20 SAMPLING THEORY

LEARNING OBJECTIVES

After studying this chapter, you will be able to:

- Different procedure of sampling which will be the best representative of the population;
- The concept of sampling distribution; and
- The techniques of construction and interpretation of confidence interval estimates as well as sample size with defined degree of precision.

POPULATION:

Whole of the information which comes from statistical investigation is called population.

SAMPLE:

Selected portion from the population is called sample.

FINITE & INFINITE POPULATION:

A population may be finite or infinite according as the number of individuals in it are finite or infinite. The population of weights of students of Class XII in a Government school is an example of a finite population. The population of pressures at different points in the atmosphere is an example of an infinite population.

PARAMETER:

Any statistical measurement (mean, median, mode, S.D., variance etc.) which comes from sample data is called statistic.

Notations		
Statistical Measure	**Population**	**Sample**
Mean	μ	$\bar{X}$
Standard Deviation	σ	S
Proportion	P	p
Size	N	n

SAMPLING:

The process of selecting sample from the population is called sampling. Sampling theory based on two method.

1. Test of estimation or theory of estimation
2. Test of significance or hypothesis testing

Estimation: If the population date is defined by the sample data, then it is known as an Estimation

There are two types of estimation: **point estimation** and **interval estimation**.

Point Estimation:

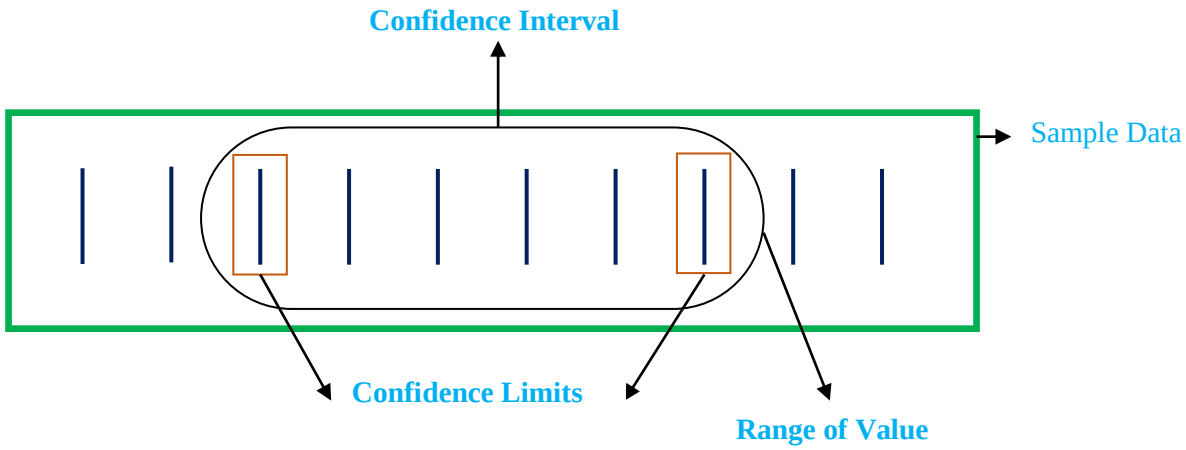
A single statistic is used to provide an estimate of the population parameter is called point estimation.

Interval Estimation:

An interval estimation is the range of values which is used for making estimation of a population parameter.

CONFIDENCE LIMITS:

In the interval estimation, the estimate for the parameter lies between two limits. The two limits within which the estimate for the parameter lies are known as confidence limits and the interval bounded by these two limits as confidence interval.



* Confidence interval based on confidence level.

Confidence Level	Confidence (Coeff.)
(1- α)%	(Z_{α})
90%	1.64
95%	1.96
98%	2.33
99%	2.58
Without any reference to the confidence level	3

n > 30	Large Samples	Z-test
n < 30	Small Samples	t-test

Z – test

Confidence interval estimation for a mean:

$$[\{\bar{X} - SE\ (\bar{X}).Z_{\propto}\};\{\bar{X}\ + S.E(\bar{X}).Z_{\propto}\}]$$

Where, $S.E(\bar{X}) = \frac{\sigma}{\sqrt{n}}$

$S.E(\bar{X}) = \frac{S}{\sqrt{n-1}}$

$$S.E(\bar{X}) = \frac{S}{\sqrt{n-1}}\sqrt{\frac{N-n}{N-1}}$$

* The factor $\sqrt{\frac{N-n}{N-1}}$ is known as finite population correction or finite population multiplier.

CONFIDENCE INTERVAL ESTIMATION OF THE PROPORTION:

Population Proportion:

The population proportion P is the ratio of the number of elements possessing the characteristics to the total number of elements in the population, i.e.,

$$P = \frac{Number\ of\ elements\ possessing\ the\ characteristics}{Total\ number\ of\ elements\ in\ the\ populaiton}$$

Sample Proportion:

The sample proportion p is the ratio of the number of elements possessing a characteristics to the total number of elements 'n' in the sample

$$p = \frac{Number\ of\ elements\ possessing\ the\ characteristics}{Total\ number\ of\ elements\ in\ the\ sample}$$

$$Limits\ \rightarrow\ [\{p - SE(p)Z_{\propto}\};\{p + SE(p)Z_{\propto}\}]$$

Where, $SE(p) = \sqrt{\frac{PQ}{n}}$ $\qquad$ P + Q = 1 ⇒ Q = 1 – P

$$SE(p) = \sqrt{\frac{pq}{n}} \qquad p + q = 1 \Rightarrow q = 1 - p$$

$$SE(p) = \sqrt{\frac{PQ}{n}}\sqrt{\frac{N-n}{N-1}}$$

$$SE(p) = \sqrt{\frac{pq}{n}}\sqrt{\frac{N-n}{N-1}}$$

T – test

Confidence interval estimation of a mean:

$$[\{\bar{X} - SE\ (\bar{X}).t_{\propto}\};\{\bar{X}\ + S.E(\bar{X}).t_{\propto}\}]$$

Where, $SE(\bar{X}) = \frac{S}{\sqrt{n-1}}$ $\qquad \boxed{S = \sqrt{\frac{\sum(X-\bar{X})^2}{n}}}$

Properties of t distribution:

* t-distribution is asymptotic to x-axis, i.e., it extends to infinity on either side
* the shape of the curve or from of t-distribution varies with the degree of freedom. The degree of freedom is defined as (size of samples – 1).
* t-distribution is a symmetrical distribution with mean zero.
* Sampling distribution of t does not depend on population parameter but it depends only on (the degree of freedom) = n – 1 i.e., on the sample size.

Sample Size:

(i) Size of sample (n) = $\left(\frac{\sigma Z_{\propto}}{E}\right)^2$

(ii) Size of sample (n) = $\left[PQ\left(\frac{Z_{\propto}}{E}\right)^2\right]$

Where, σ – Standard deviation of population
P – Population proportion
Q – 1 – P
E – Average, True average, Errors or (P – p)

Standard Errors (SE):

$$\boldsymbol{SRSWR} - Simple\ random\ sample\ with\ replacement$$
$$\boldsymbol{SRSWOR} - Simple\ random\ sample\ without\ replacement$$

* $SE(\bar{X}) = \frac{\sigma}{\sqrt{n}}$ (WR)

* $SE(\bar{X}) = \frac{\sigma}{\sqrt{n}}\sqrt{\frac{N-n}{N-1}}$ (WOR) If sample SD is known

* $SE(\bar{X}) = \frac{S}{\sqrt{n-1}}$ (WR)

* $SE(\bar{X}) = \frac{S}{\sqrt{n-1}}\sqrt{\frac{N-n}{N-1}}$ (WOR) If sample SD is known

* $SE(p) = \sqrt{\frac{pq}{n}}$ (WR)

* $SE(p) = \sqrt{\frac{pq}{n}}\sqrt{\frac{N-n}{N-1}}$ (WOR) If sample proportion is known

SAMPLING DISTRIBUTION:

Starting with a population of N units, we can draw many a sample of a fixed size n. if case of sampling with replacement, the total number of samples that can be drawn is N^n and when it comes to sampling without replacement of the sampling units, the total number of samples that can be drawn is ${}^{N}C_{n}$.

The criterion for an ideal estimator are:

(a) Unbiased ness and minimum variance
(b) Consistency and efficiency
(c) Sufficiency

(a) A statistic T is known to be an biased estimator of θ if the expectation of T is θ. Thus T is unbiased of θ if

E(T) = θ …….(15.11)

If (15.11) does not hold then T is known to be a biased estimator of θ. The bias is known to be positive if E(T) - θ > 0 and negative if E(T) - θ < 0.

A statistic T is known to be a minimum variable unbiased estimator (MVUE) of θ if (i) T is unbiased for θ and (ii) T has the minimum variance among all the unbiased estimators of θ.

For a parameter θ, there exists a good number of unbiased statistics and that is why unbiasedness is considered along with minimum variance. The sample mean is an MVUE for population mean. The sample standard deviation

$$S = \sqrt{\frac{\sum(X_1 - \bar{X})^2}{n}}$$

is a biased estimator of the population standard deviation σ. However, a straight adjustment can produce an unbiased estimator of σ. Instead of S is we consider

$$S = \sqrt{\frac{\sum(X_1 - \bar{X})^2}{n-1}}$$

i.e the sample standard deviation with divisor as (n – 1), then we get an unbiased estimator of σ. The sample proportion p is an MVUE for the population proportion p.

(b) Consistency and Efficiency

A statistic T is known to be consistent estimator of the parameter θ if the difference between T and θ can be made smaller and smaller by taking the sample size n larger and larger. Mathematically, T is consistent for θ if.

$E(T) \rightarrow \theta$

and $V(T) \rightarrow \theta$ as $n \rightarrow \infty$

The sample mean, sample SD and sample proportion are all consistent estimators for the corresponding population parameters.

A statistic T is known to be an efficient estimator of θ if T has the minimum standard error among all the estimators of θ when the sample size is kept fixed. Like unibis/ased estimator, more than one consistent estimators exists for θ. To

choose the best among them, we consider that estimator which is both consistent and efficient. The sample mean is both consistent and efficient estimator for the population mean.

METHODS OF SAMPLING

A sample can be selected from a population in various ways. Different situations call for different methods of sampling. There are two methods of sampling:

1. Random Sampling of Probability Sampling Method
2. Non-Random Sampling or Non-Probability Sampling Method.

Random or Probability Sampling:

Random of Probability sampling is the scientific technique of drawing samples from the population according to some laws of chance in which each unit in the universe or population has some definite pre-assigned probability of being selected in the sample. It is of two types:

(a) **Simple Random Sampling:**
It is the method of selection of a sample in such a way that each and every member of population or universe has an equal chance or probability of being included in the sample. Random sampling can be carried out in two ways:

(i) Lottery Method: It is the simplest, most common and important method of obtaining a random sample. Under this method all the members of the population or universe are serially numbered on small slips of a paper. They are put in a drum and thoroughly mixed by vibrating the drum. After mixing, the numbered slips are drawn out of the drum one by one according to the size of the sample. The number of slips so drawn constitute a random sample.

(ii) Random Number Method: In this method, sampling is conducted on the basis of random numbers which are available from the random number tables. The various random number tables available are

(a) Tippet's Random Number series;
(b) Fisher's and Yales Random Number series;
(c) Kendall and Badington Random Number series;
(d) Rand Corporation Random Number series;

One major disadvantage of random sampling is that all the members of the population must be known and be serially numbered. It will entail a lot of

difficulties in case the population is of large size and will be impossible in case the population is of infinite size.

(b) Restricted Random Sampling:

It is three types:
(i) Stratified Sampling
(ii) Systematic Sampling
(iii) Multi-Stage Sampling

***Stratified Sampling*:** In stratified random sampling, the population is divided into strata (groups) before the sample is drawn. Strata are so designed that they do not overlap. Elementary units from each stratum is drawn at random and the units so drawn constitute a sample. Stratified sampling is suitable in those cases where the population is hetrogeneous but there is a homogeneity within each of the group or strata.

Advantages
(i) It is a representative sample of the hetrogeneous population
(ii) It lessens the possibility of bias of one sidedness.

Disadvantages
(i) It may be difficult to divide the population into hetrogeneous groups.
(ii) There may be over- lapping of different strata of the population which will provide an unrepresentative sample.

Systematic Sampling: In this method every elementary unit of the population is arranged in order and the sample units are distributed at equal and regular intervals. In order words, a sample of suitable size is obtained (from the orderly arranged population) by taking every unit say tenth unit of the population, one of the first units in this ordered arrangement is chosen at random and the sample is computed by selecting every tenth unit (say) from the rest of the lot. If the first unit selected is 4, then the order units constituting the sample will be 14, 24, 34, 44, and so on.

Advantages
It is most suitable where the population units are serially numbered or serially arranged.

Disadvantages
It may not provide a desirable result due to large variation in the items selected.

Multistage Sampling: In this sampling method, sample of elementary units is selected in stage. Firstly a sample of cluster is selected and from among them a sample of elementary units is selected. It is suitable in those cases where population size is very big and it contains a large number of units.

Non-Random of Non-Probability Sampling Method.

A sample of elementary units that is being selected on the basis of personal judgement is call a non-probability sampling. It is of five types:

(i) Purposive Sampling
(ii) Cluster Sampling
(iii) Quota Sampling
(iv) Convenience Sampling
(v) Sequential Sampling

Purposive Sampling: Purposive sampling is the method of sampling by which a sample is drawn from a population based entirely in the personal judgement of the investigator. It is also known as **Judgement Sampling** or **Deliberate Sampling**. A randomness finds no place in it and so the sample drawn under this method cannot be subjected to mathematical concepts used in computing sampling error.

Cluster Sampling: Cluster Sampling involves arranging elementary items in a population into hetrogeneous subgroups that are representative of the overall population. One such group constitutes a sample for study.

Quota Sampling: In quota sampling method, quotas are fixed according to the basic parameters of the population determined earlier and each filed investigator is assigned with quotas of number of elementary units to be interviewed.

Convenience Sampling: In convenience sampling, a sample is obtained be selecting convenient population elements from the population.

Sequential Sampling: In sequential sampling a number of sample lots are drawn one after another from the population depending on the results of the earlier samples drawn from the same population.

Sequential sampling is very useful in Statistical Quality Control. If the first sample is acceptable, then no further sample is drawn. On the other hand if the lot is completely unacceptable, it is rejected straightway. But if the initial lot is of doubtful and marginal character falling in the bond lying between the acceptance and rejection limits, a second sample is drawn and if need be a third sample of bigger size may be drawn in order to arrive at a decision on the final acceptance or rejection of the lot. Such sampling can be based on any of the random or non-random method of selection.

ADVANTAGES OF RANDOM OR PROBABILITY SAMPLING

1. Random sampling is objective and unbiased. As a result, it is defensible before the superiors or even before the court of law

2. The size of sample depends on demonstrable statistical method and therefore, it has a justification for the expenditure involved.

3. Statistical measures, i.e., **parameters** based on the population can be estimated and evaluated by sample statistic in terms of certain degree of precision required

4. It provides a more accurate method of drawing conclusions about the characteristics of the population as parameters

5. It is used to draw the statistical inference.

6. The samples may be combined and evaluated, even though accomplished by different individuals

7. The results obtained can be assessed in terms of probability, and the sample accepted or rejected on a consideration of the extent to which it can be considered representative.

8.8 SAMPLING AND NON-SAMPLING ERRORS

A sample is a part of the whole population. A sample drawn from the population depends on chance and as such all the characteristics of the population may not be present in the sample drawn from the same population. Any statistical measure say mean of the sample may not be equal to the corresponding statistical measure (mean) of the population from which the samples has been drawn. Thus there can be discrepancies in the statistical measure of population, i.e., parameters and the statistical measures of sample drawn from the same population, i.e., statistics. These discrepancies are known as Error in Sampling. Errors in sampling are of two types.

(i) Sampling Errors

(ii) Non-Sampling Errors or Bias.

I. Sampling Errors:

Sampling error is inherent in the method of sampling. Sampling depends on chance and due to the existence of chance in sampling, the sampling errors occur. Errors in sampling arise primarily due to the following reasons:

a. ***Faulty selection of the sample:*** This may be due to selection of defective sampling techniques which may introduce the element of biasness. e.g., purposive of judgement sampling, in which investigator deliberately selects a non-representative sample.

b. ***Sunstitution:*** Some times an investigator while collecting the information from a particular sampling unit, included in the random selection substitutes a convenient member of the population and this may lead to some bias as the characteristic possessed by the sustituted unit may be different from those possessed by original unit included in sampling.

c. Faulty demarcation of sampling units.

d. ***Variability of the population:*** Sampling error may also depend on the variability of hetrogeneous of the population from which the samples are to be drawn.

II. NON-SAMPLING ERRORS OR BIAS

Non-sampling errors or bias auromatically creep in due to human factors which always varies from one investigator to another. Bias may arise in the following different ways:

i. Due to negligence and carelessness on the part of investigator.
ii. Due to faulty planning of sampling.
iii. Due to the faulty selection of sample units.
iv. Due to incomplete investigation and sample survey.
v. Due to framing of a wrong questionnaire.
vi. Due to negligence and non-response on the part of the respondents.
vii. Due to substitution of a selected unit by another.
viii. Due to error in compilation.
ix. Due to applying wrong statistical measure.

EXERCISE

Note : Pick up the correct answer from the following :

1 Sampling errors are:

(a) Caused by inaccurate measurement

(b) The result of the chance selection of the sampling units

(c) Of no great concern

(d) Large for a census than for a sample.

2. Non sampling errors are:

(a) Caused by inaccurate measurement

(b) The result of the chance selection of the sampling units

(c) Of no great concern

(d) Always larger for a census than for a sample.

3. A sample consist of:

(a) All units of the population (b) 50 percent units of the population

(c) 5 percent units of the population (d) Any fraction of the population

4. The number of possible samples of size n from a population of N units with replacement is:

(a) N^2 (b) N^n (c) ∞ (d) None of these

5. A function of variates error of an estimation a parameter is called:

(a) An estimate (b) An estimator (c) A frame (d) A statistic

6. Let the standard error of an estimator T under SRSWOR is more than the standard error of T under stratified randomly sampling. Then T under stratified sampling as compared to T under SRSWOR is:

(a) More Reliable (b) Equally Reliable (c) Less Reliable (d) None of these

7. The number of types of random sampling is:

(a) 2 (b) 1 (c) 3 (d) 4

8. Single, double, multiple and sequential and several types are
   (a) Discovery Sampling Method (b) Acceptance Sampling Method
   (c) Discovery Sampling Variable (d) None of these

9. If population variance of an infinite population is θ^2 and a sample of n items is selected from this population, the standard error of sample mean is equal to:
   (a) $\frac{\sigma}{n}$ (b) $\frac{\propto^2}{n}$ (c) $\frac{\sigma}{\sqrt{n}}$ (d) σ

10. Sampling fraction is:
   (a) $\frac{n}{N}$ (b) $\frac{N}{n}$ (c) $\frac{n+1}{N}$ (d) $\frac{N+1}{n}$

11. The number of possible sample of size n out of N population units without replacement is:
   (a) ${}^{N}C_{n}$ (b) N^n (c) n^2 (d) n_1

12. In Hypothesis testing when H_o is true, accepting H_1 is called
   (a) Type I error (b) Type II error (c) Type III error (d) Type IV error

13. P (Type I error) means:
   (a) P (Accepting H_o when H_1 is true) (b) P (Rejection H_o when H_0 is true)
   (c) P (Accepting H_o when H_0 is true) (d) P (Rejection H_o when H_1 is true)

14. A parameter is characteristic of:
   (a) Population (b) Sample (c) Both (a) and (b) (d) None of these

15. The most commonly used confidence levels are:
   (a) Greater than and equal to 90% (b) Less than 90%
   (c) 95% (d) Less than and equal to 99%

16. Standard error of mean may be defined as the standard deviation in the sampling distribution of:
   (a) Mean (b) Median (c) Mode (d) None of these

17. The standard deviation of the …… Distribution is called standard error.
(a) Normal (b) Poisson (c) Binomial (d) Sampling

18. The criteria for an ideal estimator are:
(a) Unbiasedness, consistency, efficiency and sufficient
(b) Unbiasedness, expectation, sampling and estimated
(c) Estimation, consistency, sufficiency and efficiency
(d) Estimation, expectation, unbiasedness and sufficiency

19. The confidence limits are the upper and lower limits of the –
(a) Point estimate (b) Interval estimate
(c) Confidence interval (d) None of these

20. The type of estimates are
(a) Point estimate (b) Interval estimate
(c) Estimation of confidence region (d) All of the above

21. Statistical hypothesis is an
(a) Error (b) Assumption (c) Both (a) and (b) (d) None of these

22. A range of values is
(a) A point estimation (b) Interval estimation
(c) Both (a) and (b) (d) None of these

23. We use t-distribution when samples are drawn from the …….. Population.
(a) Normal (b) Binomial (c) Poisson (d) None of these

24. For 5 sample values, we have ……. Degree of freedom
(a) 5 (b) 3 (c) 4 (d) None of these

25. An interval estimate is:

(a) A range of values used to estimate the population parameter.

(b) A single value that is used to estimate the population parameter

(c) Always unbiased

(d) Always a sufficient statistic

26. A simple random sample of size 16 is drawn from a population with 50 members. What is the S.E. of sample mean if the population variance is known to be 25 given that the sampling is done with replacement?

(a) 1.25 (b) 6.25 (c) 1.04 (d) 1.56

27. If a random sample of 500 oranges produces 25 rotten oranges, then the estimate of S.E. of the proportion of rotten oranges in the sample is

(a) 0.0097 (b) 0.01 (c) 1.04 (d) 0.0593

28. If the population S.D. is known to be 5 for a population containing 80 units then the standard error of sample mean for a sample of size 25 without replacement is

(a) 5 (b) 0.20 (c) 1 (d) 0.83

29. A sample of size 3 is taken from a population of 10 members with replacement. If the sample observations are 1, 3 and 5. What is the estimate the standard error of sample mean?

(a) 1.96 (b) 1.02 (c) 1.25 (d) 2

30. A simple random sample of size 10 is drawn without replacement from a universe containing 85 units. If the mean and S.D. as obtained from the sample are 90 and 4 respectively, what is the estimate of the standard error of sample mean?

(a) 0.58 (b) 1.26 (c) 0.63 (d) 0.72

31. A random sample of the heights of 100 students from a large population of students having S.D. as 0.35 m. shows an average height of 1.75m. What are the 95% confidence limits for the average height of all the students forming the population?

(a) [1.68m.. 1.82m.] (b) [1.58m.. 1.90m.]

(c) [1.58m.. 1.92m.] (d) [1.5m.. 2.0m.]

32. A random sample of group of people is taken and 120 were found to be in favour of liberalizing licensing regulations. If the proportion of people in the population found in favour of liberalization with 95 confidence lies between 0.683 and 0.817, then the number of people in the group is.

(a) 140 (b) 150 (c) 160 (d) 175

33. If it is known that the 95% LCL & UCL to population means are 48.04 and 51.96 respectively, what is the value of the population variance when the sample size is 100?

(a) 8 (b) 100 (c) 12 (d) 12.50

34. A factory produces 60,000 pairs of shoes on a daily basis. From a sample of 600 pairs, 3 percent were found to be inferior quality, estimate the number of pairs that can be reasonably expected to be spoiled in the daily production process at 95% level of confidence.

(a) 982, 2618 (b) 782, 2618 (c) 882, 2618 (d) None of these

35. A random sample of 100 days shows an average daily sale of Rs. 1000 with a standard deviation of Rs. 250 in a particular shop. Assuming a normal distribution, find the limits which have a 95% chance of including the expected sales per day.

(a) [Rs. 950.75; Rs. 949.25] (b) [Rs. 950.75; Rs. 1049.25]

(c) [Rs. 950.75; Rs. 1149.25] (d) None of these

36. The incidence of a particular disease in an area is such that 20 percent people of that area suffers from it. What size of sample should be taken so as to ensure that the error of estimation of the proportion should not be more than 5 percent with 95 percent confidence?

(a) 246 (b) 236 (c) 226 (d) 286

37. A simple random sample of size 66 was drawn in the process of estimating of mean annual income of a certain township. The mean and standard deviation of the samples were found to be Rs. 4730 and Rs. 7.65 respectively. Find a 95% confidence interval for the population mean (Table value of Z for confidence level at 95% is 1.96).

(a) [4728.15, 4731.85] (b) [4278.15, 4308.85]

(c) [4278.15, 4796.85] (d) None of these

38. The mean height obtained from a sample of size 100 taken randomly from a population is 164 cm. If the standard deviation of the height distribution of the population is 3 cm, set up 95% confidence limits for the mean height of the population

(a) [163.41, 164.59] (b) [153.41, 154.59]

(c) [173.41, 174.59] (d) None of these

39. A random sample of 100 ball bearings selected from a shipment of 2000 ball bearing has an average diameter of 0.354 cm. and SD is 0.048 cm., find 95% confidence interval for the average diameter of these 2000 ball bearings.

(a) [0.345, 0.363] (b) [0.445, 0.463]

(c) [0.245, 0263] (d) None of these

40. 500 apples are taken at random from a large basket and 50 are found to be bad. Estimate the proportion of bad apples in the basket and assign limits within which the percentage most probably lie. A random sample of 700 units from a large consignment showed that 200 were damaged. Find 95% confidence limits for the proportion of damaged units in the consignment.

(a) (0.074 & 0.126) & (0.25 & 0.32) (b) (0.074 & 0.126) & (0.52 & 0.32)

(c) (0.074 & 0.52) & (0.52 & 0.126) (d) None of these

41. For a given sample of 200 items drawn from a large population, the mean is 65 and the standard deviation is 8. Find the 95% confidence limits for the population mean.

(a) [65.11, 63.89] (b) [66.11, 63.89]

(c) [67.11, 64.89] (d) None of these

42. In a sample of 900 shareholders of a company, 400 stated that their major aim is holding stocks in capital application. What is the 90% confidence range within which lies the population of stock holders who hold stocks for application?

(a) [0.317, 0.372] (b) [0.417, 0.472]

(c) [0.517, 0.572] (d) None of these

43. A researcher wishes to estimate the mean of a population by using sufficiently large sample. The probability is 0.95 that the sample mean will not differ from the true mean by more than 25% of the standard deviation. How large sample should be taken?

(a) 52 (b) 42 (c) 62 (d) 72

44. A random sample of size 17 has 52 as mean. The sum of the squares of the deviation from mean is 160. The 99% confidence limits for the mean are:

Given: [t(0.01, 15) = 2.60]; [t(0.01, 16) = 2.57]; [t(0.05, 16) = 2.92]

(a) 43, 6 (b) 45, 59 (c) 42.77, 61.23 (d) 48, 56

45. It is known that population standard deviation is waiting time for new gas connection in a particular town is 20 days. How large sample should be chosen to the 95% confident that the average waiting time is within 3 days of true average?

(a) 58 (b) 59 (c) 61 (d) 171

46. A random sample of 100 items taken from a large batch of articles contains 5 defective items set up 95 percent confidence limits for the proportion of defective items in the batch.

(a) [0.007, 0.093] (b) [0.006, 0.095]

(c) [0.015, 0.095] (d) None of these

47. A manufacturing concern wants to estimate the average amount of purchase of its product in a month by the customer. If the standard deviation is Rs. 10, find the sample size if the maximum error is not to exceed Rs. 3 with a probability of 0.99.

(a) 72 (b) 73 (c) 74 (d) None of these

48. In a sample of 1,000 TV viewers, 340 watched a particular programme. Find 99% confidence limits for the percentage of all viewers who watch this programme.

(a) [30.13, 35.89] (b) [30.13, 37.87]

(c) [31.13, 38.87] (d) None of these

49. Out of a consignment of 10000 tennis balls, 400 were selected at random and examined. It was found that 200 of these were defective. How many defective balls can you reasonably expect to have in the whole consignment at 95% confidence level?

(a) [4510, 5490] (b) [4765, 5035] (c) [4875, 5235] (d) None of these

50. A dice is thrown 9000 times and a throw of 3 or 4 is observed 3240 times. Find the limits between which the probability of a throw of 3 or 4 lies.

(a) [0.345, 0.375] (b) [0.365, .395] (c) [0.360, 0.391] (d) None of these

51. In a marking survey for the introduction of a new product in a town a sample of 400 persons was drawn. When they were approached for sale, 80 of them purchased the product. Find 95% confidence limits for the percentage of persons who would buy the product in the town.

(a) 0.125, 0.195 (b) 0.025, 0.095 (c) 12.5, 19.5 (d) None of these

ANSWERS

1 (a)	2 (b)	3 (d)	4 (b)	5 (d)	6 (a)	7 (c)
8 (b)	9 (c)	10 (a)	11 (a)	12 (a)	13 (b)	14 (a)
15 (c)	16 (a)	17 (d)	18 (a)	19 (c)	20 (d)	21 (b)
22 (b)	23 (a)	24 (c)	25 (a)	26 (a)	27 (b)	28 (d)
29 (d)	30 (c)	31 (c)	32 (c)	33 (b)	34 (a)	35 (c)
36 (a)	37 (a)	38 (a)	39 (a)	40 (a)	41 (b)	42 (b)
43 (a)	44 (c)	45 (d)	46 (a)	47 (b)	48 (b)	49 (a)
50 (a)	51 (a)					