Analysis of Categorical Variables

- **Question:** From your analysis of the categorical variables from the dataset, what could you infer about their effect on the dependent variable?

- **Seasonal Impact:** The highest number of bike bookings occurs during the Fall season, suggesting that cooler weather conditions are more favorable for biking.

- **Monthly Trends:** September consistently sees the highest number of bookings, followed by October and August. This indicates a peak in biking activities towards the end of summer and beginning of fall.

- **Trend Analysis:** From March to October, there is a noticeable upward trend in bookings, highlighting increased outdoor activity during these months.

- **Weather Influence:** Clear weather conditions significantly boost bike bookings, whereas rainy weather leads to a marked decrease in bookings.

- **Annual Growth:** The data shows a substantial increase in bookings in 2019 compared to the previous year, reflecting positive growth and popularity of the bike-sharing service.

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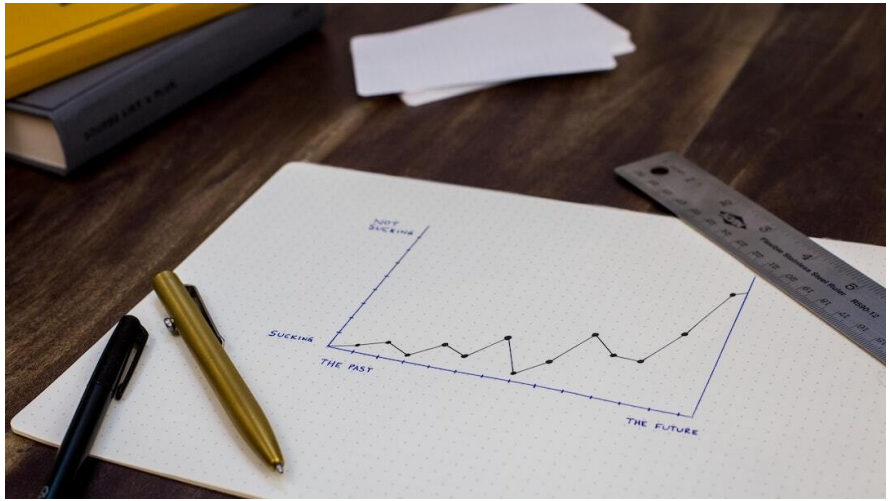
Importance of `drop_first=True` in Dummy Variable Creation

- **Question:** Why is it important to use drop_first=True during dummy variable creation?
- **Preventing Multicollinearity:** Using `drop_first=True` helps to avoid multicollinearity by removing one category level, thereby preventing perfect collinearity among dummy variables.
- **Reducing Redundancy:** By dropping the first category, the total number of dummy variables is reduced, which simplifies the model and improves efficiency.
- **Model Interpretability:** This practice ensures that the model remains interpretable and free from redundant variables, making it easier to understand and analyze the effects of other predictors.



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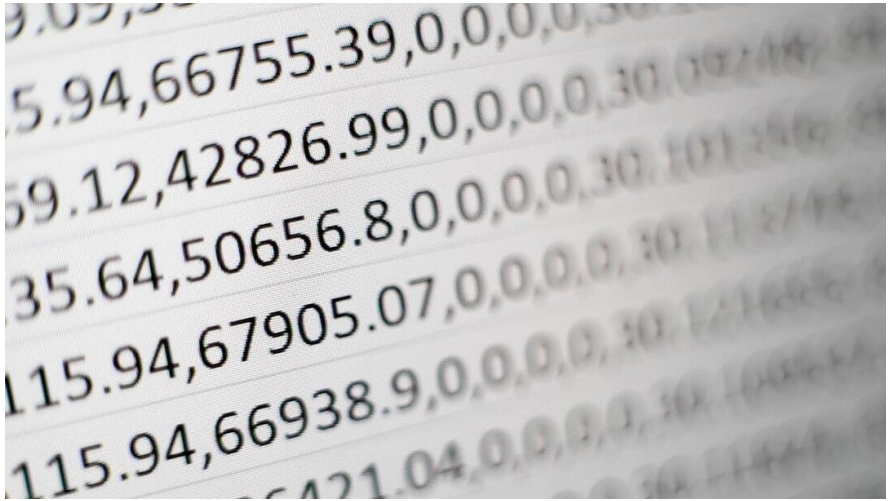
Pair-Plot Analysis of Numerical Variables

- **Question:** Looking at the pair-plot among the numerical variables, which one has the highest correlation with the target variable?

- **Highest Correlation:** In the pair-plot analysis, the temperature variable shows the highest correlation with the target variable, with a correlation coefficient of 0.63. This strong positive correlation indicates that higher temperatures are associated with an increase in bike bookings.



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Validation of Linear Regression Assumptions

- **Question:** How did you validate the assumptions of Linear Regression after building the model on the training set?

- **Residual Analysis:** Plotting the residuals using a histogram or Q-Q plot to check for normality. If the residuals follow a normal distribution, the assumption is met.
- **Multicollinearity Check:** Calculating the Variance Inflation Factor (VIF) to ensure no high multicollinearity among the predictors.
- **Homoscedasticity Check:** Plotting residuals against the predicted values or each predictor to ensure there is no pattern, indicating constant variance of residuals (homoscedasticity).

Top Features Contributing to Bike Demand

- **Question:** Based on the final model, which are the top 3 features contributing significantly towards explaining the demand of the shared bikes?
- **Temperature:** Higher temperatures correlate with more bike rentals.
- **Year:** The year variable indicates an increasing trend in bike usage over time.
- **Weather Conditions (Light Rain):** Light rain conditions have a measurable impact, suggesting users are more willing to rent bikes even in mild adverse weather.

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Explaining Linear Regression Algorithm

- **Question:** Explain the linear regression algorithm in detail.
- **Model Definition:** Linear regression models the relationship between a dependent variable (Y) and one or more independent variables (X) using a linear equation.
- **Least Squares Method:** The goal is to find the values of the coefficients that minimize the sum of squared errors (SSE) between observed and predicted values.
- **Algorithm Steps:** Includes data preparation, model building, model training, evaluation, and tuning.

Anscombe’s Quartet

- **Question:** Explain the Anscombe’s quartet in detail.
- **Purpose:** Demonstrates the importance of data visualization in statistical analysis and the potential for outliers to distort statistical results.
- **Components:** Each dataset in the quartet has the same statistical properties but different distributions when graphed.
- **Conclusion:** Highlights that summary statistics alone can be misleading without considering the underlying data distribution.

Pearson’s R

- **Question:** What is Pearson’s R?
- **Definition:** Pearson's correlation coefficient measures the strength and direction of a linear relationship between two continuous variables.
- **Range:** Ranges from -1 to 1, where 1 indicates a perfect positive linear relationship, 0 indicates no linear relationship, and -1 indicates a perfect negative linear relationship.
- **Calculation:** Calculated using the covariance of the variables divided by the product of their standard deviations.

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Scaling in Machine Learning

- **Question:** What is scaling? Why is scaling performed? What is the difference between normalized scaling and standardized scaling?
- **Purpose of Scaling:** Scaling transforms numerical features to a common scale, which is crucial for algorithms sensitive to the scale of input features.
- **Normalized Scaling:** Also known as min-max scaling, it rescales features to a range of [0, 1] or [-1, 1]. Useful when the data is not normally distributed.
- **Standardized Scaling:** Transforms features to have a mean of 0 and a standard deviation of 1. Useful when the data needs to be normalized for statistical analysis and is less sensitive to outliers.

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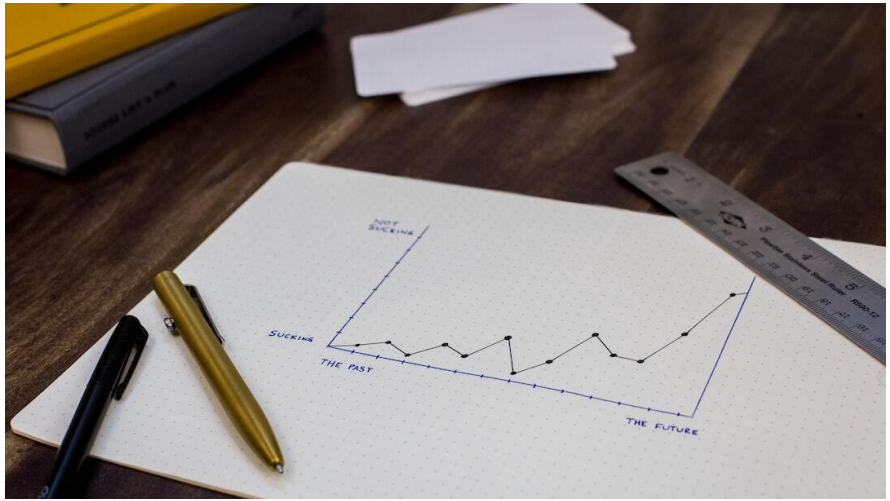
Variance Inflation Factor (VIF)

- **Question:** You might have observed that sometimes the value of VIF is infinite. Why does this happen?
- **Perfect Multicollinearity:** Occurs when one variable is a perfect linear combination of others, leading to an undefined variance and infinite VIF.
- **Near Perfect Multicollinearity:** High correlations between independent variables can significantly inflate the VIF value, indicating multicollinearity issues.
- **Impact on Model:** High VIF values can lead to unstable coefficient estimates and inflated standard errors, compromising model reliability.

Q-Q Plot in Linear Regression

- **Question:** What is a Q-Q plot? Explain the use and importance of a Q-Q plot in linear regression.
- **Purpose:** Q-Q plot compares quantiles of observed data against a theoretical distribution, typically the normal distribution.
- **Normality Assumption:** Used to check if residuals follow a normal distribution, a key assumption in linear regression.
- **Outlier Detection:** Identifies outliers or deviations from normality, guiding model refinement and validation.



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Conclusion

- **Key Learnings:** Summarized the analysis of categorical variables, importance of dummy variable creation, pair-plot analysis, validation of linear regression assumptions, and identified top features contributing to bike demand.
- **Statistical Insights:** Explored Pearson’s correlation coefficient, scaling techniques, and the importance of VIF and Q-Q plots in linear regression.
- **Practical Applications:** Demonstrated the importance of data visualization and thorough statistical analysis in understanding and predicting bike-sharing demand.