Project 2

March 19, 2017

1 Project 2

I chose to investigate the Titanic data. It looks like a sample of the passengers on the Titanic. The question I'd like to answer through this project is:

What factors made people more likely to survive?

In this analysis, I'll be examining 3 factors: - Gender - Age - Class

I will use Jupyter Notebook, along with the numpy, pandas, and matplotlib python libraries to aid me in analyzing the dataset.

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

        data = pd.read_csv("/Users/davidhe/Downloads/UDAND/Project 2/titanic-data.c
        data.head() #Checking to see if the csv file was read properly
        data.tail()
```

```
Out[2]:      PassengerId  Survived  Pclass                                      Nam
        886          887         0       2                           Montvila, Rev. Juoza
        887          888         1       1                    Graham, Miss. Margaret Edit
        888          889         0       3  Johnston, Miss. Catherine Helen "Carrie
        889          890         1       1                           Behr, Mr. Karl Howel
        890          891         0       3                             Dooley, Mr. Patric

                Sex   Age  SibSp  Parch      Ticket   Fare Cabin Embarked
        886    male  27.0      0      0      211536  13.00   NaN        S
        887  female  19.0      0      0      112053  30.00   B42        S
        888  female   NaN      1      2  W./C. 6607  23.45   NaN        S
        889    male  26.0      0      0      111369  30.00  C148        C
        890    male  32.0      0      0      370376   7.75   NaN        Q
```

After getting a feel for what fields this data contains and what it looks like, I'm ready to check the data types and clean the data, since there are missing values based on what I see above in the last 5 rows of data.

1.1 Cleaning Data

Now, I want to keep only the relevant columns that will help with my analysis, and check to see the data types and missing values in my data.

I think the following can be dropped for the following reason:

- Name - this analysis is objective, the name is irrelevant
- Ticket - it does not provide any sort of pattern, and cannot be calculated into something useful
- Cabin - same as above, and also Pclass and Fare can be good substitutes, with more telling data
- Embarked - unless people who board the ship at different stations tend to behave in a drastically different way, or have much better physique to survive cold ocean water... probably not relevant in this analysis

```
In [3]: new_Data = data.drop(['Name','Ticket','Cabin','Embarked'],1)
        new_Data.head() # Looks good
```

```
Out[3]:    PassengerId  Survived  Pclass     Sex   Age  SibSp  Parch     Fare
        0            1         0       3    male  22.0      1      0   7.2500
        1            2         1       1  female  38.0      1      0  71.2833
        2            3         1       3  female  26.0      0      0   7.9250
        3            4         1       1  female  35.0      1      0  53.1000
        4            5         0       3    male  35.0      0      0   8.0500
```

```
In [4]: new_Data.dtypes # Checking to see if the data types are appropriate. Looks
```

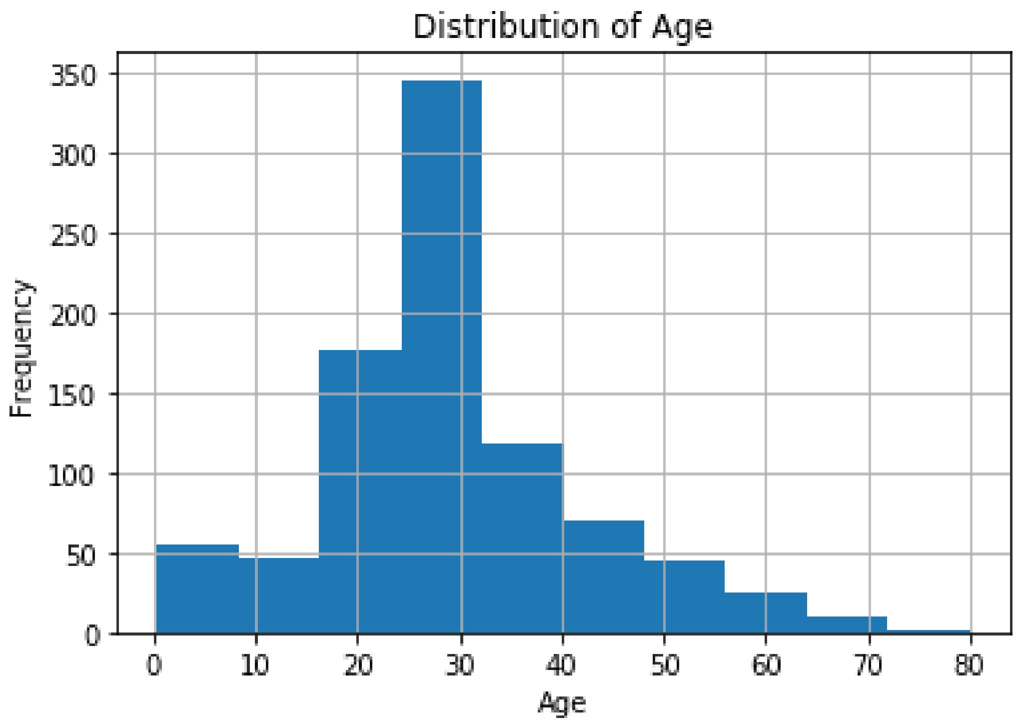
```
Out[4]: PassengerId      int64
        Survived         int64
        Pclass           int64
        Sex             object
        Age            float64
        SibSp            int64
        Parch            int64
        Fare           float64
        dtype: object
```

```
In [5]: new_Data.isnull().sum() # Looks like Age has missing columns.
```

```
Out[5]: PassengerId      0
        Survived         0
        Pclass           0
        Sex              0
        Age            177
        SibSp            0
        Parch            0
        Fare             0
        dtype: int64
```

```
In [16]: new_Data['Age'].hist()
         plt.xlabel('Age')
         plt.ylabel('Frequency')
         plt.title('Distribution of Age')
```

```
Out[16]: <matplotlib.text.Text at 0x111d7a1d0>
```



I choose to fill all the NaNs as the median of 'Age'. This should improve potential future calculations done to 'Age', while not drastically affecting the data quality.

```
In [7]: new_Data['Age'].fillna(new_Data['Age'].median(), inplace = True)
        new_Data.isnull().sum() # No more missing values
```

```
Out[7]: PassengerId    0
        Survived       0
        Pclass         0
        Sex            0
        Age            0
        SibSp          0
        Parch          0
        Fare           0
        dtype: int64
```

1.2 Data Exploration and Visualization

```
In [8]: new_Data.describe() # Descriptive statistics
```

```
Out[8]:        PassengerId    Survived      Pclass         Age       SibSp  \
        count   891.000000  891.000000  891.000000  891.000000  891.000000
        mean    446.000000    0.383838    2.308642   29.361582    0.523008
        std     257.353842    0.486592    0.836071   13.019697    1.102743
        min       1.000000    0.000000    1.000000    0.420000    0.000000
        25%     223.500000    0.000000    2.000000   22.000000    0.000000
        50%     446.000000    0.000000    3.000000   28.000000    0.000000
        75%     668.500000    1.000000    3.000000   35.000000    1.000000
        max     891.000000    1.000000    3.000000   80.000000    8.000000

                    Parch        Fare
        count  891.000000  891.000000
        mean     0.381594   32.204208
        std      0.806057   49.693429
        min      0.000000    0.000000
        25%      0.000000    7.910400
        50%      0.000000   14.454200
        75%      0.000000   31.000000
        max      6.000000  512.329200
```

1.2.1 In the movie, I vaguely remember the line "Women and children first!" Think they had a higher survival rate?

The Gender Factor

```
In [9]: print new_Data.groupby('Sex')['Survived'].mean()

        gender_survival = new_Data[new_Data['Survived'] == 1].groupby(['Sex']).size
        gender_nonsurvival = new_Data[new_Data['Survived'] == 0].groupby(['Sex']).s
```

```
Sex
female    0.742038
male      0.188908
Name: Survived, dtype: float64
```

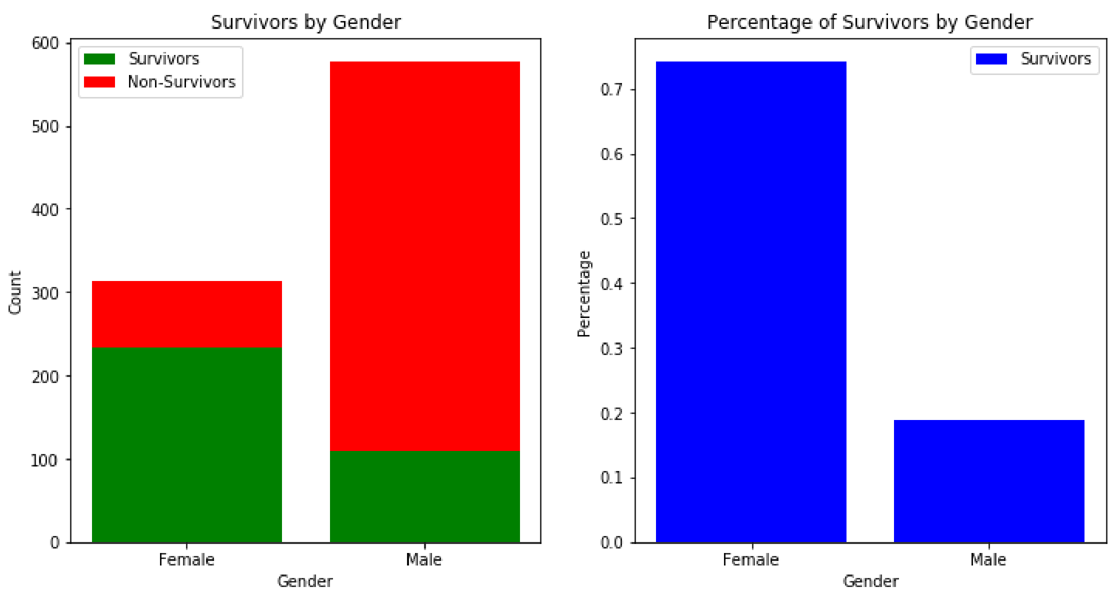
```
In [10]: male_survival_rate = new_Data['Survived'][new_Data['Sex'] == 'male'].mean
         female_survival_rate = new_Data['Survived'][new_Data['Sex'] == 'female'].m
         gender_survival_rate = [female_survival_rate,male_survival_rate]

         print 'Men had a survival rate of ', male_survival_rate
         print 'Women had a survival rate of ', female_survival_rate
```

```
Men had a survival rate of  0.188908145581
Women had a survival rate of  0.742038216561
```

```
In [11]: gender = ['Female','Male']
         fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(12,6))
```

```
ax1.bar(range(len(gender_survival)), gender_survival, label = 'Survivors',
ax1.bar(range(len(gender_nonsurvival)),gender_nonsurvival,label = 'Non-Sur
plt.sca(ax1)
plt.xticks([0, 1], gender)
ax1.set_xlabel('Gender')
ax1.set_ylabel('Count')
ax1.set_title('Survivors by Gender')
plt.legend()

plt.sca(ax2)
ax2.bar(range(len(gender_survival_rate)), gender_survival_rate,label = 'Su
plt.xticks([0,1], gender)
ax2.set_xlabel('Gender')
ax2.set_ylabel('Percentage')
ax2.set_title('Percentage of Survivors by Gender')
plt.legend()
```

Out[11]: <matplotlib.legend.Legend at 0x1114a5fd0>



As I suspected, women had a much higher survival rates (74%) than men (19%). It is also worth noting that there were a lot more male passengers onboard than female passengers.

The Age Factor

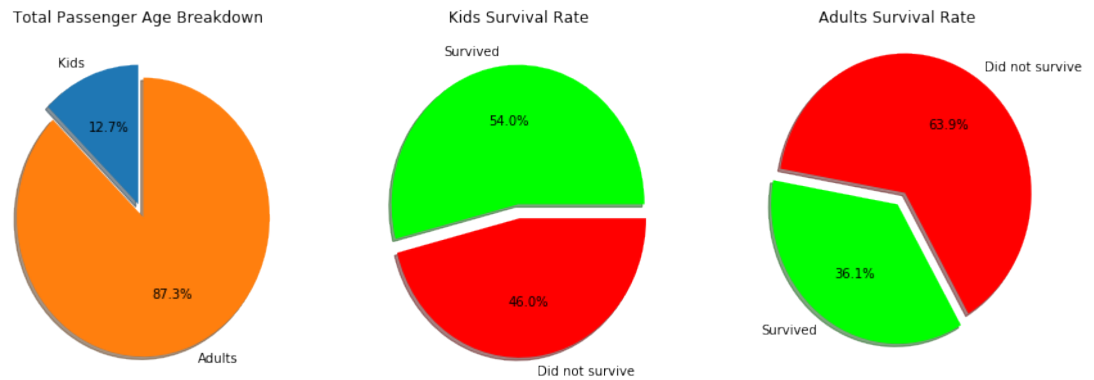
In [12]:
```
kid_survival_rate = new_Data['Survived'][new_Data['Age'] < 18].mean()
adult_survival_rate = new_Data['Survived'][new_Data['Age'] >= 18].mean()
age_survival_rate = [kid_survival_rate, adult_survival_rate]
kid_nonsurvival_rate = 1 - kid_survival_rate
adult_nonsurvival_rate = 1 - adult_survival_rate
```

```
        print 'The survival rate of kids below the age of 18 is', kid_survival_rat
        print 'The survival rate of adults is', adult_survival_rate
```

```
The survival rate of kids below the age of 18 is 0.53982300885
The survival rate of adults is 0.36118251928
```

```
In [13]: age_count = [len(new_Data[new_Data['Age'] < 18]), len(new_Data[new_Data['A
         kid_survival = [kid_survival_rate,kid_nonsurvival_rate]
         adult_survival = [adult_survival_rate, adult_nonsurvival_rate]
         labels1 = 'Kids', 'Adults'
         labels2 = 'Survived', 'Did not survive'
         colors = ['lime','red']
         explode = (0, 0.1)

         fig, (ax1, ax2, ax3) = plt.subplots(1,3,figsize=(15,5))
         ax1.pie(age_count, explode=explode, labels=labels1,autopct='%1.1f%%',shado
         ax1.set_title("Total Passenger Age Breakdown")

         ax2.pie(kid_survival,explode=explode,labels=labels2,autopct='%1.1f%%',shad
         ax2.set_title('Kids Survival Rate')

         ax3.pie(adult_survival,explode=explode,labels=labels2,autopct='%1.1f%%',sh
         ax3.set_title('Adults Survival Rate')
```

```
Out[13]: <matplotlib.text.Text at 0x1119244d0>
```



Judging by the pie charts, there were fewer kids onboard than adults, but kids are more likely to survive than adults (54% vs 38%)

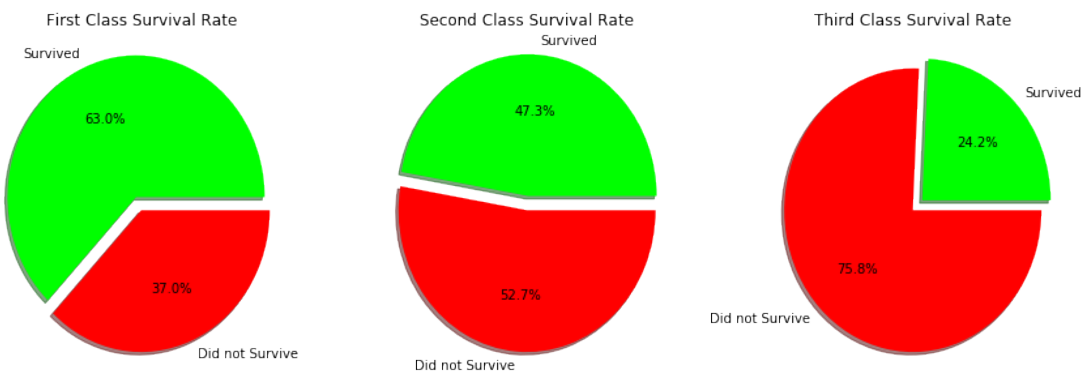
The Class Factor

```
In [14]: class1_survival_rate = new_Data['Survived'][new_Data['Pclass'] == 1].mean
         class2_survival_rate = new_Data['Survived'][new_Data['Pclass'] == 2].mean
         class3_survival_rate = new_Data['Survived'][new_Data['Pclass'] == 3].mean
         class1_survival = [class1_survival_rate, 1 - class1_survival_rate]
         class2_survival = [class2_survival_rate, 1 - class2_survival_rate]
         class3_survival = [class3_survival_rate, 1 - class3_survival_rate]

         print 'The survival rate of first class passengers is', class1_survival_ra
         print 'The survival rate of second class passengers is', class2_survival_r
         print 'The survival rate of third class passengers is', class3_survival_ra
```

```
The survival rate of first class passengers is 0.62962962963
The survival rate of second class passengers is 0.472826086957
The survival rate of third class passengers is 0.242362525458
```

```
In [15]: fig, (ax1, ax2, ax3) = plt.subplots(1,3,figsize=(15,5))
         labels = ['Survived','Did not Survive']
         colors = ['lime','red']
         explode = [0.1, 0]

         ax1.pie(class1_survival, explode=explode, shadow=True,labels=labels,autopc
         ax2.pie(class2_survival, explode=explode, shadow=True,labels=labels,autopc
         ax3.pie(class3_survival, explode=explode, shadow=True,labels=labels,autopc
         ax1.set_title('First Class Survival Rate')
         ax2.set_title('Second Class Survival Rate')
         ax3.set_title('Third Class Survival Rate')
```

```
Out[15]: <matplotlib.text.Text at 0x111c8c710>
```



Based on the pie charts, it seems first class passengers have the best chance for survival, second class passengers having the second best, while third class passengers have the worst chance. This is expected - paying more equates to better positioning on the ship, which would mean faster time to get to the lifeboats.

1.3 Conclusion

1.3.1 Limitations

In conclusion, I'd like to state some limitations of this dataset: 1) missing data and 2) only a sample of the actual data.

Missing data reduce the representativeness of the sample, and can reduce the effectiveness of the analysis done to infer attributes and relationships amongst the population. Therefore, during the analysis, I decided to clean the missing data by imputing the variable Age's missing values as the median of all known ages.

The imputation I did could have introduced bias to the distribution and variance, as well as statistical testing and assumptions. Furthermore, in the case of heteroskedasticity in the data, imputing missing values as the median would actually hurt more than help if there were severe outliers in the data. Depending on the nature of the missing values, there may be better imputation methods. In the case of the Age values being "missing at random", perhaps it is better to do multiple imputations, based on the expectation-maximization algorithm, or full information maximum likelihood estimation.

1.3.2 Other variables to consider

In order to make better predictions, I think the following variables should have been introduced and would be interesting to analyze.

- **distance to lifeboat**: did it matter if the people were close to the lifeboats and aboard them first? Were first class passengers naturally closer to the lifeboats, therefore supporting the conclusion that 1st class passengers had better survival rates than passengers in other classes? For the passengers of third class that survived, did they survive because they were closer to the lifeboats than the third class passengers who did not survived?
- **passenger or crew**: were crews more likely to survive, since they knew the layout of the ship and emergency procedures in the case of a disaster? Or did they put the passengers' lives before their own?

1.3.3 Final note

To summarize, the factors that made people more likely to survive are: - Gender - Age - Class

Based on the findings of this analysis, female passengers were much more likely to survive than their male counterparts. Children below the age of 18 have noticeably higher survival rate than adults. Finally, first class passengers are much more likely to survive than second or third class passengers. These findings make total sense, because at that point in time, women and children came first, and money buys safety.

I'll be likely to revisit this project once I'm more familiar with Python and Regression techniques, so I can find the factor(s) that have the most weight on the survival of any given passenger.

References:

https://www.quora.com/How-do-you-handle-missing-data-statistics-What-imputation-techniques-do-you-recommend-or-follow#!n=18

https://en.wikipedia.org/wiki/Missing_data#Imputation

http://stats.stackexchange.com/questions/133272/how-bad-can-heteroscedasticity-be-before-causing-problems

https://www.analyticsvidhya.com/blog/2016/01/12-pandas-techniques-python-data-manipulation
https://www.stackoverflow.com/questions/34162443/why-do-many-examples-use-fig-ax-plt-subplots-in-matplotlib-pyplot-python
https://www.matplotlib.org/1.3.0/examples/pie_and_polar_charts/pie_demo_features.html

```
In [ ]:
```