3-FINAL

September 30, 2018

1 Assigment 3

This assigment focuses on getting comfortable with working with multidimensional data and linear regression. Key items include: - Creating random n-dimensional data - Creating a Model that can handle the data - Plot a subset of the data along with the prediction - Using a Dataset to read in and choose certain columns to produce a model - Create several models from various combinations of columns - Plot a few of the results - BONUS: Perform all the plots in 3D instead of 2D

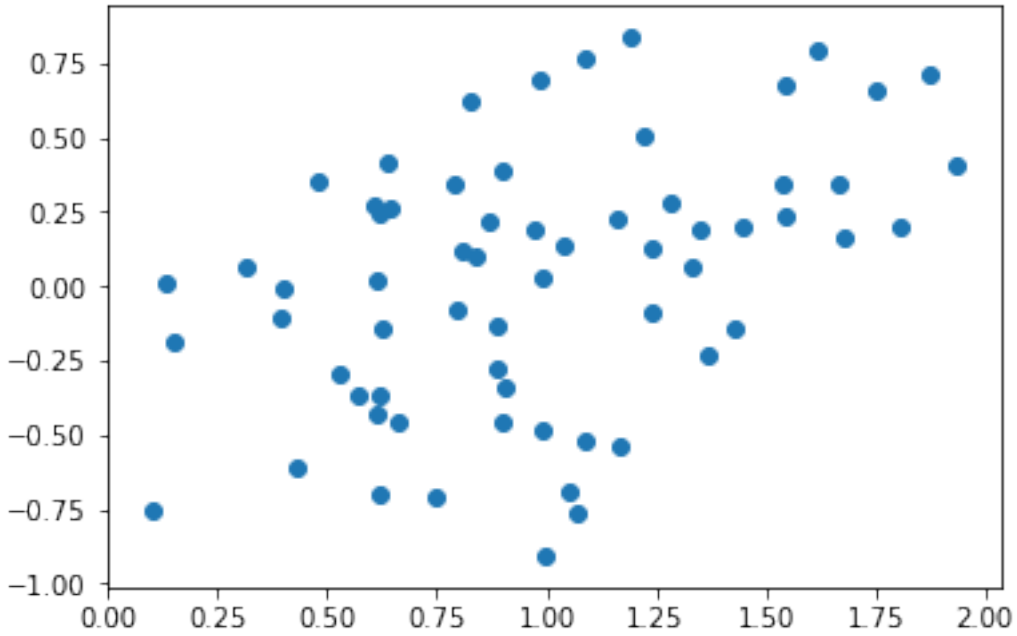
```
In [135]: import numpy as np
          import matplotlib.pylab as plt
          %matplotlib inline
```

1.1 1. Create a 4 dimensional data set with 64 elements and show 2D plots of the data $x_1 \rightarrow y, x_2 \rightarrow y$, etc.

```
In [136]: n=64
          x=np.linspace(0,1,n) + np.random.rand(4, n)
          x=np.vstack([x,np.ones(len(x.T))]).T
          y=np.linspace(0,1,n)+ np.random.rand(n) -1
```

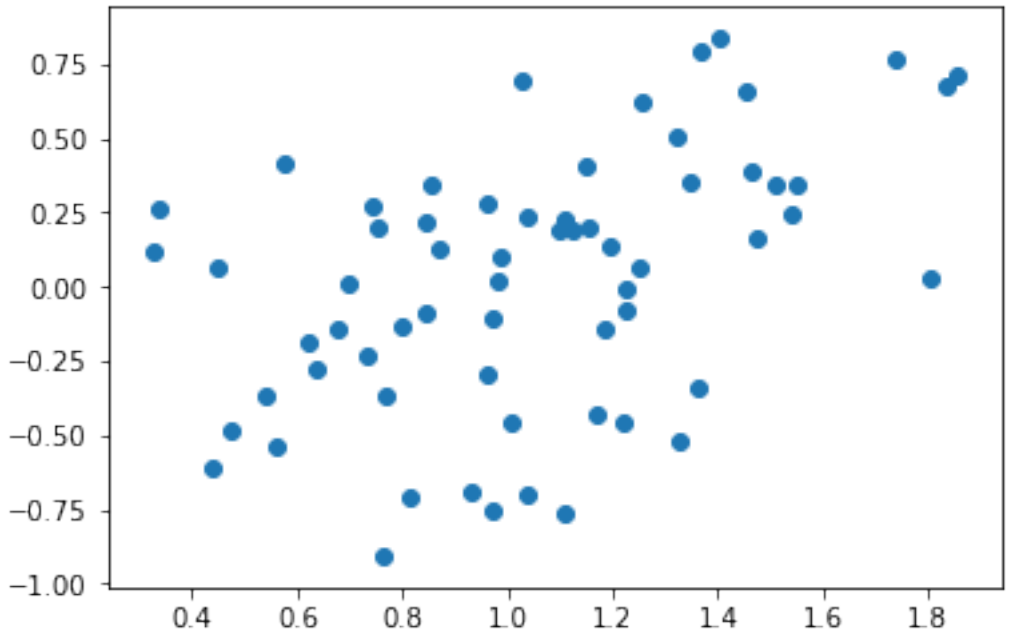
```
In [137]: plt.scatter(x.T[0],y)
```

```
Out[137]: <matplotlib.collections.PathCollection at 0x16756997d68>
```

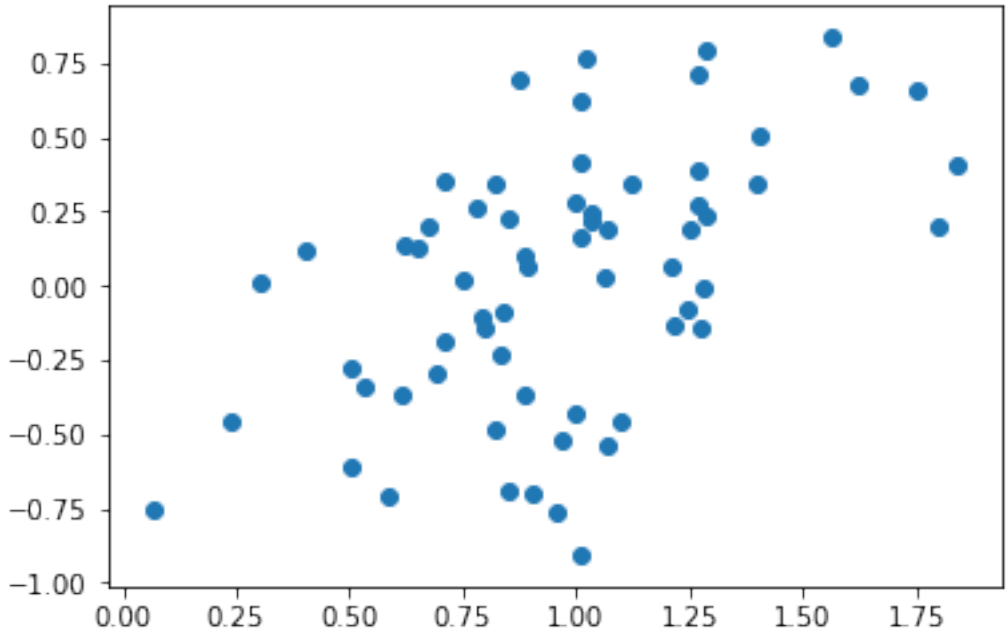


In [141]: plt.scatter(x.T[1],y)

Out[141]: <matplotlib.collections.PathCollection at 0x16756b27208>

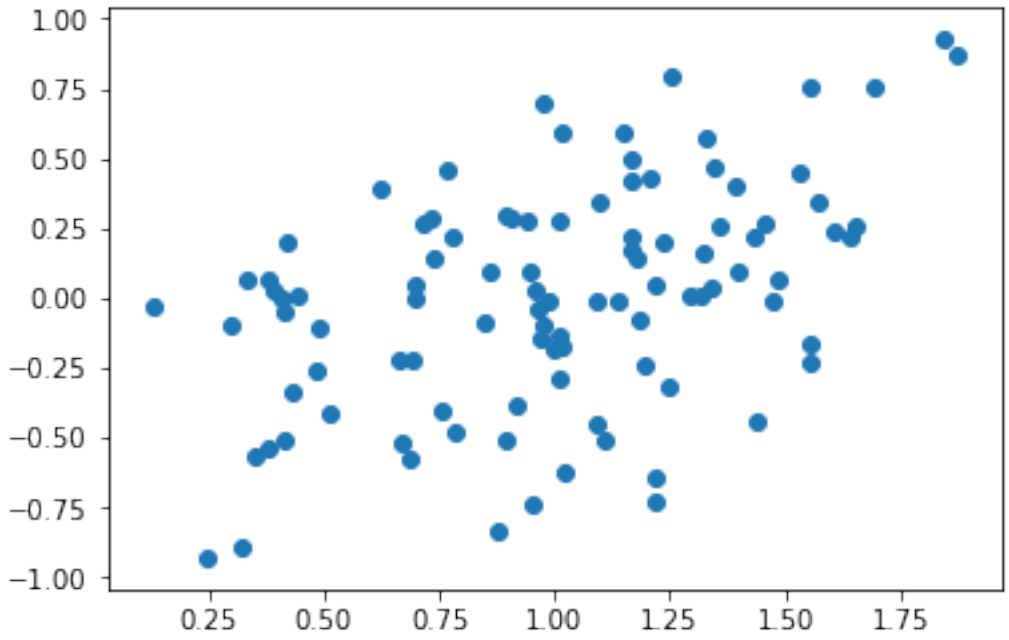


```
In [142]: plt.scatter(x.T[2],y)

Out[142]: <matplotlib.collections.PathCollection at 0x16756b855c0>
```



1.2 2. Create a model to fit the data. Hint: follow the example from Lesson 3

```
In [143]: n=100
          x=np.linspace(0,1,n) + np.random.rand(5, n)
          x=np.vstack([x,np.ones(len(x.T))]).T
          y=np.linspace(0,1,n)+ np.random.rand(n) -1

In [144]: plt.scatter(x.T[0],y)

Out[144]: <matplotlib.collections.PathCollection at 0x16756be3940>
```

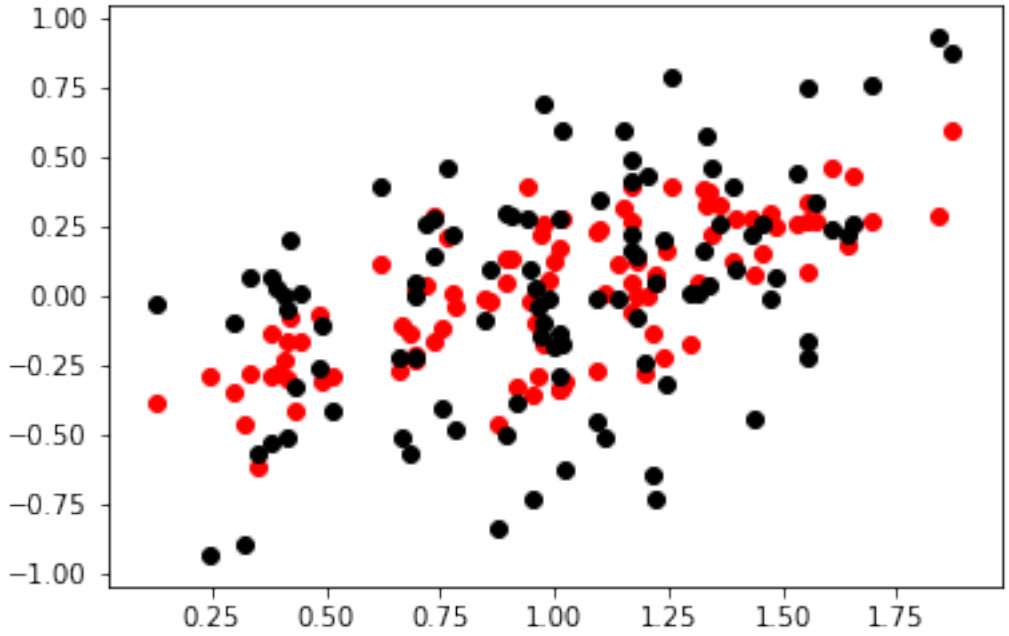



```
In [145]: left=np.linalg.inv(np.dot(x.T, x))

In [146]: right=np.dot(y.T, x)

In [147]: np.dot(left, right)

Out[147]: array([ 0.15709266,  0.01034207,  0.24679659,  0.01966989,  0.32320673,
                 -0.77011875])

In [148]: beta=np.linalg.lstsq(x,y) [0]
          beta

C:\Users\Erin\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: FutureWarning: `rcond` para
To use the future default and silence this warning we advise to pass `rcond=None`, to keep usi
  """Entry point for launching an IPython kernel.


Out[148]: array([ 0.15709266,  0.01034207,  0.24679659,  0.01966989,  0.32320673,
                 -0.77011875])
```

1.3 3. Plot the model's prediction in 2D for 2 of the dimensions ($x_1 \rightarrow y_p, x_2 \rightarrow y_p$) along with the original points

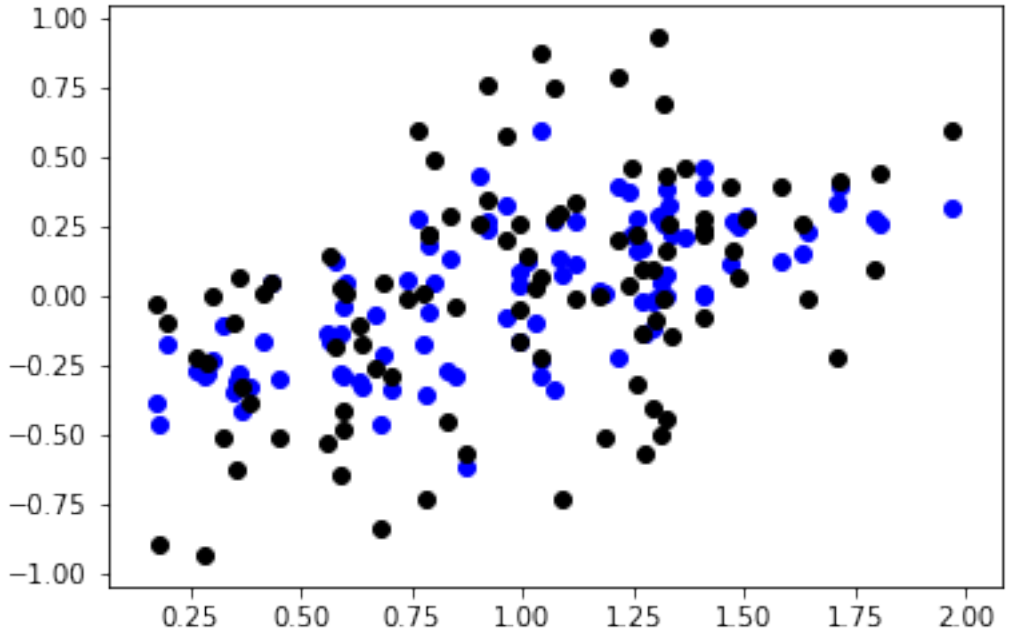
```
In [149]: pred=np.dot(x, beta)

In [150]: plt.scatter(x.T[0], pred, c='red')
          plt.scatter(x.T[0], y, c='black')
```

```
Out[150]: <matplotlib.collections.PathCollection at 0x167568d79b0>
```




```
In [151]: plt.scatter(x.T[1], pred, c='blue')
          plt.scatter(x.T[1], y, c='black')
```

```
Out[151]: <matplotlib.collections.PathCollection at 0x167551ad550>
```



1.4 4. Read in `mlnn/data/Credit.csv` with Pandas and create a model to predict Credit Rating (`Rating`). Use only the numeric columns in your model, but feel free to experiment which which columns you believe are better predicters of Credit Rating

```
In [152]: import pandas as pd
          credit = pd.read_csv('../data/Credit.csv')
          credit.head()
```

Out[152]:

	Unnamed: 0	Income	Limit	Rating	Cards	Age	Education	Gender	Student	Married	Ethnicity	Balance
0	1	14.891	3606	283	2	34	11	Male	No	Yes	Caucasian	333
1	2	106.025	6645	483	3	82	15	Female	Yes	Yes	Asian	903
2	3	104.593	7075	514	4	71	11	Male	No	No	Asian	580
3	4	148.924	9504	681	3	36	11	Female	No	No	Asian	964
4	5	55.882	4897	357	2	68	16	Male	No	Yes	Caucasian	331

```
In [157]: X = credit[['Income', 'Limit']].as_matrix()
          X = np.vstack([X.T, np.ones(len(X))]).T
          X
```

```
C:\Users\Erin\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: FutureWarning: Method .as_ma
  """Entry point for launching an IPython kernel.
```

```
Out[157]: array([[1.48910e+01, 3.60600e+03, 1.00000e+00],
                 [1.06025e+02, 6.64500e+03, 1.00000e+00],
                 [1.04593e+02, 7.07500e+03, 1.00000e+00],
                 ...,
                 [5.78720e+01, 4.17100e+03, 1.00000e+00],
                 [3.77280e+01, 2.52500e+03, 1.00000e+00],
                 [1.87010e+01, 5.52400e+03, 1.00000e+00]])
```

```
In [158]: y = credit[['Rating']].as_matrix()-1
```

```
C:\Users\Erin\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: FutureWarning: Method .as_ma
  """Entry point for launching an IPython kernel.
```

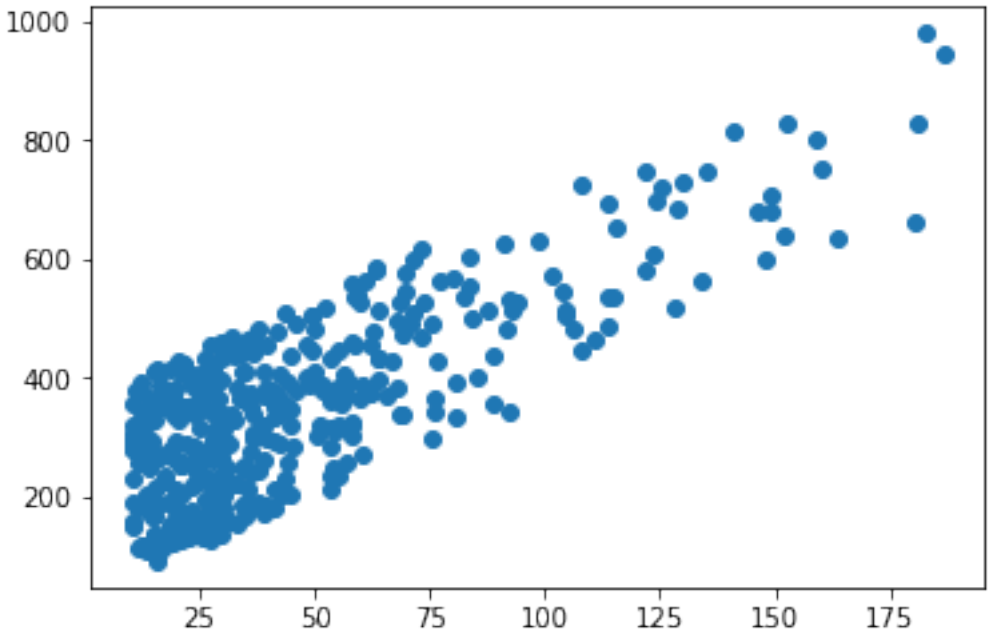
```
In [159]: len(X) == len(y)
```

```
Out[159]: True
```

1.4.1 5. Plot your results (Bonus if you use 3D plots). Show as many of your columns vs. credit rating that you can.

```
In [161]: plt.scatter(X.T[0], y)
```

```
Out[161]: <matplotlib.collections.PathCollection at 0x167551e2160>
```




```
In [162]: left = np.linalg.inv(np.dot(X.T, X))
```

```
In [163]: right = np.dot(y.T, X)
```

```
In [166]: np.dot(left, right)
```

```
---------------------------------------------------------------------------

ValueError                                Traceback (most recent call last)

<ipython-input-166-0729c2a30d7d> in <module>()
----> 1 np.dot(left, right)


ValueError: shapes (3,3) and (1,3) not aligned: 3 (dim 1) != 1 (dim 0)
```

```
In [167]: beta = np.linalg.lstsq(X, y)[0]
          beta
```

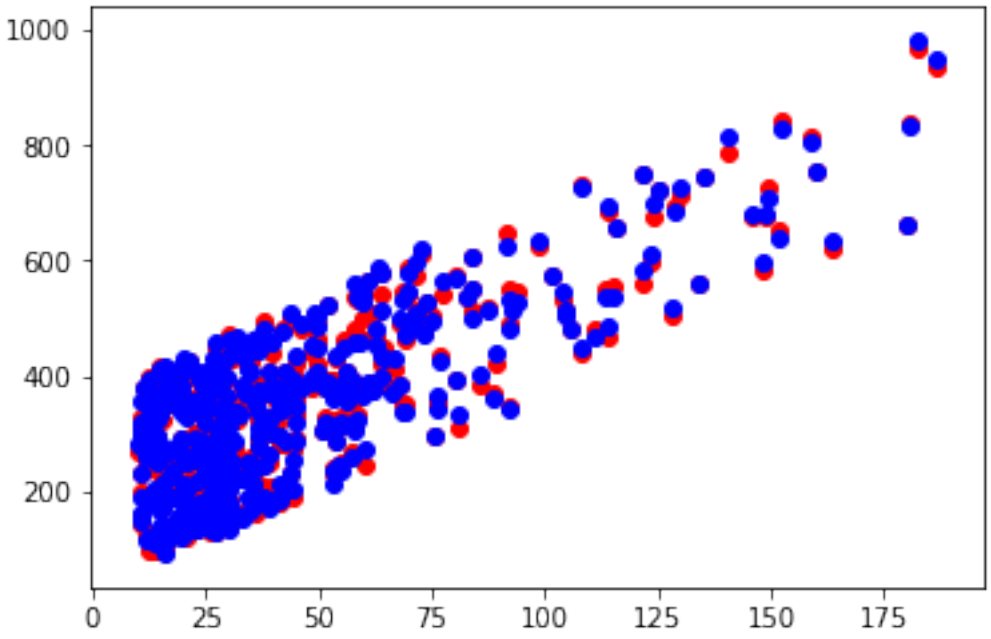
```
C:\Users\Erin\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: FutureWarning: `rcond` paran
To use the future default and silence this warning we advise to pass `rcond=None`, to keep usin
  """Entry point for launching an IPython kernel.
```

```
Out[167]: array([[2.07464217e-02],
                 [6.65723378e-02],
                 [3.77419069e+01]])
```

```
In [171]: pred = np.dot(X, beta)
```

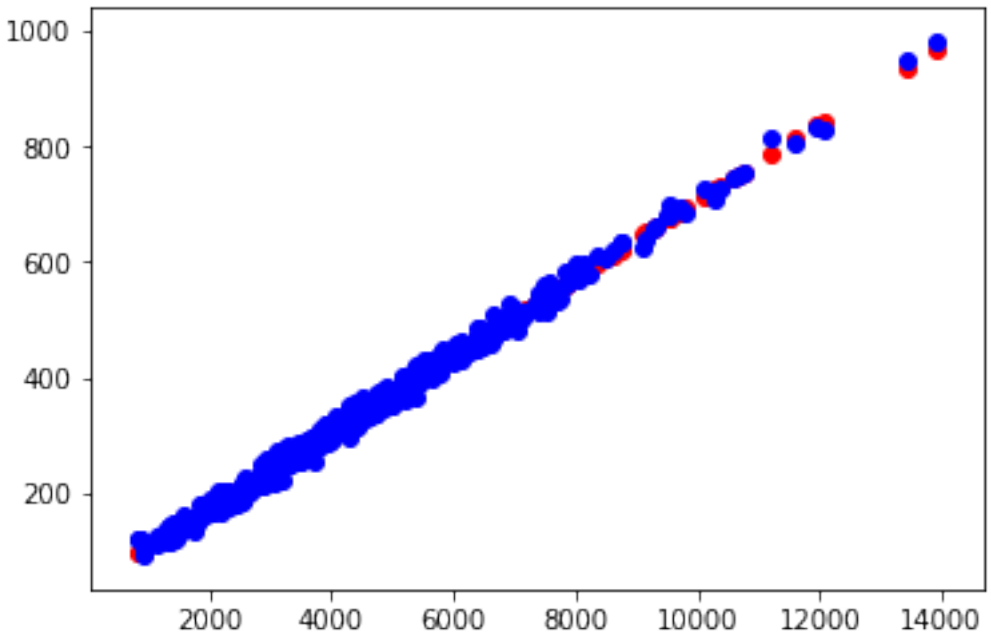
```
In [169]: plt.scatter(X.T[0], pred, c='red')
          plt.scatter(X.T[0], y, c='b')
```

```
Out[169]: <matplotlib.collections.PathCollection at 0x167551f78d0>
```



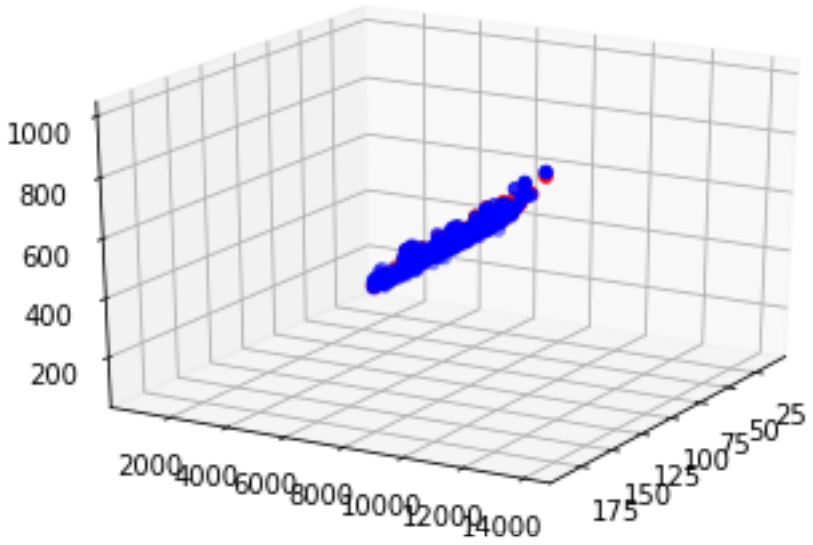

```
In [170]: plt.scatter(X.T[1], pred, c='red')
          plt.scatter(X.T[1], y, c='b')
```

```
Out[170]: <matplotlib.collections.PathCollection at 0x167551ba748>
```



In [172]:
```
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D

fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.view_init(23, 30)
ax.scatter(X.T[0], X.T[1], pred, zdir='z', c='r')
ax.scatter(X.T[0], X.T[1], y, zdir='z', c='b')
```

Out[172]:
```
<mpl_toolkits.mplot3d.art3d.Path3DCollection at 0x16756c48eb8>
```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8000
10000
12000
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125
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