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M.C.O.-22

Quantitative Analysis for Managerial Applications

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By: *Prieti Gupta*

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Mob.: 8510009872, 8510009878 E-mail: info@neerajbooks.com
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Sample Preview of the Solved Sample Question Papers

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QUESTION PAPER

June – 2024

(Solved)

QUANTITATIVE ANALYSIS FOR MANAGERIAL APPLICATIONS

M.C.O.- 22

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

Note: *Attempt any five questions. All questions carry equal marks.*

Q. 1. Discuss the applications of quantitative techniques in various functional areas of management. Elucidate your answer with the help of a suitable example.

Ans. Quantitative techniques are those statistical and programming techniques: which support the decision making process especially related to industry and business. QT takes into consideration the elements of qualities such as use of numbers, symbols and other mathematical expressions. QT is basically helpful enhancement to judgment and intuition. Quantitative techniques assess planning factors and alternatives as and when they arise rather than suggest courses of action. There are two types of quantitative methods for management: mathematical techniques and statistical techniques.

Mathematical Techniques: Mathematical quantitative techniques are based on quantitative data. There are many tools available, such as algebra, permutations and combinations, set theory and others, using principles of mathematics. These include a wide range of tools such as algebra, differentiation and differential equations. Most of these mathematical techniques result in decision models that are deterministic in nature.

Statistical Techniques: This is one of the commonly used quantitative approaches to management. Statistical inquiry drives it and it may also include the use of many statistical tools for analyzing data. This can result in better decision-making. Because decision-making is based on the availability of information, correct and timely information must be obtained through well-documented data. In most cases, data may be readily available from secondary sources. However, in some situations, managers may have to generate fresh data from primary sources. This entails carrying out surveys and using methods such as data collection and data analysis. Most of the models developed using statistical techniques include probabilistic models of decision-making.

In any business, the ability to make the right decisions is crucial for remaining competitive. Whether you're launching a new product, hiring people or looking at funding resources, you must make the best decisions based on practical evaluations. Quantitative approaches to management can help in the decision-making process. Many times, you may have to make these decisions without access to requisite data and other resources. This can make decision-making quite challenging. You must have a logical approach that's detached from the intuition and experience of the decision-makers. Here, quantitative methods for management come to the fore. Quantitative techniques in management provide managers with various tools from mathematics, economics, statistics and operational research. Managers can use these tools to get a more accurate view of a problem and find the perfect solution. For example, inventory management involves planning and controlling the inventory of a business. A large and idling inventory can cut into profits. A shortage of inventory can also affect profitability, resulting in loss of sales opportunities. Quantitative techniques can maintain a balance between the right and excess inventory. You'll get a clear picture of how much and when to buy.

Q. 2. What do you understand by the term 'Probability theory'? Explain different approaches to Probability theory.

Ans. Ref.: See Chapter-5, Page No. 64, 'Basic Concepts: Experiment, Sample space, Event' and Page No. 65, 'Different Approaches to Probability Theory'.

Q. 3. What is a Chi-square distribution? How would you use it in testing the goodness of fit and testing independence of categorized data?

Ans. Ref.: See Chapter-12, Page No. 148, 'Introduction', Page No. 151, 'Testing the Goodness of Fit', Page No. 153, 'Testing Independence of Categorised Data'.

Q. 4. Bring out the points of similarities and differences between stratified sampling and cluster sampling. Which one is preferred in what circumstances?

Ans. Ref.: See Chapter-9, Page No. 105, 'Stratified Sampling', Page No. 107, 'Cluster Sampling', Page No. 113, Q. No. 5.

Q. 5. What do you understand by decision theory? What are the key issues in decision theory? Explain decision tree approach for managerial applications.

Ans. Ref.: See Chapter-8, Page No. 95, 'Introduction, Certain key issues in Decision Theory and Page No. 96, Decision Tree Approach'.

Q. 6. Find out Spearman's rank coefficient of correlation with the help of the following data:

X	Y
48	13
33	13
40	22
9	6
16	14
65	20
26	9
15	6
57	15

Ans. Given Data:

X:	48	33	40	9	16	65	26	15	57
Y:	13	13	22	6	14	20	9	6	15

Step 1: Rank the values in X and Y.

We first assign ranks to the values in both X and Y. The rank for the smallest value is 1, the second smallest is 2, and so on. If two or more values are the same, assign the average rank to those values.

Rank X:

X:	48	33	40	9	16	65	26	15	57
Sorted X:	9	15	16	26	33	40	48	57	65
Ranks for X:	4	6	7	1	2	9	3	2.5	8

Rank X:

Y:	13	13	22	6	14	20	9	6	15
Sorted Y:	6	6	9	13	13	14	15	20	22
Ranks for Y:	2	2	4	1	3	5	6	1	7

Step 2: Calculate the difference in ranks (D)

Now, subtract the ranks of Y from the ranks of X for each corresponding data point:

X	Y	Rank Y	Rank	D (Rank X - Rank Y)	D^2
48	13	7	4.5	2.5	6.25
33	13	6	4.5	1.5	2.25
40	22	8	7	1	1
9	6	1	1	0	0
16	14	2	3	-1	1
65	20	9	6	3	9
26	9	3	2	1	1
15	6	2	1	1	1
57	15	8	5	3	9

Step 3: Compute the sum of D^2

Sum of $D^2 = 6.25 + 2.25 + 1 + 0 + 1 + 9 + 1 + 1 + 9 = 30.5$

Step 4: Use the Spearman's rank correlation coefficient formula

$$\rho = 1 - \frac{6\sum D^2}{n(n^2-1)}$$

Where:

(ΣD^2) is the sum of squared rank differences (30.5),

(n) is the number of pairs (9 in this case).

$$\rho = 1 - \frac{6 \times 30.5}{9(9^2-1)} = 1 - \frac{183}{9 \times 80} = 1 - \frac{183}{720}$$

$$= 1 - 0.2542 = 0.7458$$

Step 5: Final Spearman's rank coefficient

The calculated Spearman's rank correlation coefficient is approximately 0.746.

Q. 7. The mean square deviation of set of n observations $x_1, x_2, \ldots\ldots, x_n$ about a point C is defined as:

$$\frac{1}{n}\sum_{i=1}^{n}(X_i - C)^2$$

The mean square deviation about –2 and 2 are 18 and 10 respectively, then calculate standard deviation of this set of observations.

Ans. We are given the mean square deviations about two points, –2 and 2, and we need to calculate the standard deviation of the set of observations. Let's break it down step by step.

Sample Preview of The Chapter

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QUANTITATIVE ANALYSIS FOR MANAGERIAL APPLICATIONS

BLOCK-1 : DATA COLLECTION AND ANALYSIS

Collection of Data

1

INTRODUCTION

A business decision is based upon the data available with a company. The quantitative representation of the facts is referred to as data. The entire structure of statistical analysis is based upon the on a systematic collection of data. Collection of data is the first step in any kind of statistical investigation. Success of decision depends on the accurateness of the data collected. Thus the process of measurement combined with systematic recording of the results can be referred to as the collection of data.

CHAPTER AT A GLANCE

PRIMARY AND SECONDARY DATA

Data can be classified as primary and secondary data. Primary data refers to the data which an investigator or an agency collects for the first time, for any statistical analysis. Secondary data on the other hand, refers to the data that has already been collected by some agency and is being used by another agency for their statistical work.

Following example will make the distinction between the two types of data more clear. Suppose a company wants to figure out the consumer's preference for different brands in a particular area. If company A collects data themselves to draw conclusions, the data is referred to as primary data. If company B uses the data collected by company A, the data by company B will be referred to as secondary data.

METHOD OF COLLECTING PRIMARY DATA

There are two methods of collecting primary data:

1. Observation Method

The investigator asks no questions in this process. He just observes situation and notes down the necessary observations. Observations can be taken by an individual both manually as well as with the help of mechanical and electronic devices.

Demerit: The data collected under this process is not always accurate. Any misinterpretation of facts by the observer can result in inaccuracy of the data. An inaccurate data may mislead the business organization and thus resulting in faulty decision-making.

2. Questionnaire Method

To overcome the limitation of the observation method, questionnaire method was introduced. Under this, the investigator prepares a list of questions necessary for extracting the desired conclusion and records the responses. The various methods of conducting this are:

(a) **Personal Interview:** The investigator personally collects data by going to the field. He personally approaches the informants and records their responses during a face to face interview. This method should be used only if the investigation is confined to a particular location, area or region. The data collected under this method is original and accurate.
Demerit: The process is time consuming since the informants can only be approached as per their convenience and sometimes research demands a wider coverage.

(b) **Mail Questionnaire:** A questionnaire is mailed to the informants with a request of furnishing correct answers to the questions for backing the survey that is being conducted. It seeks full cooperation from the respondents and expects them to return the questionnaire duly filled in the specified time period. This method is economical as well as less time consuming but one of the serious drawbacks of this method is that it can only be used when the people to be questioned are literate, can understand the questions and reply accordingly.

(c) **Telephone:** Under this method, the investigator asks relevant questions over the

telephone from the informants. This method is less expensive but the major draw back is that information could be collected only from the people possessing a phone. This limitation actually limits our scope.

Thus, we see that the questionnaire method provides more accuracy in data collection and is efficient. The only serious limitation of this method is that it is difficult to collect data about certain things like income and various other personal details, which individuals are not always willing to share. Errors can also occur due to the inability to construe the data correctly.

DESIGNING OF QUESTIONNAIRE

A questionnaire must be designed with utmost care as it is the only medium of communication between the investigator and the informant. It should be able to extract all the necessary information required without any difficulty and ambiguity. The following things must be kept in mind while framing a questionnaire:

1. Covering Letter: This should briefly define the objectives and the scope of the survey to evoke interest among the informants and thus extract the data needed for the survey. Surety of confidentiality must be provided to the participants. To ensure a quick response, the respondents could be offered free gifts and some other incentive.

2. Number of questions should be kept to a minimum: Number of questions should be kept to minimum, keeping in view the nature, scope and enquiry. Only the most important and relevant questions should be used in the questionnaire to avoid any wastage of respondents' time and becoming a cause of annoyance. Ideally a questionnaire should not consist of more than 25 questions. If the number of questions needed to be answered is more than 25, then the questionnaire should be divided into different sections or parts.

3. Questions should be simple, short and unambiguous: The questions should be such that it is easily comprehendible by the respondents. It should not create any confusion. Example, questions like 'Are you literate?' can carry different meanings for different people. To some people, literacy may mean the ability to read and write while for some it may be an university degree or anything higher and lower than that. Instead of such ambiguous questions, it is better to give different choices like: *(a)* High school *(b)* graduation, etc. Open ended questions like 'how should the education system in India be revamped?' can carry varied answers and hence it could be difficult to tabulate such diversified opinions.

4. Questions of sensitive or personal nature should be avoided: Questions like 'how much do you owe to your creditors?' or 'what is your income?' etc., should be avoided. Such questions are generally confidential and the respondents may not be willing to share such information. If the survey demands these questions necessarily, the respondents must be given complete assurance that their responses will be completely confidential and will not in any way be used to their disadvantage.

5. Answer should not require calculations: Questions requiring a lot of calculations should be avoided as such questions may prove to be a burden for the informants. People generally avoid such questionnaires since it is time consuming and requires a lot of mind work.

6. Logical arrangement: The questions should be arranged in a logical order, e.g. 'do you own a vehicle?' 'When did you buy it?' 'How much did it cost to you?' 'Is its performance satisfactory?' A logical order leaves no chance of duplication and error. This also facilitates in data tabulation. Crucial questions should be placed in the beginning and light questions at the end so that the respondent frames a positive impression.

7. Cross-check and Footnotes: The questions need to be designed in such a way that there are internal checks on the accuracy of the information supplied by the respondents. This can be done by including some connected questions which are fundamental to the enquiry. e.g. to find out the 'Age at the time of marriage?' the question may be supplemented by 'What is the age of your first child?' and the like.

For clarity, the questions can include footnotes. In questions like monthly expenditure, if the options are continuous in nature i.e. 1000-2000, 2000-3000, etc. the person might get confused if his income is exactly 2000. In such cases footnotes can be of major help if it answers the question.

PRE-TESTING THE QUESTIONNAIRE

After the questionnaire has been designed, it needs to be pre-tested on a smaller scale before applying it to the main survey. The pre-testing of a questionnaire is known as pilot survey. This method is extremely useful in reality as it helps in locating loopholes and thus improving the questionnaire before applying for the main survey. Proper testing ensures reliability of the data collected and thus success of the survey.

EDITING PRIMARY DATA

Secondary data must be used only after editing the primary data for the success of a survey. The data collected must be edited to ensure completeness, consistency, accuracy and homogeneity.

1. Completeness: Each questionnaire should be duly filled by the informants ensuring completeness of the data. If any of the important questions remain left unanswered by the respondent, attempts should be made to contact the respondent and get the answer.

Completeness of the data is one of the pre-requisites of successful data collection and thus the survey.

2. Consistency: The questionnaire should be checked for any kind of discrepancy in terms of different questions. Here the questions placed for internal checks are of great help. Contradictory responses may arise if can be wrong information is supplied by the respondent. For example, if there are two questions such as 'Do you own a vehicle?' 'What was the price of the vehicle bought?' and if the person answers 'no' to the first and some figure to the second, then this must be clarified from the informant because the answers are contradictory in nature.

3. Accuracy: The data must be cross checked until the investigator is satisfied with reliability of the data available at hand. The more accurate the data is the more helpful would it be to extract the required conclusions and ensure success of the survey. Inaccurate data lead to wrong conclusions and thus to wrong decisions. This is one of the most difficult tasks since it is difficult to cross check and ensure the reliability of the data.

4. Homogeneity: The information supplied by all the informants must be homogeneous i.e. same in terms of units. If income of informants is being asked, the answers must be same in terms of the time period for which the information is being supplied i.e. yearly, quarterly, monthly, etc. Same units facilitate comparisons and can be helpful in deriving required conclusion.

SOURCES OF SECONDARY DATA

The sources of secondary data are broadly divided into published and unpublished sources.

Published Sources: Various national and international organizations gather statistical data and publish their findings in statistical reports periodically. Central Statistical Organization (CSO); National Sample Survey Organization (NSSO); Office of the Registrar General and Census Commissioner of India; Federation of Indian Chambers of Commerce and Industry; Indian Council of Agricultural Research (ICAR), etc. are some of the national organizations which collect, compile and publish statistical data. While international organisations such as United Nations Organization (UNO); World Health Organization (WHO); International Labour Organization (ILO); International Monetary Fund (IMF); World Bank, etc. also provide valuable statistical data.

Unpublished Sources: Unpublished data refers to any information source that is not officially released by an individual, publishing house, business organizations or other company, and can include both paper and electronic sources. Some examples of unpublished sources may include manuscripts accepted for publication but still "in-press," data from an unpublished study, letters, manuscripts in preparation, memos, personal communications, etc.

PRECAUTIONS IN THE USE OF SECONDARY DATA

Before using secondary data, the investigators must re-check the data. The investigator should proceed only when He is satisfied with it in terms of reliability, accuracy, adequacy and suitability.

1. **Suitability:** The suitability of the data can be checked by comparing the objectives, nature and scope of the given enquiry under investigation with the original investigation. The units in the secondary source must be same to the enquiry at hand. For example, if we want to find the cost of living indices, it must be ensured that the original data relating to price is collected from retail shops, cooperative stores, super bazaars and not from wholesale market.
2. **Reliability:** The reliability of the data can be assessed by checking integrity and experience of the collecting organization and the method used for collecting and analysing the data. It should be ensured that the collecting organization is unbiased, the data is thoroughly scrutinized and edited, data is collected during normal times free from both periods of economic boom and depression or natural calamities.
3. **Adequacy:** The amount of information contained in the survey may not be adequate for purpose of a certain given enquiry, e.g. if the data at hand is related to the consumption pattern of a particular state and we require data for an entire country then data at hand would be considered as inadequate.

CENSUS AND SAMPLE

If secondary data is not available then the investigator may conduct a research and collect the primary data. The primary data can be collected either by census method or sampling method.

1. Census Method: Census method is also referred to as complete enumeration survey since it takes into account the details of each and every item in the population. In short, it takes the entire population into consideration.

Merit: The information about each item is available and is comparatively more accurate.

Demerit: It is a time consuming and an expensive method.

2. Sample Method: Under this method, only a sample is taken into consideration. Research is conducted by studying the samples at hand, which is representative of the population.

Merit: This is less time consuming and is widely used.

Demerit: Not very accurate.

ACTIVITIES

Q. 1. Explain clearly the observation and questionnaire methods of collecting primary data. Highlight their merits and limitations.

Ans. Observation Method: The observation method is the most commonly used method especially in studies relating to behavioral sciences. In a way, we all observe things around us, but our observation is not always scientific in nature. Observation becomes a scientific tool and the method of data collection for the researcher, when it serves a formulated research purpose, is systematically planned and recorded which is subjected to various checks and controls for its validity and reliability. Under the observation method, information is sought by investigator's own ways of direct observation without asking the respondent. For instance, in a study related to consumer behavior, the investigator instead of asking the brand of watch used by the respondent, may himself look at the watch.

Merits

1. The main advantage of this method is that subjective bias is eliminated, if observation is done accurately.
2. The information obtained under this method relates to what is currently happening i.e. it is not complicated by either the past behaviour or future intentions as well as attitudes.
3. This method is independent of respondents' willingness to respond and is relatively less demanding in terms of active cooperation on the part of respondents as happens to be the case in the interview and the questionnaire method.
4. This method is particularly suitable in studies which deal with subjects (i.e., respondents) who are not capable of giving verbal reports of their feelings for one reason or the other.

Limitations

1. It is an expensive method.
2. The information provided by this method is very limited.
3. Sometimes unforeseen factors may interfere with the observational task.
4. Some people are rarely accessible to direct observation thus creates obstacle for this method to collect data effectively.
5. The researcher should keep in mind things like: What should be observed? How should the observations be recorded? Or how the accuracy of observation could be ensured?, otherwise observation may give biased results.

Questionnaire Method: In this method, a questionnaire is sent (usually by post) to the people concerned with a request to answer the questions and return the questionnaire. A questionnaire consists of a number of questions printed or typed in a definite order on a form or set of forms. A questionnaire is mailed to respondents who are expected to read and understand the questions and write down in the space meant for the purpose in the questionnaire itself. The respondents need to answer the questions on their own. The method of collecting data by mailing the questionnaires to respondents is most extensively employed in various economic and business surveys.

Merits

1. This is a low cost method, even if the universe is large and is widely spread geographically.
2. It is free from any kind of bias on the part of the interviewer; answers are in respondents' own words.
3. Respondents have adequate time to give well thought answers.
4. Respondents who are not easily approachable can also be reached conveniently.
5. Large samples could be made use of and thus results can be made more dependable and reliable.

Limitations

1. Low rate of return of the duly filled in questionnaires; bias due to no-response is often indeterminate.
2. It can be used only when respondents are educated and cooperating.
3. The control over the questionnaire may be lost once it is sent.
4. There is an inbuilt inflexibility because of the difficulty in amending the approach once questionnaires are despatched.
5. There is also a possibility of ambiguous replies or omission of replies altogether to certain questions; interpretation of omissions is difficult.
6. It is difficult to know whether willing respondents are truly representative.
7. This method is likely to be the slowest of all.

Q. 2. Describe the personal interviews and mail questionnaire method of data collection.

Ans. Personal Interviews: A personal or face to face interview is one that employs a standard structured questionnaire (or interview schedule) to ensure that all respondents are asked the same set of questions in a same sequence. It is a two-way conversation initiated by an interviewer to obtain information from a respondent.

Advantages

- Collect complete information with greater understanding.