Assignment-based Subjective Questions

1. From your analysis of the categorical variables from the dataset, what could you infer about

their effect on the dependent variable?

Ans. Seasons: We could see business was operating similar days in all four seasons.

Yr: Number of days operation in both the year are almost same.

Month: We could see business was operating similar days in all 12 months.

Holiday: Business was operating in 3% days of holiday

weekdays: We could see business was operating similar percentage in all weekdays.

Workingday: Bisuness was operating in 68% in workign days and 32% in nonworking days.

Weathersit: From the above analaysis it is being observed that there is no data for 4th category of weathersit i.e Heavy Rain + Ice Pallets + Thunderstorm + Mist, Snow + Fog.May be the company is not operating on those days or there was no demand of bike.

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 extracolumn created during dummy variable creation. Hence it reduces thecorrelations created among dummy variables.

3. Looking at the pair-plot among the numerical variables, which one has the highest correlation

with the target variable?

Ans. From the pairplot we could observe that, temp has highest positive correlation with target variable cnt.

4. How did you validate the assumptions of Linear Regression after building the model on the

training set?

Ans. 1.We could see the distribution plot of error term shows the normal distribution with mean at Zero.

2.The corresponding residual plot appeared to be reasonably random.

3.Also the error terms satisfies to have reasonably constant variance (homoscedasticity)

5. Based on the final model, which are the top 3 features contributing significantly towards

explaining the demand of the shared bikes?

Ans. Based on final model top three features contributing significantly towards explaining the demand are:

1. Temperature (0.552)

2. weathersit : Light Snow, Light Rain + Thunderstorm + Scattered clouds, Light Rain + Scattered clouds (-0.264)

3. year (0.256)

General Subjective Questions

1. Explain the linear regression algorithm in detail

Ans. Linear regression is one of the very basic forms of machine learning where we train a model to predict the behaviour of your data based on some variables. In the case of linear regression as you can see the name suggests linear that means the two variables which are on the x-axis and y-axis should be linearly correlated.

Mathematically, we can write a linear regression equation as:

y = a + bx

Here, x and y are two variables on the regression line.

b = Slope of the line

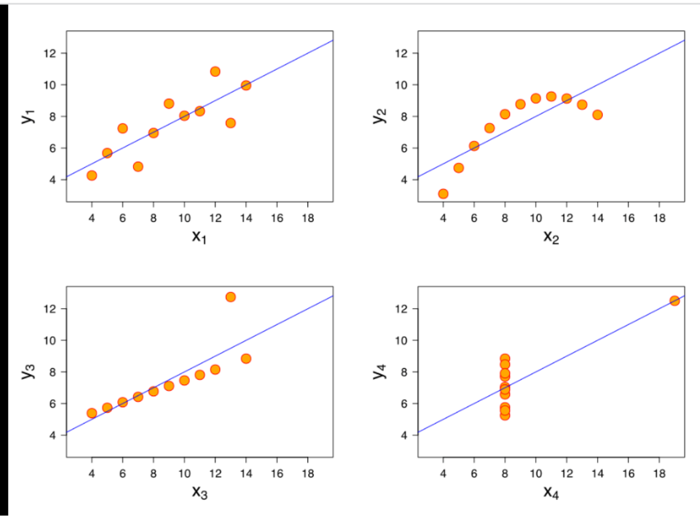
a = y-intercept of the line

x = Independent variable from dataset

y = Dependent variable from dataset

2. Explain the Anscombe's quartet in detail.

Ans. **Anscombe's quartet** comprises four data sets that have nearly identical simple descriptive statistics, yet have very different distributions and appear very different when graphed. Each dataset consists of eleven *(x,y)* points. They were constructed in 1973 by the statistician Francis Anscombe to demonstrate both the importance of graphing data when analyzing it, and the effect of outliers and other influential observations on statistical properties. He described the article as being intended to counter the impression among statisticians that "numerical calculations are exact, but graphs are rough."



All four sets are identical when examined using simple summary statistics, but vary considerably when graphed

For all four datasets:

Property	Value	Accuracy
Mean of *x*	9	exact
Sample variance of *x* : s^2_x	11	exact
Mean of *y*	7.50	to 2 decimal places
Sample variance of *y* : s^2_y	4.125	±0.003
Correlation between *x* and *y*	0.816	to 3 decimal places
Linear regression line	$y = 3.00 + 0.500x$	to 2 and 3 decimal places, respectively
Coefficient of determination of the linear regression :	0.67	to 2 decimal places

- The first scatter plot (top left) appears to be a simple linear relationship, corresponding to two variables correlated where y could be modelled as gaussian with mean linearly dependent on *x*.
- The second graph (top right); while a relationship between the two variables is obvious, it is not linear, and the Pearson correlation coefficient is not relevant. A more general regression and the corresponding coefficient of determination would be more appropriate.
- In the third graph (bottom left), the modelled relationship is linear, but should have a different regression line (a robust regression would have been called for). The calculated regression is offset by the one outlier which exerts enough influence to lower the correlation coefficient from 1 to 0.816.
- Finally, the fourth graph (bottom right) shows an example when one high-leverage point is enough to produce a high correlation coefficient, even though the other data points do not indicate any relationship between the variables.

The quartet is still often used to illustrate the importance of looking at a set of data graphically before starting to analyze according to a particular type of relationship, and the inadequacy of basic statistic properties for describing realistic datasets

3. What is Pearson's R?

Ans. The Pearson correlation coefficient (r) is the most common way of measuring a linear correlation. It is a number between –1 and 1 that **measures the strength and direction of the relationship between two variables**.

Formula:

$$r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}}$$

r = correlation coefficient

x_i = values of the x-variable in a sample

$\bar{x}$ = mean of the values of the x-variable

y_i = values of the y-variable in a sample

$\bar{y}$ = mean of the values of the y-variable

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

Ans. It is a step of data Pre-Processing which is applied to independent variables to normalize the data within a particular range. It also helps in speeding up the calculations in an algorithm.

Most of the times, collected data set contains features highly varying in magnitudes, units and range. If scaling is not done then algorithm only takes magnitude in account and not units hence incorrect modelling. To solve this issue, 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 typically means rescales the values into a range of [0,1]. Standardization typically means rescales data to have a mean of 0 and a standard deviation of 1 (unit variance).

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

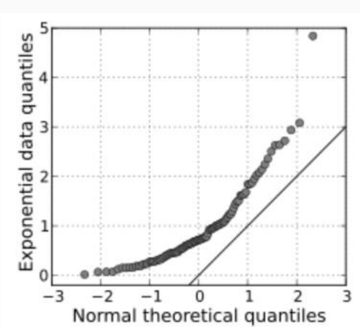
Ans. If there is perfect correlation, then VIF = infinity. This shows a perfect correlation between two independent variables. In the case of perfect correlation, we get R2 =1, which lead to 1/(1-R2) infinity. To solve this problem we need to drop one of the variables from the dataset which is causing this perfect multicollinearity.

An infinite VIF value indicates that the corresponding variable may be expressed exactly by a linear combination of other variables (which show an infinite VIF as well).

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. For example, the median is a quantile where 50% of the data fall below that point and 50% lie above it. The purpose of Q Q plots is to find out if two sets of data come from the same distribution. A 45 degree angle is plotted on the Q Q plot; if the two data sets come from a common distribution, the points will fall on that reference line.

A Q Q plot showing the 45 degree reference line:



If the two distributions being compared are similar, the points in the Q–Q plot will approximately lie on the line y = x. If the distributions are linearly related, the points in the Q–Q plot will approximately lie on a line, but not necessarily on the line y = x. Q–Q plots can also be used as a graphical means of estimating parameters in a location-scale family of distributions.

A Q–Q plot is used to compare the shapes of distributions, providing a graphical view of how properties such as location, scale, and skewness are similar or different in the two distributions.