Frequently Asked Questions

1. What are the stages of scientific enquiry?

Answer:
Traditional scientific inquiry consists of four interrelated stages:
i. Problem Definition
ii. Data Gathering
iii. Data Analysis and
iv. Data Interpretation

2. What are the purposes of statistical Analysis?

Answer:
The general purpose of statistical analysis is to provide meaning to what otherwise would be a collection of numbers and/or values. The "meaningfulness" of data derives from the clarity with which one specifies the problem or questions being addressed (Stage 1 of the inquiry process) and the precision with which pertinent information is gathered (Stage 2)
Statistical procedures fall loosely into three general categories: descriptive, associative, and inferential.

3. What do you mean by Descriptive and Associative Statistics?

Answer:
Descriptive statistics portrays individuals or events in terms of some predefined characteristics. Addressing the question "What is the average diastolic blood pressure of middle-age women?" is a problem definition suitable for analysis by descriptive statistics.

Associative statistics seek to identify meaningful interrelationships between or among data. Addressing the question "Is there a relationship between salt intake and diastolic blood pressure among middle-age women?" is a problem definition suitable for analysis by associative statistics.

4. Explain inferential statistics.

Answer:
Inferential statistics seeks to assess the characteristics of a sample in order to make more general statements about the parent population, or about the relationship between different samples or populations. Addressing the question "Does a low sodium diet lower the diastolic blood pressure of middle-age women?" represents a problem definition suitable for inferential statistics.

5. What do you mean by levels of measurements?

Answer:
Levels of Measurement:
Once categorized according to the specific scheme (i.e., independent, dependent, intervening), variables must be measured. This, of course, is the basis for data

gathering. Data gathering employs measurement scales or sets of rules for quantifying and assigning values to a particular variable. Typically, four levels of measurement apply to data gathering. Data levels may be characterized as nominal, ordinal, interval, or ratio.

6. Explain nominal and ordinal measurement.

Answer:
The term nominal means to name. Hence, a nominal scale does not measure but rather names. A nominal variable thus consists of named categories. Examples of nominal variables include sex, religion, and "group" assignment (such as treatment/no treatment).

The term ordinal means to order. In other words, an ordinal scale is a rank ordering of things, with a categorization in terms of more than or less than. Examples of variables measured on an ordinal scale would be pain levels (on a high-medium-low scale), or the rank ordering of patients according to their diastolic blood pressure.

7. Distinguish between interval scale and ratio measurement.

Answer:
Interval scales not only tell the order of things; they also measure the distance between values. For instance, assume you measure two patients' temperatures as 41 degrees C and 37 degrees C. Not only does the first patient have a higher temperature than the second, but his temperature is 4 degrees C higher.

Ratio measurement goes one step beyond interval scaling by providing an "absolute zero" point. With ratio measures, we can compare values not only according to the absolute interval between them, but also their relative magnitude. Thus, on a ratio scale, a variable with a value of 40 represents twice as much of the quantity being measured as a value of 20. Common examples of ratio level measurements include a patient's age, weight, height and pulse rate. For most statistical computations, ratio and interval data are considered equivalent.
Whenever possible, data should be gathered at the highest level. The higher level of precision provided by interval and ratio data allows for more powerful statistical testing. Moreover, high level data easily can be converted to lower levels, i.e. ordinal or nominal. The reverse is not true.

8. Briefly explain statistical tests with an example

Answer:
A statistical hypothesis test is a method of making decisions using data, whether from a controlled experiment or an observational study (not controlled). In statistics, a result is called statistically significant, if it is unlikely to have occurred by chance alone, according to a pre-determined threshold probability, the significance level. The phrase "test of significance" was coined by Ronald Fisher: Statistical hypothesis testing is a key technique of frequentist statistical inference. The Bayesian approach to hypothesis testing is to base rejection of the hypothesis on the posterior probability.[ ] Other approaches to reaching a decision based on data are available via decision theory and optimal decisions.
Suppose a new method of sealing of bulbs has been developed. Now one may estimate the average life of bulbs sealed by the new method and may further make use of this estimate in comparing the new method of sealing with the old one that is in finding whether or not the new method gives greater average life to the bulbs than the old

method. Here one may make the statement that the new method is no better than the old method and test whether the statement is true or not by using the estimate obtained from the sample values. The above problem of testing may be considered as a problem of testing of hypothesis. In the example we find that estimation and testing of hypothesis are closely associated.
Statistical tests deals with the problems of testing of hypothesis.

9. Name the different types of statistical tests?

Answer:
There are three types of Statistical tests. They are

i. Parametric tests
ii. Non Parametric tests
iii. Sequential tests

10. Explain briefly the three types of test procedures.

Answer:
If the distribution of the parent population is known or if the test requires the specification of the parameters then such a test is known as the parametric tests. Some of the parametric tests are Z-test, t-test, F-test, ANOVA etc

If the test does not require the knowledge of the parent population or in other words if the test does not require any such specification of the parameters it is known as Non Parametric tests.

For example: Chi-square test, Sign test, Run test, Mann Whitney U test etc.
Testing of hypothesis may be based on samples of fixed size or based on samples of varying size. A test procedure in which a sample size is not fixed in advance which will be decided only at the end of the test procedure is known as sequential tests.

11. What are the assumptions behind Parametric and Non parametric Tests?

Answer:
Parametric Assumptions

- The observations must be independent
- The observations must be drawn from normally distributed populations
- These populations must have the same variances
- The means of these normal and homoscedastic populations must be linear combinations of effects due to columns and/or rows

Nonparametric Assumptions are

- Observations are independent
- Variable under study has underlying continuity

12. Make a comparative study of Parametric and Nonparametric tests.

Answer:
Non Parametric test are approximate tests and in case parametric tests exists they are more powerful than the Non parametric tests. Nonparametric tests are designed to test the statistical hypothesis only and for estimating the parameters.

Parametric tests are preferred because, in general, for the same number of observations, they are more likely to lead to the rejection of a false hull hypothesis. That is, they have more power. This greater power stems from the fact that if the data have been collected at an interval or ratio level, information is lost in the conversion to ranked data (i.e., merely ordering the data from the lowest to the highest value).
Nonparametric tests are also referred to as distribution-free tests.

These tests have the obvious advantage of not requiring the assumption of normality or the assumption of homogeneity of variance. They compare medians rather than means and, as a result, if the data have one or two outliers, their influence is negated.
Generally, running nonparametric procedures is very similar to running parametric procedures, because the same design principle is being assessed in each case. So, the process of identifying variables, selecting options, and running the procedure are very similar. The final p-value is what determines significance or not in the same way as the parametric tests.

13. List the common parametric tests.

Answer:
One-sample tests are appropriate when a sample is being compared to the population from a hypothesis. The population characteristics are known from theory or are calculated from the population.
Two-sample tests are appropriate for comparing two samples, typically experimental and control samples from a scientifically controlled experiment.
Paired tests are appropriate for comparing two samples where it is impossible to control important variables. Rather than comparing two sets, members are paired between samples so the difference between the members becomes the sample. Typically the mean of the differences is then compared to zero.

Z-tests are appropriate for comparing means under stringent conditions regarding normality and a known standard deviation.
T-tests are appropriate for comparing means under relaxed conditions (less is assumed).
Tests of proportions are analogous to tests of means (the 50% proportion).
Chi-squared tests use the same calculations and the same probability distribution for different applications:

- Chi-squared tests for variance are used to determine whether a normal population has a specified variance. The null hypothesis is that it does

- Chi-squared goodness of fit tests are used to determine the adequacy of curves fit to data

The null hypothesis is that the curve fit is adequate. It is common to determine curve shapes to minimize the mean square error, so it is appropriate that the goodness-of-fit calculation sums the squared errors.

- F-tests (analysis of variance, ANOVA) are commonly used when deciding whether groupings of data by category are meaningful

If the variance of test scores of the left-handed in a class is much smaller than the variance of the whole class, then it may be useful to study lefties as a group. The null hypothesis is that two variances are the same - so the proposed grouping is not meaningful.

14. Briefly explain a testing process

Answer:

In the statistical literature, statistical hypothesis testing plays a fundamental role. The usual line of reasoning is as follows:

1. There is an initial research hypothesis of which the truth is unknown.
2. The first step is to state the relevant null and alternative hypotheses.
3. The second step is to consider the statistical assumptions being made about the sample in doing the test; for example, assumptions about the statistical independence or about the form of the distributions of the observations. This is equally important as invalid assumptions will mean that the results of the test are invalid.
4. Decide which test is appropriate, and state the relevant test statistic.
5. Derive the distribution of the test statistic under the null hypothesis from the assumptions. In standard cases this will be a well-known result. For example the test statistic may follow a Student's t distribution or a normal distribution.
6. Select a significance level (α), a probability threshold below which the null hypothesis will be rejected. Common values are 5% and 1%.
7. The distribution of the test statistic under the null hypothesis partitions the possible values of statistic into those for which the null-hypothesis is rejected, the so called critical region, and those for which it is not. The probability of the critical region is α.
8. Compute from the observations the observed value of the test statistic.
9. Decide to either fail to reject the null hypothesis or reject it in favour of the alternative.

An alternative process is commonly used:

10. Compute from the observations the observed value of the test statistic

11. From the statistic calculate a probability of the observation under the null hypothesis (the p-value)

12. Reject the null hypothesis or not. The decision rule is to reject the null hypothesis if and only if the p-value is less than the significance level (the selected probability) threshold

The two processes are equivalent. The former process was advantageous in the past when only tables of test statistics at common probability thresholds were available. It allowed a decision to be made without the calculation of a probability. It was adequate for class work and for operational use, but it was deficient for reporting results.
The latter process relied on extensive tables or on computational support not always available. The explicit calculation of a probability is useful for reporting. The calculations are now trivially performed with appropriate software.

15. What are the uses and importance of Statistical tests?

Answer:

Statistics are helpful in analyzing most collections of data. This is equally true of hypothesis testing which can justify conclusions even when no scientific theory exists.
Real world applications of hypothesis testing include:

- Testing whether more men than women suffer from nightmares
- Establishing authorship of documents
- Evaluating the effect of the full moon on behaviour
- Determining the range at which a bat can detect an insect by echo
- Deciding whether hospital carpeting results in more infections
- Selecting the best means to stop smoking
- Checking whether bumper stickers reflect car owner behaviour
- Testing the claims of handwriting analysts