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QUANTITATIVE ANALYSIS FOR MANAGERIAL APPLICATIONS

By:

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Reference Book

Including

Solved Question Papers

New Edition

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QUANTITATIVE ANALYSIS FOR MANAGERIAL APPLICATIONS

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Sample Preview of the Solved Sample Question Papers

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QUESTION PAPER

(June – 2017)

(Solved)

QUANTITATIVE ANALYSIS FOR MANAGERIAL APPLICATIONS

Time: 3 Hours] *[Maximum Marks : 100*

(Weightage 70%)

Note: *(i) Section A has **six** questions. Attempt **any four** questions from this section.*

*(ii) Section **B** has **two** questions. Attempt **both** the questions from this section.*

SECTION-A

Q. 1. Define a matrix. Discuss some special matrices. Give examples of some business applications of matrices and determinants.

Ans. Ref.: See Chapter-4, Page No. 26-27, 'Matrices: Definition and Notations', 'Some Specical Matrices', Page No. 35, 'Applications of Matrices' and Page No. 30, 'Determinant of a Square Matrix'.

Q. 2. You are given the frequency distribution of 292 workers of a factory according to their average weekly income. Calculate Quartile deviation and its coefficient from the following data:

Weekly income (Rs.)	Below 1350	1350-1370	1370-1390	1390-1410	1410-1430	1430-1450	1450-1470	1470-1490	1490-1510	1510-1530	1530 and above
No of workers	8	16	39	58	60	40	22	15	15	9	10

Ans.

Weekly Income	No. of workers	Cf (Cumilative Frequency)
Below 1350	8	8
1350-1370	16	24
1370-1390	39	63
1390-1310	58	121
1410-1430	60	181
1430-1450	40	221
1470-1490	15	258
1490-1510	15	273
1510-1530	9	282
1530 if above	10	292

$$Q_1 = \frac{N}{4} \text{ observation size}$$

$$= \frac{292}{4} = 73\text{th}$$

Which comes in 1390–1410 interval

$$= L + \frac{N/4 - pcf}{f} \times i$$

$$= 1390 + \frac{(73-63)}{58} \times 20$$

$$= 1393.44$$

$$Q_3 = \frac{3N}{4} \text{th observation size}$$

$$= \frac{3 \times 292}{4} = 219$$

$$Q_3 = L + \frac{3N/4 - PCf}{f} \times i$$

$$= 1430 + \frac{219-181}{40} \times 20$$

$$= 1449$$

None

Quartile deviation (Q D)

$$\text{Coefficient} = \frac{Q_3 - Q_1}{Q_3 + Q_1} = \frac{1449 - 1392{\cdot}44}{2}$$

$$= 27.78$$

$$\text{Coefficient} = \frac{Q_3 - Q_1}{Q_3 + Q_1} = \frac{Q_3 - Q_1}{Q_3 + Q_1} = 0.02$$

Q. 3. Among the examinees in an examination 30%, 35% and 45% failed in Statistics, in Mathematics and in at least one of the subjects respectively. An examinee is selected at random. Find the probabilities that:

***(a)* He failed in Mathematics only**

***(b)* He passed in Statistics if it is known that he failed in Mathematics.**

Ans. P (Failed in Maths) = P(m) = 0.35

P(Failed in stalistics) = P (S) = 0.30

P (Failed in atleast one of the subjects)

$$= P(M \cup S) = 0.45$$

$$P(MUS) = P(M) + P(S) - P(M \cap S)$$

$$= 0.45 = 0.30 + 0.35 - P(M \cap S)$$

$$= P(M \cap S) = 0.20$$

P (Failed in Maths only) = P (Failed in maths) – P (Failed in atleast one of statistics)

= 0.30 – 0.20

= 0.10

P (Passed in statistics given that he failed in Amination $= \frac{P(M \cap S)}{P(M)} = \frac{0.2}{0.3} = \frac{2}{3}$.

Q. 4. The mean length of life of a certain cutting tool is 41.5 hours with a standard deviation of 2.5 hours. What is the probability that a simple random sample of size 50 drawn from this population will have a mean between 40.5 hours and 42 hours?

(Given : P(0 ≤ z ≤ 1.414) = 0.4251; P (0 ≤ z ≤ 2.828) = 0.4980

Ans.

Mean Length of life = 41·5 hours

σ = 2·5 hours

n = 50

It is necessary to find the probability that mean length of life ($\bar{n}$) should be in between

P (40·5 ≤ $\bar{n}$ ≤ 42)

$u_{\bar{z}} = u$ =41·5

$$\sigma_{\bar{x}} = \frac{6}{\sqrt{n}} = \frac{2{\cdot}5}{\sqrt{50}} = \frac{2{\cdot}5}{7{\cdot}0711} = 0{\cdot}3536$$

We can apply central limit theorm, hence normal distribution can be used.

$$P(40{\cdot}5 \le \bar{n} \le 42) = P\left[\frac{\bar{n}_1 - u}{\sigma\bar{n}} \le z \le \frac{\bar{n}_2 - u}{\sigma\bar{n}}\right]$$

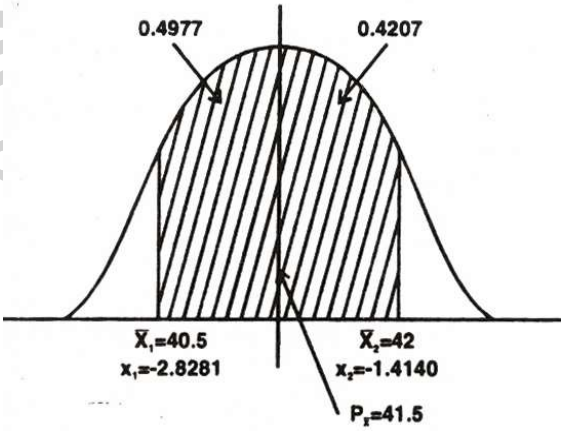
$$= P\left[\frac{40{\cdot}5 - 41{\cdot}5}{0{\cdot}3536} \le z \le \frac{42 - 41{\cdot}5}{0{\cdot}3536}\right]$$

$$= P[-2{\cdot}8281 \le z \le 1{\cdot}4140]$$

$$= P[-z \ge -2{\cdot}8281] + P[z \le 1{\cdot}4140]$$

$$= 0{\cdot}4977 + 0{\cdot}4207 = 0{\cdot}9184$$

$$P(40{\cdot}5 \le \bar{n} \le 42) = 0{\cdot}9184$$



Q. 5. A leading company engaged in the production of detergents had vacancies of salesman for which (N =) 15 persons were called for personal interview. The interview board consisted of sales manager and a psychologist. The ranks given by the two to all the 15 candidates who attended the interveiw. Using the two set of ranks, compute the coefficient of rank correlation.

Sample Preview of The Chapter

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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.