STATISTICS WORKSHEET-1

Q1 to Q9 have only one correct answer. Choose the correct option to answer your question.

1. Bernoulli random variables take (only) the values 1 and 0.
   a) True
   b) False

   Answer:-a) True

2. Which of the following theorem states that the distribution of averages of iid variables, properly normalized, becomes that of a standard normal as the sample size increases?
   a) Central Limit Theorem
   b) Central Mean Theorem
   c) Centroid Limit Theorem
   d) All of the mentioned

   Answer:-a) Central Limit Theorem

3. Which of the following is incorrect with respect to use of Poisson distribution?
   a) Modeling event/time data
   b) Modeling bounded count data
   c) Modeling contingency tables
   d) All of the mentioned

   Answer:-b) Modeling bounded count data

4. Point out the correct statement.
   a) The exponent of a normally distributed random variables follows what is called the log- normal distribution
   b) Sums of normally distributed random variables are again normally distributed even if the variables are dependent
   c) The square of a standard normal random variable follows what is called chi-squared distribution
   d) All of the mentioned

   Answer:-d)All of the mentioned

5. _____ random variables are used to model rates.
   a) Empirical
   b) Binomial
   c) Poisson
   d) All of the mentioned

   Answer:-c)Poisson

6. 10. Usually replacing the standard error by its estimated value does change the CLT.
   a) True
   b) False

   Answer:-b)False

7. 1. Which of the following testing is concerned with making decisions using data?
   a) Probability
   b) Hypothesis
   c) Causal
   d) None of the mentioned

   Answer:-b) Hypothesis

8. 4. Normalized data are centered at___and have units equal to standard deviations of the original data.
   a) 0
   b) 5
   c) 1
   d) 10

   Answer:-a) 0

9. Which of the following statement is incorrect with respect to outliers?
   a) Outliers can have varying degrees of influence
   b) Outliers can be the result of spurious or real processes
   c) Outliers cannot conform to the regression relationship
   d) None of the mentioned

   Answer:-c) Outliers cannot conform to the regression relationship

Q10and Q15 are subjective answer type questions, Answer them in your own words briefly.

10. What do you understand by the term Normal Distribution?

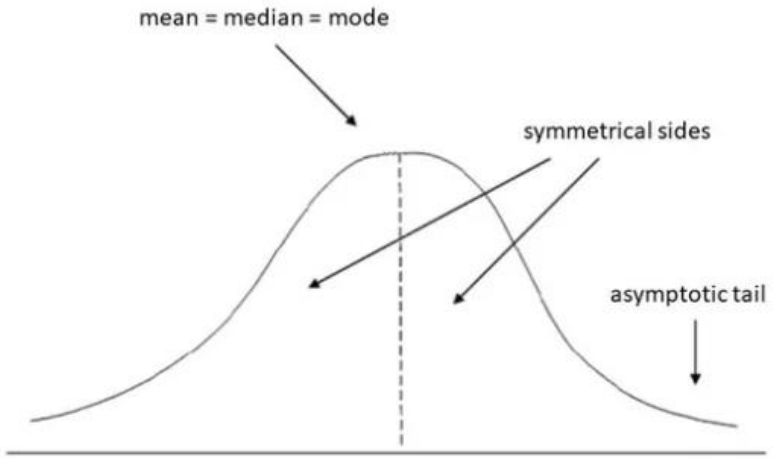
Answer:-

The normal distribution is a continuous probability distribution that is symmetrical on both sides of the mean, so the right side of the center is a mirror image of the left side.

The area under the normal distribution curve represents probability and the total area under the curve sums to one.

Most of the continuous data values in a normal distribution tend to cluster around the mean, and the further a value is from the mean, the less likely it is to occur. The tails are asymptotic, which means that they approach but never quite meet the horizon.

For a perfectly normal distribution the mean, median and mode will be the same value, visually represented by the peak of the curve.



The normal distribution is often called the bell curve because the graph of its probability density looks like a bell. It is also known as called Gaussian distribution, after the German mathematician Carl Gauss who first described it.

Why is the normal distribution is important ?

The normal distribution is the most important probability distribution in statistics because many continuous data in nature and psychology displays this bell-shaped curve when compiled and graphed.

For example, if we randomly sampled 100 individuals we would expect to see a normal distribution frequency curve for many continuous variables, such as IQ, height, weight and blood pressure.

11. How do you handle missing data? What imputation techniques do you recommend?

Answer:-

Best techniques to handle missing data

1. Use deletion methods to eliminate missing data. The deletion methods only work for certain datasets where participants have missing fields.
2. Use regression analysis to systematically eliminate data.
3. Data scientists can use data imputation techniques.

Data Imputation Techniques:-

1. **Mean**
2. **Median**
3. **Mode**

12. What is A/B testing?

Answer:-

A/B testing is a method of comparing two versions of a webpage or app against each other to determine which one performs better.
A/B testing is essentially an experiment where two or more variants of a page are shown to users at random, and statistical analysis is used to determine which variation performs better for a given conversion goal.

13. Is mean imputation of missing data acceptable practice?

Answer:-

Missing Data: Two Big Problems with Mean Imputation

Mean imputation: So simple. And yet, so dangerous .Perhaps that's a bit dramatic, but mean imputation (also called mean substitution) really ought to be a last resort.
It's a popular solution to missing data, despite its drawbacks. Mainly because it's easy. It can be really painful to lose a large part of the sample you so carefully collected, only to have little power.

But that doesn't make it a good solution, and it may not help you find relationships with strong parameter estimates. Even if they exist in the population.

On the other hand, there are many alternatives to mean imputation that provide much more accurate estimates and standard errors, so there really is no excuse to use it.

This post is the first explaining the many reasons not to use mean imputation (and to be fair, its advantages).

First, a definition: mean imputation is the replacement of a missing observation with the mean of the non-missing observations for that variable.

Problem #1: Mean imputation does not preserve the relationships among variables.

True, imputing the mean preserves the mean of the observed data. So if the data are missing completely at random, the estimate of the mean remains unbiased. That's a good thing.

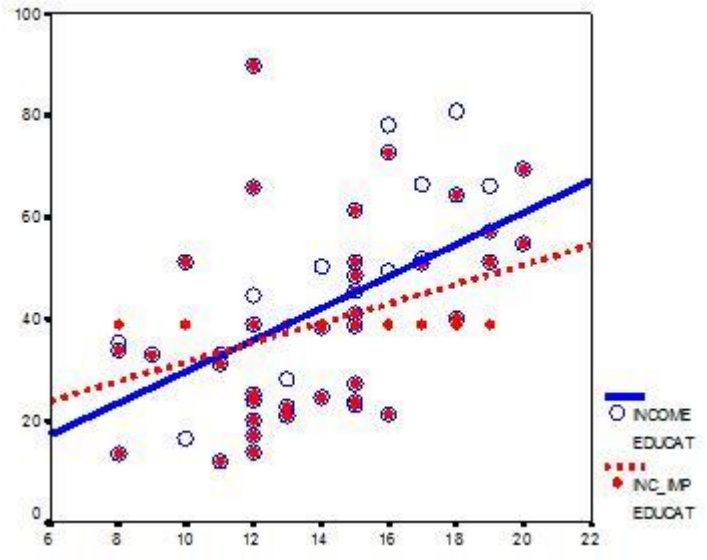
Plus, by imputing the mean, you are able to keep your sample size up to the full sample size. That's good too.

This is the original logic involved in mean imputation.

If all you are doing is estimating means (which is rarely the point of research studies), and if the data are missing completely at random, mean imputation will not bias your parameter estimate.

It will still bias your standard error, but I will get to that in another post.

Since most research studies are interested in the relationship among variables, mean imputation is not a good solution. The following graph illustrates this well:



This graph illustrates hypothetical data between X=years of education and Y=annual income in thousands with n=50. The blue circles are the original data, and the solid blue line indicates the best fit regression line for the full data set. The correlation between X and Y is r = .53.

I then randomly deleted 12 observations of income (Y) and substituted the mean. The red dots are the mean-imputed data.

Blue circles with red dots inside them represent non-missing data. Empty Blue circles represent the missing data. If you look across the graph at Y = 39, you will see a row of red dots without blue circles. These represent the imputed values.

The dotted red line is the new best fit regression line with the imputed data. As you can see, it is less steep than the original line. Adding in those red dots pulled it down.

The new correlation is r = .39. That's a lot smaller that .53.

The real relationship is quite underestimated.

Of course, in a real data set, you wouldn't notice so easily the bias you're introducing. This is one of those situations where in trying to solve the lowered sample size, you create a bigger problem.

One note: if X were missing instead of Y, mean substitution would artificially *inflate* the correlation.

In other words, you'll think there is a stronger relationship than there really is. That's not good either. It's not reproducible and you don't want to be overstating real results.

This solution that is so good at preserving unbiased estimates for the mean isn't so good for unbiased estimates of relationships.

Problem #2: Mean Imputation Leads to An Underestimate of Standard Errors

A second reason is applies to any type of single imputation. Any statistic that uses the imputed data will have a standard error that's too low.

In other words, yes, you get the same mean from mean-imputed data that you would have gotten without the imputations. And yes, there are circumstances where that mean is unbiased. Even so, the standard error of that mean will be too small.

Because the imputations are themselves estimates, there is some error associated with them. But your statistical software doesn't know that. It treats it as real data.

Ultimately, because your standard errors are too low, so are your p-values. Now you're making Type I errors without realizing it.

14. What is linear regression in statistics?

Answer:-

Linear regression is a basic and commonly used type of predictive analysis.

The overall idea of regression is to examine two things:

1) Does a set of predictor variables do a good job in predicting an outcome (dependent) variable?

(2) Which variables in particular are significant predictors of the outcome variable, and in what way do they–indicated by the magnitude and sign of the beta estimates–impact the outcome variable? These regression estimates are used to explain the relationship between one dependent variable and one or more independent variables.

The simplest form of the regression equation with one dependent and one independent variable is defined by the formula y = c + b*x, where y = estimated dependent variable score, c = constant, b = regression coefficient, and x = score on the independent variable.

Types of Linear Regression

Simple linear regression

1 dependent variable (interval or ratio), 1 independent variable (interval or ratio or dichotomous)

Multiple linear regression

1 dependent variable (interval or ratio) , 2+ independent variables (interval or ratio or dichotomous)

Logistic regression

1 dependent variable (dichotomous), 2+ independent variable(s) (interval or ratio or dichotomous)

Ordinal regression

1 dependent variable (ordinal), 1+ independent variable(s) (nominal or dichotomous)

Multinomial regression

1 dependent variable (nominal), 1+ independent variable(s) (interval or ratio or dichotomous)

Discriminant analysis

1 dependent variable (nominal), 1+ independent variable(s) (interval or ratio)

When selecting the model for the analysis, an important consideration is model fitting. Adding independent variables to a linear regression model will always increase the explained variance of the model (typically expressed as R^2). However, overfitting can occur by adding too many variables to the model, which reduces model generalizability. Occam's razor describes the problem extremely well – a simple model is usually preferable to a more complex model. Statistically, if a model includes a large number of variables, some of the variables will be statistically significant due to chance alone.

15. What are the various branches of statistics?

Answer:-

There two main branches in statistics:-

1. **Descriptive statistics**
2. **Inferential statistics**.

Both of these are employed in scientific analysis of data and both are equally important for the student of statistics.