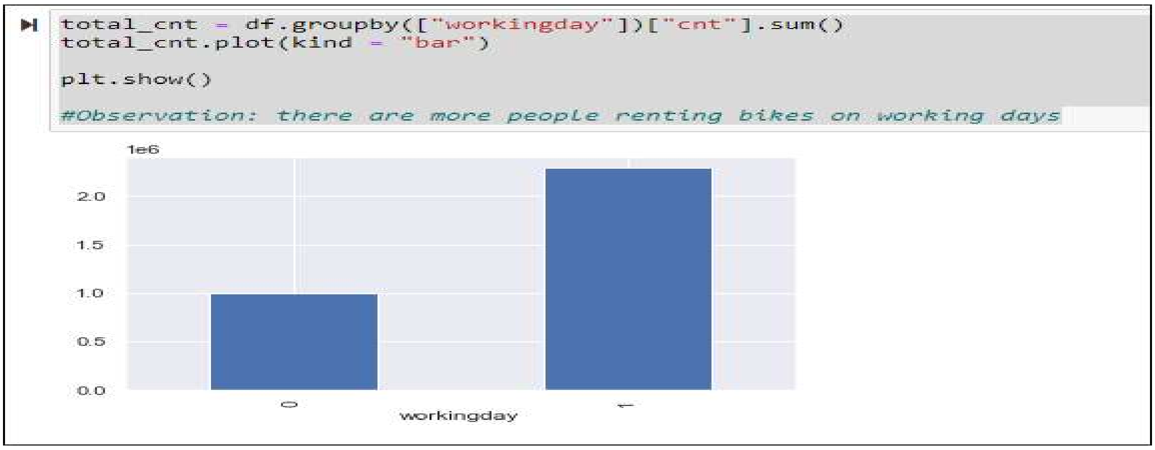
Assignment-based Subjective Questions

1. **From your analysis of the categorical variables from the dataset, what could you infer about their effect on the dependent variable? (3 marks)**
   - More people rent bikes during working days.

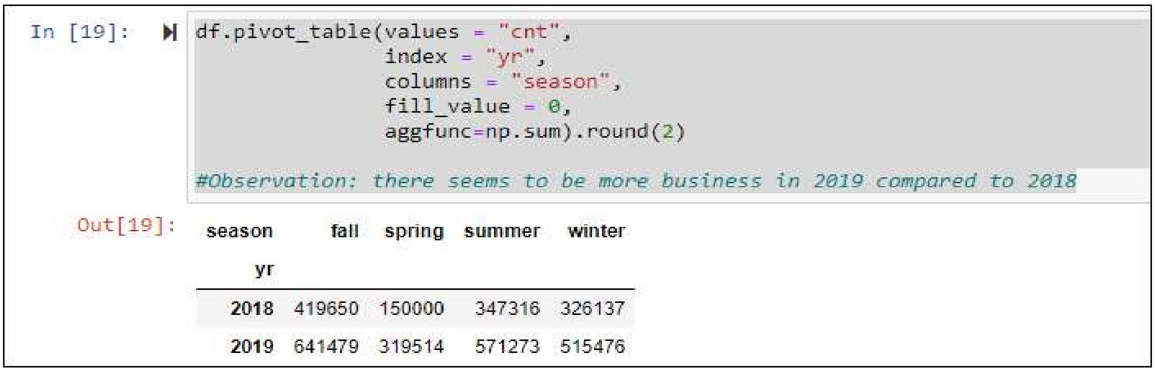


```
total_cnt = df.groupby(["workingday"])["cnt"].sum()
total_cnt.plot(kind = "bar")

plt.show()

#Observation: there are more people renting bikes on working days
```

   - Business is more in 2019 compared to 2018.



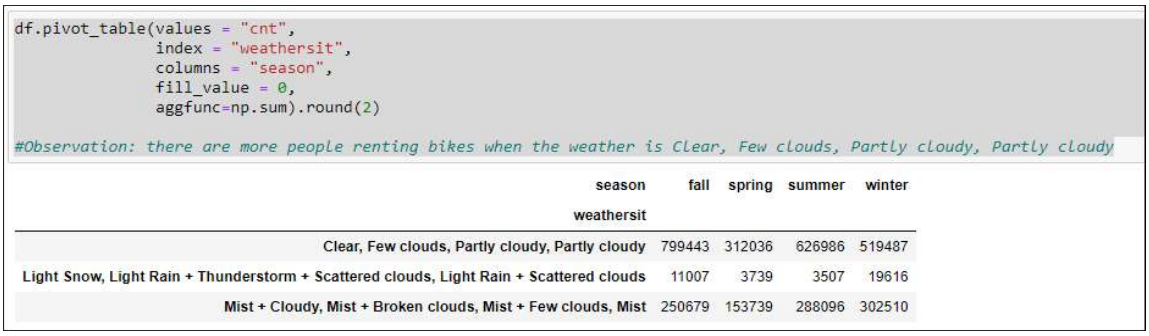
```
In [19]:  df.pivot_table(values = "cnt",
                         index = "yr",
                         columns = "season",
                         fill_value = 0,
                         aggfunc=np.sum).round(2)

          #Observation: there seems to be more business in 2019 compared to 2018
```

Out[19]:

season	fall	spring	summer	winter
yr				
2018	419650	150000	347316	326137
2019	641479	319514	571273	515476

   - There are more people using boombikes when the weather is "Clear, Few clouds, partly cloudy, partly cloudy"

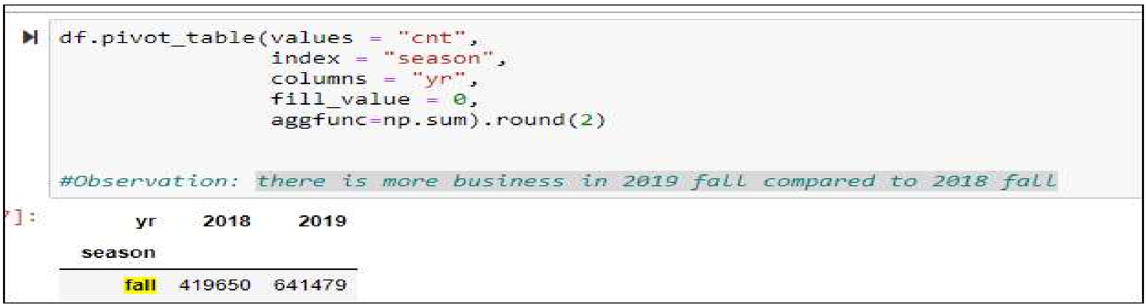


```
df.pivot_table(values = "cnt",
               index = "weathersit",
               columns = "season",
               fill_value = 0,
               aggfunc=np.sum).round(2)

#Observation: there are more people renting bikes when the weather is Clear, Few clouds, Partly cloudy, Partly cloudy
```

season	fall	spring	summer	winter
weathersit				
Clear, Few clouds, Partly cloudy, Partly cloudy	799443	312036	626986	519487
Light Snow, Light Rain + Thunderstorm + Scattered clouds, Light Rain + Scattered clouds	11007	3739	3507	19616
Mist + Cloudy, Mist + Broken clouds, Mist + Few clouds, Mist	250679	153739	288096	302510

   - There is more business in 2019 fall compared to 2018 fall



```
df.pivot_table(values = "cnt",
               index = "season",
               columns = "yr",
               fill_value = 0,
               aggfunc=np.sum).round(2)

#Observation: there is more business in 2019 fall compared to 2018 fall
```

]:

yr	2018	2019
season		
fall	419650	641479

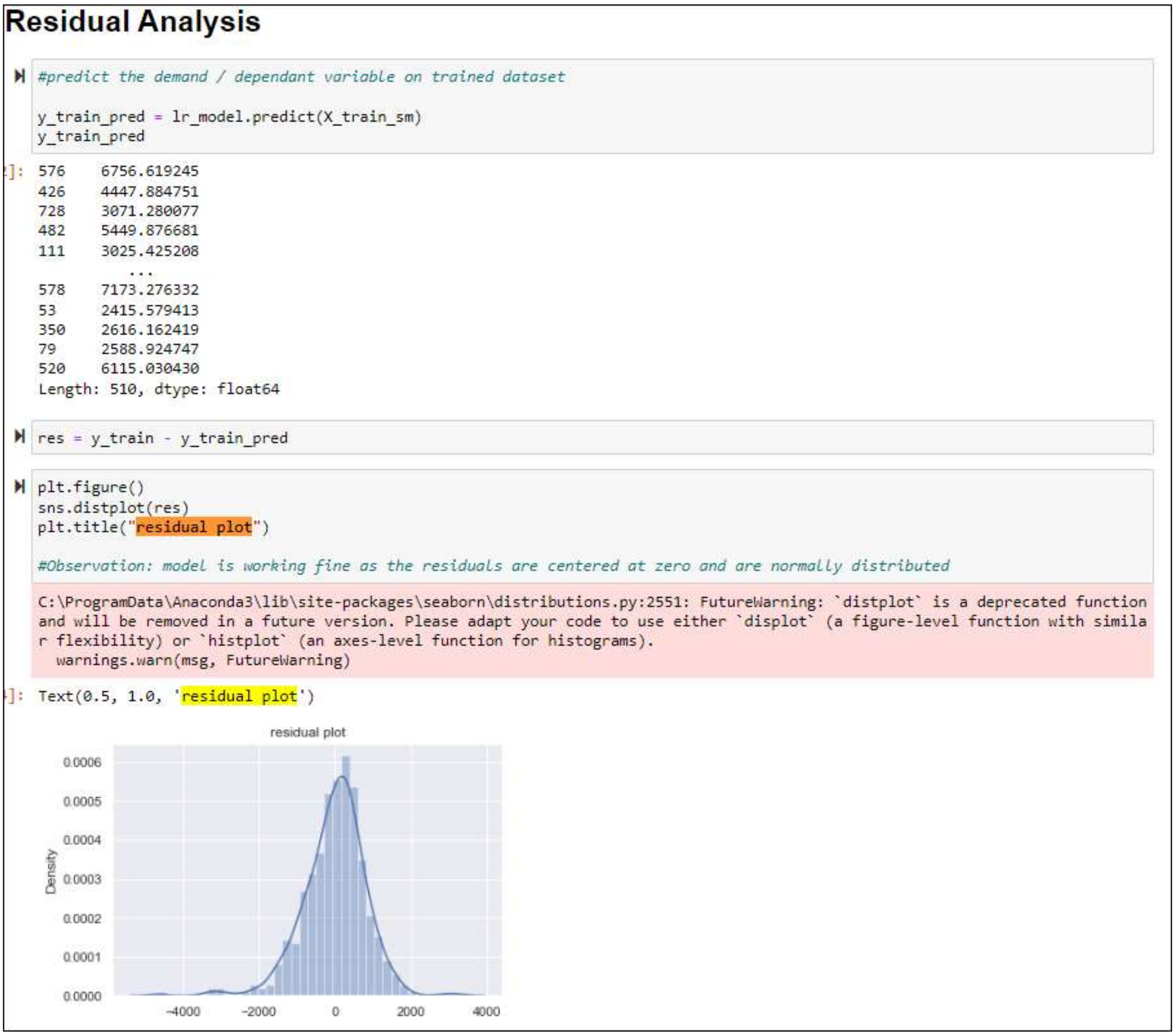
2. **Why is it important to use drop_first=True during dummy variable creation? (2 mark)**

While creating dummy variables to represent categorical data, it's common practice to drop one of the dummy variables to avoid multicollinearity in simple words when all given variables are included, they become perfectly correlated, leading to multicollinearity. By dropping one, we avoid this redundancy.

3. **Looking at the pair-plot among the numerical variables, which one has the highest correlation with the target variable? (1 mark)**
   Temperature in Celsius (temp) and feeling temperature in Celsius (atemp)
   has highest correlation of 0.63

4. **How did you validate the assumptions of Linear Regression after building the model on the training set? (3 marks)**
   We validate the assumptions of linear regression after building the model on the training set by doing residuals analysis, which concludes residuals are normally distributed.

   Pic depicts: Center of distribution is zero and shape is normal distribution.



Residual Analysis

```
#predict the demand / dependant variable on trained dataset

y_train_pred = lr_model.predict(X_train_sm)
y_train_pred
```

```
]: 576    6756.619245
   426    4447.884751
   728    3071.280077
   482    5449.876681
   111    3025.425208
             ...
   578    7173.276332
   53     2415.579413
   350    2616.162419
   79     2588.924747
   520    6115.030430
   Length: 510, dtype: float64
```

```
res = y_train - y_train_pred
```

```
plt.figure()
sns.distplot(res)
plt.title("residual plot")

#Observation: model is working fine as the residuals are centered at zero and are normally distributed
```

```
C:\ProgramData\Anaconda3\lib\site-packages\seaborn\distributions.py:2551: FutureWarning: `distplot` is a deprecated function
and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with simila
r flexibility) or `histplot` (an axes-level function for histograms).
  warnings.warn(msg, FutureWarning)
```

```
]: Text(0.5, 1.0, 'residual plot')
```

5. **Based on the final model, which are the top 3 features contributing significantly towards explaining the demand of the shared bikes? (2 marks)**
   Top 3 features contributing to demand in shared bikes are:
   1. Weather Light Snow, Light Rain + Thunderstorm + Scattered clouds, Light Rain + Scattered clouds which has strong negative correlation

2. Windspeed also negative correlation
3. Year has strong positive correlation

General Subjective Questions

1. **Explain the linear regression algorithm in detail. (4 marks)**
   Linear regression is a supervised machine-learning algorithm, where there is linear relationship between independent variables (x1, x2 etc) and dependent variable(y).

   Based on the data points machines learns and plots a line that models the line best. The line is modelled as below linear equation

   y = b0 + b1X1

   For multiple linear regression where multiple independent variables are there, the equation is as follows:

   y = b0 + b1X1 + b2X2 + …. + bnXn

2. **Explain the Anscombe's quartet in detail. (3 marks)**

   Anscombe's quartet comprises four data sets with eleven data points that have similar descriptive statistics, yet have very different distributions and appear very different when graphed. They were constructed in 1973 by the statistician Francis Anscombe to demonstrate both the importance of graphing data when analysing 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."

3. **What is Pearson's R? (3 marks)**

   Pearson's correlation coefficient also known as Person's r is a statistic that measures the strength of linear correlation between two variables.

   The more inclined the value of Pearson's r towards +1 or – 1, the stronger is the association between two variables.

   +1 indicates perfect positive relationship, -1 indicates a perfect negative relationship and 0 indicates no relationship exists.

4. **What is scaling? Why is scaling performed? What is the difference between normalized scaling and standardized scaling? (3 marks)**

   Scaling is bringing all the variables to a common scale.

   If the variables are at *different or larger scale,* then the coefficients of the variables also vary accordingly.

   If the variables are at *same* scale, then the coefficients are also comparable.

   Scaling is performed to make the minimization routine faster and much effective.

   Normalized scaling converts the data of the variable between 0 and 1 whereas standardized scaling changes the mean of the data to 0 and standard deviation to 1.

5. **You might have observed that sometimes the value of VIF is infinite. Why does this happen? (3 marks)**

   In case of perfect correlation, R square is 1 leading to VIF infinite value.

   To solve this, we can drop one of the variables from the dataset, which is causing this perfect multicollinearity.

6. **What is a Q-Q plot? Explain the use and importance of a Q-Q plot in linear regression. (3 marks)**

   Quantile-Quantile (Q-Q) plot is a graphical tool, which show the quantiles two of sample distribution to determine if the two sets of data come from same distribution.

   This helps to confirm the training and test set of data for our linear regression are from populations with same distributions, have common location and scale, have similar distributional shapes (normal, exponential or uniform) and have similar tail behaviour.