Logistic Regression Project

June 10, 2018

1 Logistic Regression Project

In this project we will be working with a fake advertising data set, indicating whether or not a particular internet user clicked on an Advertisement on a company website. We will try to create a model that will predict whether or not they will click on an ad based off the features of that user.

This data set contains the following features:

- 'Daily Time Spent on Site': consumer time on site in minutes
- 'Age': cutomer age in years
- 'Area Income': Avg. Income of geographical area of consumer
- 'Daily Internet Usage': Avg. minutes a day consumer is on the internet
- 'Ad Topic Line': Headline of the advertisement
- 'City': City of consumer
- 'Male': Whether or not consumer was male
- 'Country': Country of consumer
- 'Timestamp': Time at which consumer clicked on Ad or closed window
- 'Clicked on Ad': 0 or 1 indicated clicking on Ad

1.1 Import Libraries

```
In [97]: import pandas as pd
         import numpy as np
         import matplotlib.pyplot as plt
         import seaborn as sns
         %matplotlib inline
```

1.2 Get the Data

Read in the advertising.csv file and set it to a data frame called ad_data.

```
In [98]: ad_data = pd.read_csv('advertising.csv')
```

Check the head of ad_data

```
In [40]: ad_data.head()
```

```
Out[40]:    Daily Time Spent on Site  Age  Area Income  Daily Internet Usage  \
         0                     68.95   35     61833.90                256.09
         1                     80.23   31     68441.85                193.77
         2                     69.47   26     59785.94                236.50
         3                     74.15   29     54806.18                245.89
         4                     68.37   35     73889.99                225.58

                            Ad Topic Line            City  Male     Country  \
         0     Cloned 5thgeneration orchestration     Wrightburgh     0     Tunisia
         1     Monitored national standardization       West Jodi     1       Nauru
         2       Organic bottom-line service-desk        Davidton     0  San Marino
         3  Triple-buffered reciprocal time-frame  West Terrifurt     1       Italy
         4          Robust logistical utilization    South Manuel     0     Iceland

                      Timestamp  Clicked on Ad
         0  2016-03-27 00:53:11              0
         1  2016-04-04 01:39:02              0
         2  2016-03-13 20:35:42              0
         3  2016-01-10 02:31:19              0
         4  2016-06-03 03:36:18              0
```

** Use info and describe() on ad_data**

```
In [41]: ad_data.info()

<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 10 columns):
Daily Time Spent on Site    1000 non-null float64
Age                         1000 non-null int64
Area Income                 1000 non-null float64
Daily Internet Usage        1000 non-null float64
Ad Topic Line               1000 non-null object
City                        1000 non-null object
Male                        1000 non-null int64
Country                     1000 non-null object
Timestamp                   1000 non-null object
Clicked on Ad               1000 non-null int64
dtypes: float64(3), int64(3), object(4)
memory usage: 78.2+ KB


In [42]: ad_data.describe()

Out[42]:        Daily Time Spent on Site          Age   Area Income  \
         count               1000.000000  1000.000000   1000.000000
         mean                  65.000200    36.009000  55000.000080
         std                   15.853615     8.785562  13414.634022
         min                   32.600000    19.000000  13996.500000
```

```
25%                   51.360000    29.000000  47031.802500
50%                   68.215000    35.000000  57012.300000
75%                   78.547500    42.000000  65470.635000
max                   91.430000    61.000000  79484.800000
```

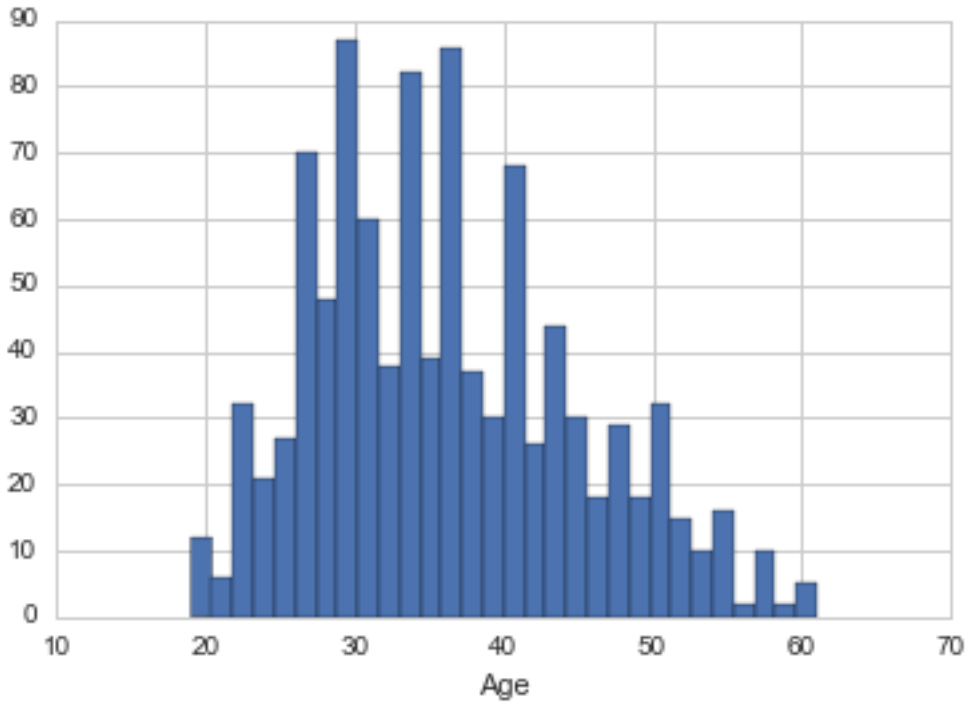
```
       Daily Internet Usage         Male  Clicked on Ad
count           1000.000000  1000.000000     1000.00000
mean             180.000100     0.481000        0.50000
std               43.902339     0.499889        0.50025
min              104.780000     0.000000        0.00000
25%              138.830000     0.000000        0.00000
50%              183.130000     0.000000        0.50000
75%              218.792500     1.000000        1.00000
max              269.960000     1.000000        1.00000
```

1.3 Exploratory Data Analysis

** Create a histogram of the Age**

```
In [48]: sns.set_style('whitegrid')
         ad_data['Age'].hist(bins=30)
         plt.xlabel('Age')
```

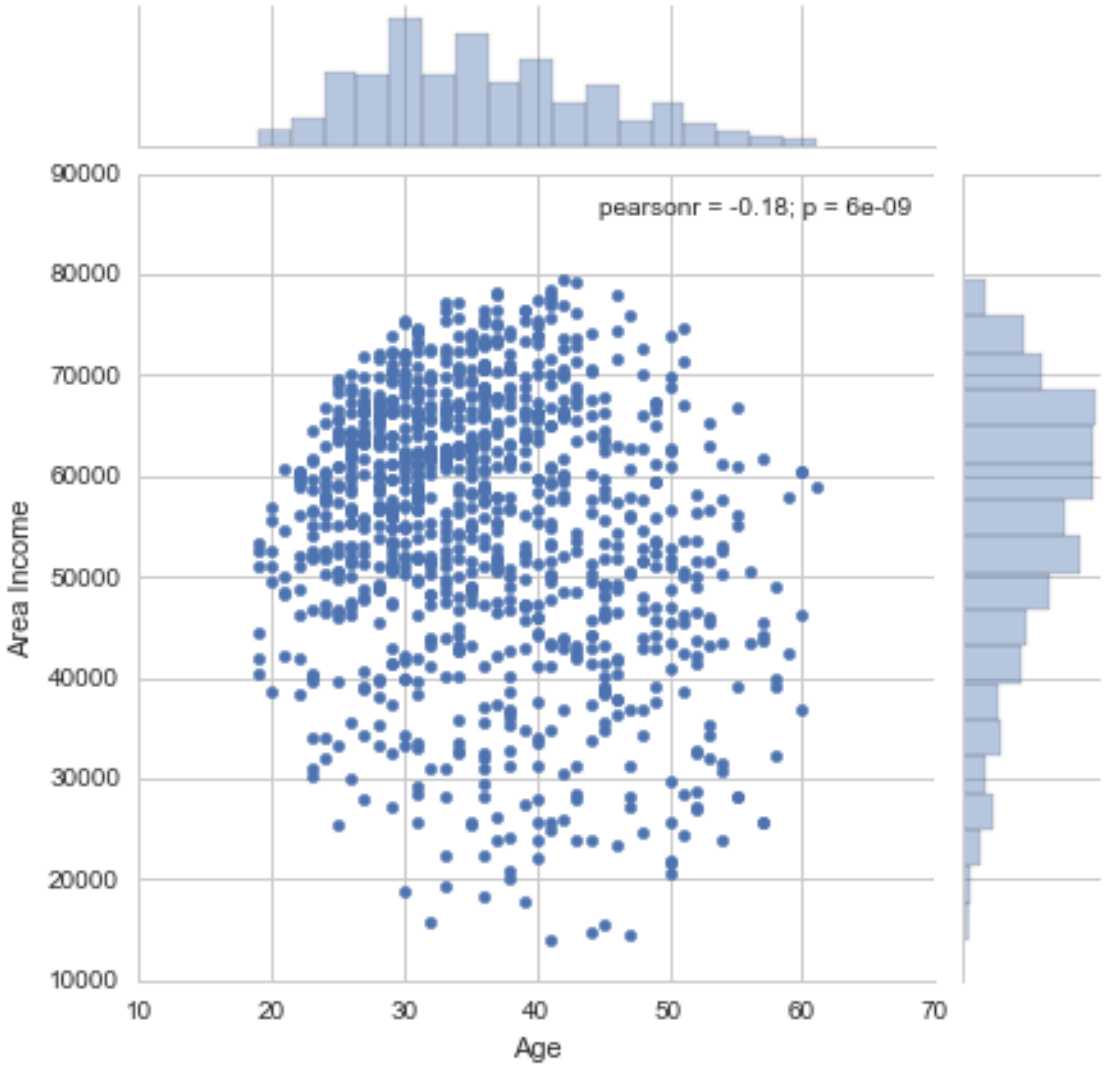
```
Out[48]: <matplotlib.text.Text at 0x11a05b908>
```



Create a jointplot showing Area Income versus Age.

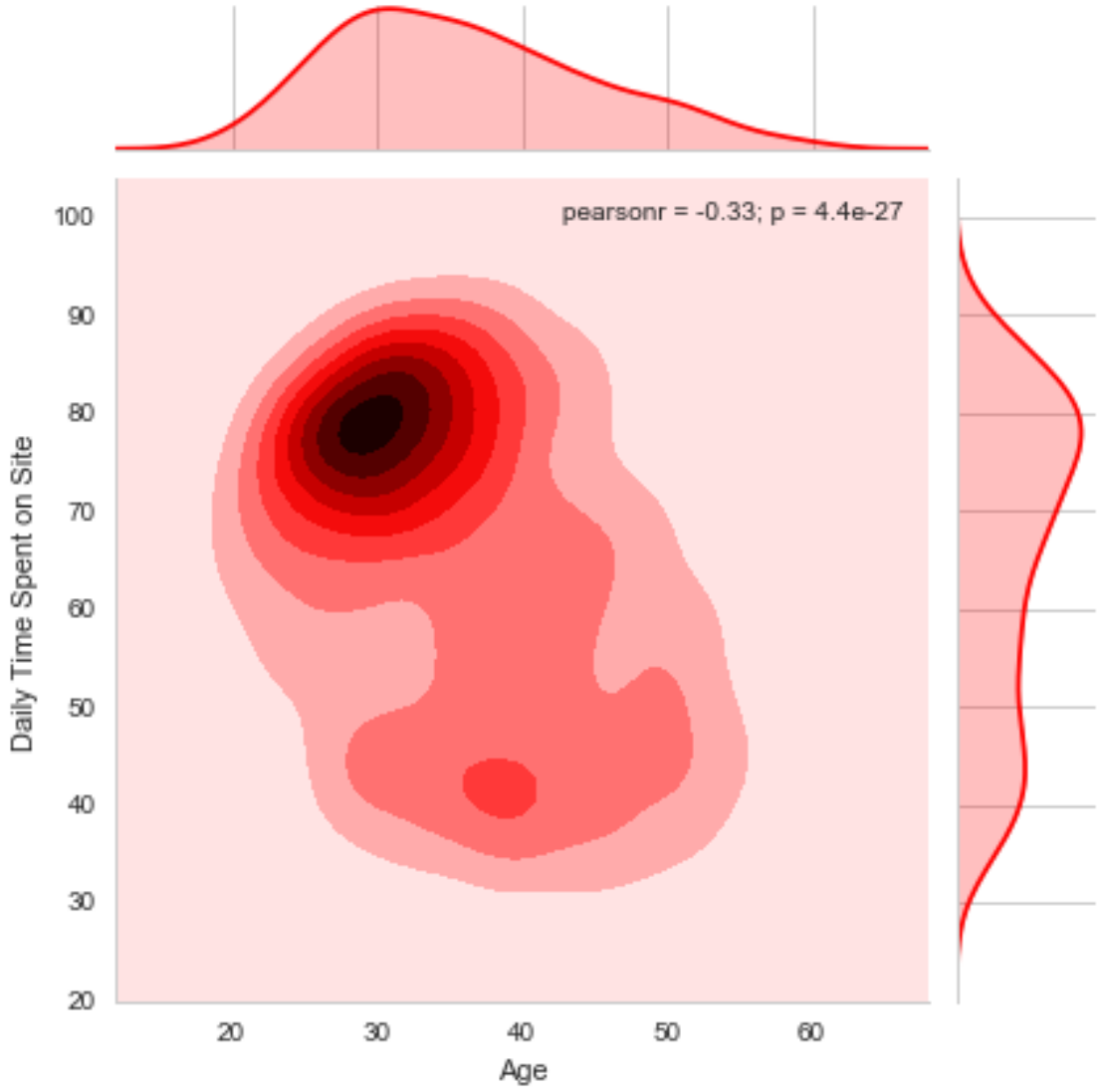
```
In [64]: sns.jointplot(x='Age',y='Area Income',data=ad_data)
```

```
Out[64]: <seaborn.axisgrid.JointGrid at 0x120bbb390>
```



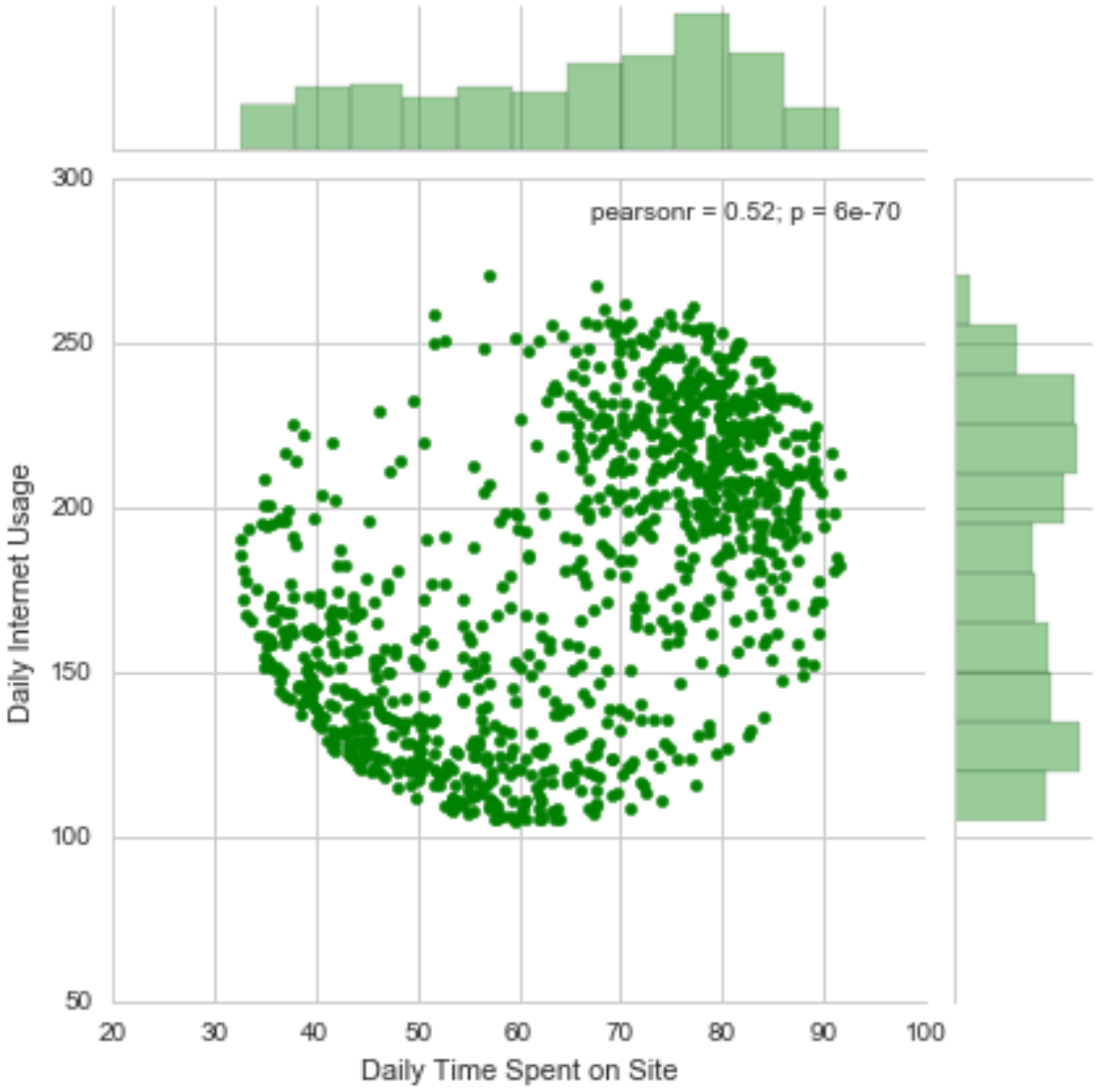
Create a jointplot showing the kde distributions of Daily Time spent on site vs. Age.

```
In [66]: sns.jointplot(x='Age',y='Daily Time Spent on Site',data=ad_data,color='red',kind='kde
```



** Create a jointplot of 'Daily Time Spent on Site' vs. 'Daily Internet Usage'**

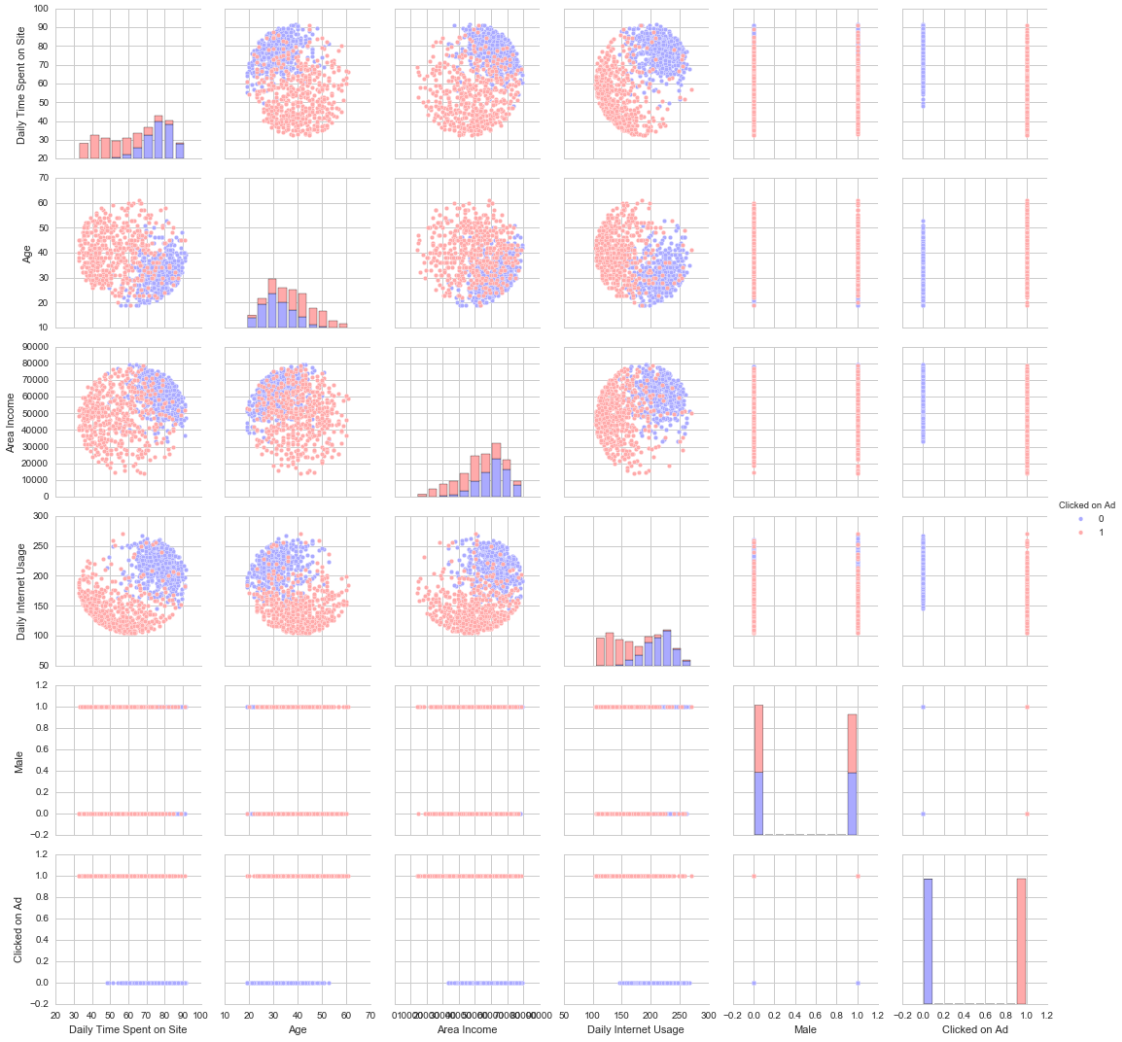
```
In [72]: sns.jointplot(x='Daily Time Spent on Site',y='Daily Internet Usage',data=ad_data,colo

Out[72]: <seaborn.axisgrid.JointGrid at 0x121e8cb00>
```



** Finally, create a pairplot with the hue defined by the 'Clicked on Ad' column feature.**

```
In [84]: sns.pairplot(ad_data,hue='Clicked on Ad',palette='bwr')
```

```
Out[84]: <seaborn.axisgrid.PairGrid at 0x12a97fdd8>
```



2 Logistic Regression

Now it's time to do a train test split, and train our model!

** Split the data into training set and testing set using train_test_split**

```
In [85]: from sklearn.model_selection import train_test_split
```

```
In [88]: X = ad_data[['Daily Time Spent on Site', 'Age', 'Area Income','Daily Internet Usage',
         y = ad_data['Clicked on Ad']
```

```
In [89]: X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, random_state
```

** Train and fit a logistic regression model on the training set.**

```
In [91]: from sklearn.linear_model import LogisticRegression
```

```
In [92]: logmodel = LogisticRegression()
         logmodel.fit(X_train,y_train)
```

```
Out[92]: LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
                   intercept_scaling=1, max_iter=100, multi_class='ovr', n_jobs=1,
                   penalty='l2', random_state=None, solver='liblinear', tol=0.0001,
                   verbose=0, warm_start=False)
```

2.1 Predictions and Evaluations

** Now predict values for the testing data.**

```
In [94]: predictions = logmodel.predict(X_test)
```

** Create a classification report for the model.**

```
In [95]: from sklearn.metrics import classification_report
```

```
In [96]: print(classification_report(y_test,predictions))
```

```
             precision    recall  f1-score   support

          0       0.87      0.96      0.91       162
          1       0.96      0.86      0.91       168

avg / total       0.91      0.91      0.91       330
```