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Quantitative Analysis for Managerial Applications

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QUANTITATIVE ANALYSIS FOR MANAGERIAL APPLICATIONS

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QUESTION PAPER

June – 2024

(Solved)

QUANTITATIVE ANALYSIS FOR MANAGERIAL APPLICATIONS

$\boxed{\text{M.M.P.C.-5}}$

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

Note: *Section A has six questions. Attempt any four questions. Section B is compulsory. Attempt both the questions. Use of calculator is permissible.*

SECTION-A

Q. 1. "Primary data may either be collected through the observation method or through the questionanaire method." Explain, in view of statement, any one method in brief.

Ans. Ref.: See Chapter-1, Page No. 1, 'Methods of Collecting Primary Data'.

Q. 2. Seven methods of imparting business education were marked by the MBA students of two universities as follows:

Method of Teaching	I	II	III	IV	V	VI	VII
Rank by Students of University A	2	1	5	3	4	7	6
Rank of Students of University B	1	3	2	4	7	5	6

Ans.

Teaching Methods	R_A	R_B	$D=R_A-R_B$	D^2
I	2	1	1	1
II	1	3	–2	4
III	5	2	3	9
IV	3	4	–1	1
V	4	7	–3	9
VI	7	5	2	4
VII	6	6	0	0
				$\Sigma D^2 = 28$

$$N = 7$$

$$r_k = 1 - \frac{6\Sigma D^2}{N^3 - N}$$

$$= 1 - \frac{6 \times 28}{343 - 7}$$

$$= \frac{336 - 168}{336}$$

$$= 0.5$$

Hence, $r_k = 0.5$

Q. 3. The distribution of the total time a light bulb will burn from the moment it is first put into service is known to be exponential with mean time between failure of the bulbs equal to 1000 hours. What is the probability that a bulb will burn more than 1000 hours?

(The value of $e^{-1} = 0.368$).

Ans.

Here, $m = \dfrac{1}{1000}$

and $f(t) = \begin{cases} \dfrac{1}{1000} \ e^{-t/100} & \text{for } t \geq 0 \\ 0 & \text{otherwise} \end{cases}$

We are interested in finding the probability that $t > 1000$ hrs.

$$P (t > 1000) = 1 - p(t \leq 1000) = 1 - F (1000)$$

$$F(1000) = 1 - e^{-1000 \times 1/1000} = 1 - e^{-1}$$

∴ The required probability $= e^{-1} = 0.368$.

Q. 4. Explain why forecasting is so important in business. Identify the applications of forecasting for medium and short-term decisions.

Ans. Ref.: See Chapter-13, Page No. 169, Q. No. 1.

Q. 4. Explain the concept of sampling distribution. Also, state why do we need to study sampling distributions.

Ans. Ref.: See Chapter-10, Page No. 117, 'Introduction'.

QUESTION PAPER

December – 2023

(Solved)

QUANTITATIVE ANALYSIS FOR MANAGERIAL APPLICATIONS

M.M.P.C.-5

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

Note: There are total **7** questions. Answer any **five questions**. All question are of equal marks. Calculators are allowed.

Q. 1. What do you understand by sampling? What are the various reasons that make sampling so attractive in drawing conclusions about the population?

Ans. Ref.: See Chapter-9, Page No. 103, 'Introduction', 'Why Sampling', Page No. 109, Q. No. 1.

Q. 2. Calculate the median from the following data:

Age	No. of Persons
55-60	7
50-55	13
45-50	15
40-45	20
35-40	30
30-35	33
25-30	28
20-25	14

Ans.

Age	No. of Persons	Cumulative Frequency (c.f.)
55-60	7	150
50-55	13	143
45-50	15	130
40-45	20	120
35-40	30	105
30-35	33	75
25-30	28	42 (c.f.)
20-25	14	14

Note: Please write 'person' in place of 'students'.

Median class is given by the size of $\left(\dfrac{N}{2}\right)^{th}$ item,

i.e. $\left(\dfrac{150}{2}\right)^{th}$ item, which is 75th item. This correspounds to the class interval of $(30-35)$, so this is the median class.

$$\text{Median} = l_1 + \frac{\dfrac{N}{2} - c.f.}{f} \times i$$

so, $$\text{Median} = l_1 + \frac{\dfrac{150}{2} - c.f.}{f} \times i$$

or, $$\text{Median} = 30 + \frac{75 - 42}{33} \times 5$$

or, $$\text{Median} = 30 + \frac{33}{33} \times 5$$

Thus, Median = 35

Q. 3. Past experience says that average life of a bulb (assumed to be continuous random variable following exponential distribution) is 110 hours, calculate the probability that the bulb will work for atmost 25 hours. (Given that $\rightarrow e^{-0.23} = 0.7945$).

Ans. Given the average life the bulb is 110 hours, the parameter λ of the exponential distribution is the reciprocal of the mean life, i.e., $\lambda = \dfrac{1}{110}$. The probability that the bulb will work for at most 25 hours is given by $P(X \le 25)$, where X follows an exponential distribution with parameter λ. The CDF of an exponential distriction is $P(X \le x) = 1 - e^{-\lambda x}$. Substituting $\lambda = \dfrac{1}{110}$ and $x = 25$, we get:

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.