Analysis of Presentation of Statistical Data in University Reports

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Abstracts: Considering the current trends in presenting scientific information through academic papers, scientific articles, and professional reports, it is pertinent to know the relevance of data presentation. In this sense, this paper has developed a documentary review on the display of statistical data in university reports, showing the best visual strategies to present information interestingly and globally. For this purpose, many documents from different open-access sources have been analyzed, and the most commonly used methods that offer the best results have been selected. Finally, the importance of data presentation in university papers and its relevance for the argumentation of scientific information and the display of results is presented.

Keywords: Statistical data, Presentation of information, Scientific research, Presentation of results.

1. INTRODUCTION

In an increasingly knowledge-driven world, evidence-based decision-making has become the cornerstone of academic excellence and scientific progress. In this context, university reports are crucial in communicating research, findings, and advances in various disciplines. However, more than simply presenting information is needed to convey the true meaning and relevance of the findings (Few, 2009). Here, statistical data emerge as a powerful tool that unlocks the hidden clues in the vast oceans of information when correctly interpreted and visualized. In this sense, it is argued that statistical data in university reports supports and validates scientific conclusions and plays a fundamental role in informed decision-making and generating effective policies. These data, obtained through rigorous research methods, provide an objective and quantitative look at complex phenomena, allowing researchers and academics to uncover patterns, identify trends, and assess the significance of their findings.

Furthermore, the proper presentation of statistical data in university reports is not only an essential requirement for effective communication but also plays a vital role in the transparency and reproducibility of research. By providing clear, detailed, and visually appealing information, statistical data facilitate the understanding and evaluation of findings by the international scientific community, thus fostering knowledge sharing and multidisciplinary collaboration (Tufte, 2001). With these premises, and considering that the world is increasingly interconnected, where science transcends national borders, it is essential to emphasize that the presentation of statistical data in university reports should have a scientific and international character. This implies adopting rigorous methodological standards and promoting the use of globally recognized tools and techniques to ensure that the presentation of data is accurate, consistent, and accessible to a diverse and multicultural audience.

In this paper, we will explore the analysis of statistical data presentation in university reports, examining theoretical underpinnings, best practices, and prominent examples in the international academic community. In doing so, we hope to foster a greater understanding of the importance and impact of statistical data in university research and to provide researchers, students, and practitioners with the tools necessary to communicate their findings concisely and compellingly.

2. METHODOLOGY

In this work, different sources of information were analyzed to evaluate their contribution to the presentation of statistical data. Table 1 shows the documents analyzed; these reviewed articles provide a variety of valuable contributions to research on the analysis of statistical data presentation in university reports, addressing topics such as design best practices, the impact of different presentation techniques, the use of visualization tools, the influence

of graph and table design, among other relevant aspects. In addition, each article offers a unique perspective that contributes to the knowledge and understanding of this topic.

Table 1. Documents Analyzed According to the Research Topic.

Paper	Contributions
(Batanero, Gea, Arteaga, & Contreras, 2014)	It provides guidelines for selecting appropriate charts in university reports and highlights design best practices.
(Benavides, 2022)	It analyzes the influence of using different graphs on the understanding and perception of data in academic reports.
(Enrique & Peña, 2020)	It examines the impact of statistical analysis techniques on the effective presentation of results in university reports.
(Limache, Vidal, & Piaggio, 2022)	Explore using interactive visualization tools to improve the communication of statistical data in academic reports.
(Saavedra, María, Saavedra, & Miriam, 2015)	It proposes a conceptual framework for presenting complex statistical data in university social science reports.
(Zapata-Cardona, 2020)	Analyzes the impact of different data presentation techniques on the understanding and retaining information in academic reports.
(Rodríguez, Ramírez, & Castañeda, 2022)	It examines the effectiveness of numerical summaries in communicating complex statistical data in university research reports.
(Veiga, Otero, & Torres, 2020)	Provides guidelines for selecting appropriate colors to display statistical data in university reports.
(Estrada, Gallegos, & Huaypar, 2022)	It compares different approaches to data visualization in university reports and analyzes their impact on decision-making.
(Ruz, Molina-Portillo, & Contreras, 2020)	Examines three-dimensional visualization techniques to present statistical data in university natural science reports.
(Rivadeneira, Barrera, & De la Hoz)	Analyzes the influence of graphic design on the interpretation and perception of statistical data in university economics reports.
(Logroño-Naranjo, López-Paredes, Moyano-Jácome, & Oyague-Bajaña, 2020)	It provides a systematic review of the literature on the presentation of statistical data in university reports in psychology.
(Vásquez & García-Alonso, 2020)	It examines the use of line charts in university reports and evaluates their effectiveness in communicating trends and changes over time.
(Espitia Castle, 2020)	It discusses using tables in university reports and proposes guidelines to improve their readability and comprehension.
(Calizaya, Alemán, Bellido, & Ceballos, 2022)	It examines the impact of different data presentation formats on the retention and understanding of information in university medical reports.

Source: Own (2023).

Table 2 shows the inclusion and exclusion criteria considered for this study; these criteria helped to ensure the selection of relevant and quality articles that addressed the analysis of statistical data presentation in university reports.

Table 2. Inclusion and Exclusion Criteria were Considered for the Study.

Inclusion Rites	Exclusion Criteria
Articles published in peer-reviewed scientific journals.	Articles not related to statistical data presentation analysis.
Articles are written in English or with translation available.	Articles that are duplicates or not available in full format.
Articles that focus specifically on university reports.	Articles with flawed methodologies or lack of scientific rigor.
Articles that address theoretical, practical, or methodological aspects.	Articles with a minor or unrepresentative sample.
Articles that present findings, recommendations, or good practices.	Articles published before 2015 (unless they are highly relevant).
Articles covering a wide range of academic disciplines.	Articles with too specific or limited focuses in their thematic scope.

Source: Own (2023).

On the other hand, the quality of the analyzed documents was evaluated using Table 3, where it was possible to categorize the information for later analysis.

Table 3. Evaluation of the Quality of the Documents Analyzed.

Quality Control (QA)	Quality Assessment Questions	Answer
QA1	Does the paper describe the contributions of data presentation in academic and scientific papers?	(+1) Yes/ (+0) No
QA2	Does the document specify the characteristics of the presentation of statistical information?	(+1) Yes/ (+0) No
QA3	Does the paper present any discussion of the findings surrounding the presentation of statistical data?	(+1) Yes/ (+0) No
QA4	Are the present limitations in the presentation of statistical data considered?	(+1) Yes/ (+0) No
QA5	Are future projections made on how statistical data should be presented to reach a good research projection?	(+1) Yes/ (+0) No

Source: Own (2023).

In addition, the following questions were analyzed to determine the relevance and quality of the documents found to make a wide selection.

1. Was the article published in a peer-reviewed scientific journal?
2. Do the authors have recognized institutional affiliations in the academic field?
3. Does the article present a solid, rigorous methodology to address the issue?
4. Are relevant references and citations from reliable, up-to-date sources included?
5. Are the results and findings presented supported by appropriate statistical analyses?
6. Does the article present clear conclusions supported by the results obtained?
7. Are limitations and possible biases mentioned in the study?
8. Does the article propose practical and valuable recommendations for presenting statistical data in university reports?
9. Are the discussion and analysis of the results coherent and sustained?
10. Is the article relevant to the topic of analysis of the presentation of statistical data in university reports?

3. RESULTS

3.1. Analysis of Visualization Techniques

Different statistical data visualization techniques used in university reports were compared and evaluated; the main ones used are bar graphs, histograms, and dispersion plots.

3.1.1. Flowchart

Flowcharts are easy to identify in a process, from the trajectory of a product or service and the people and resources that make it up. In SysML (System Modeling Language), the diagram is used to indicate flows between steps that move physical elements (e.g., gasoline) or energy (e.g., pressure). Additional changes allow the diagram to support better behavioral flows and continuous data. These diagrams are supported by images that represent the steps of the algorithm and personify the execution flow using arrows that join the start and end points of the process (Figure 1).
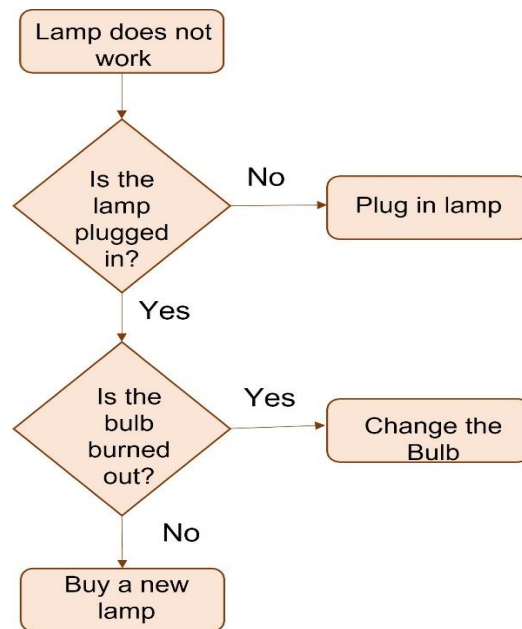
Figure 1. Flowchart Example.
Source: Own (2023).

3.1.2. Ishikawa Diagram

Also recognized as a Cause-Effect Diagram, it is a tool that graphically represents the relationships between effect (result) and its causes (factors). It allows one to identify, evidence, and classify possible causes and specific problems, such as quality characteristics (Statistical Vocation, 2018). The advantages it presents are that it allows one to focus on the problem, having aside the personal interests that the members of the group could be subject to, it promotes the participation of the members, obtaining more significant benefit from the personal knowledge about the process.
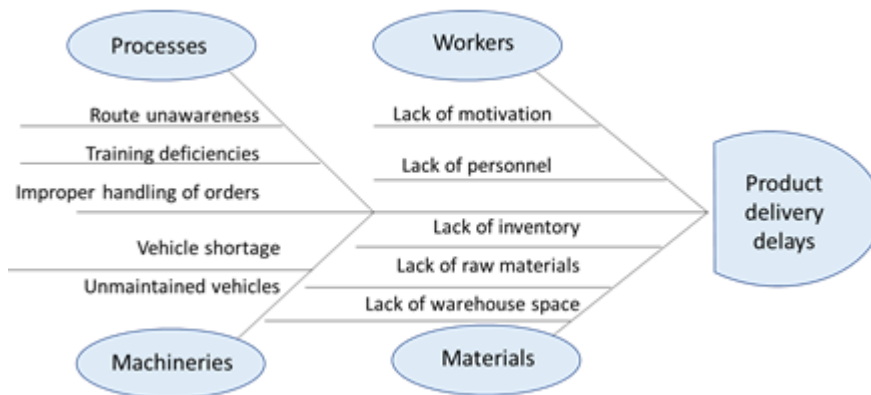

Figure 2. Ishikawa Diagram to Analyze the Delay in the Delivery of Products.
Source: Own (2023).

3.1.3. Pareto Chart

It is summarized in a simple and graphic method of analysis that manages to differentiate between the causes of a problem and those of greater importance, allowing it to direct the most significant efforts to the fundamental problems to be solved (Figure 3). It determines the causes, isolates the minor problems, and focuses on the real solutions. "The Pareto chart can investigate both effects and causes" (Ortiz, 2018).
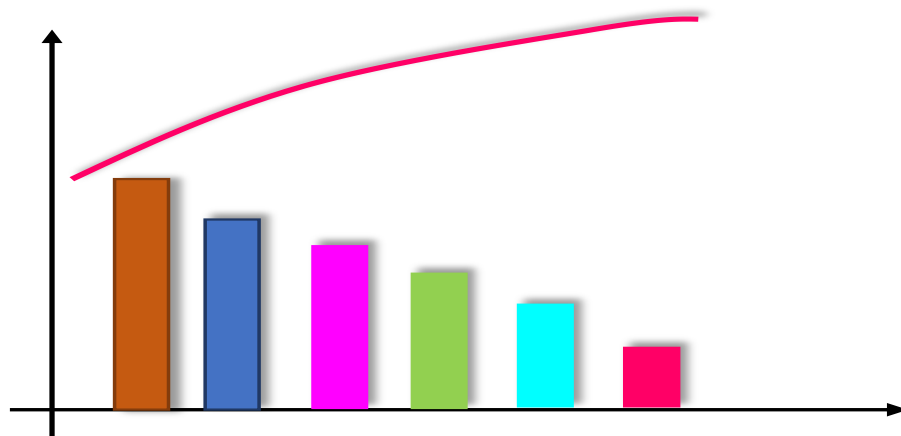
Figure 3. Example of the Pareto Chart.

An application of this diagram is in business analysis because one of the most common mistakes in companies to generate more income is to raise the production of products and services. However, this process can generate considerable losses considering that these products can lower prices due to the comprehensive list that customers can have in sight. This diagram is precise to avoid these possible problems since, with its use, you can identify imminent needs and redirect efforts to them without wasting resources that can be lost (Ortiz, 2018).

Table 4. Features and advantages of the Application of the Pareto Chart.

Characteristics	Advantages
Easy to calculate technique	Focuses on the improvements that will give them the most benefit
Analyzes, recognizes, prioritizes, and prioritizes essential goals	Describe priority problems. It is easy to use and apply.
Make decisions based on authoritative data based on opinions	Take steps so that problems do not become intensive

Fountain: (Ortiz, 2018).

3.1.4. Histograms

They are known as Frequency Distribution Diagrams. They are "graphical representations of a frequency distribution of a continuous variable using vertical bars, each of which reflects an interval" (Mendez, 2022).
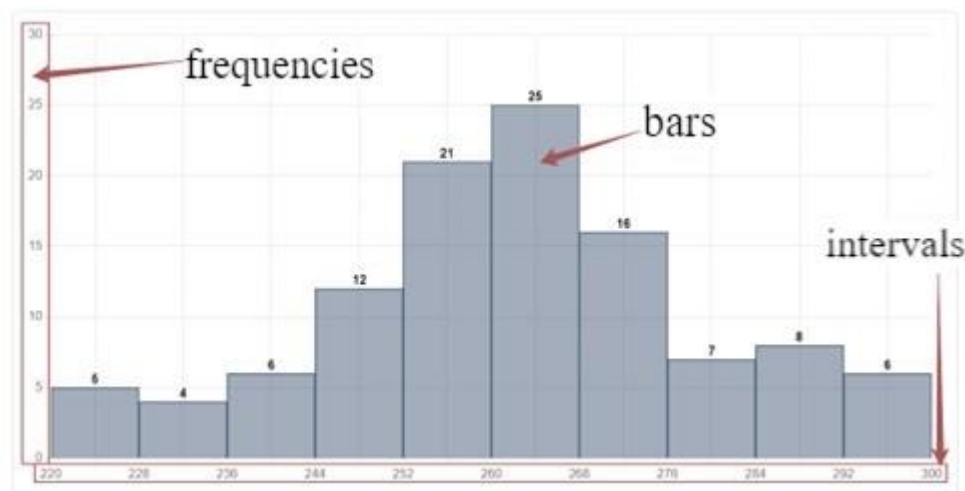

Figure 4. Parts of a Histogram.

Fountain: (Mendez, 2022).

They are usually used to evaluate the effectiveness of the improvement measures implemented or to check the degree of compliance with the specifications of the limits determined in the results of the processes, among others (Dutra & Flach, 2021). In addition, it graphically summarizes the distribution of a group of data or patterns that allows you to discover unusual trends or characteristics.

Due to its effectiveness, it is used most by researchers, statisticians, and analysts who rely on techniques or tools such as surveys, observational studies, and experiments. It is considered the most used and essential among the seven quality tools (Mendez, 2022). There are several ways to use histography according to its form can be.

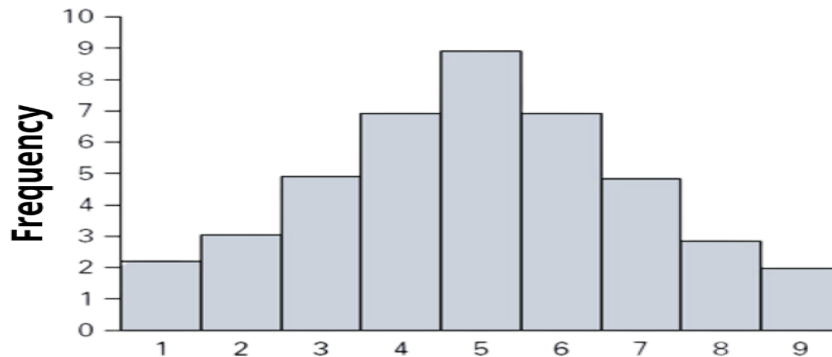### 3.1.4.1. Symmetric Histogram. Balance in Observations

Figure 5. Symmetrical Histogram.
Fountain: (Mendez, 2022).

3.1.4.2. Asymmetric or Skewed Histogram

The data is not evenly distributed on either side of the middle.

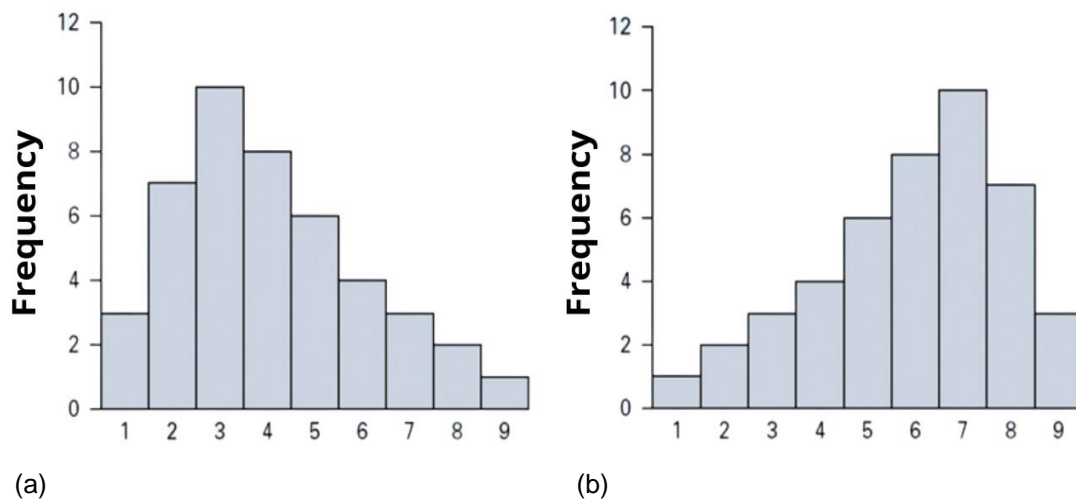(a)   (b)

Figure 6. Asymmetric or Skewed Histogram, (a) Positive Bias (b) Negative Bias.
Fountain: (Mendez, 2022).

3.1.4.3. Absolute Frequency Histogram

Applied when we refer to a statistical histogram." The histogram of absolute frequencies (Mendez, 2022) represents the absolute frequency of distribution in the height of each bar" (Mendez, 2022).
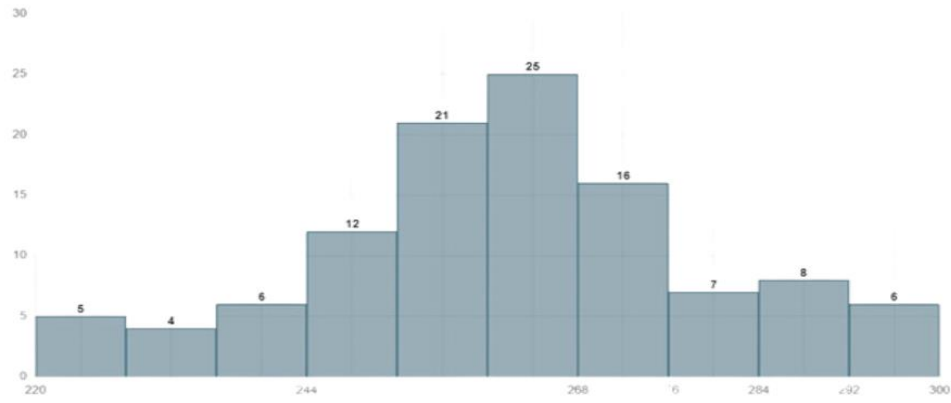
Figure 7. Absolute Frequency Histogram.
Fountain: (Mendez, 2022).

3.1.4.4. Relative Frequency Histogram

"It represents the relative frequencies of a distribution in the heights of each bar. For the same data set, the histogram of absolute and relative frequencies has the same shape" (Mendez, 2022).
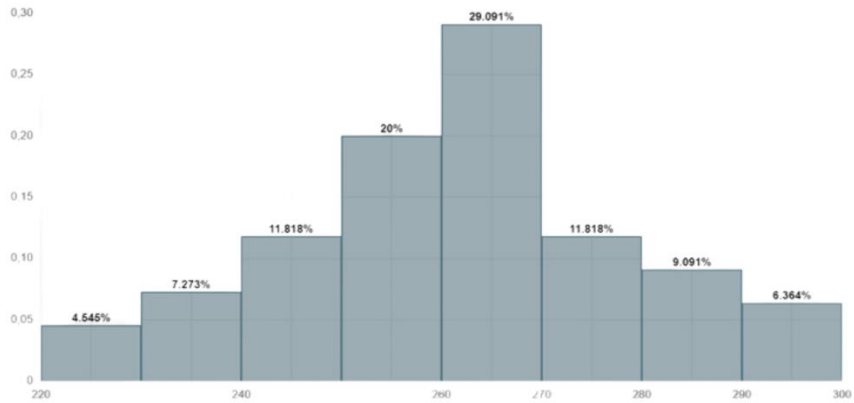

Figure 8. Relative Frequency Histogram.
Fountain: (Mendez, 2022).

3.1.4.5. Histogram of Accumulated Frequencies

It is used to represent relative and absolute frequencies in graphs. Relative frequencies are considered from 0% to 100%.
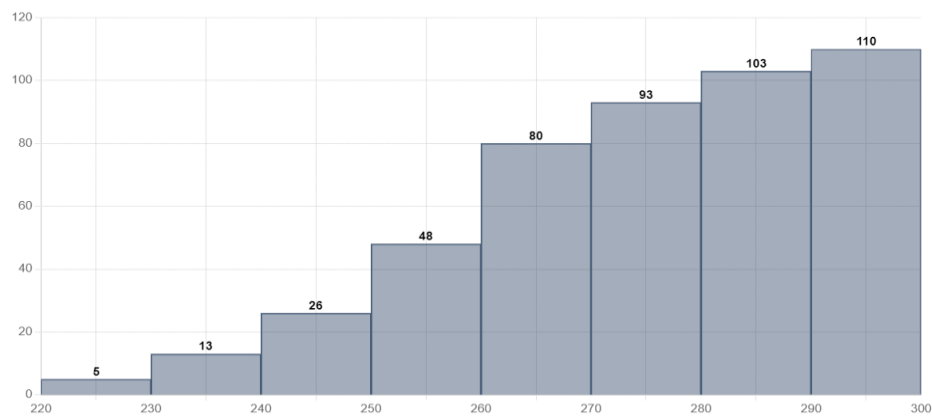

Figure 9. Histogram of Accumulated Frequencies.
Fountain: (Mendez, 2022).

A summary table of the main types of graphical representations is shown in Table 5.

Table 5. Primary Techniques for Presenting Information used in Academic papers.

Presentation Technique	Data Clarity and Interpretation Improvements
Bar Charts	Use contrasting colors and clear labels to make it easier to compare categories.
Histograms	Ensure that class intervals are adequate and axes are correctly labeled.
Scatter Plots	Include trend lines or calculate correlation coefficients to highlight patterns or relationships.
Pie charts	Use clear labels and legends to avoid confusion and ensure proper proportionality.
Line Charts	Use appropriate axes and appropriate scales to show trends over time.
Geospatial Maps and Graphics	Use appropriate colors and legends to highlight spatial variations and geographic patterns.

Source: Own (2023).

These statistical data presentation techniques are the most common. Each can be effective in different situations and for communicating specific types of information. In addition to these specific improvements, it is essential to consider factors such as simplicity, consistency, suitability for the target audience, and clarity in the presentation of data.

3.2. Impact of Report Design

We analyzed how the overall design of university reports, including the organization of sections and the use of colors, fonts, and tables, influences the perception and impact of statistical data. The results could highlight the importance of consistent and attractive design for effective data communication.

Table 6. Aspects to Consider in the Design of University Academic Reports.

Aspect	Description	Importance
Organization of Sections	A clear and logical structure in the organization of sections facilitates the navigation and understanding of the report.	It helps readers quickly locate themselves in the report, find relevant information, and follow the flow of content.
Use of Colors	Proper use of colors can highlight important information, distinguish categories, or show differences in data.	It allows to capture the reader's attention visually and facilitates the interpretation of statistical data.
Font Selection	The choice of clear and legible fonts improves the report's readability and makes statistical data easier to read.	It ensures the data is easy to read and understand, avoiding confusion and eye strain.
Table Design	A clean and well-structured layout in the tables does reading and understanding the data more manageable, highlighting critical information and using a consistent format.	Improve the clarity and interpretation of data by presenting it in an organized and understandable way.
Visual Coherence	Maintaining consistency in visual design throughout the report creates a professional appearance and makes it easier to assimilate information.	Create a consistent visual experience that helps readers process information more efficiently.

Source: Own (2023).

A university report's consistent and attractive design is critical for effectively communicating statistical data. The organization of clear sections, the appropriate use of colors to highlight relevant information, the choice of readable fonts, the careful design of tables, and visual consistency throughout the report contribute to the perception and impact of the data, improving the understanding and facilitating the interpretation of statistical information.

Evaluation of the quality of reports: A methodology is proposed to evaluate the quality of university reports regarding the presentation of statistical data. This includes criteria for readability, consistency, accuracy, and compliance with established presentation standards.

3.3. Legibility
- Analyze the report's structure, including the organization of sections, headings, and subsections.
- Check if the structure is clear and facilitates navigation and understanding of the content.
- Evaluate the clarity and conciseness of the language used in the report.
- Look for simple wording, avoiding unnecessary jargon or excessive technical language.
- Consider using paragraphs, sentences, and bullet points appropriately to improve readability and reading fluency.
- Use readability assessment tools like the Flesch-Kincaid Index to measure text readability quantitatively.

3.4. Coherence
- Examine the consistency in the report's structure and flow of information.
- Check whether the introduction, methods, results, and conclusions are presented logically and coherently.
- Review consistency in the terminology used throughout the report.
- Ensure that terms are used consistently and unambiguously.
- Assess consistency in writing styles, such as tone, level of formality, and voice used in the report. Look for a uniform style appropriate to the academic context.

3.5. Precision
- Verify the accuracy of the data and results presented in the report. Check if the calculations, figures, and statistics are correct and backed by suitable sources.
- Evaluate the accuracy of the statements and conclusions made in the report.
- Ensure that they are supported by solid evidence and fit the results obtained.
- Review the accuracy of citations and references used in the report. Ensure proper citation conventions are followed, and all sources are cited correctly and completely.

3.6. Compliance with Presentation Standards
- Verify whether the report meets established presentation standards, such as using a specific format, an academic report structure, or required style and citation standards.
- Evaluate whether the recommended presentation and design guidelines are followed for the report's graphs, tables, images, and other visual elements.
- Review whether all required sections are included in an academic report, such as introduction, methods, results, and conclusions, as well as additional sections, such as literature review or discussion.

4. CONCLUSIONS
- The effective presentation of statistical data in university reports is crucial to convey information clearly and understandably.
- Proper selection of visualization techniques, such as graphs and tables, can improve the clarity and interpretation of data.
- The logical and consistent organization of the sections of the report facilitates the understanding and navigation of statistical information.
- Using appropriate colors, fonts, and visual styles can highlight relevant information and improve data perception.
- It is essential to maintain the accuracy of the data and results presented, supporting them with reliable sources and appropriate methodologies.
- Adhering to established presentation standards, such as specific formats and citation standards, ensures consistency and compliance in reporting.

- Clarity of language used in statistical reports is essential for readers to understand the concepts and results presented.
- Careful review of grammar, spelling, and text structure contributes to the overall quality of reports.
- Attention to visual details, such as spacing, alignment, and design consistency, improves reports' appearance and readability.
- Effective presentation of statistical data in university reports involves clear communication of results and the ability to tell a story through data to make a meaningful impact.

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