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Linear Regression Project

An Ecommerce company based in New York City that sells clothing online but they also have in-store style and clothing advice sessions. Customers come in to the store, have sessions/meetings with a personal stylist, then they can go home and order either on a mobile app or website for the clothes they want.

The company is trying to decide whether to focus their efforts on their mobile app experience or their website.

Imports

Import pandas, numpy, matplotlib,and seaborn.

In [2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

In [3]:
```
%matplotlib inline
```

Get the Data

Ecommerce Customers csv file from the company. It has Customer info, suchas Email, Address, and their color Avatar. Then it also has numerical value columns:

- Avg. Session Length: Average session of in-store style advice sessions.
- Time on App: Average time spent on App in minutes
- Time on Website: Average time spent on Website in minutes
- Length of Membership: How many years the customer has been a member.

In [4]:
```
customers = pd.read_csv('Ecommerce Customers')
```

Checking the head of customers, and checking out its info() and describe() methods.

In [5]:
```
customers.head()
```

Out[5]:

	Email	Address	Avatar	Avg. Session Length	Time on App	Time on Website	Length of Membership	Yearly Amount Spent
0	mstephenson@fernandez.com	835 Frank Tunnel\nWrightmouth, MI 82180-9605	Violet	34.497268	12.655651	39.577668	4.082621	587.951054
1	hduke@hotmail.com	4547 Archer Common\nDiazchester, CA 06566-8576	DarkGreen	31.926272	11.109461	37.268959	2.664034	392.204933
2	pallen@yahoo.com	24645 Valerie Unions Suite 582\nCobbborough, D...	Bisque	33.000915	11.330278	37.110597	4.104543	487.547505
3	riverarebecca@gmail.com	1414 David Throughway\nPort Jason, OH 22070-1220	SaddleBrown	34.305557	13.717514	36.721283	3.120179	581.852344
4	mstephens@davidson-herman.com	14023 Rodriguez Passage\nPort Jacobville, PR 3...	MediumAquaMarine	33.330673	12.795189	37.536653	4.446308	599.406092

In [6]:
```
customers.describe()
```

Out[6]:

	Avg. Session Length	Time on App	Time on Website	Length of Membership	Yearly Amount Spent
count	500.000000	500.000000	500.000000	500.000000	500.000000
mean	33.053194	12.052488	37.060445	3.533462	499.314038
std	0.992563	0.994216	1.010489	0.999278	79.314782
min	29.532429	8.508152	33.913847	0.269901	256.670582
25%	32.341822	11.388153	36.349257	2.930450	445.038277
50%	33.082008	11.983231	37.069367	3.533975	498.887875
75%	33.711985	12.753850	37.716432	4.126502	549.313828
max	36.139662	15.126994	40.005182	6.922689	765.518462

In [7]:
```
customers.info()
```

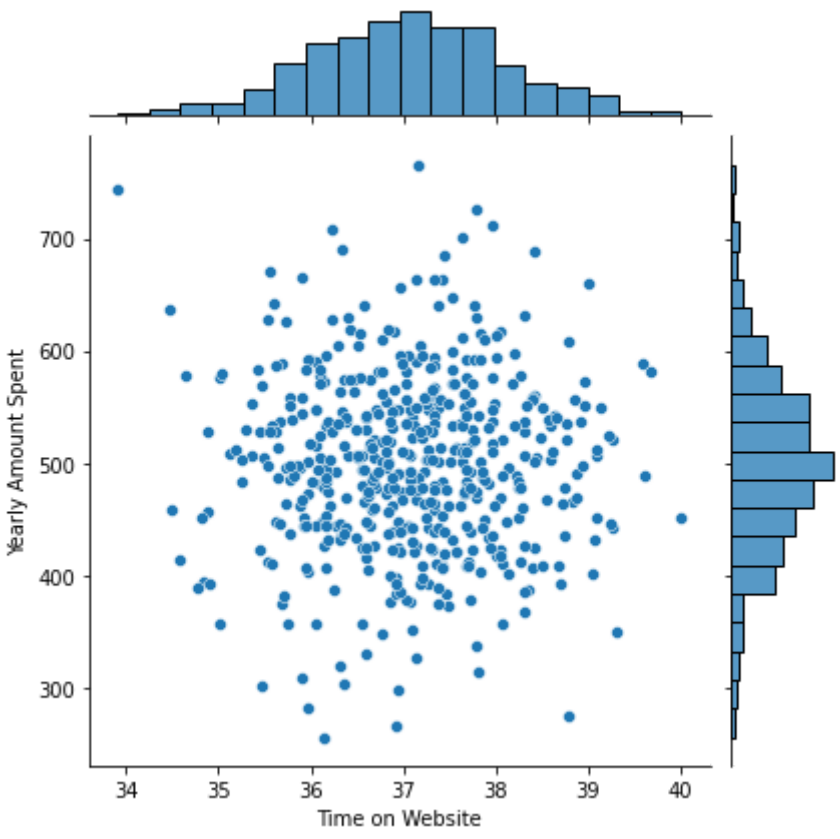
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 500 entries, 0 to 499
Data columns (total 8 columns):
 #   Column                Non-Null Count  Dtype  
---  ------                --------------  -----  
 0   Email                 500 non-null    object 
 1   Address               500 non-null    object 
 2   Avatar                500 non-null    object 
 3   Avg. Session Length   500 non-null    float64
 4   Time on App           500 non-null    float64
 5   Time on Website       500 non-null    float64
 6   Length of Membership  500 non-null    float64
 7   Yearly Amount Spent   500 non-null    float64
dtypes: float64(5), object(3)
memory usage: 31.4+ KB
```

Exploratory Data Analysis

**Using seaborn to create a jointplot to compare the Time on Website and Yearly Amount Spent columns.

In [8]:
```
sns.jointplot(data=customers,x='Time on Website',y='Yearly Amount Spent')
```

Out[8]: <seaborn.axisgrid.JointGrid at 0x28528592dd0>



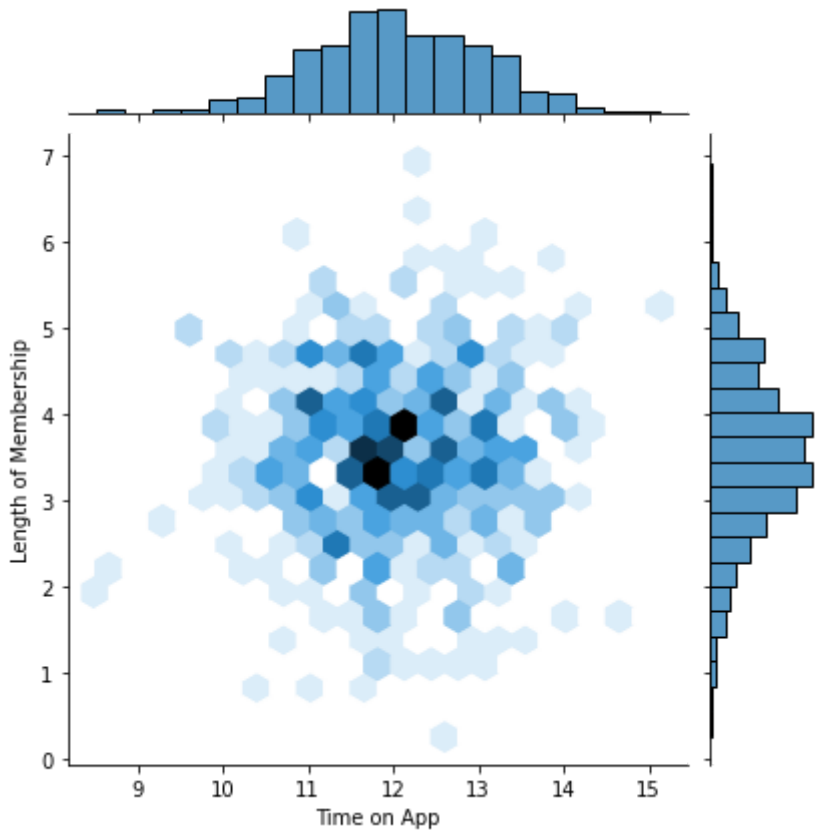
** Doing the same but with the Time on App column instead. **

In [9]:
```
sns.jointplot(data=customers,x='Time on App',y='Yearly Amount Spent')
```

** Using jointplot to create a 2D hex bin plot comparing Time on App and Length of Membership.**

In [10]:
```
sns.jointplot(data=customers,x='Time on App',y='Length of Membership', kind='hex')
```

Out[10]: <seaborn.axisgrid.JointGrid at 0x2852a9932b0>



**exploring these types of relationships across the entire data set. Using [pairplot]

In [11]:
```
sns.pairplot(customers)
```

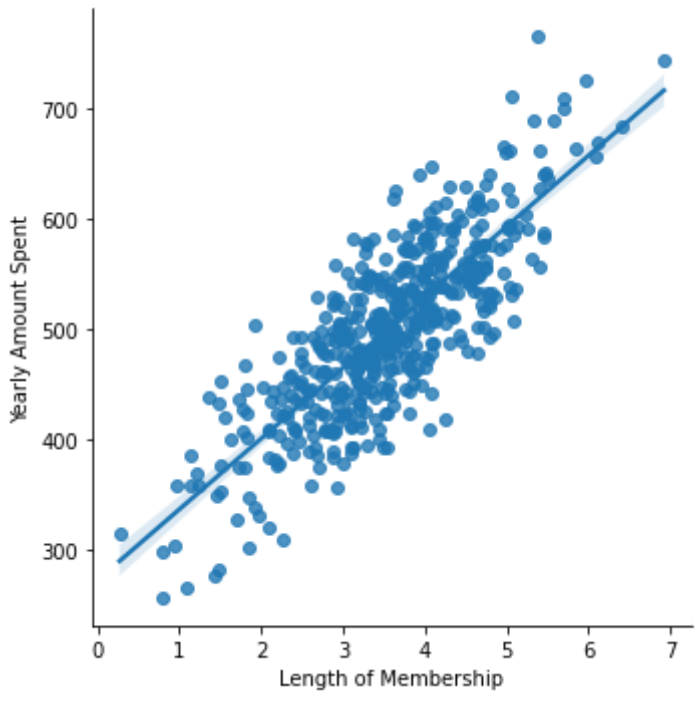
Based off this plot what looks to be the most correlated feature with Yearly Amount Spent?

In [285]:
```
#Length of Membership
```

*Creating a linear model plot (using seaborn's lmplot) of Yearly Amount Spent vs. Length of Membership. *

In [12]:
```
sns.lmplot(x='Length of Membership',y='Yearly Amount Spent', data=customers)
```

Out[12]: <seaborn.axisgrid.FacetGrid at 0x2852841b1c0>



Training and Testing Data

split the data into training and testing sets. ** Setting a variable X equal to the numerical features of the customers and a variable y equal to the "Yearly Amount Spent" column. **

In [13]:
```
customers.columns
```

Out[13]:
```
Index(['Email', 'Address', 'Avatar', 'Avg. Session Length', 'Time on App',
       'Time on Website', 'Length of Membership', 'Yearly Amount Spent'],
      dtype='object')
```

In [18]:
```
y = customers['Yearly Amount Spent']
```

In [19]:
```
X = customers[['Avg. Session Length', 'Time on App',
       'Time on Website', 'Length of Membership']]
```

** Using model_selection.train_test_split from sklearn to split the data into training and testing sets. Set test_size=0.3**

In [20]:
```
from sklearn.model_selection import train_test_split
```

In [22]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3)
```

Training the Model

** Importing LinearRegression from sklearn.linear_model **

In [23]:
```
from sklearn.linear_model import LinearRegression
```

Creating an instance of a LinearRegression() model named lm.

In [24]:
```
lm = LinearRegression()
```

** Train/fit lm on the training data.**

In [25]:
```
lm.fit(X_train,y_train)
```

Out[25]:
```
LinearRegression()
```
In a Jupyter environment, please rerun this cell to show the HTML representation or trust the notebook.
On GitHub, the HTML representation is unable to render, please try loading this page with nbviewer.org.

Print out the coefficients of the model

In [26]:
```
lm.coef_
```

Out[26]:
```
array([25.98154972, 38.59015875,  0.19040528, 61.27909654])
```

Predicting Test Data

Evaluating its performance by predicting off the test values!

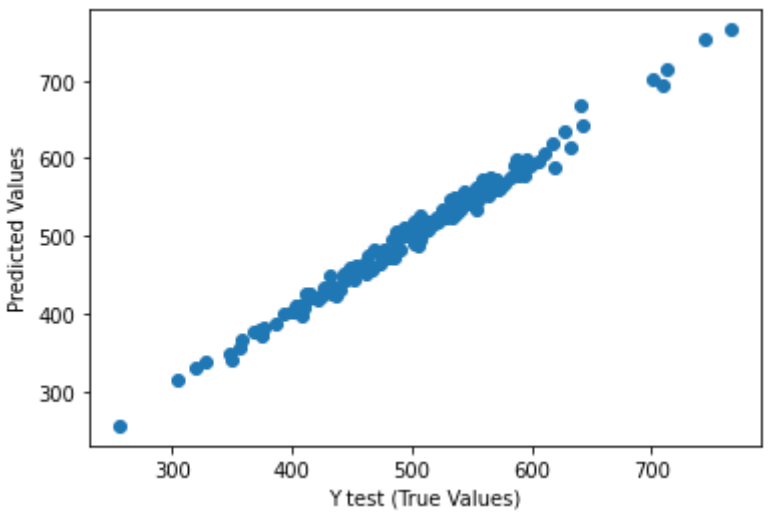
** Using lm.predict() to predict off the X_test set of the data.**

In [27]:
```
predictions = lm.predict(X_test)
```

** Creating a scatterplot of the real test values versus the predicted values. **

In [28]:
```
plt.scatter(y_test,predictions)
plt.xlabel('Y test (True Values)')
plt.ylabel('Predicted Values')
```

Out[28]:
```
Text(0, 0.5, 'Predicted Values')
```



Evaluating the Model

Evaluating our model performance by calculating the residual sum of squares and the explained variance score (R^2).

** Calculating the Mean Absolute Error, Mean Squared Error, and the Root Mean Squared Error.**

In [29]:
```
from sklearn import metrics
```

In [30]:
```
print('MAE', metrics.mean_absolute_error(y_test,predictions))
print('MAE', metrics.mean_squared_error(y_test,predictions))
print('MAE', np.sqrt(metrics.mean_absolute_error(y_test,predictions)))
```

```
MAE 7.228148653430826
MAE 79.81305165097427
MAE 2.688521648309871
```

In [31]:
```
metrics.explained_variance_score(y_test,predictions)
```

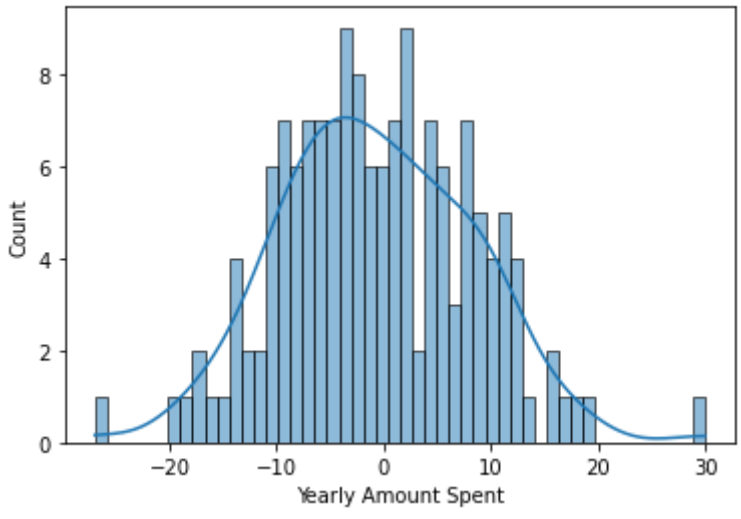
Out[31]:
```
0.9890771231889606
```

Residuals

Ploting a histogram of the residuals and make sure it looks normally distributed

In [34]:
```
sns.histplot((y_test-predictions),bins=50, kde=True)
```

Out[34]: <AxesSubplot:xlabel='Yearly Amount Spent', ylabel='Count'>



Conclusion

Recreating the dataframe below.

In [37]:
```
cdf = pd.DataFrame(lm.coef_,X.columns, columns=['Coeff'])

cdf
```

Out[37]:

	Coeff
Avg. Session Length	25.981550
Time on App	38.590159
Time on Website	0.190405
Length of Membership	61.279097

Interpreting these coefficients?

1. Unit increase in Avg. Session Length, leads to $25.98 increase in yearly amount spent
2. Unit increase in Time on App, leads to $38.59 increase in yearly amount spent
3. Unit increase in Time on Website, leads to $0.19 increase in yearly amount spent
4. Unit increase in Length of Membership , leads to $61.27 increase in yearly amount spent