Assignment-based Subjective Questions

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Q 1. From your analysis of the categorical variables from the dataset, what could you infer about their effect on the dependent variable?

Ans- In the bike sharing Assignment, we have count as a dependent variable and season, yr, mnth, holiday, weekday, working day, and weathersit are the categorical variables.

The demand of bike is low in the month of spring when compared with other seasons, as it has negative coefficient. The demand bike increases in the year 2019 compared with year 2018.

Let's consider the effect of the categorical variable 'weathersit' on the target variable 'cnt'.

Following are the observation:

a. Season- In winter season number of bikes rented is high.
b. Weather- The number of bikes rented is high when the weather is clear, few clouds but it goes decreasing when the weathersit is going to be moderate to bad.
c. Weekdays-The number of bikes rented goes high during mid week. On holidays it goes decreasing.
d. Month-The number of bikes rented goes high during mid year.

Q 2. Why is it important to use drop_first=True during dummy variable creation?

Ans- **drop_first=True** is important to use, as it helps in reducing the extra column created during dummy variable creation. Hence it reduces the correlations created among dummy variables.

Q 3. Looking at the pair-plot among the numerical variables, which one has the highest correlation with the target variable?

Ans- The numerical variable 'registered' has the highest correlated with target variable 'cnt', if we consider all the features.
We dropped 'registered' variable due to multicollinearity.
After the data preparation, numerical variable 'atemp' has the highest correlation with the target variable 'cnt' .

Q 4. How did you validate the assumptions of Linear Regression after building the model on the training set?

Ans- **Assumption of linear regression are follow:**

Linear relationship between X and y –
Using pairplot checked with the correlations. Pairwise correlation could be the first step to identify potential relation between various independent variables.

a. Error terms are normally distributed-
Plotted the histogram of the error terms using difference between y_train and y_train_pred data. It gives normal distribution curve.

b. Error terms are independent to each other-
Variable should not be auto-correlated, we used the Durbin-Watson test. The test gave output values between zero and four. If the output value is closer to two, there will be less autocorrelation between variables.
[0–2: positive auto-correlation]

[2–4: negative auto-correlation].

c. Checked with P-value and VIF value in the model:-
If significant level is not given then we'll analyse 0.05 as standard significant level and if p-value increases above 0.05 then it becomes insignificant.

d. Error terms have constant variance (Homoscedasticity)-
In regression analysis , homoscedasticity means a situation in which the variance of the dependent variable is the same for all the data. We have checked it by building multiple model.

Q 5. Based on the final model, which are the top 3 features contributing significantly towards explaining the demand of the shared bikes?

Ans-

a. Temp- The number of bikes rented goes high during summer days when temperature goes high.
b. Yr- Based on previous data it is expected to have a boom in number of users once situation comes back to normal, compared to 2018 i.e The demand bike boost in the year 2019 compared with year 2018.
c. Mnth_sept & season_winter- Count for rented bikes are more in winter and month of September.

General Subjective Questions

Q 1. Explain the linear regression algorithm in detail.

Ans- Linear Regression is a type of supervised Machine Learning algorithm that is used for the prediction of numeric value. Linear Regression is the more basic form of regression analysis. Regression is the mostly commonly used in predictive analysis model.

Linear regression is based on the popular equation

“$y = mx + c$”

It presumes that there is a linear relation between the dependent variable(y) and the predictor(s)/independent variable(x). In regression, we calculate the best fit line which describes the relation between the independent and dependent variable. Regression is performed when the dependent variable is of continuous data type and Predictors or independent variables could be of any data type like continuous, nominal etc. Regression method tries to find the best fit line which shows the relation between the dependent variable and predictors with least error. In regression, the output/dependent variable is the function of an independent variable and the coefficient and the error term. Regression is divided into simple linear regression and multiple linear regression.

1. Simple Linear Regression : SLR is used when the dependent variable is predicted using only one independent variable.

2. Multiple Linear Regression :MLR is used when the dependent variable is predicted using multiple independent variables.

The equation for MLR will be:

β1 = coefficient for X1 variable

β2 = coefficient for X2 variable

β3 = coefficient for X3 variable

and so on…

β0 is the intercept (constant term).

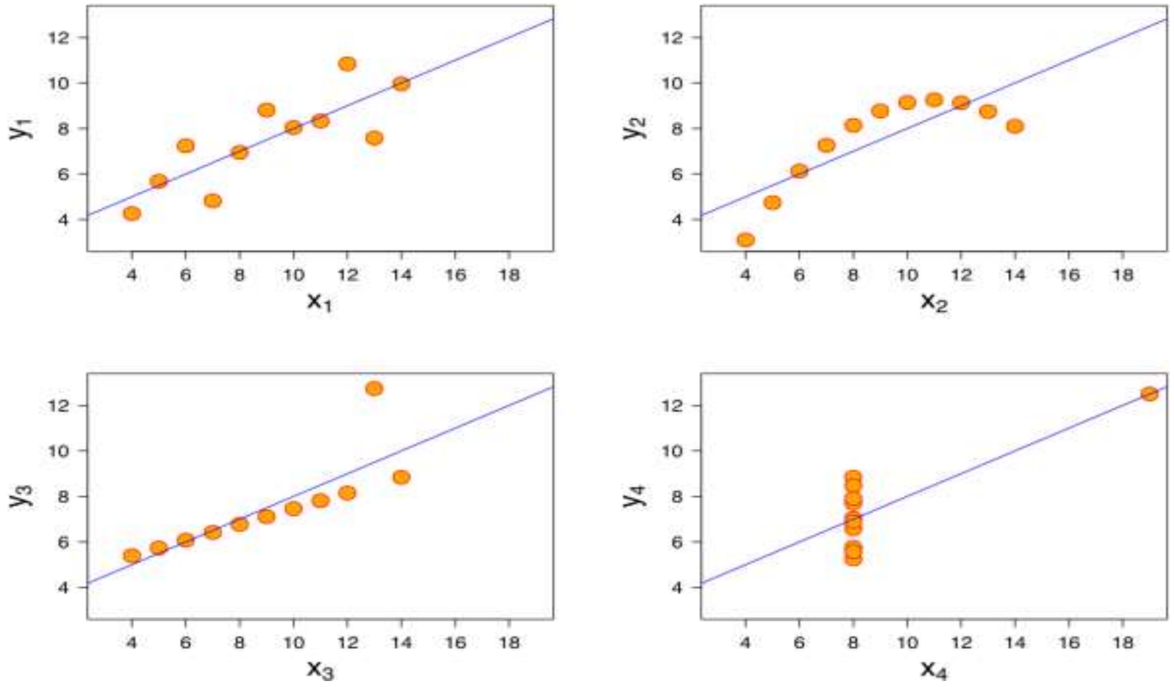
Equation :

$$y_i = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \dots \beta_p x_{ip} + \varepsilon_i \quad \text{for } i = 1,2, \dots n.$$

Q 2. Explain the Anscombe’s quartet in detail.

Ans- Anscombe's Quartet is a very good demo of the importance of graphing data to analyze it. simply variance means, values, and even linear regressions can’t accurately portray data in its native form.

Anscombe's Quartet multiple data sets shows that with many similar statistical properties can still be vastly different from one another when graphed. Additionally, Anscombe's Quartet warns of



the dangers of outliers in data sets.
Think about it: if the bottom two graphs didn't have that one point that strayed so far from all the other points, their statistical properties would no longer be identical to the two top graphs. In fact, their statistical properties would mostly accurately resemble the lines that the graphs seem to depict. How to analyze your data. For example, while all four data sets have the same linear regression, it is obvious that the top right graph really shouldn't be analyzed with a linear regression at all because it's a curvature. Conversely, the top left graph probably should be analyzed with a linear regression because it's a scatter plot that moves in a roughly linear manner. These observations demonstrate the value in graphing your data before analyzing it.

- The first scatter plot (top left) appears to be a simple linear relationship

- The second graph (top right) is not distributed normally; while there is a relation between them, it’s not linear.

Q 3. What is Pearson’s R?

Ans- Pearson's r is a numerical compendium of the strength of the linear association between the variables. It value ranges between -1 to +1. It shows the linear relationship between two sets of data. In simple terms, it tells us can we draw a line graph to represent the data? r = 1 means the data is perfectly linear with a positive slope r = -1 means the data is perfectly linear with a negative slope r = 0 means there is no linear association

For Example:

Demand and Supply in an economy when the price of the product and the quantity demanded and supplied is known. The values are represented using a simple linear regression. Pearson R shows that demand and supply have a positive correlation. As more consumers demand products, the amount suppliers are will to produce increases as well. The opposite is true with regard to price.

Q 4. What is scaling? Why is scaling performed? What is the difference between normalized scaling and standardized scaling?

Ans- It is performed during the data pre-processing stage to deal with varying values in the dataset. Feature scaling is a method used to normalize or standardize the range of independent variables or features of data. If feature scaling is not done, then a machine learning algorithm tends to weigh greater values, higher and consider smaller values as the low values, irrespective of the units of the values.

● Normalization is generally used when you know that the distribution of your data does not follow a Gaussian distribution. This can be useful in algorithms that do not assume any distribution of the data like K-Nearest Neighbors and Neural Networks. we have to do scaling to bring all the variables to the same level of magnitude. It is important to note that scaling just affects the coefficients and none of the other parameters like t-statistic, F-statistic , p-values, R-squared, etc. Normalization/Min-Max Scaling: It brings all of the data in the range of 0 and 1. sklearn. preprocessing. MinMaxScaler helps to implement normalization in python.

{ MinMax scaling:x=x-min(x)/max(x)-min(x) }

Standardization Scaling: Standardization replaces the values by their Z scores. It brings all of the data into a standard normal distribution which has mean (μ) zero and standard deviation one (σ).

● Standardisation:
x=x-mean(x)/std sklearn.preprocessing.scale helps to implement standardization in python. One disadvantage of normalization over standardization is that it loses some information in the data, especially about outliers

Q 5. You might have observed that sometimes the value of VIF is infinite. Why does this happen?

Ans- Fullform of VIF VIF - the variance inflation factor

The VIF gives how much the variance of the coefficient estimate is being inflated by collinearity.

(VIF) =1/(1-R_1^2).

If there is totally perfect correlation, then VIF = infinity.

Where R-1 is the R-square value of that independent variable which we want to check how well this independent variable is explained well by other independent variables- If that independent variable can be explained perfectly by other independent variables, then it will have perfect correlation and it's R-squared value will be equal to 1.

So, VIF = 1/(1-1)

which gives VIF = 1/0 which results in "infinity"

Q 6. What is a Q-Q plot? Explain the use and importance of a Q-Q plot in linear regression?

Ans- Q-Q Plots (Quantile-Quantile plots) are plots of two quantiles against each other. A quantile is a fraction where certain values fall below that quantile. A q-q plot is a plot of the quantiles of the first data set against the quantiles of the second data set. It is used to compare the shapes of distributions. A Q-Q plot is a scatterplot created by plotting two sets of quantiles against one another. If both sets of quantiles came from the same distribution, we should see the points forming a line that's roughly straight.