.
• For example, a researcher might be asked to examine brand loyalty among consumers of Cosmopolitan magazine. It wouldn't be possible to compile a complete list of consumers of Cosmopolitan magazine.
• Without a complete sampling frame, it is not possible to engage in probability sampling, as without a sampling frame it is not possible to guarantee that every member of the population has an equally likely chance of being included in the study.
• Non-probability sampling techniques include judgmental sampling, quota sampling, snowball sampling, and convenience sampling.

Judgemental or purposive

- Using a judgmental or purposive sampling technique the researcher decides or makes a judgement, about whom to include in the research.
- The criterion for inclusion in the research is the capacity of the participant to inform the research.
- Each person, or unit, chosen to be included must have a contribution to make to the research.
- People who chose to be included in such a sample would be key informants on the topic under investigation.

Convenience and Quota

- Quota Sampling
  - Using a quota sampling technique the researcher develops a sample of participants for the research using different quota criteria.

- Convenience Sampling
  - Using a convenience sampling technique the researcher engages those participants in the research it is easiest to include, for example, people in the newsagents, people in the supermarket and so on. The researcher knows how many people to include in the sample, then s/he continues to engage people in the research until the sample has been filled.

Snow ball sampling

- Using a snowball sampling technique the researcher finds one participant in the research, s/he conducts the research with that participant, and then s/he asks that participant to recommend the next participant.

- Participants must fit the inclusion criteria for the research project.

- The researcher goes through the procedure with the second participant and when finished, asks that participant to recommend another participant to be included in the research.

- The researcher continues in this manner, conducting the research with participants and then asking each participant to recommend the next participant until the sample is complete.

Probability sampling

• **Simple random sampling**
Simple random sampling involves selecting a sample at random from a sampling frame. Let us say that you want to study the population of your class, and there are thirty students in your class. The first thing to do is to make a list on a sheet of paper of all of the names of the people in your class.
• Systematic sampling
Systematic sampling involves selecting items at systematic or regular intervals from the sampling frame. Suppose there are 500 houses in the estate and you begin at a random starting point and then sample every third house, or every fifth house, or whatever interval of houses you decide on until you complete your sample. You are engaging in systematic sampling.
• Stratified sampling A Stratified Sample is a sample selected based on some known characteristic of the population, a characteristic which will have an impact on the research. Using stratified sampling the researcher divides or stratifies, the sample selected for use in the research using the characteristic that s/he knows will have an impact on the research

Questionnaire design rules

- Comprehension. *Can respondents understand the question?*
  - Requirements: (i) Avoid jargon, (ii) Avoid ambiguity, (iii) Define terms clearly
- Willingness. *Is the respondent willing to answer the question?*
  - Some questions are very sensitive (e.g. money, health, relationships, etc.)
  - Requirements: (i) Ensure respondent feels the survey is important, (ii) Lead up to sensitive questions, (iii) Consider using prompt cards with categories (e.g. income)
- Ability. *Can the respondent answer the question?*
  - A questionnaire may be perceived as difficult if it requires (i) feats of memory, and (ii) technical knowledge.

Question types

Open	Free range of answers
Closed	Limited range of answers.
List	One from a list
Categorical	Choice of category
Rating	Attitude questions.
Rank order	Respondent orders items to reveal preferences.
Semantic differential scale	Questions progress from one extreme to another to discern strength of response.
Filter of contingency	One question to determine progress to others

An open question

List three things you like about Portsmouth.
1.
2.
3.

A closed question

Question	Yes / No
Do you like chocolate?	Yes / No
Do you buy a bar of chocolate everyday?	Yes / No
Do you find chocolate expensive?	Yes / No
Milk chocolate has a great taste	Yes / No

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A list question

What is your religion (please tick ✔ as appropriate)	
Buddhist	
Christian	
Hindu	
Jewish	
Muslim	
Other	✔

A category question

What is your gross annual income?	
£0-9,999	✔
£10,000 – 19,999	
£20,000-39,999	
£40,000-49,000	
£50,000 +	

A Likert scale question

✔	Strongly agree	Agree	Neither	Disagree	Strongly disagree
Bank employees deserve their bonuses					

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A rank-order question

Which is your favorite breakfast cereal?
(*Indicate your TOP three brands, with 1 being your first choice, 2 being your second choice, and 3 your third choice*)

Cornflakes	
Weetabix	3
Muesli	2
Porridge	1
Rice Krispies	
Other	

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Semantic differential question

Information Sources and Research Methods is (please circle the appropriate number)

Difficult	1	2	3	4	5	Easy
Enjoyable	1	2	3	4	5	Boring
Relevant	1	2	3	4	5	Irrelevant

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Figure 4: RANK

A filter or contingency question

Have you ever smoked marijuana?	
Yes	
No	

If Yes, about how many times have your smoked marijuana? If not, proceed to the next question.	
Once	
2-5 times	
6-10 times	
11-20 times	
More than 20 times	

A filter question lets you ask the respondent one question to determine if they are qualified to answer another.

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Saturation point

- In some qualitative research projects the research is allowed to unfold, and so the population or the samples used are sometimes not defined from the outset.
- A frequently asked question in such circumstances is, when does the researcher stop engaging participants in the research?
- The answer is when the researcher reaches a saturation point.
- Saturation point is reached when the researcher, though continuing to explore the phenomenon with participants in the research, no longer hears any new thoughts, feelings, attitudes, emotions, intentions, etc.
- This is the saturation point, the researcher is 'saturated' with knowledge on the topic and continuing to engage participants would not be useful, necessary, or ethically sound, as engaging further participants in the research will not add in any way to the knowledge generated.

Sample questionnaire

Sample Questionnaire

Variables: Charismatic Leadership, Employee Training, Organizational Commitment, Employee Organizational Identification, Strategy Internalization and Employee Performance

SECTION B: EMPLOYEE TRAINING

To what extent do you agree or disagree with the following statements in regard to employee training

		strongly disagree				strongly agree
11	I receive periodic and intensive training by my organization with respect to my job function	1	2	3	4	5
12	The training I receive empowers me to perform	1	2	3	4	5
13	I frequently receive hints and suggestions from my manager on how to improve my job function	1	2	3	4	5
14	The training I receive help improve my skills and capabilities	1	2	3	4	5
15	The training I receive offer me opportunities to advance within my organization	1	2	3	4	5

Correlation Matrix

- Shows the degree of association or relationship between variables.
- The correlation analysis only tells one about the degree of association between the variables but does not say which of the variables has an effect on the other.

	CL	OI	ET	SI
CL	1	.618**	.435**	.598**
OI	.618**	1	.361**	.441**
ET	.435**	.361**	1	.456**
SI	.598**	.441**	.456**	1

Statistic

Descriptive analysis: The mean, mode, and median are central tendency measures because they measure data distribution around a central value. The standard deviation, maximum value, and minimum value are measures of dispersion because they indicate the degree of variation of a given data from a central value.

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic
Employee_Training1	365	1	5	3.25	1.123	-.404	.128	-.666
Employee_Training2	365	1	5	3.54	1.077	-.693	.128	-.162
Employee_Training13	365	1	5	4.02	.966	-1.190	.128	1.411
Employee_Training4	365	1	5	3.62	1.043	-.750	.128	.143
Employee_Training5	365	1	5	3.38	1.086	-.453	.128	-.294
Valid N (listwise)	365							

Referencing in Research

Referencing in research involves providing proper citations for sources you have consulted, allowing readers to trace and verify your information and giving credit to the original authors. The specific citation style may vary depending on the academic discipline or the preferences of the publication, but some common styles include APA (American Psychological Association), MLA (Modern Language Association), and Chicago/Turabian. Here's a general guide on how to do referencing in research

- **Understand the Citation Style**: Identify the citation style required by your instructor, academic institution, or the publication you are submitting to.
- **Record Source Information** Gather details about each source, including the author(s), title, publication date, publisher, page numbers, and URL (for online sources).
- **In-Text Citations** Author-Date Styles (e.g., APA): Use the author's last name and the publication year within parentheses, e.g., (Smith, 2020). Author-Page Number Styles (e.g., MLA): Include the author's last name and the page number within parentheses, e.g., (Smith 45).

Examples of referencing style: Articles

• **MLA**: Opoku-Sarkodie, Richmond, et al. "Dynamics of an SIRWS model with waning of immunity and varying immune boosting period." Journal of Biological Dynamics 16.1 (2022): 596-618.
• **APA**: Opoku-Sarkodie, R., Bartha, F. A., Polner, M., & Röst, G. (2022). Dynamics of an SIRWS model with waning of immunity and varying immune boosting period. Journal of Biological Dynamics, 16(1), 596-618.
• **Chicago**: Opoku-Sarkodie, Richmond, Ferenc A. Bartha, Mónika Polner, and Gergely Röst. "Dynamics of an SIRWS model with waning of immunity and varying immune boosting period." Journal of Biological Dynamics 16, no. 1 (2022): 596-618.
• **Harvard**: Opoku-Sarkodie, R., Bartha, F.A., Polner, M. and Röst, G., 2022. Dynamics of an SIRWS model with waning of immunity and varying immune boosting period. Journal of Biological Dynamics, 16(1), pp.596-618.
• **Vancouver**: Opoku-Sarkodie R, Bartha FA, Polner M, Röst G. Dynamics of an SIRWS model with waning of immunity and varying immune boosting period. Journal of Biological Dynamics. 2022 Dec 31;16(1):596-618.

Books referenicing style

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Formal research steps as an IT professional

• **Identify a Problem**: Choose a specific problem, challenge, or question within the IT domain that interests you or aligns with your expertise.
• **Review Existing Work** Conduct a thorough literature review to understand what has already been done in the chosen area.
• **Identify Gaps** Identify gaps, unanswered questions, or areas where existing solutions fall short.
• **Define Clear Questions** Formulate clear and concise research questions that guide your investigation.
• **Establish Objectives**: Define the objectives of your research.
• **Formulate Hypotheses**: If applicable, create hypotheses to test or validate.
• **Research Methodology**: Choose Methods: Decide on research methods (experimental, observational, survey, case study, etc.) based on your research questions and objectives. Data Collection: Plan how you will collect and analyze data (e.g., surveys, experiments, interviews, code analysis).
• **Data Analysis**: Choose Analysis Techniques: Select appropriate statistical or qualitative analysis techniques based on your research methodology. Tools: Utilize relevant tools and software for data analysis.

IT steps

• **Implementation** (If Applicable): Develop Solutions: If your research involves creating software or solutions, proceed with the development phase. Coding Practices: Follow good coding practices and document your code thoroughly.
• **Conclusion**: Summarize: Summarize the key findings and contributions of your research. Recommendations: Provide recommendations for future research or practical applications.
• **Documentation and Reporting**:
Document the Process: Keep detailed records of your research process, methods, and outcomes. Write a Report: Prepare a well-organized research report or paper adhering to the standards of academic or professional writing.
• **Publication and Presentation**:
Publish Research: Consider submitting your research to conferences or journals within the IT community. Present Findings: If possible, present your research at conferences or events to reach a broader audience.
Remark Remember that research in IT can take various forms, including applied research to solve practical problems, theoretical research to advance knowledge, or a combination of both. Adjust your approach based on the nature of your research goals.