Research Methods & Technical Writing

Lesson 10 - Week 10

Interpretation and Report writing

Lecturer: Dr. Msagha J Mbogholi, PhD

Flashback from Lesson 9 (1 of 2)

- Multivariate techniques transform a mass of observations into a smaller number of composite scores in such a way that they may reflect as much information as possible contained in the raw data obtained concerning a research study. Thus, the main contribution of these techniques is in arranging a large amount of complex information involved in the real data into a simplified visible form.
- An explanatory variable is a type of independent variable. It is what a researcher manipulates or observes changes in. In other words, an explanatory variable is the expected cause, and it explains the results. It is also known as a causal or predictor variable.
- A criterion variable is simply another name for a *dependent variable* or a *response variable*. This is the variable that is being predicted in a statistical analysis.
- Five main assumptions underlying multiple regression models must be satisfied: (1) linearity, (2) homoscedasticity (homogeneity of variances in the different groups), (3) independence of errors, (4) normality, and (5) independence of independent variables.

Flashback from Lesson 9 (2 of 2)

- Discriminant analysis differs from regression analysis in that "discriminant analysis is a technique that is used by the researcher to analyze the research data when the criterion or the dependent variable is categorical and the predictor or the independent variable is interval in nature
- In an ANOVA, we examine for statistical differences on one continuous dependent variable by an independent grouping variable. The MANOVA extends this analysis by taking into account multiple continuous dependent variables, and bundles them together into a weighted linear combination or composite variable
- The purpose of Canonical Correlation Analysis is to explain the variability within and between sets through identification of several sets of canonical variates.
- Factor Analysis (FA) is an exploratory technique applied to a set of outcome variables that seeks to find the underlying factors (or subsets of variables) from which the observed variables were generated. Common methods of FA are: Centroid method, principal component method, and maximum likelihood estimation.

Content

- Introduction
- Interpretation
- Report writing

Part 1

Introduction

Introduction

- You have done some investigation regarding a problem (or opportunity). You then formulate a research question, hypothesis to work with, and some clear objectives of your research.
- Thereafter you determine the best data collection methods to use for your study, and go out to collect the data.
- In this course you have learnt various techniques of interpreting the data using univariate, bivariate, or multivariate analysis. What next?
- You have to go back to your working theory (hypothesis) to see whether it was true or not. Remember that in research, even proving yourself wrong is also a finding. Many researchers feel that they have worked for naught when their theories turn out not to be true, but this is not the case; as long as the proper scientific approach was followed it means the results were valid.
- I recall when I was doing my doctoral studies my supervisor reminded me more than once that even proving myself wrong would still award me my PhD!

Introduction

- However, what good is it to have this knowledge and not share the findings?
- Essentially this means that you have to share the findings with the community who will benefit from it.
- In research there are different protocols (rules if you like) regarding how the findings should be presented, mostly depending on who the target audience is.
- In this lesson we discuss these protocols, how to go about writing the report, its layout and the different types of reports commonly in use.

Part 2

Interpretation

2.1 Meaning of interpretation

- The Webster dictionary defines interpretation as:
- " to explain or tell the meaning of **:** present in understandable terms"
- " to conceive in the light of individual belief, judgment, or circumstance"
- In research we can investigate all phenomena; however, we have to explain the meaning of all the data we collected in relation to the objective of the investigation.
- In scientific arena we analyze the data to give it meaning using accepted formulae.
- Data analysis summarizes collected data. It involves the interpretation of data gathered through the use of analytical and logical reasoning to determine patterns, relationships or trends. (Steynberg, 2022)

2.1 Meaning of interpretation

- Before going deeper into understanding what interpretation is about it is worth reviewing the different types of data analysis, since the two go hand in hand in terms of explaining the findings of a research. The four types of data analysis are (Gibson, 2018):
- Descriptive analysis: Descriptive analysis answers the "what happened" by summarizing past data; dashboards are effective in representing this.
- Diagnostic analysis: After asking the main question of "what happened", the next step is to dive deeper and ask why did it happen? This is where diagnostic analysis comes in. Diagnostic analysis takes the insights found from descriptive analytics and drills down to find the causes of those outcomes.
- Predictive analysis: Predictive analysis attempts to answer the question "what is likely to happen". This type of analytics utilizes previous data to make predictions about future outcomes.
- Prescriptive analysis: it combines the insight from all previous analyses to determine the course of action to take in a current problem or decision.

2.1 Meaning of interpretation

- Thus, what is the importance of data interpretation in research? (Villegas, 2022) shares the following points on the importance of data interpretation from a business perspective:
- Data interpretation helps to make better decisions. " when you know how to collect and understand data well, you can make better decisions. You can confidently choose a path for your organization or even your life instead of working with assumptions."
- Data interpretation enables you to find trends and take action.
- Data interpretation helps in better resource allocation. "For example, If you know via strong data interpretation that a market is underserved, you'll go after it with more energy and win."
- Villegas (2022) also shares the steps in data interpretation:
- Step 1: Gather the data - The very first step in data interpretation is gathering all relevant data. You can do this by first visualizing it in a bar, graph, or pie chart. This step aims to analyze the data accurately and without bias. Now is the time to recall how you conducted your research.

2.1 Meaning of interpretation

- Step 2: Develop your discoveries - This is a summary of your findings. Here, you thoroughly examine the data to identify trends, patterns, or behavior. If you are researching a group of people using a sample population, this is the section where you examine behavioral patterns.
- Step 3: Draw conclusions - After you've developed your findings from your data sets, you can draw conclusions based on your discovered trends. Your findings should address the questions that prompted your research.
- Step 4: Give recommendations - The interpretation procedure of data comes to a close with this stage. Every research conclusion must include a recommendation. As recommendations are a summary of your findings and conclusions, they should be brief. There are only two options for recommendations; you can either recommend a course of action or suggest additional research.
- At this point the learner is probably asking the question, "wait! We just discussed data analysis and here we are back at interpretation (eyes rolling). What is the difference between the two?"
- Table 1 explains the difference between data analysis and interpretation.

Table 1. Data analysis and interpretation compared. (Seth, 2021)

Basis	Data Analysis	Data Interpretation
Meaning	Data analysis is the process of uncovering patterns and trends in the data.	Data interpretation is the process of assigning meaning to the data. It involves explaining those discovered patterns and trends in the data.
Chronology	Data analysis comes first, followed by data interpretation.	Data interpretation is the next proceeding step after data analysis.
Types/Methods	The five types of data analysis are Descriptive Analysis, Diagnostic Analysis, Predictive Analysis, Prescriptive Analysis, and Cognitive Analysis.	The data interpretation methods are Quantitative Methods and Qualitative Methods.
Why is it needed?	To summarize, condense data in a comprehensible and usable form for further advanced analytics and prediction.	Data interpretation is required because the numbers can not speak for themselves. It needs manual human intervention to understand what the numbers are saying.
Example	For example, the top 5 teams in terms of the winning Percentages are Real Madrid, Barcelona, Atletico Madrid, Valencia, and Athletic Bilbao.	An example of interpretation is what does it imply 95% of the population lies within the range of 136.54 to 143.45.

2.2 Importance of (data analysis and) interpretation

- Seth (2021) shares the following regarding the importance of interpretation:"
- Data analysis aims to bring order and structure to data by manipulating, summarizing, and reducing it to an interpretable form. It helps to uncover the patterns in the data. Data interpretation aims to execute and apply processes that assign meaning to these discovered patterns by analyzing data. It draws statistical conclusions, infers the relationships and implications.
- **Informed decision-making:** Data analysis and interpretation are instrumental in making informed decisions, relying on data, applying methodical analysis techniques, and not intuition or guessing.
- **Identification of trend and forecasting needs:** Data analysis offers insights that can predict and set trends that can positively impact an industry level.

2.2 Importance of (data analysis and) interpretation

- …(cont'd)
- **Cost-efficient:** One of the most important goals for any business apart from maximum returns is to reduce costs. Data-driven informed decisions not only help in improving business metrics but also in reducing costs, which is another avenue of generating revenue. Predictive data analytics helps achieve this objective by using response modeling, uplift response modeling, churn modeling, churn uplift modeling, risk modeling, and fraud detection….(cont'd)
- **Clear Insights:** These processes allow organizations to get foresight in their performance and processes."

2.3 Significance of interpretation

- Kothari (2004) opines that interpretation is considered a basic component of research process because of the following reasons:"
- It is through interpretation that the researcher can well understand the abstract principle that works beneath his findings. Through this he can link up his findings with those of other studies, having the same abstract principle, and thereby can predict about the concrete world of events. Fresh inquiries can test these predictions later on. This way the continuity in research can be maintained.
- Interpretation leads to the establishment of explanatory concepts that can serve as a guide for future research studies; it opens new avenues of intellectual adventure and stimulates the quest for more knowledge.
- Researcher can better appreciate only through interpretation why his findings are what they are and can make others to understand the real significance of his research findings.
- The interpretation of the findings of exploratory research study often results into hypotheses for experimental research and as such interpretation is involved in the transition from exploratory to experimental research. Since an exploratory study does not have a hypothesis to start with, the findings of such a study have to be interpreted on a *post-factum* basis in which case the interpretation is technically described as '*post factum*' interpretation.

2.4 Technique of interpretation

- The technique of interpretation involves the following steps (Kothari, 2004):
- Researcher must give reasonable explanations of the relations which he has found and he must interpret the lines of relationship in terms of the underlying processes and must try to find out the thread of uniformity that lies under the surface layer of his diversified research findings. In fact, this is the technique of how generalization should be done and concepts be formulated.
- Extraneous information, if collected during the study, must be considered while interpreting the final results of research study, for it may prove to be a key factor in understanding the problem under consideration.
- It is advisable, before embarking upon final interpretation, to consult someone having insight into the study and who is frank and honest and will not hesitate to point out omissions and errors in logical argumentation. Such a consultation will result in correct interpretation and, thus, will enhance the utility of research results.
- Researcher must accomplish the task of interpretation only after considering all relevant factors affecting the problem to avoid false generalization. He must be in no hurry while interpreting results, for quite often the conclusions, which appear to be all right at the beginning, may not at all be accurate.

2.5 Common Data Analysis And Interpretation Problems

- Some of the most common data misinterpretation risks and how they can be avoided (Calzon, 2023):"
- **Correlation mistaken for causation:** our first misinterpretation of data refers to the tendency of data analysts to mix the cause of a phenomenon with correlation. It is the assumption that because two actions occurred together, one caused the other. This is not accurate as actions can occur together absent a cause-and-effect relationship.
- Digital age example: assuming that increased revenue is the result of increased social media followers… there might be a definitive correlation between the two, especially with today's multi-channel purchasing experiences. But, that does not mean an increase in followers is the direct cause of increased revenue. There could be both a common cause and an indirect causality.
- Remedy: attempt to eliminate the variable you believe to be causing the phenomenon…..(cont'd)

2.5 Common Data Analysis And Interpretation Problems

- ..(cont'd): **Confirmation bias:** our second problem is data interpretation bias. It occurs when you have a theory or hypothesis in mind but are intent on only discovering data patterns that provide support to it while rejecting those that do not.
- Digital age example: your boss asks you to analyze the success of a recent multi-platform social media marketing campaign. While analyzing the potential data variables from the campaign (one that you ran and believe performed well), you see that the share rate for Facebook posts was great, while the share rate for Twitter Tweets was not. Using only Facebook posts to prove your hypothesis that the campaign was successful would be a perfect manifestation of confirmation bias.
- Remedy: as this pitfall is often based on subjective desires, one remedy would be to analyze data with a team of objective individuals. If this is not possible, another solution is to resist the urge to make a conclusion before data exploration has been completed. Remember to always try to disprove a hypothesis, not prove it…(cont'd)

2.5 Common Data Analysis And Interpretation Problems

- …(cont'd) **Irrelevant data:** the third data misinterpretation pitfall is especially important in the digital age. As large data is no longer centrally stored, and as it continues to be analyzed at the speed of thought, it is inevitable that analysts will focus on data that is irrelevant to the problem they are trying to correct.
- Digital age example: in attempting to gauge the success of an email lead generation campaign, you notice that the number of homepage views directly resulting from the campaign increased, but the number of monthly newsletter subscribers did not. Based on the number of homepage views, you decide the campaign was a success when really it generated zero leads.
- Remedy: proactively and clearly frame any data analysis variables and KPIs prior to engaging in a data review. If the metric you are using to measure the success of a lead generation campaign is newsletter subscribers, there is no need to review the number of homepage visits. Be sure to focus on the data variable that answers your question or solves your problem and not on irrelevant data…(cont'd)

2.5 Common Data Analysis And Interpretation Problems

- ..(cont'd)..**Truncating an Axes:** When creating a graph to start interpreting the results of your analysis it is important to keep the axes truthful and avoid generating misleading visualizations. Starting the axes in a value that doesn't portray the actual truth about the data can lead to false conclusions.
- Digital age example: In fig 1 we can see a graph from Fox News in which the Y-axes start at 34%, making it seem that the difference between 35% and 39.6% is way higher than it actually is. This could lead to a misinterpretation of the tax rate changes.
- Remedy: Be careful with the way your data is visualized. Be respectful and realistic with axes to avoid misinterpretation of your data. See fig 2, how the Fox News chart looks when using the correct axes values…(cont'd)

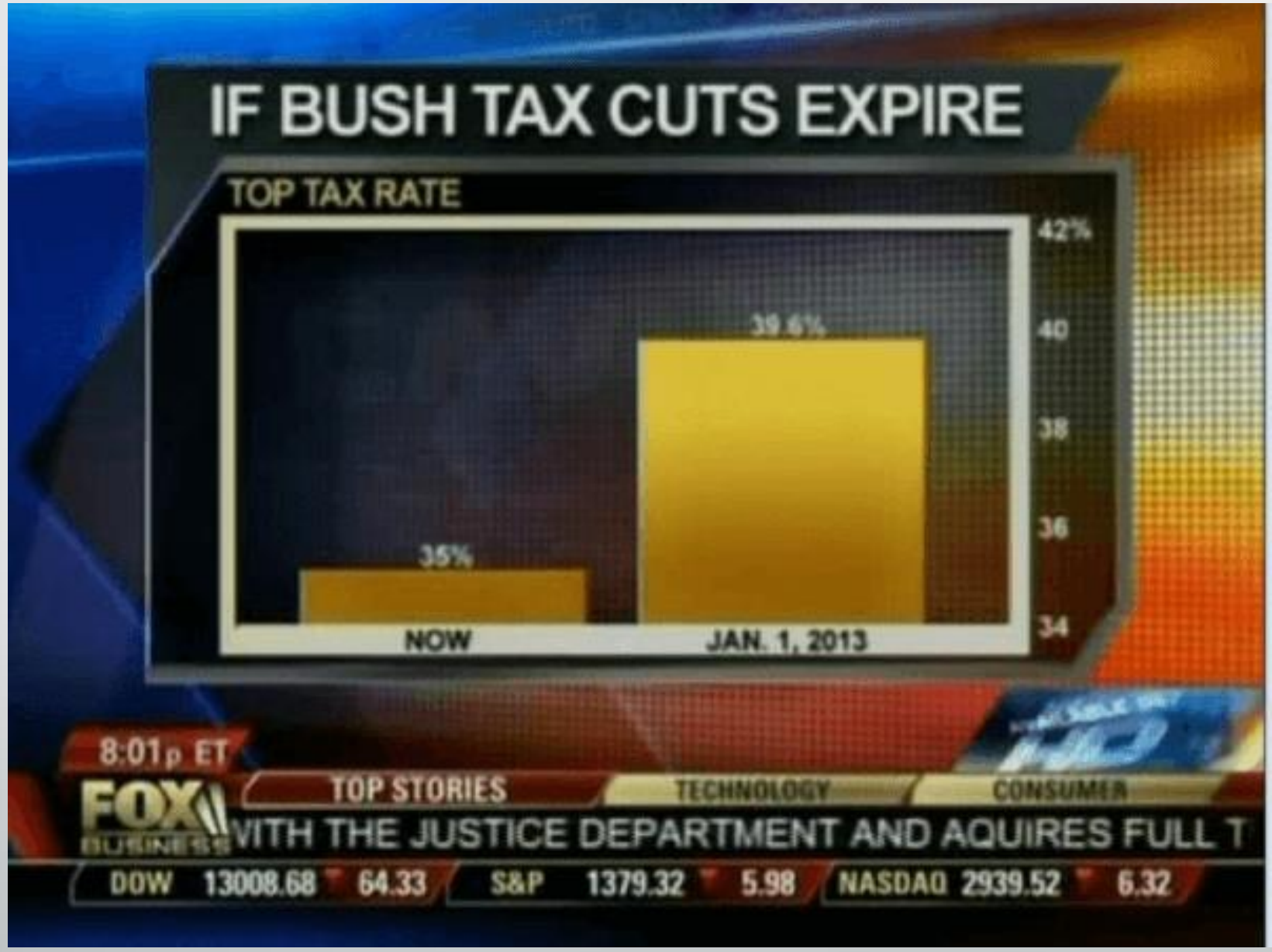

Fig 1. Misrepresented data (Calzon, 2023)

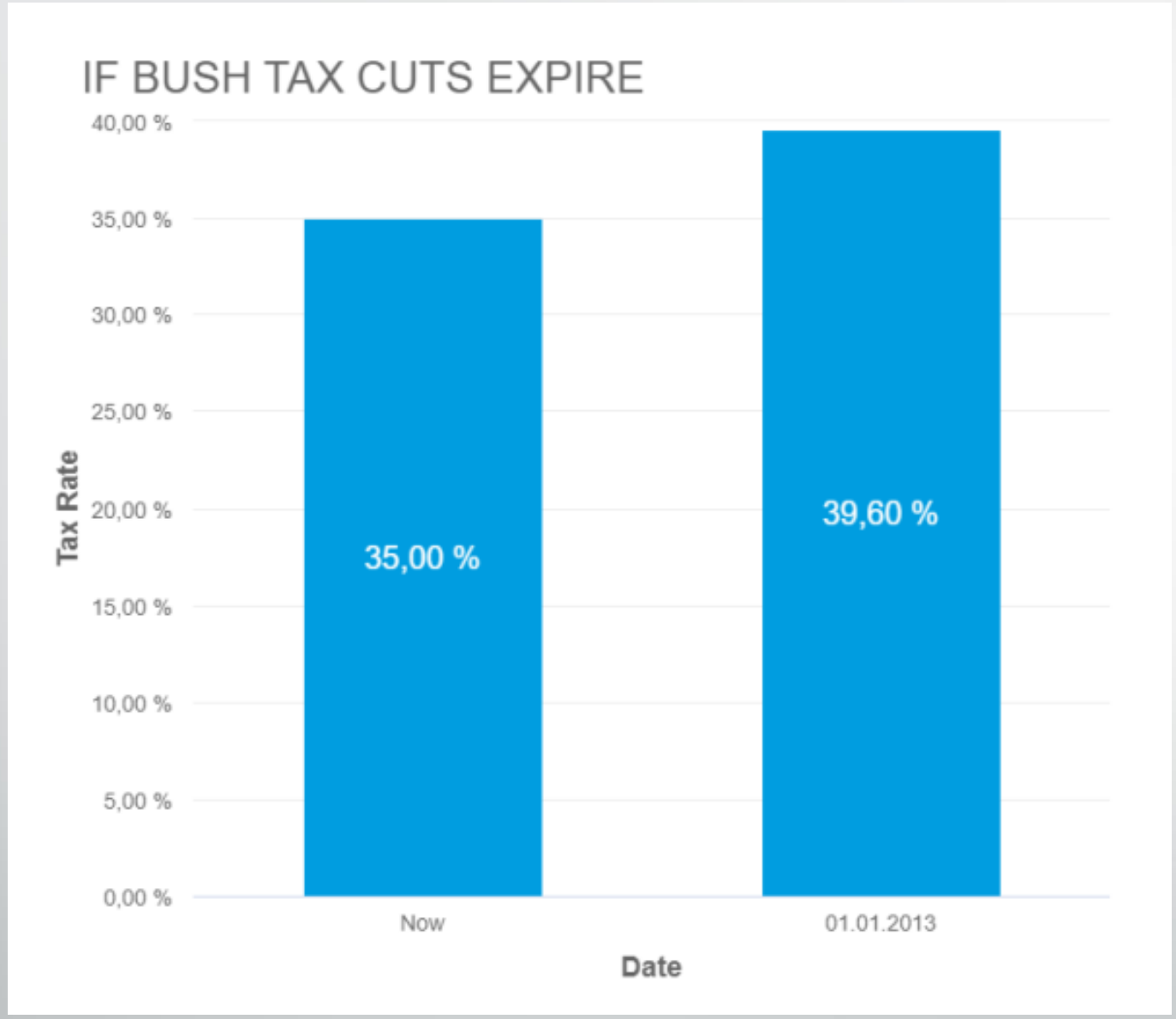

Fig 2. Correct representation of data (Calzon, 2023)

2.5 Common Data Analysis And Interpretation Problems

- …(cont'd) **(Small) sample size:** Another common problem is the use of a small sample size. Logically, the bigger the sample size the most accurate and reliable the results. However, this also depends on the size of the effect of the study. For example, the sample size in a survey about the quality of education will not be the same as for one about people doing outdoor sports in a specific area.
- Digital age example: Imagine you ask 30 people a question and 29 answers "yes" resulting in 95% of the total. Now imagine you ask the same question to 1000 and 950 of them answer "yes", which is again 95%. While these percentages might look the same, they certainly do not mean the same thing as a 30 people sample size is not a significant number to establish a truthful conclusion.
- Remedy: Researchers say that in order to determine the correct sample size to get truthful and meaningful results it is necessary to define a margin of error that will represent the maximum amount they want the results to deviate from the statistical mean. Paired with this, they need to define a confidence level that should be between 90 and 99%. With these two values in hand, researchers can calculate an accurate sample size for their studies…(cont'd)

2.5 Common Data Analysis And Interpretation Problems

- …(cont'd) **Reliability, subjectivity, and generalizability**: When performing qualitative analysis, researchers must consider practical and theoretical limitations when interpreting the data. In some cases, this type of research can be considered unreliable because of uncontrolled factors that might or might not affect the results. This is paired with the fact that the researcher has a primary role in the interpretation process, meaning he or she decides what is relevant and what is not, and as we know, interpretations can be very subjective.
- Generalizability is also an issue that researchers face when dealing with qualitative analysis. As mentioned in the point about having a small sample size, it is difficult to draw conclusions that are 100% representative because the results might be biased or unrepresentative of a wider population.
- While these factors are mostly present in qualitative research, they can also affect the quantitative analysis. For example, when choosing which KPIs to portray and how to portray them, analysts can also be biased and represent them in a way that benefits their analysis…(cont'd)

2.5 Common Data Analysis And Interpretation Problems

- ..(cont'd) Digital age example: Biased questions in a survey are a great example of reliability and subjectivity issues. Imagine you are sending a survey to your clients to see how satisfied they are with your customer service with this question: "how amazing was your experience with our customer service team?". Here we can see that this question is clearly influencing the response of the individual by putting the word "amazing" on it.
- Remedy: A solution to avoid these issues is to keep your research honest and neutral. Keep the wording of the questions as objective as possible. For example: "on a scale of 1-10 how satisfied were you with our customer service team". This is not leading the respondent to any specific answer, meaning the results of your survey will be reliable. "

2.6 Interpretation techniques and methods

- Calzon (2023) asserts that "the first step to interpreting data in a successful way is to identify the type of analysis you will perform and apply the methods respectively. Clearly differentiate between qualitative (observe, document, and interview notice, collect and think about things) and quantitative analysis (you lead research with a lot of numerical data to be analyzed through various statistical methods). " She also offers the following tips:
- **Ask the right data interpretation questions :**The first data interpretation technique is to define a clear baseline for your work. This can be done by answering some critical questions that will serve as a useful guideline to start. Some of them include: what are the goals and objectives of my analysis? What type of data interpretation method will I use? Who will use this data in the future? And most importantly, what general question am I trying to answer?
- **Collect and assimilate your data:** Now that a clear baseline has been established it is time to collect the information you will use. Always remember your methods for data collection will vary depending on what type of analysis method you use which can be qualitative or quantitative…(cont'd)

2.6 Interpretation techniques and methods

- …(cont'd)…**Use the right data visualization type :** Data visualizations such as business graphs, charts, and tables are fundamental to successfully interpreting data. This is because the visualization of data via interactive charts and graphs makes the information more understandable and accessible. Some of the common data visualization tools include:
  - **Bar chart:** One of the most used chart types, the bar chart uses rectangular bars to show the relationship between 2 or more variables
  - **Line chart:** Most commonly used to show trends, acceleration or decelerations, and volatility, the line chart aims to show how data changes over a period of time for example sales over a year.
  - **Pie chart:** Although it doesn't do a lot in terms of analysis due to its uncomplex nature, pie charts are widely used to show the proportional composition of a variable.
  - **Tables:** While they are not a specific type of chart, tables are wildly used when interpreting data. Tables are especially useful when you want to portray data in its raw format. ..(cont'd)

2.6 Interpretation techniques and methods

- …(cont'd) **Start interpreting :** The way you decide to interpret the data will solely depend on the methods you initially decided to use. If you had initial research questions or hypotheses then you should look for ways to prove their validity. If you are going into the data with no defined hypothesis, then start looking for relationships and patterns that will allow you to extract valuable conclusions from the information.
- **Keep your interpretation objective :** Being the person closest to the investigation, it is easy to become subjective when looking for answers in the data. A good way to stay objective is to show the information to other people related to the study, for example, research partners or even the people that will use your findings once they are done.
- **Mark your findings and draw conclusions:** Findings are the observations you extracted from your data. They are the facts that will help you drive deeper conclusions about your research. For example, findings can be trends and patterns you found during your interpretation process. To put your findings into perspective you can compare them with other resources that used similar methods and use them as benchmarks.

2.6 Interpretation techniques and methods

- Kothari (2004) also adds emphasis on the issue of objectivity in interpretation, as well as correct perspective in interpretation: "
- At the outset, researcher must invariably satisfy himself that (a) the data are appropriate, trustworthy and adequate for drawing inferences; (b) the data reflect good homogeneity; and that (c) proper analysis has been done through statistical methods.
- The researcher must remain cautious about the errors that can possibly arise in the process of interpreting results. Errors can arise due to false generalization and/or due to wrong interpretation of statistical measures, such as the application of findings beyond the range of observations, identification of correlation with causation and the like. Another major pitfall is the tendency to affirm that definite relationships exist on the basis of confirmation of particular hypotheses. In fact, the positive test results accepting the hypothesis must be interpreted as "being in accord" with the hypothesis, rather than as "confirming the validity of the hypothesis". The researcher must remain vigilant about all such things so that false generalization may not take place. He should be well equipped with and must know the correct use of statistical measures for drawing inferences concerning his study...(cont'd)

2.6 Interpretation techniques and methods

- …(cont'd) He must always keep in view that the task of interpretation is very much intertwined with analysis and cannot be distinctly separated. As such he must take the task of interpretation as a special aspect of analysis and accordingly must take all those precautions that one usually observes while going through the process of analysis viz., precautions concerning the reliability of data, computational checks, validation and comparison of results.
- He must never lose sight of the fact that his task is not only to make sensitive observations of relevant occurrences, but also to identify and disengage the factors that are initially hidden to the eye. This will enable him to do his job of interpretation on proper lines. Broad generalization should be avoided as most research is not amenable to it because the coverage may be restricted to a particular time, a particular area and particular conditions. Such restrictions, if any, must invariably be specified and the results must be framed within their limits.
- The researcher must remember that "ideally in the course of a research study, there should be constant interaction between initial hypothesis, empirical observation and theoretical conceptions. It is exactly in this area of interaction between theoretical orientation and empirical observation that opportunities for originality and creativity lie." He must pay special attention to this aspect while engaged in the task of interpretation."

Part 3

Report Writing

3.1 Introduction

- After performing data analysis and interpretation the only other step is to present your findings to the targeted audience. This may be a particular group, organization, or the wider research community (those who have an interest in the topic of research).
- How will you present these findings? The best way to do this is in the form of a report. Reports are of different types as we shall see in this section; however, they seek to answer just a few simple questions:
  - What was the research about?
  - Who is the target group?
  - Why is it significant?
  - How was the research carried out?
  - What is the conclusion/finding of the research?
- These are just broad questions that a curious person picking the report to read will be looking for. Let us go into some of the details.

3.2 Steps in Report Writing

- (Ar Rashid, 2023) suggests the following steps to write a report:
- **Define the Purpose and Scope of the Report**: Determine the reason for writing the report and what you want to achieve with it. This will help you to focus your research and determine what information to include in the report.
- **Gather Data and Information:** Collect relevant data and information from various sources, such as books, articles, interviews, and surveys. Ensure that the information you gather is accurate and relevant to the purpose of the report.
- **Analyze the Data:** Organize and analyze the data to identify trends, patterns, and relationships. This will help you to draw meaningful conclusions and make recommendations.
- **Outline the Report Structure:** Create an outline of the report's structure, including the main sections, sub-sections, and headings. This will help you to organize the information and ensure that the report is easy to read and understand.
- **Write the Report:** Start by writing the introduction, which should provide background information and explain the purpose of the report. Then, write the main body of the report, including the results, discussion, and conclusion. Finally, write the executive summary and conclusion, which should summarize the main findings and recommendations of the report.

3.2 Steps in Report Writing

- **Format and Present the Report:** Format the report to ensure that it is visually appealing and easy to read. Choose appropriate charts, tables, and graphs to present the data and make sure they are easy to understand.
- **Review and Edit the Report:** Review the report for grammar, spelling, and punctuation errors. Ensure that the report is well-structured and that the information is presented in a clear and concise manner. Make revisions as needed to improve the overall quality of the report.
- **Finalize the Report:** After you have reviewed and edited the report, it's time to finalize it. This can include adding a title page, table of contents, references, and appendices, if necessary.
- Kothari (2004) outlines the same steps but adds an additional step that provides emphasis on the bibliography. It is worthwhile to differentiate the bibliography from the reference list, as these two terms seem to be synonymous to most writers: "A reference list is the detailed list of references that are cited in your work. A bibliography is a detailed list of references cited in your work, plus the background readings or other material that you may have read, but not actually cited. " (University of Birmingham, 2023).

3.2 Steps in Report Writing

- Kothari (2004) describes it thus:
- *Preparation of the final bibliography:* Next in order comes the task of the preparation of the final bibliography. The bibliography, which is generally appended to the research report, is a list of books in some way pertinent to the research which has been done. It should contain all those works which the researcher has consulted. The bibliography should be arranged alphabetically and may be divided into two parts; the first part may contain the names of books and pamphlets, and the second part may contain the names of magazine and newspaper articles. Generally, this pattern of bibliography is considered convenient and satisfactory from the point of view of reader, though it is not the only way of presenting bibliography. The entries in bibliography should be made adopting the following order:

3.2 Steps in Report Writing

- *For books and pamphlets the order may be as under:*
  - 1. Name of author, last name first.
  - 2. Title, underlined to indicate italics.
  - 3. Place, publisher, and date of publication.
  - 4. Number of volumes.
- *Example*
- Kothari, C.R., *Quantitative Techniques*, New Delhi, Vikas Publishing House Pvt. Ltd., 1978.
- He goes further to suggest how to order the rest of the bibliography. There is a lot of literature available on how to arrange the bibliography; however, the best guide to use is the referencing style, for example, Harvard, APA, and so on.

3.3 Report layout

- The layout of the report means as to what the research report should contain. A comprehensive layout of the research report should comprise (A) preliminary pages; (B) the main text; and (C) the end matter (Kothari, 2004). Let us briefly describe these contents as shared by Kothari (2004):
- Preliminary pages: these pages should carry a *title and date*, followed by acknowledgements in the form of 'Preface' or 'Foreword'. Then there should be a *table of contents* followed by *list of tables and illustrations* so that the decision-maker or anybody interested in reading the report can easily locate the required information in the report.
- Main Text: The main text provides the complete outline of the research report along with all details. Title of the research study is repeated at the top of the first page of the main text and then follows the other details on pages numbered consecutively, beginning with the second page. Each main section of the report should begin on a new page. The main text of the report should have the following sections: (i) Introduction; (ii) Statement of findings and recommendations; (iii) The results; (iv) The implications drawn from the results (inferences); and (v) The summary.

3.3 Report layout

- End Matter: At the end of the report, appendices should be enlisted in respect of all technical data such as questionnaires, sample information, mathematical derivations and the like ones. Bibliography of sources consulted should also be given. Index (an alphabetical listing of names, places and topics along with the numbers of the pages in a book or report on which they are mentioned or discussed) should invariably be given at the end of the report. The value of index lies in the fact that it works as a guide to the reader for the contents in the report.
- This order is usually followed in academia when students are doing research. Students will normally present a proposal containing three chapters which cover the following key points: introduction (what the background to the research is), objectives/hypothesis, a problem statement (in most cases), literature review (what does the current literature have to say about this problem), and research methodology (how the student intends to carry out the research).
- When the proposal is accepted the student then goes to collect data, analyze it, interpret it, and present the findings in a final report. The layout of this report varies from university to university but generally contains the material in the proposal (plus any changes, including an updated literature review which should be more thorough), plus the data collection, analysis, interpretation, inferences, and some gaps that can provide the basis for more research.

3.4 Types of reports

- As is to be expected there are very many different types of reports, depending on many factors such as the audience, environment (business, scientific, technical and so on) and many other such factors. However, these can be categorized as follows (Ar Rashid, 2023) :
- **Business Reports:** These reports provide information and analysis to support decision-making in a business setting. They may include financial reports, marketing reports, operational reports, and strategic reports.
- **Academic Reports:** Academic reports are written for educational purposes and often take the form of research reports, lab reports, or case studies. They are used to present the results of academic research and provide a detailed analysis of the findings.
- **Technical Reports:** Technical reports are written to document the results of scientific or engineering research. They often include detailed descriptions of methods, procedures, and results, as well as graphs, diagrams, and other visual aids.

3.4 Types of reports

- **Feasibility Reports:** Feasibility reports are written to assess the viability of a proposed project or initiative. They include an analysis of the costs, benefits, and risks associated with the project, as well as a recommendation as to whether or not it should be pursued.
- **Progress Reports:** Progress reports are written to provide updates on the progress of a project or initiative. They are often used to communicate the status of the project to stakeholders and provide information on any challenges or obstacles that have been encountered.
- **Incident Reports:** Incident reports are written to document events or incidents that have taken place, such as accidents, security breaches, or equipment failures. They are used to record what happened, why it happened, and what steps were taken to address the issue.
- **Analytical Reports:** Analytical reports are written to provide a comprehensive analysis of a particular issue or topic. They may include an analysis of data, trends, and patterns, as well as recommendations for future action.

3.5 Precautions for writing reports

- Kothari (2004) advises that reports should be written bearing in mind the following precautions:
- 1. While determining the length of the report (since research reports vary greatly in length), one should keep in view the fact that it should be long enough to cover the subject but short enough to maintain interest. In fact, report-writing should not be a means to learning more and more about less and less.
- 2. A research report should not, if this can be avoided, be dull; it should be such as to sustain reader's interest.
- 3. Abstract terminology and technical jargon should be avoided in a research report. The report should be able to convey the matter as simply as possible. This, in other words, means that report should be written in an objective style in simple language, avoiding expressions such as "it seems," "there may be" and the like.
- 4. Readers are often interested in acquiring a quick knowledge of the main findings and as such the report must provide a ready availability of the findings. For this purpose, charts, graphs and the statistical tables may be used for the various results in the main report in addition to the summary of important findings.

3.5 Precautions for writing reports

- 5. The layout of the report should be well thought out and must be appropriate and in accordance with the objective of the research problem.
- 6. The reports should be free from grammatical mistakes and must be prepared strictly in accordance with the techniques of composition of report-writing such as the use of quotations, footnotes, documentation, proper punctuation and use of abbreviations in footnotes and the like.
- 7. The report must present the logical analysis of the subject matter. It must reflect a structure wherein the different pieces of analysis relating to the research problem fit well.
- 8. A research report should show originality and should necessarily be an attempt to solve some intellectual problem. It must contribute to the solution of a problem and must add to the store of knowledge.
- 9. Towards the end, the report must also state the policy implications relating to the problem under consideration. It is usually considered desirable if the report makes a forecast of the probable future of the subject concerned and indicates the kinds of research still needs to be done in that particular field.

3.5 Precautions for writing reports

- 10. Appendices should be enlisted in respect of all the technical data in the report.
- 11. Bibliography of sources consulted is a must for a good report and must necessarily be given.
- 12. Index is also considered an essential part of a good report and as such must be prepared and appended at the end.
- 13. Report must be attractive in appearance, neat and clean, whether typed or printed.
- 14. Calculated confidence limits must be mentioned and the various constraints experienced in conducting the research study may also be stated in the report.
- 15. Objective of the study, the nature of the problem, the methods employed and the analysis techniques adopted must all be clearly stated in the beginning of the report in the form of introduction.

Summary

- Data analysis summarizes collected data. It involves the interpretation of data gathered through the use of analytical and logical reasoning to determine patterns, relationships or trends.
- The four types of data analysis are descriptive analysis, diagnostic analysis, predictive analysis, and prescriptive analysis.
- Data analysis aims to bring order and structure to data by manipulating, summarizing, and reducing it to an interpretable form. It helps to uncover the patterns in the data. Data interpretation aims to execute and apply processes that assign meaning to these discovered patterns by analyzing data. It draws statistical conclusions, infers the relationships and implications.
- The steps to write a report are: gather data and information, analyze the data, outline the report structure, write the report, format and present the report, review and edit the report, and finalize the report
- Reports can be categorized as business reports, academic reports, technical reports, feasibility reports, progress reports, incident reports, and analytical reports

References

- Ar Rashid, H. (2023, February 11). *Different Steps in Writing Report | Types of Report Writing | Layout of the Research Report*. Library & Information Management. https://limbd.org/different-steps-in-writing-report-types-of-report-writing-layout-of-the-research-report/
- Calzon, B. (2023, January 16). *What Is Data Interpretation? Meaning, Methods & Examples*. BI Blog | Data Visualization & Analytics Blog | Datapine. https://www.datapine.com/blog/data-interpretation-methods-benefits-problems/#importance
- Gibson, P. (2018). *Types of Data Analysis*. Chartio; Chartio. https://chartio.com/learn/data-analytics/types-of-data-analysis/
- Kothari, C. R. (2004). *Research methodology : methods & techniques* (2nd ed.). New Age International (P) Ltd., Publishers, Cop.

References

- Seth, N. (2021, July 21). *Difference Between Data Analysis and Interpretation - An Overview*. Blogs & Updates on Data Science, Business Analytics, AI Machine Learning. https://www.analytixlabs.co.in/blog/data-analysis-and-interpretation/#:~:text=What%20is%20the%20difference%20between%20Data%20Analysis%20and%20Interpretation%3F
- Steynberg, S. (2022). *Subject Guides: Research Guide: Data analysis and findings*. Library.up.ac.za. https://library.up.ac.za/c.php?g=485435&p=4425510#:~:text=Data%20analysis%20is%20the%20most
- *Types of Research*. (2019, August 2). Library & Information Management. https://limbd.org/research-types-of-research-objectives-of-research-characteristics-of-research/
- University of Birmingham. (2023). *Harvard: reference list and bibliography*. Intranet.birmingham.ac.uk. https://intranet.birmingham.ac.uk/as/libraryservices/library/referencing/icite/harvard/referencelist.aspx#:~:text=A%20reference%20list%20is%20the

References

- Villegas, F. (2022, July 5). *Data Interpretation: Definition and Steps with Examples*. QuestionPro. https://www.questionpro.com/blog/data-interpretation/#:~:text=Data%20interpretation%20is%20the%20process