Analyzing and Interpreting the Data

- Objectives
- we will show how to perform data analysis to obtain accurate results so that readers can replicate them.
- The third major section of a research paper includes results and discussion.
- The results section contains facts related to your experiment. We should use figures, tables, and equations so that understanding our data becomes easier. The results are interpreted in the discussion section.

Qualitative vs Quantitative Research

Qualitative Research

- In case of qualitative research, its deals with subjective analysis. More of psychological aspects involved here.
- A survey about how much people are depressed if they spend time on social media can be an example of qualitative analysis. We can relate it to the behavior or cognitive sciences.
- A very common example we can say about qualitative analysis is of social network sites. We often get recommendations for some specific posts. Though there is some sort of intelligence embedded in the methodology that is used, but the outcomes are qualitative.

Qualitative vs Quantitative Research

Quantitative Research

- A measurable amount is referred as “quantity.”
- Therefore, something that one can express in the results with a specific amount that could be compared can be called as quantitative research.
- Imagine a researcher trying to gain insights about the amount of pollution and its percentage impact.
- Such a research is a case of quantitative research- that has rigorous experimentation and many findings.
- Therefore, for the said example findings can be different plots with percentile impacts on people in different geographical areas and so on.

Qualitative vs Quantitative Research

Quantitative Research

Quantitative Research

- Mean – The mean value represents a numerical average for a set of responses. For a data set, the terms arithmetic mean, mathematical expectation, and sometimes average are used synonymously to refer to a central value of a discrete set of numbers: specifically, the sum of the values divided by the number of values. If the data set were based on a series of observations obtained by sampling from a statistical population, the arithmetic mean is termed the sample mean to distinguish it from the population mean.
- Standard deviation – The standard deviation represents the distribution of the responses around the mean. It indicates the degree of consistency among the responses. The standard deviation, in conjunction with the mean, provides a better understanding of the data. For example, if the mean is 3.3 with a standard deviation (SD) of 0.4, then two-thirds of the responses lie between 2.9 (3.3– 0.4) and 3.7 (3.3 + 0.4).
- Frequency distribution – Frequency distribution indicates the frequency of each response. For example, if respondents answer a question using an agree/disagree scale, the percentage of respondents who selected each response on the scale would be indicated. The frequency distribution provides extra information beyond the mean, since it allows for examining the level of consensus among the data.
- Higher levels of statistical analysis (e.g., t-test, factor analysis, regression, ANOVA) can be conducted on the data, but these are not regularly used in most program/project assessments.

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Methods of Displaying Analyzed Data

- Having analyzed the data that, we collected through either quantitative or qualitative method(s), the next task is to present our findings to our readers.
- The main purpose of using data display techniques is to make the findings easy and clear to understand, and to provide extensive and comprehensive information in a succinct and effective way.
- There are many ways of presenting information. The choice of a particular method should be determined primarily by our impressions/knowledge of our likely readership's familiarity with the topic and with the research methodology and statistical procedures.
- If our readers are likely to be familiar with 'reading' data, we can use complicated methods of data display; if not, it is wise to keep to simple techniques. Although there are many ways of displaying data, this chapter is limited to the more commonly used ones. There are many computer programs that can help us with this task.

Five ways of communicating and displaying the analyzed data

- Text
- Tables
- Graphs
- Statistical measures, and
- Equations.
- Because of the nature and purpose of investigation in qualitative research, text becomes the dominant and usually the sole mode of communication. In quantitative studies, the text is very commonly combined with other forms of data display methods, the extent of which depends upon your familiarity with them, the purpose of the study and what you think would make it easier for your readership to understand the content and sustain their interest in it. Hence as a researcher, it is entirely up to you to decide the best way of communicating your findings to your readers.

Five ways of communicating and displaying the analyzed data

- **Text**

- Text, is the most common method of communication in both quantitative and qualitative research studies and, perhaps, the only method in the latter.
- It is, therefore, essential that we know how to communicate effectively, keeping in view the level of understanding, interest in the topic and need for academic and scientific rigor of those for whom we are writing.
- Our style should be such that it strikes a balance between academic and scientific rigor and the level that attracts and sustains the interest of our readers.

Five ways of communicating and displaying the analyzed data

- **Table**
- Other than text, tables are the most common method of presenting analyzed data.
- Tables offer a useful means of presenting large amounts of detailed information in a small space.
- They can dramatically clarify text, provide visual relief, and serve as quick point of reference.
- It is, therefore, essential for beginners to know about their structure and types.

Five ways of communicating and displaying the analyzed data

- A table has five parts
- Title: This normally indicates the table number and describes the type of data the table contains. It is important to give each table its own number as we will need to refer to the tables when interpreting and discussing the data (refer them with Table 1, Table 2, ...). The tables should be numbered sequentially as they appear in the text.
- Stub: The subcategories of a variable, listed along the y-axis (the left-hand column of the table). The stub, usually the first column on the left, lists the items about which information is provided in the horizontal rows to the right.
- Column headings: The subcategories of a variable, listed along the x-axis (the top of the table).
- Body: The cells housing the analyzed data.
- Supplementary notes: There are four types of footnote: source notes; other general notes; notes on specific parts of the table; and notes on the level of probability. These notes should be identified at the bottom of the table.

Five ways of communicating and displaying the analyzed data

Title

Table X. YY: Attitudes towards uranium mining by age

(x-axis)

Column heading

Attitude towards uranium mining	Age of respondent					Total
	<25	25–34	35–44	45–54	55+	
Strongly favourable						
Favourable						
Uncertain						
Unfavourable						
Strongly unfavourable						
Total						

(*y*-axis)

Source: ..... Hypothetical data

Stub

Body

Supplementary notes

Five ways of communicating and displaying the analyzed data

TABLE 16.1 *Respondents by age (frequency table for one population – hypothetical data)*

Age	No. of respondents
<20 years	2 (2.0)
20–24	12 (12.0)
25–29	22 (22.0)
30–34	14 (14.0)
35–39	17 (17.0)
40–44	10 (10.0)
45–49	11 (11.0)
50–54	9 (9.0)
55+00	3 (3.0)
Total	100 (100.0)

Note: Figures in parentheses are percentages.

TABLE 16.2 *Respondents by age (frequency table comparing two populations – hypothetical data)*

Age	Population A	Population B
<20	2 (2.0)	1 (0.6)
20–24	12 (12.0)	17 (10.9)
25–29	22 (22.0)	23 (14.7)
30–34	14 (14.0)	18 (11.5)
35–39	17 (17.0)	26 (16.7)
40–44	10 (10.0)	16 (10.3)
45–49	11 (11.0)	18 (11.5)
50–54	9 (9.0)	27 (17.3)
55+00	3 (3.0)	10 (6.4)
No response	0 (0.0)	0 (0.0)
Total	100 (100.0)	156 (99.9*)

Note: Figures in parentheses are percentages (*rounding error).

TABLE 16.3 *Respondents by attitude towards uranium mining and age (cross-tabulation – hypothetical data)*

Attitude towards uranium mining	Age					Total
	<25	25–34	35–44	45–54	55+	
Strongly favourable	(0.0)* 0 (0.0)@	(5.5) 2 (12.5)@	(14.8) 4 (25.0)@	(35.0) 7 (43.6)@	(100.0) 3 (18.6)@	16 (100.0)@
Favourable	(0.0)* 0 (0.0)	(8.3) 3 (25.0)	(18.5) 5 (41.7)	(20.0) 4 (33.3)	(0.0) 0 (0.0)	12 (100.0)
Uncertain	(0.0)* 0 (0.0)	(0.0) 0 (0.0)	(7.4) 2 (33.3)	(20.0) 4 (66.7)	(0.0) 0 (0.0)	6 (100.0)
Unfavourable	(14.3)* 2 (20.0)	(19.4) 7 (70.0)	(3.7) 1 (10.0)	(0.0) 0 (0.0)	(0.0) 0 (0.0)	10 (100.0)
Strongly unfavourable	(85.7)* 12 (21.4)	(66.7) 24 (42.9)	(55.6) 15 (26.8)	(25.0) 5 (8.9)	(0.0) 0 (0.0)	56 (100.0)
Total	(100.0)* 14	(100.0) 36	(100.0) 27	(100.0) 20	(100.0) 3	(100.0) 100

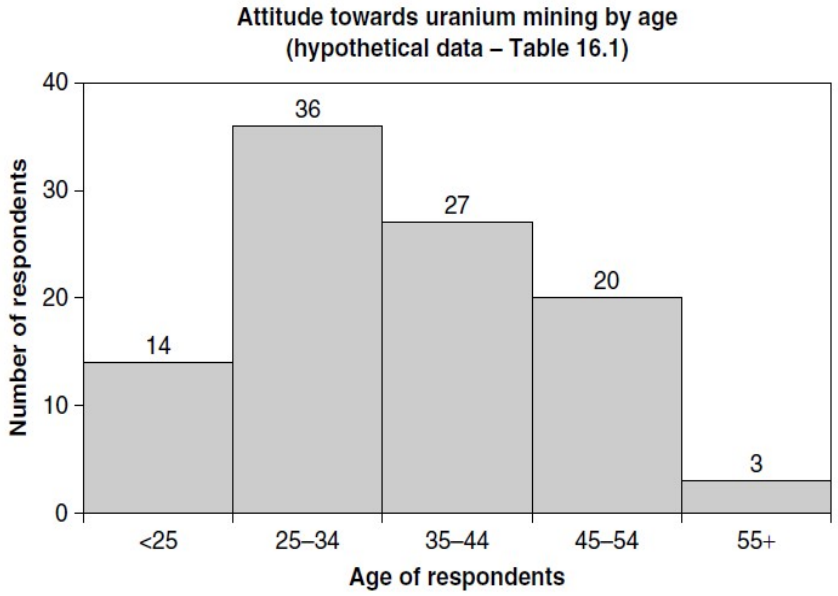
* = Column percentage; @ = Row percentage.

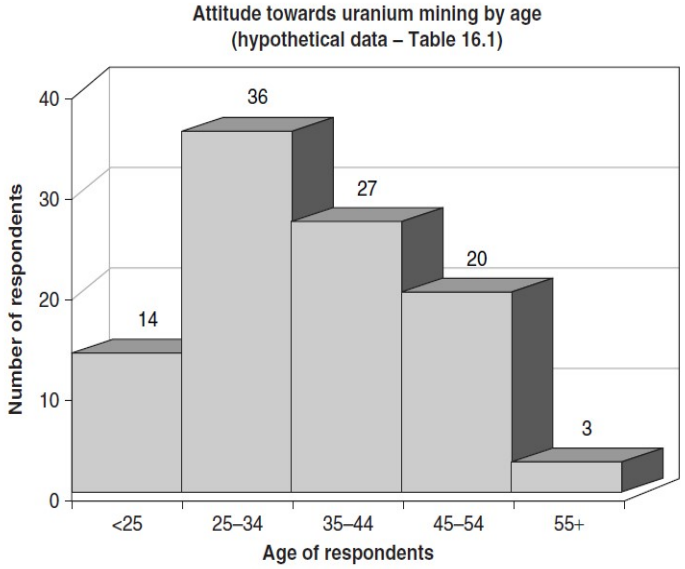
TABLE 16.4 *Attitude towards uranium mining by age and gender (hypothetical data)*

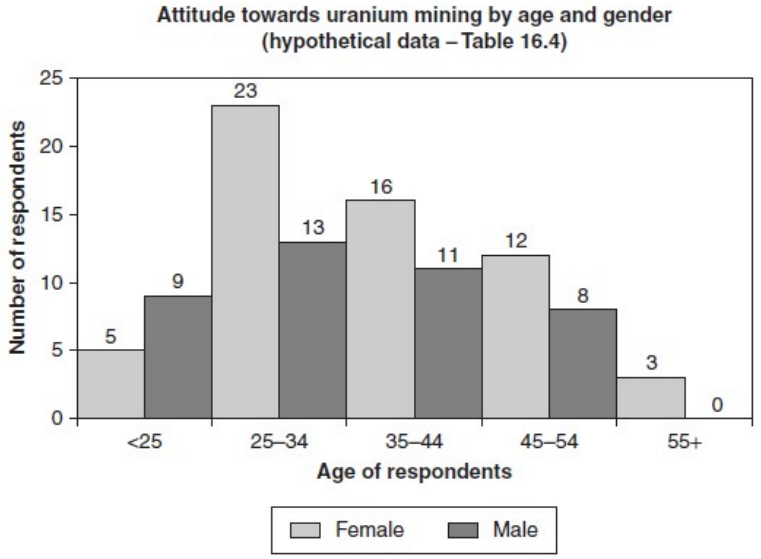
Attitude towards uranium mining	Number of respondents												
	<25		25–34		35–44		45–54		55+		Total		
	F	M	F	M	F	M	F	M	F	M	F	M	T
Strongly favourable	0	0	1	1	3	1	5	2	3	–	12	4	16
Favourable	0	0	1	2	3	2	3	1	0	0	7	5	12
Uncertain	0	0	0	0	1	1	2	2	0	0	3	3	6
Unfavourable	1	1	4	3	1	0	0	0	0	0	6	4	10
Strongly unfavourable	4	8	17	7	8	7	2	3	0	0	31	25	56
Total	5	9	23	13	16	11	12	8	3	0	59	41	100

Five ways of communicating and displaying the analyzed data

- The Histogram
- A histogram consists of a series of rectangles drawn next to each other without any space between them, each representing the frequency of a category or subcategory. Their height is in proportion to the frequency they represent. A histogram can be drawn for both categorical and continuous variables.



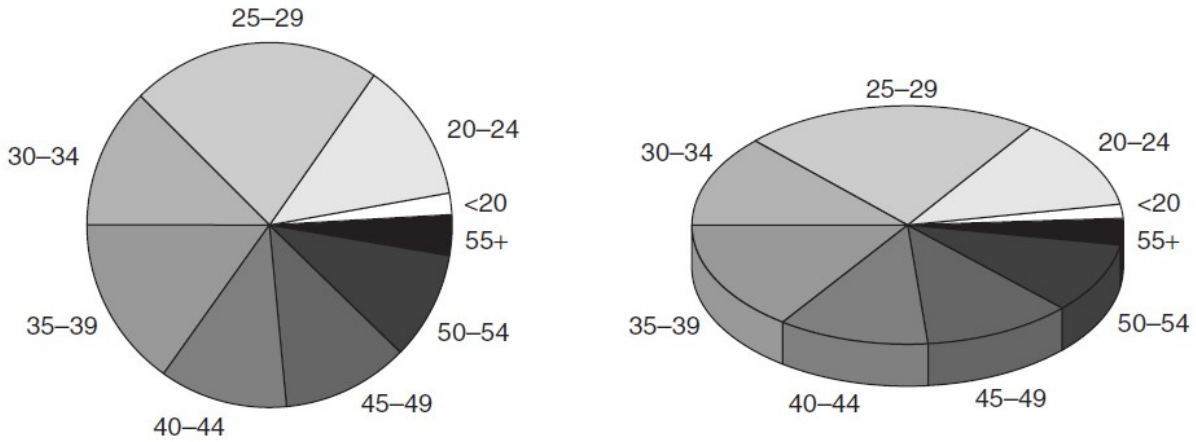




Five ways of communicating and displaying the analyzed data

- The Pie Chart
- The pie chart is another way of representing data graphically this time as a circle.
- There are 360 degrees in a circle, and so the full circle can be used to represent 100 per cent, or the total population.
- The circle or pie is divided into sections in accordance with the magnitude of each subcategory, and so each slice is in proportion to the size of each subcategory of a frequency distribution.
- The proportions may be shown either as absolute numbers or as percentages.
- Manually, pie charts are more difficult to draw than other types of graph because of the difficulty in measuring the degrees of the pie/circle.

Respondents by age
Attitude towards uranium mining (hypothetical data)



Five ways of communicating and displaying the analyzed data

- Statistical Measures
- Statistical measures are extremely effective in communicating the findings in a precise and succinct manner. Their use in certain situations is desirable and in some it is essential, however, we can conduct a perfectly valid study without using any statistical measure.
- Use of statistical measures is dependent upon the type of data collected, our knowledge of statistics, the purpose of communicating the findings, and the knowledge base in statistics of our readership.
- There are many statistical measures ranging from very simple to extremely complicated. We have simple descriptive measures such as mean, mode, median and, on the other; there are inferential statistical measures like analysis of variance, factorial analysis, multiple regressions and chi-square test.

Testing of Hypothesis

- One of the prime objectives of experimentation whether it is in field or laboratory, is the comparison of treatments means and variances under study. A researcher is usually interested in the following comparisons for drawing logical conclusions of the study undertaken by him. The statistical tests which are applicable in different situations are also given:

1. One sample Z-test and one sample t-test
2. Two sample Z-test, two sample t-test and paired t-test
3. F-test

Testing of Hypothesis

- P-value:
- It indicates the strength of evidence for rejecting the null hypothesis H0, rather than simply concluding 'reject H0' or 'do not reject H0'. Small p values suggest that the null hypothesis is unlikely to be true. The smaller, it is the more convincing, is the rejection of the null hypothesis.

- Test statistic:
- It is the statistic whose value is calculated from the sample data and then
- compared with critical or table value to decide whether to reject or accept H0.

Testing of Hypothesis

- The one-sample t-test is a statistical hypothesis test used to determine whether an unknown population mean is different from a specific value.
- The one-sample z-test is used to test whether the mean of a population is greater than, less than, or not equal to a specific value. Because the standard normal distribution is used to calculate critical values for the test, this test is often called the one-sample z-test.
- The two-sample t-test determines if two population means are equal, often to test if a new process is superior to a current one
- A two-sample z-test is used to test whether two population means are equal. This test assumes that the standard deviation of each population is known
- F test is a statistical test that is used in hypothesis testing to check whether the variances of two populations or two samples are equal or not.
- A p-value, or probability value, is a number describing the likelihood of obtaining the observed data under the null hypothesis of a statistical test

Results and Discussion

- After performing the experiment on our chosen problem, we should prepare the section on results and discussion.
- In this section, we should give all evidence relevant to the research problem and its solution.
- A bare statement of the findings is not enough; the implications need to be informed. Data analysis and the report must be accurate.
- These must be based on the research questions we have formulated. This section must include statistical operations.
- We compare our findings to see whether they agree with previous research.
- We inform the strengths and weaknesses of our work and our suggestions for the study.
- In addition, we can show the direction of our future research