Quantitative Analysis for Managerial Applications

By: Reetika Chaudhary

This reference book can be useful for

BBA, MBA, B.Com, BMS, M.Com, BCA, MCA

and many more courses for Various Universities

NEERAJ PUBLICATIONS
www.neerajbooks.com

Published by:

NEERAJ PUBLICATIONS
(Publishers of Educational Books)

Sales Office : 1507, 1st Floor,
Nai Sarak, Delhi-110 006
E-mail: info@neerajbooks.com
Website: www.neerajbooks.com

Typesetting by: Competent Computers

Terms & Conditions for Buying E-Book

- The User must Read & Accept the Terms and Conditions (T&C) carefully before clicking on the accept option for Buying the Online Soft Copy of E-books. Under this Particular Facility you may buy only the Online Soft Copy of E-books, no Hard Copy or Printed Copy shall be provided under this facility.

- These E-Books are valid for 365 days online reading only (From the Date of Purchase) and no kind of Downloading, Printing, Copying, etc. are allowed in this facility as these products are just for Online Reading in your Mobile / Tablet / Computers.

- All the online soft copy E-books given in this website shall contain a diffused watermark on nearly every page to protect the material from being pirated / copy / misused, etc.

- This is a Chargeable Facility / Provision to Buy the Online Soft Copy of E-books available online through our Website Which a Subscriber / Buyer may Read Online on his or her Mobile / Tablet / Computer. The E-books content and their answer given in these Soft Copy provides you just the approximate pattern of the actual Answer. However, the actual Content / Study Material / Assignments / Question Papers might somewhat vary in its contents, distribution of marks and their level of difficulty.

- These E-Books are prepared by the author for the help, guidance and reference of the student to get an idea of how he/she can study easily in a short time duration. Content matter & Sample answers given in this E-Book may be Seen as the Guide/Reference Material only. Neither the publisher nor the author or seller will be responsible for any damage or loss due to any mistake, error or discrepancy as we do not claim the Accuracy of these solution / Answers. Any Omission or Error is highly regretted though every care has been taken while preparing these E-Books. Any mistake, error or discrepancy noted may be brought to the publishers notice which shall be taken care of in the next edition. Please consult your Teacher/Tutor or refer to the prescribed & recommended study material of the university / board / institute / Govt. of India Publication or notification if you have any doubts or confusions before you appear in the exam or Prepare your Assignments before submitting to the University/Board/Institute.

· Publisher / Study Badshah / shall remain the custodian of the Contents right / Copy Right of the Content of these reference E-books given / being offered at the website www.studybadshah.com.

- The User agrees Not to reproduce, duplicate, copy, sell, resell or exploit for any commercial purposes, any portion of these Services / Facilities, use of the Service / Facility, or access to the Service / Facility.

- The Price of these E-books may be Revised / Changed without any Prior Notice.

- The time duration of providing this online reading facility of 365 days may be alter or change by studybadshah.com without any Prior Notice.

- The Right to accept the order or reject the order of any E-books made by any customer is reserved with www.studybadshah.com only.

- All material prewritten or custom written is intended for the sole purpose of research and exemplary purposes only. We encourage you to use our material as a research and study aid only. Plagiarism is a crime, and we condone such behaviour. Please use our material responsibly.

- In any Dispute What so ever Maximum Anyone can Claim is the Cost of a particular E-book which he had paid to Study Badshah company / website.

- If In case any Reader/Student has paid for any E-Book and is unable to Access the same at our Website for Online Reading Due to any Technical Error/ Web Admin Issue / Server Blockage at our Website www.studybadshah.com then He will be send a New Link for that Particular E-Book to Access the same and if Still the Issue is Not Resolved Because of Technical Error/ Web Admin Issue / Server Blockage at our website then His Amount for that Particular Purchase will be refunded by our website via PayTM.

- All the Terms, Matters & Disputes are Subjected to "Delhi" Jurisdiction Only.

CONTENTS

QUANTITATIVE ANALYSIS FOR MANAGERIAL APPLICATIONS

Basic Mathematics for Managements

Quantitative Decision-making–An Overview

1

INTRODUCTION

Prior to industrial revolution, the business activities were confined to small units operating in their own areas. The owner of the firms personally looked after all the departments of the business activities like production, sales, etc., he was in direct contact with the customers and hence knew their exact requirements. Thus, he made decisions based upon his past experience and intuition only.

However today, with the growing size of the business firms, it has become impossible for the owners to make personal contacts with the customers or base their decisions on mere intuition. Thus more and more quantitative techniques are used these days for effective decision-making. Computers have played an important role in the application of these quantitative techniques by providing speed and accuracy. Thus, quantitative approach combined with the ability to judge, experience and knowledge of decision-maker helps in most efficient decision-making.

CHAPTER AT A GLANCE

MEANING OF QUANTITATIVE TECHNIQUES

Quantitative techniques refer to the group of statistical data and the mathematical models constructed under operations research to represent the situation under study.

The Quantitative approach is based on the facts, information, the data collected and logic rather than the intuition of the decision-maker to help him select appropriate decision to help him select appropriate course of action.

STATISTICS AND OPERATIONS RESEARCH

Statistics

The word statistics has been used to convey different meanings in singular and plural sense.

1. **Plural Sense (Statistical data):** When used as plural, statistics means numerical set of data. It generally takes the form of counts and measurements, e.g. counting the total number of students and conducting a separate counting under different categories like male and female. They also include measurements such as their heights and weights.

2. **Singular Sense (Statistical methods):** When used in singular sense, it means the science of statistical methods embodying the theory and techniques used for collecting, analysing and drawing inferences from the numerical data which can be used to explain certain phenomena.

The most commonly used method of statistical analysis includes five stages. The five stages can be explained using the following example. Suppose we are interested in knowing the income level of the people living in a certain city. We can derive this by fulfilling the following five stages:

(a) **Data Collection:** Utmost care must be exercised in collecting because they form the foundation of

statistical analysis. If data are faulty, the conclusions drawn can never be reliable. In case of the stated example, we need the following data:

1. Population of the city.
2. Number of individuals who are getting the income.
3. Daily income of each earning individual.

(b) **Organize (or condense) the Data:** The data must be organized by editing, classifying and tabulating it in order to provide clarity in the presentation of the data and reduce the bulk of the data. As per the example, the data obtained should now be organized in different income groups.

(c) **Presentation:** Data presented in orderly manner helps in statistical analysis. It can be presented by means of graphs, diagrams or other visual aids.

(d) **Analysis:** The data presented must be analyzed using methods of statistical analysis, example mean, correlation etc. As per the example, we must now determine the average income of an individual and analyze the existing disparity.

(e) **Interpretation:** This includes drawing conclusion from the data collected and analyzed. Correct interpretation will lead to a valid conclusion of the study and thus can aid in taking suitable decision.

Characteristics of Data

Numerical data is referred to as statistics only if it processes the following characteristics. So, the following characteristics are the most important requirement of statistics:

1. **Aggregate of facts:** Single figures are not statistics because such figures are unrelated and cannot be compared. **Example:** income of 'A' is Rs. 90,000 p.a.; this would not constitute statistics although it is numerical statement of facts.

2. **Affected to a marked extent by the multiplicity of causes:** The facts and figures are affected by number of forces operating together, e.g. statistics of production of rice are affected by the rainfall, quality of soil, seeds and manure etc.

3. **Enumerated or estimated according to reasonable standards of accuracy:** It is sometimes difficult to acquire data, e.g. calculating the country's population. In this case, the data is estimated by drawing small samples from the larger once.

4. **Collected in a systematic manner for a pre-determined purpose:** Data collected in a haphazard way will not conform to the reasonable standards of accuracy and the conclusions based on them might lead to wrong or misleading decisions. The data collected should be collected keeping in view of the objectives.

Example: The data collected in price will be useless if data on wholesale prices is collected when retail prices were needed.

5. **Comparable:** Data must be comparable with respect to some unit, generally time or place. **Example:** Population of a country in different years constitutes statistics since they are comparable.

6. **Must be expressed numerically:** Any fact can be called statistics if it is expressed numerically or quantitatively.

Types of Statistical Data

Statistical data can be of two types:

1. **Primary Data:** The data which are originally collected by an investigator or agency for the first time for any statistical investigation and used by them in statistical analysis are termed as primary data. It can be collected by observation, survey or experimentation.

2. **Secondary Data:** The data already processed and published by some organizations and are used by others. These data must be scrutinized properly and checked for relevance and accuracy in consideration with the subject concerned.

The data collected by CSO and NSSO for various surveys are primary as far as these departments are concerned but they become secondary if such data are used by other department and organization.

Data are also classified as micro and macro. Micro refers to a single unit whereas macro refers to aggregates.

OPERATIONS RESEARCH

Mathematical models are used to represent situation and to predict the performance or lay any action to achieve certain performance level.

CLASSIFICATION OF STATISTICAL METHODS

Statistical methods are of three types:

1. **Descriptive Statistics:** It is used to summarize large data for easy understanding. It can be done with the help of measures of central tendency and dispersion trends, index numbers, etc.

2. **Inductive Statistics:** It is concerned with estimation of small samples drawn from large samples or population parameter for deriving a statistical inference. It may not be feasible as well as expensive to attain data of entire population. It includes methods like probability distribution, sampling, hypothesis testing, etc.

3. **Statistical Decision-making:** A businessman has to operate in an atmosphere of uncertainty and has to select the best course of action out of the available alternatives. Statistical

decision theory helps in selecting the best alternative by using quantitative techniques. It is also called 'Bayesian Decision Theory' since it revises the prior probabilities with the help of Baye's Theorem.

MODELS IN OPERATIONS RESEARCH

A model represents a part of the reality. It explains and helps to foresee the behaviour of the system before actual implementation.

The Operations Research models can be classified as follows:

1. Purpose: Depending upon the exact purpose of constructing the model, it can be classified as:

(a) **Descriptive Model:** It explains the situation by describing all the aspects clearly along with graphs specifying the alternative choices that are available to the decision-maker.

(b) **Explanatory Model:** It establishes a proper linkage between all the factors of the situation and explains it briefly. **Example:** Variations in demand can be explained by combining factors like change in taste, price, preference, etc.

(c) **Predictive Model:** It is used to predict and forecast the status of a situation in near future.

(d) **Prescriptive (or normative) Model:** It is used to describe the rules of comparing different alternatives and selecting the best.

2. Degree of Abstraction: As per the degree of abstraction i.e. least abstract to most abstract, the models can be classified as:

(a) **Physical Model:** It is the part representation of reality in three dimensional form, e.g. model of an airplane.

(b) **Graphic Model:** It shows the relationship of a situation with other factors graphically.

(c) **Schematic:** It uses flow chart to project the activity in a particular sequence.

(d) **Analog Model:** It is the physical representation of reality having characteristics similar to the real object, e.g. children toy.

(e) **Mathematical (or symbolic) Model:** It is represented by using mathematical equations and laws, e.g. input output model.

3. Degree of Certainty: According to this models can be classified as:

(a) **Deterministic Model:** A model in which unique result can be determined for each situation, e.g. linear programming.

(b) **Probalistic Model:** The results are unknown and more than one for each situation stated with certain degree of confidence, e.g. decision theory models.

4. Specified Behaviour Characteristics:

(a) **Static Model:** The models are based on fixed conditions independent of time. There are no alterations in the short run, e.g. linear programming.

(b) **Dynamic Model:** The models are dependent on time and hence are altered according the demands of the situation.

(c) **Linear Model:** The relationship between the dependent and independent variables are directly proportional, e.g. $y = a + bx$ where a and b are constants.

(b) **Non-linear Model:** When the degree of the independent variable is more than one, they represent non-linear model, e.g. $y = 5x^2 + 3xy + 7y^2$.

5. Procedure (or method) of Solution:

(a) **Analytical Models:** It is in mathematical form and is solved using mathematical techniques, e.g. Game theory models.

(b) **Simulation Model:** It experiments on a mathematical structure using different values to evaluate the system's behaviour over a period of time.

VARIOUS STATISTICAL TECHNIQUES

(a) **Measures of Central Tenancy:** It summarise the data using frequencies and thus helps us to make useful inferences. It provides different averages under different methods, the three averages are:

1. **Mean:** It is calculated by summing up all the value of the variables divided by the total number of items.
2. **Median:** It refers to the middle value of the distribution arranged in ascending or descending order.
3. **Mode:** It is the value in a series of observations which occurs with greatest frequency.

(b) **Measure of Dispersion:** It describes the variability or the degree of scatterness around the central value. The measures of dispersion are range, mean deviation and standards deviation. Skewness measures the degree of symmetry and direction whereas Kurtosis measures the peakedness.

(c) **Correlation:** It explains and measures the closeness of relationship between the variables.

(d) **Regression Analysis:** It reveals the average relationship between two variables and this makes estimation or prediction possible.

(e) **Time Series Analysis:** It consists of collection of data belonging to different time periods of some variables e.g. index of industrial production.

(f) **Index Numbers:** It is a relative figure expressed in percentage form which expresses the relationship between two figures, where one of the figure is used as a base.

(g) **Sampling and Statistical Inference:** Sample refers to a small part drawn from the universe. The process of selection of sample analysis is known as sampling. Sampling analysis can be performed using z-test, *t*-test, *f*-test and χ^2 (chi-square).

ADVANTAGES OF QUANTITATIVE APPROACH TO MANAGEMENT

The quantitative techniques are useful for decision-making since they possess the following advantages:

1. **Definiteness:** Facts conveyed numerically are more definite and convincing.
2. **Condensation:** It simplifies a large set of data using graphs etc., to present it meaningfully.
3. **Comparison:** It is easier to compare the figures of different time periods; industries etc., and hence draw meaningful conclusions.
4. **Formulation of policies:** It provides the basis for formulating proper policies for the future or various events.
5. **Formulating and testing hypothesis:** Using the various statistical tests we can test the various assumptions and even develop new theories.
6. **Prediction:** It helps in forecasting future trends.

QUANTITATIVE TECHNIQUES IN BUSINESS AND MANAGEMENT

Statistics and Management: Management consists of following areas i.e. marketing, production, finance, accounting, investment and personnel. Quantitative techniques are of immense help in formulating suitable policies. In case of marketing, the statistical analysis of consumer preferences helps in analyzing the market demand. Similarly, the technique of statistical quality control helps in maintaining quality standard without inspecting each and every item in case of production. Hence, we can see that statistical provides the manager with an effective tool to analyses and decide.

Statistics and Economics: Economics is concerned with the production and distribution of wealth as well as with the complex institutional set-up connected with consumption, saving and investment of income. Statistical data and statistical methods are of immense help in the proper understanding of the economic problems and in the formulation of economic policies e.g. measuring gross national product, analyzing population.

Statistics and Research & Development: Statistics in indispensable in research work. It helps in developing new products, efficient use of resources etc.

Statistics and Natural Science: It is useful in the study of natural science like astronomy, medicine, zoology etc. **For example:** study of plant life.

USE OF COMPUTERS

The computers have made it possible to undertake statistical studies that involve the compilation and analysis of large mass of data and several variables in few minutes.

SELF-ASSESSMENT QUESTIONS

Q. 1. Think of any major decision you made recently. Recall the steps taken by you to arrive at the final decision. Prepare a list of those steps.

Ans. The major decisions that I undertook recently was to buy my own flat. Before arriving at the final decision I understand the following steps:

1. Collected the required data: The collected data included:
(a) the flats available in the city.
(b) The per square feet rate charged by the builders across the city.
(c) The running rate of the properties in that locality.
(d) The earthquake zones.
(e) The owners credibility.
(f) Personal budget.

2. Organized and analyzed the data:
1. Compared and selected a few options and checked if they did not lie in the earthquake zone.
2. Chose the one that best fitted my personal needs and budget.

Q. 2. Comment on the following statements:
(a) **"Statistics are numerical statement of facts but all facts numerically stated are not statistics."**
(b) **"Statistics is the science of averages."**

Ans. *(a)* The following statement for example "income of A is Rs. 90,000 p.a." though a numerical statement of fact but cannot be constituted as statistics since it deals only with single person and hence cannot be compared. So, the numerical data must are called statistics. The characteristics are:
1. Aggregate of facts
2. Affected to a marked extent by multiplicity of causes.
3. Enumerated an estimated according to reasonable standards of accuracy.
4. Collected in a systematic manner for a pre-determined purpose.
5. Comparable.
6. Numerically expressed.

Ans. *(b)* This definition is not satisfactory since averages are only one of the devices used in statistical analysis. The other devices like dispersion, skewness, correlation, etc. are not at all covered by this definition.

Q. 3. What is the type of the following models?
(a) **Frequency curves in statistics.**
(b) **Motion films.**
(c) **Flow-chart in production control.**
(d) **Family of equations describing the structure of an atom.**

Ans. *(a)* Graphical model.
(b) Explanatory model.
(c) Schematic model.
(d) Mathematical model.

Q. 4. List at least applications of statistics in each functional area of management.