```
<b>Vishal Maru</b>
<b>IT 418 Final Exam</b>
<b>Dr. Rajeev Bukralia</b>
<b>May 4, 2020</b>
```

In [1]:

```
import numpy as np
import pandas as pd

from pandas import Series, DataFrame

import scipy
from scipy.stats import spearmanr

from pylab import rcParams
import seaborn as sb
import matplotlib.pyplot as plt

import sklearn
from sklearn.preprocessing import scale
from sklearn.linear_model import LogisticRegression
from sklearn.cross_validation import train_test_split
from sklearn import preprocessing
from sklearn import metrics
from sklearn.metrics import classification_report
from sklearn.metrics import roc_auc_score
```

A

In [2]:

```
patients = pd.read_csv('patients.csv')
```

In [3]:

```
# cars.rename( columns={'Unnamed: 0':'car_names'}, inplace=True )
```

B

In [4]:

```
patients.head()
```

Out[4]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	Pedigree	Age	Diag
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1

On seeing the first 5 rows we can clearly see some invlaid values where Skin Thickness and Insulin are zero

Type *Markdown* and LaTeX: α^2

In [5]:

```
print ("median  ", patients.Pregnancies.median())
print (patients.Pregnancies.describe())
```

```
median   3.0
count    768.000000
mean       3.845052
std        3.369578
min        0.000000
25%        1.000000
50%        3.000000
75%        6.000000
max       17.000000
Name: Pregnancies, dtype: float64
```

In [6]:

```
print ("median  ", patients.Glucose.median())
print (patients.Glucose.describe())
```

```
median   117.0
count    768.000000
mean     120.894531
std       31.972618
min        0.000000
25%       99.000000
50%      117.000000
75%      140.250000
max      199.000000
Name: Glucose, dtype: float64
```

In [7]:

```
print ("median  ", patients.BloodPressure.median())
print (patients.BloodPressure.describe())
```

```
median   72.0
count    768.000000
mean      69.105469
std       19.355807
min        0.000000
25%       62.000000
50%       72.000000
75%       80.000000
max      122.000000
Name: BloodPressure, dtype: float64
```

In [8]:

```
print ("median  ", patients.SkinThickness.median())
print (patients.SkinThickness.describe())
```

```
median   23.0
count    768.000000
mean      20.536458
std       15.952218
min        0.000000
25%        0.000000
50%       23.000000
75%       32.000000
max       99.000000
Name: SkinThickness, dtype: float64
```

In [9]:

```
print ("median  ", patients.Insulin.median())
print (patients.Insulin.describe())
```

```
median   30.5
count    768.000000
mean      79.799479
std      115.244002
min        0.000000
25%        0.000000
50%       30.500000
75%      127.250000
max      846.000000
Name: Insulin, dtype: float64
```

In [10]:

```
print ("median  ", patients.BMI.median())
print (patients.BMI.describe())
```

```
median   32.0
count    768.000000
mean      31.992578
std        7.884160
min        0.000000
25%       27.300000
50%       32.000000
75%       36.600000
max       67.100000
Name: BMI, dtype: float64
```

In [11]:

```
print ("median  ", patients.Pedigree.median())
print (patients.Pedigree.describe())
```

```
median   0.3725
count    768.000000
mean       0.471876
std        0.331329
min        0.078000
25%        0.243750
50%        0.372500
75%        0.626250
max        2.420000
Name: Pedigree, dtype: float64
```

In [12]:

```
print ("median  ", patients.Age.median())
print (patients.Age.describe())
```

```
median   29.0
count    768.000000
mean      33.240885
std       11.760232
min       21.000000
25%       24.000000
50%       29.000000
75%       41.000000
max       81.000000
Name: Age, dtype: float64
```

Number of observations for each variable is the same which is 768.

D

In [13]:

```
patients.min()
```

Out[13]:

```
Pregnancies       0.000
Glucose           0.000
BloodPressure     0.000
SkinThickness     0.000
Insulin           0.000
BMI               0.000
Pedigree          0.078
Age              21.000
Diagnosis         0.000
dtype: float64
```

In [14]:

```
def fill_missing_glucose(value):

    if value == 0:
        return 117
    else:
        return value

patients['Glucose']=patients.apply(lambda row:fill_missing_glucose(row['Glucose']
```

In [15]:
```
patients.Glucose.min()
```

Out[15]:
```
44.0
```

In [16]:
```
def fill_missing_bp(value):

    if value == 0:
        return 72
    else:
        return value

patients['BloodPressure']=patients.apply(lambda row:fill_missing_glucose(row['Blo
```

In [17]:
```
def fill_missing_st(value):

    if value == 0:
        return 23
    else:
        return value

patients['SkinThickness']=patients.apply(lambda row:fill_missing_glucose(row['Ski
```

In [18]:
```
def fill_missing_insulin(value):

    if value == 0:
        return 30.5
    else:
        return value

patients['Insulin']=patients.apply(lambda row:fill_missing_glucose(row['Insulin']
```

In [19]:
```
def fill_missing_bmi(value):

    if value == 0:
        return 32
    else:
        return value

patients['BMI']=patients.apply(lambda row:fill_missing_glucose(row['BMI']), axis=
```

In [20]:
```
def fill_missing_Pedigree(value):

    if value == 0:
        return 0.3725
    else:
        return value

patients['Pedigree']=patients.apply(lambda row:fill_missing_glucose(row['Pedigree
```

E

In [40]:

```
g_outliers = patients.Glucose.quantile([0.25, 0.75])
g_outliers
```

Out[40]:

```
0.25     99.75
0.75    140.25
Name: Glucose, dtype: float64
```

In [21]:

```
outliers=[]
median = patients.Glucose.median()
def detectFill_outliers_g(value):

    if value < 99.75 or value > 140.25:
        outliers.append(value)
        return median
    else:
        return value

patients['Glucose']=patients.apply(lambda row:detectFill_outliers_g(row['Glucose'

if (len(outliers) > 0):
    print("outlier list: ", outliers)
else:
    print("No outliers in the column.")
```

In [38]:

```
bp_outliers = patients.BloodPressure.quantile([0.25, 0.75])
bp_outliers
```

Out[38]:

```
0.25    64.0
0.75    82.0
Name: BloodPressure, dtype: float64
```

In [39]:
```
outliers=[]
median = patients.BloodPressure.median()
def detectFill_outliers_bp(value):

    if value < 64 or value > 82:
        outliers.append(value)
        return median
    else:
        return value

patients['BloodPressure']=patients.apply(lambda row:detectFill_outliers_bp(row['B

if (len(outliers) > 0):
    print("outlier list: ", outliers)
else:
    print("No outliers in the column.")
```

```
outlier list:  [40.0, 50.0, 117.0, 96.0, 92.0, 60.0, 117.0, 84.0, 30.0, 88.0, 8
4.0, 90.0, 94.0, 92.0, 58.0, 92.0, 60.0, 84.0, 92.0, 110.0, 56.0, 117.0, 50.0,
90.0, 50.0, 88.0, 117.0, 62.0, 58.0, 88.0, 92.0, 85.0, 90.0, 86.0, 48.0, 117.0,
44.0, 117.0, 108.0, 55.0, 62.0, 48.0, 50.0, 90.0, 60.0, 96.0, 56.0, 122.0, 58.
0, 58.0, 85.0, 62.0, 62.0, 54.0, 92.0, 48.0, 60.0, 30.0, 58.0, 88.0, 84.0, 56.
0, 60.0, 60.0, 52.0, 62.0, 86.0, 88.0, 52.0, 56.0, 90.0, 88.0, 90.0, 117.0, 60.
0, 110.0, 60.0, 98.0, 62.0, 117.0, 55.0, 84.0, 58.0, 62.0, 60.0, 104.0, 84.0, 6
0.0, 85.0, 95.0, 62.0, 60.0, 90.0, 117.0, 60.0, 52.0, 86.0, 84.0, 90.0, 84.0, 5
4.0, 50.0, 85.0, 90.0, 86.0, 52.0, 84.0, 62.0, 56.0, 50.0, 117.0, 62.0, 117.0,
52.0, 117.0, 86.0, 62.0, 60.0, 62.0, 88.0, 86.0, 84.0, 86.0, 56.0, 88.0, 62.0,
48.0, 50.0, 62.0, 84.0, 117.0, 58.0, 98.0, 50.0, 60.0, 90.0, 86.0, 58.0, 117.0,
60.0, 117.0, 84.0, 86.0, 88.0, 46.0, 117.0, 62.0, 84.0, 62.0, 88.0, 50.0, 117.
0, 108.0, 54.0, 86.0, 102.0, 58.0, 52.0, 60.0, 100.0, 60.0, 62.0, 54.0, 100.0,
58.0, 56.0, 61.0, 84.0, 48.0, 62.0, 90.0, 84.0, 60.0, 84.0, 88.0, 117.0, 94.0,
117.0, 117.0, 85.0, 88.0, 104.0, 62.0, 117.0, 54.0, 62.0, 54.0, 84.0, 62.0, 98.
0, 56.0, 52.0, 117.0, 90.0, 84.0, 86.0, 88.0, 58.0, 117.0, 62.0, 90.0, 117.0, 9
0.0, 90.0, 60.0, 50.0, 62.0, 62.0, 54.0, 88.0, 86.0, 60.0, 90.0, 117.0, 58.0, 6
0.0, 60.0, 117.0, 56.0, 117.0, 90.0, 60.0, 92.0, 85.0, 90.0, 90.0, 110.0, 88.0,
62.0, 60.0, 54.0, 62.0, 96.0, 58.0, 60.0, 86.0, 44.0, 44.0, 90.0, 60.0, 56.0, 8
6.0, 117.0, 84.0, 52.0, 24.0, 38.0, 88.0, 117.0, 117.0, 60.0, 62.0, 62.0, 54.0,
58.0, 88.0, 96.0, 62.0, 117.0, 86.0, 94.0, 88.0, 60.0, 62.0, 86.0, 117.0, 50.0,
84.0, 60.0, 54.0, 60.0, 54.0, 52.0, 58.0, 106.0, 84.0, 106.0, 60.0, 58.0, 58.0,
106.0, 100.0, 86.0, 60.0, 52.0, 58.0, 56.0, 50.0, 114.0, 60.0, 90.0, 117.0, 88.
0, 88.0, 117.0, 117.0, 46.0, 62.0, 58.0, 50.0, 60.0, 86.0, 86.0, 94.0, 84.0, 8
8.0, 52.0, 86.0, 88.0, 56.0, 60.0, 86.0, 60.0, 44.0, 58.0, 94.0, 88.0, 84.0, 9
4.0, 62.0, 62.0, 88.0, 88.0, 90.0, 92.0, 58.0, 62.0, 60.0]
```

In [24]:
```
preg_outliers = patients.Pregnancies.quantile([0.25, 0.75])
preg_outliers
```

Out[24]:
```
0.25    1.0
0.75    6.0
Name: Pregnancies, dtype: float64
```

In [25]:

```
outliers=[]
median = patients.Pregnancies.median()
def detectFill_outliers_pregnancies(value):

    if value < 2 or value > 9:
        outliers.append(value)
        return median
    else:
        return value

patients['Pregnancies']=patients.apply(lambda row:detectFill_outliers_pregnancies

if (len(outliers) > 0):
    print("Pregnancies outlier list: ", outliers)
else:
    print("No outliers in Pregnancies column.")
```

```
Pregnancies outlier list:  [1.0, 1.0, 0.0, 10.0, 10.0, 10.0, 1.0, 0.0, 1.0, 1.
0, 11.0, 10.0, 1.0, 13.0, 10.0, 11.0, 0.0, 1.0, 1.0, 1.0, 1.0, 0.0, 0.0, 0.0,
0.0, 1.0, 13.0, 1.0, 1.0, 0.0, 0.0, 13.0, 15.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0,
0.0, 1.0, 1.0, 1.0, 0.0, 1.0, 0.0, 0.0, 1.0, 1.0, 1.0, 0.0, 0.0, 0.0, 0.0, 10.
0, 0.0, 1.0, 1.0, 1.0, 17.0, 0.0, 0.0, 1.0, 0.0, 0.0, 1.0, 1.0, 11.0, 1.0, 0.0,
1.0, 0.0, 1.0, 0.0, 0.0, 12.0, 0.0, 1.0, 1.0, 0.0, 0.0, 1.0, 0.0, 0.0, 1.0, 10.
0, 0.0, 1.0, 0.0, 12.0, 1.0, 1.0, 11.0, 0.0, 0.0, 10.0, 1.0, 13.0, 0.0, 0.0, 1
0.0, 1.0, 0.0, 0.0, 1.0, 0.0, 0.0, 14.0, 0.0, 10.0, 0.0, 0.0, 0.0, 0.0, 13.0,
1.0, 1.0, 10.0, 1.0, 12.0, 1.0, 0.0, 0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 13.0, 1
2.0, 1.0, 0.0, 1.0, 0.0, 0.0, 12.0, 0.0, 1.0, 0.0, 1.0, 0.0, 1.0, 1.0, 1.0, 1.
0, 1.0, 1.0, 0.0, 0.0, 1.0, 1.0, 1.0, 1.0, 0.0, 1.0, 1.0, 1.0, 0.0, 0.0, 1.0,
0.0, 1.0, 1.0, 1.0, 0.0, 12.0, 1.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 1.0, 0.0, 14.
0, 1.0, 10.0, 1.0, 10.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0,
1.0, 0.0, 10.0, 0.0, 1.0, 12.0, 0.0, 13.0, 1.0, 0.0, 0.0, 0.0, 1.0, 1.0, 0.0,
0.0, 0.0, 10.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0, 11.0, 11.0, 0.0, 1.0, 0.0, 1.0,
0.0, 1.0, 1.0, 10.0, 0.0, 12.0, 1.0, 0.0, 11.0, 0.0, 0.0, 1.0, 1.0, 1.0, 1.0,
1.0, 1.0, 1.0, 1.0, 0.0, 1.0, 11.0, 0.0, 0.0, 0.0, 0.0, 0.0, 1.0, 10.0, 13.0,
1.0, 0.0, 1.0, 0.0, 11.0, 0.0, 1.0, 1.0, 1.0, 1.0, 11.0, 10.0, 1.0, 1.0, 10.0,
1.0, 10.0, 0.0, 0.0, 0.0, 1.0, 1.0, 1.0, 13.0, 0.0, 1.0, 10.0, 10.0, 0.0, 10.0,
1.0, 1.0, 1.0, 1.0, 1.0, 0.0, 0.0, 1.0, 11.0, 1.0, 13.0, 12.0, 1.0, 1.0, 1.0,
0.0, 1.0, 0.0, 1.0, 10.0, 1.0, 1.0]
```

In [26]:

```
patients.Pregnancies.max()
```

Out[26]:

```
9.0
```

In [27]:

```
patients.describe()
```

Out[27]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	P
count	768.000000	768.000000	768.000000	768.000000	768.000000	768.000000	7
mean	3.998698	121.656250	74.437500	55.118490	136.776042	33.668359	0
std	1.897297	30.438286	15.262202	41.062553	87.179770	12.178062	0
min	2.000000	44.000000	24.000000	7.000000	14.000000	18.200000	0
25%	3.000000	99.750000	64.000000	25.000000	117.000000	27.500000	0
50%	3.000000	117.000000	73.000000	35.000000	117.000000	32.400000	0
75%	5.000000	140.250000	82.000000	117.000000	127.250000	36.825000	0
max	9.000000	199.000000	122.000000	117.000000	846.000000	117.000000	2

In [42]:

```
st_outliers = patients.SkinThickness.quantile([0.25, 0.75])
st_outliers
```

Out[42]:

```
0.25     25.0
0.75    117.0
Name: SkinThickness, dtype: float64
```

In [29]:

```
outliers=[]

def detectFill_outliers(value):

    if if value < 25 or value > 117:
        outliers.append(value)
        return patients.SkinThickness.median()
    else:
        return value

patients['SkinThickness']=patients.apply(lambda row:detectFill_outliers(row['Skin

if (len(outliers) > 0):
    print("Skin Thickness outlier list: ", outliers)
else:
    print("No outliers in Skin Thickness column.")
```

```
No outliers in Skin Thickness column.
```

In [43]:

```
i_outliers = patients.Insulin.quantile([0.25, 0.75])
i_outliers
```

Out[43]:

```
0.25    117.00
0.75    127.25
Name: Insulin, dtype: float64
```

In [46]:

```
outliers=[]

def detectFill_outliers(value):

    if value < 117 or value > 127.25:
        outliers.append(value)
        return patients.Insulin.median()
    else:
        return value



patients['Insulin']=patients.apply(lambda row:detectFill_outliers(row['Insulin'])

if (len(outliers) > 0):
    print("Insulin outlier list: ", outliers)
else:
    print("No outliers in Insulin column.")
```

```
Insulin outlier list:  [94.0, 168.0, 88.0, 543.0, 846.0, 175.0, 230.0, 83.0, 9
6.0, 235.0, 146.0, 115.0, 140.0, 110.0, 245.0, 54.0, 192.0, 207.0, 70.0, 240.0,
82.0, 36.0, 23.0, 300.0, 342.0, 304.0, 110.0, 142.0, 128.0, 38.0, 100.0, 90.0,
140.0, 270.0, 71.0, 71.0, 110.0, 176.0, 48.0, 64.0, 228.0, 76.0, 64.0, 220.0, 4
0.0, 152.0, 140.0, 18.0, 36.0, 135.0, 495.0, 37.0, 175.0, 51.0, 100.0, 100.0, 9
9.0, 135.0, 94.0, 145.0, 168.0, 225.0, 49.0, 140.0, 50.0, 92.0, 325.0, 63.0, 28
4.0, 204.0, 155.0, 485.0, 94.0, 135.0, 53.0, 114.0, 105.0, 285.0, 156.0, 78.0,
130.0, 48.0, 55.0, 130.0, 130.0, 92.0, 23.0, 495.0, 58.0, 114.0, 160.0, 94.0, 2
10.0, 48.0, 99.0, 318.0, 44.0, 190.0, 280.0, 87.0, 130.0, 175.0, 271.0, 129.0,
478.0, 190.0, 56.0, 32.0, 744.0, 53.0, 370.0, 37.0, 45.0, 192.0, 88.0, 176.0, 1
94.0, 680.0, 402.0, 55.0, 258.0, 375.0, 150.0, 130.0, 67.0, 56.0, 45.0, 57.0, 1
16.0, 278.0, 155.0, 135.0, 545.0, 220.0, 49.0, 75.0, 40.0, 74.0, 182.0, 194.0,
360.0, 215.0, 184.0, 135.0, 42.0, 105.0, 132.0, 148.0, 180.0, 205.0, 148.0, 96.
0, 85.0, 94.0, 64.0, 140.0, 231.0, 29.0, 168.0, 156.0, 68.0, 52.0, 58.0, 255.0,
171.0, 105.0, 73.0, 108.0, 83.0, 74.0, 43.0, 167.0, 54.0, 249.0, 325.0, 293.0,
83.0, 66.0, 140.0, 465.0, 89.0, 66.0, 94.0, 158.0, 325.0, 84.0, 75.0, 72.0, 82.
0, 182.0, 59.0, 110.0, 50.0, 285.0, 81.0, 196.0, 415.0, 87.0, 275.0, 115.0, 88.
0, 165.0, 579.0, 176.0, 310.0, 61.0, 167.0, 474.0, 115.0, 170.0, 76.0, 78.0, 21
0.0, 277.0, 180.0, 145.0, 180.0, 85.0, 60.0, 50.0, 14.0, 70.0, 92.0, 64.0, 63.
0, 95.0, 210.0, 105.0, 71.0, 237.0, 60.0, 56.0, 49.0, 105.0, 36.0, 100.0, 140.
0, 191.0, 110.0, 75.0, 328.0, 49.0, 250.0, 480.0, 265.0, 66.0, 76.0, 145.0, 19
3.0, 71.0, 79.0, 90.0, 170.0, 76.0, 210.0, 86.0, 105.0, 165.0, 326.0, 66.0, 13
0.0, 82.0, 105.0, 188.0, 106.0, 65.0, 56.0, 210.0, 155.0, 215.0, 190.0, 56.0, 7
6.0, 225.0, 207.0, 166.0, 67.0, 106.0, 44.0, 115.0, 215.0, 274.0, 77.0, 54.0, 8
8.0, 18.0, 165.0, 44.0, 330.0, 63.0, 130.0, 600.0, 156.0, 140.0, 115.0, 230.0,
185.0, 25.0, 293.0, 41.0, 272.0, 182.0, 158.0, 194.0, 321.0, 144.0, 15.0, 160.
0, 115.0, 54.0, 90.0, 183.0, 66.0, 91.0, 46.0, 105.0, 152.0, 440.0, 144.0, 159.
0, 130.0, 100.0, 106.0, 77.0, 135.0, 540.0, 90.0, 200.0, 70.0, 231.0, 130.0, 13
2.0, 190.0, 100.0, 168.0, 49.0, 240.0, 265.0, 45.0, 105.0, 205.0, 180.0, 180.0,
95.0, 480.0, 155.0, 200.0, 100.0, 335.0, 160.0, 387.0, 22.0, 291.0, 392.0, 185.
0, 178.0, 200.0, 105.0, 180.0, 79.0, 165.0, 160.0, 150.0, 94.0, 116.0, 140.0, 1
05.0, 57.0, 200.0, 74.0, 510.0, 110.0, 16.0, 180.0, 112.0]
```

In [ ]:

In [31]:

```
outliers=[]



def detectFill_outliers(value):

    if value < 117 or value > 127.25:
        outliers.append(value)
        return patients.Insulin.median()
    else:
        return value




patients['BMI']=patients.apply(lambda row:detectFill_outliers(row['BMi']), axis=1
if (len(outliers) > 0):
    print("BMI outlier list: ", outliers)
else:
    print("No outliers in BMI column.")
```

```
No outliers in BMI column.
```

In [32]:

```
utliers=[]

ef detectFill_outliers_pedigree(value):

   z_score = (value-patients.Pedigree.mean())/patients.Pedigree.std()

   if abs(z_score) > 3:
       outliers.append(value)
       return patients.Pedigree.median()
   else:
       return value

atients['Pedigree']=patients.apply(lambda row:fill_missing_glucose(row['Pedigree']

f (len(outliers) > 0):
   print("Pedigree outlier list: ", outliers)
lse:
   print("No outliers in Pedigree column.")
```

```
No outliers in Pedigree column.
```

In [33]:

```
outliers=[]

def detectFill_outliers_age(value):

    z_score = (value-patients.Age.mean)/patients.Age.std()

    if abs(z_score) > 3:
        outliers.append(value)
        return patients.Age.median()
    else:
        return value

patients['Age']=patients.apply(lambda row:fill_missing_glucose(row['Age']), axis=

if (len(outliers) > 0):
    print("Age outlier list: ", outliers)
else:
    print("No outliers in Age column.")
```

```
No outliers in Age column.
```

F

Since There were no outliers detected using the z score method, no values were replaced with the median.

G

In [34]:

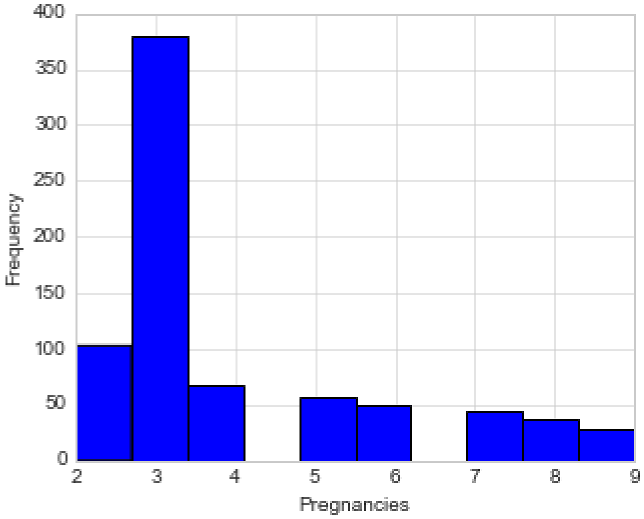
```
%matplotlib inline
rcParams['figure.figsize'] = 5, 4
sb.set_style('whitegrid')
```

H

In [35]:
```
plt.rc('grid', linestyle="-")
plt.grid(color='0.8')

plt.ylabel("Frequency")
plt.xlabel("Pregnancies")
plt.hist(patients["Pregnancies"])

plt.show()
```



In [36]:
```
patients.Pregnancies.max()
```

Out[36]:
```
9.0
```

In [ ]:

In [ ]:

In [ ]:

In [ ]:

CHECKING THE MODEL ASSUMPTIONS

CHECKING THE INDEPENDENCE BETWEEN FEATURES

It is observed that these two are in fact categorical. They only take set number of positions.

The value is really close to zero which means there is almost no correlation between the predictors

CHECKING FOR MISSING VALUES

No missing values

MAKING SURE THE TARGET VARIABLE IS BINARY OR ORDINAL

It is clear that am is binary because it only has two variables, 0 and 1. So the model assumption needs are met.

CHECKING IF THE DATASET SIZE IS SUFFICIENT

In this case we have two observations so we will need 100 observations, 50 for each variable.

Now, this dataset only has 32 observations which means our model will not be very reliable.

DEPLOYING AND EVALUATING THE MODEL

Lets scale the dataset first.

Next, Instantiate Logistic Regression Object

```
In [47]: patients.head()
```

Out[47]:

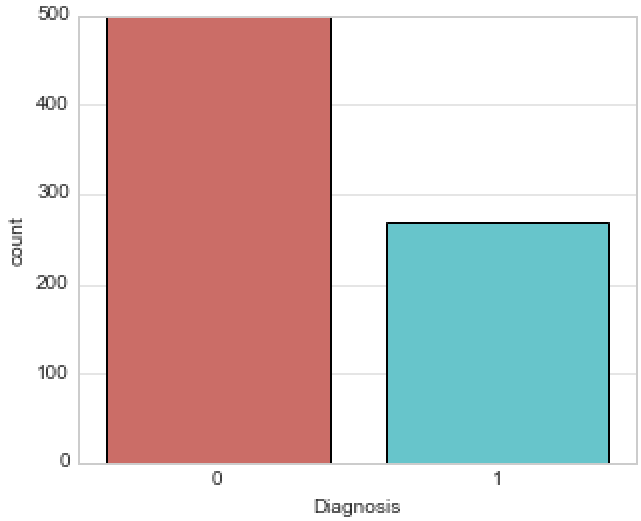
	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	Pedigree	Age	Diag
0	6.0	148.0	72.0	35.0	117.0	33.6	0.627	50.0	1
1	3.0	85.0	66.0	29.0	117.0	26.6	0.351	31.0	0
2	8.0	183.0	64.0	117.0	117.0	23.3	0.672	32.0	1
3	3.0	89.0	66.0	23.0	117.0	28.1	0.167	21.0	0
4	3.0	137.0	73.0	35.0	117.0	43.1	2.288	33.0	1

```
In [49]: patients_data = patients.ix[:, 0:7]
         patients_data_names = ['pregnancies', 'glucose', 'bp', 'st', 'i', 'bmi', 'p']

         y = patients.ix[:, 8]
```

```
In [51]: sb.countplot(x='Diagnosis', data=patients, palette='hls')

Out[51]: <matplotlib.axes._subplots.AxesSubplot at 0x1f48bdd44e0>
```



```
In [52]: X = scale(patients_data)
```

```
In [53]: LogReg = LogisticRegression()

         LogReg.fit(X, y)
         LogReg.score(X, y)

Out[53]: 0.76302083333333337
```

```
In [55]: model1 = LogReg.fit(X, y)
         model1.summary()

---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
<ipython-input-55-6e86388c961b> in <module>()
      1 model1 = LogReg.fit(X, y)
----> 2 model1.summary()

AttributeError: 'LogisticRegression' object has no attribute 'summary'
```

We got a really high value so we have a good fit.

Now we will evaluate the model

In [ ]:

```
y_pred = LogReg.predict(X)

print(classification_report(y, y_pred))
```

Total prediction for the model is 0.82 and recall is 0.81. So, we know our model is adequate.

We will also calculate area under the curve (ROC)

In [ ]:

```
roc_auc_score(y, y_pred)
```

Area under the cruve is pretty close to 1 which means this is a really good classifier. If it was 0.5, it would have no predictive value.

NAIVE BAYES CLASSIFICATION

We will use this to predict the likelihood that an event will occur.

Multinomial: for features that are categorical or continuous and describe discrete frequency counts

Bernoulli: for predictions from binary features

Gaussian: for predictions from normally distributed features.

In [ ]:

```

```