

Hill and Valley

Objective

To develop an Machine Learning Model to predict Hill and Valley using Logistic Regression method

Data Source

This dataset was taken from the github library which is maintained at YBI Foundation. Each record represents 100 points on a two dimensional graph. When plotted in order (from 1 through 100) as the Y coordinate, the point will create either a Hill (a "bump" in the terrain) or a Valley (a "Dip" in the terrain).

```
[1]: #import libraries
import pandas as pd
```

```
[2]: import numpy as np
```

```
[7]: #import data
hill= pd.read_csv('Hill Valley Dataset.csv')
```

```
[9]: hill.head()
```

```
[9]:
```

	V1	V2	V3	V4	V5	V6	V7	\
0	39.02	36.49	38.20	38.85	39.38	39.74	37.02	
1	1.83	1.71	1.77	1.77	1.68	1.78	1.80	
2	68177.69	66138.42	72981.88	74304.33	67549.66	69367.34		
	69169.41							
3	44889.06	39191.86	40728.46	38576.36	45876.06	47034.00		
	46611.43							
4	5.70	5.40	5.28	5.38	5.27	5.61	6.00	

	V8	V9	V10	...	V92	V93	V94	V95	\
0	39.53	38.81	38.79	...	36.62	36.92	38.80	38.52	
1	1.70	1.75	1.78	...	1.80	1.79	1.77	1.74	
2	73268.61	74465.84	72503.37	...	73438.88	71053.35	71112.62		
	74916.48								
3	37668.32	40980.89	38466.15	...	42625.67	40684.20	46960.73		
	44546.80								

```
4      5.38 5.34 5.87 ...      5.17 5.67 5.60 5.94
```

```
      V96      V97      V98      V99      V100 Class
0      38.07      36.73 39.46 37.50 39.10 0
1      1.74 1.80 1.78 1.75 1.69 1
2      72571.58 66348.97 71063.72 67404.27 74920.24      1
3      45410.53 47139.44 43095.68 40888.34 39615.19      0
4      5.73 5.22 5.30 5.73 5.91 0
```

```
[5 rows x 101 columns]
```

```
[10]: #Describe data
hill.describe()
```

```
[10]:
```

	V1	V2	V3	V4 \
count	1212.000000	1212.000000	1212.000000	1212.000000
mean	8169.091881	8144.306262	8192.653738	8176.868738
std	17974.950461	17881.049734	18087.938901	17991.903982
min	0.920000	0.900000	0.850000	0.890000
25%	19.602500	19.595000	18.925000	19.277500
50%	301.425000	295.205000	297.260000	299.720000
75%	5358.795000	5417.847500	5393.367500	5388.482500
max	117807.870000	108896.480000	119031.350000	110212.590000

	V5	V6	V7	V8 \
count	1212.000000	1212.000000	1212.000000	1212.000000
mean	8128.297211	8173.030008	8188.582748	8183.641543
std	17846.757963	17927.114105	18029.562695	18048.582159
min	0.880000	0.860000	0.870000	0.650000
25%	19.210000	19.582500	18.690000	19.062500
50%	295.115000	294.380000	295.935000	290.850000
75%	5321.987500	5328.040000	5443.977500	5283.655000
max	113000.470000	116848.390000	115609.240000	118522.320000

	V9	V10 ...	V92	V93 \
count	1212.000000	1212.000000 ...	1212.000000	1212.000000
mean	8154.670066	8120.767574 ...	8120.056815	8125.917409
std	17982.390713	17900.798206 ...	17773.190621	17758.182403
min	0.650000	0.620000 ...	0.870000	0.900000
25%	19.532500	19.285000 ...	19.197500	18.895000
50%	294.565000	295.160000 ...	297.845000	295.420000
75%	5378.180000	5319.097500 ...	5355.355000	5386.037500
max	112895.900000	117798.300000 ...	113858.680000	112948.830000

	V94	V95	V96	V97 \
count	1212.000000	1212.000000	1212.000000	1212.000000

mean	8158.793812	8140.885421	8213.480611	8185.594002
std	17919.510371	17817.945646	18016.445265	17956.084223
min	0.870000	0.880000	0.890000	0.890000
25%	19.237500	19.385000	19.027500	19.135000
50%	299.155000	293.355000	301.370000	296.960000
75%	5286.385000	5345.797500	5300.890000	5361.047500
max	112409.570000	112933.730000	112037.220000	115110.420000

	V98	V99	V100	Class
count	1212.000000	1212.000000	1212.000000	1212.000000
mean	8140.195355	8192.960891	8156.197376	0.500000
std	17768.356106	18064.781479	17829.310973	0.500206
min	0.860000	0.910000	0.890000	0.000000
25%	19.205000	18.812500	19.145000	0.000000
50%	300.925000	299.200000	302.275000	0.500000
75%	5390.850000	5288.712500	5357.847500	1.000000
max	116431.960000	113291.960000	114533.760000	1.000000

[8 rows x 101 columns]

```
[11]: #data preprocessing
hill.columns
```

```
[11]: Index(['V1', 'V2', 'V3', 'V4', 'V5', 'V6', 'V7', 'V8', 'V9',
'V10',
...,
'V92', 'V93', 'V94', 'V95', 'V96', 'V97', 'V98', 'V99', 'V100',
'Class'],
dtype='object',
length=101)
```

```
[12]: hill['Class'].value_counts()
```

```
[12]: 0    606
1         606
Name: Class, dtype: int64
```

```
[13]: #define target(y) and feature(X)
y=hill['Class']
```

```
[14]: y.shape
```

```
[14]: (1212,)
```

```
[15]: y
```

```
[15]: 0    0
```

```

1      1
2      1
3      0
4      0
..
1207   1
1208   0
1209   1
1210   1
1211   0

```

```
Name: Class, Length: 1212, dtype: int64
```

```
[16]: X=hill.drop('Class',axis=1)
```

```
[17]: X.shape
```

```
[17]: (1212, 100)
```

```
[18]: X
```

```

[18]:
      V1      V2      V3      V4      V5      V6      V7 \
0 39.02 36.49 38.20 38.85 39.38 39.74 37.02 1 1.83 1.71 1.77 1.77
1.68 1.78 1.80
2    68177.69 66138.42 72981.88 74304.33 67549.66 69367.34
   69169.41
3    44889.06 39191.86 40728.46 38576.36 45876.06 47034.00
   46611.43
4      5.70      5.40 5.28 5.38 5.27 5.61 6.00
...      ...      ...      ...      ...      ...      ...
1207    13.00      12.87 13.27 13.04 13.19 12.53 14.31
1208    48.66      50.11 48.55 50.43 50.09 49.67 48.95
1209   10160.65 9048.63    8994.94    9514.39    9814.74
   10195.24 10031.47
1210    34.81      35.07 34.98 32.37 34.16 34.03 33.31

```

1211	8489.43	7672.98	9132.14	7985.73	8226.85
	8554.28	8838.87			

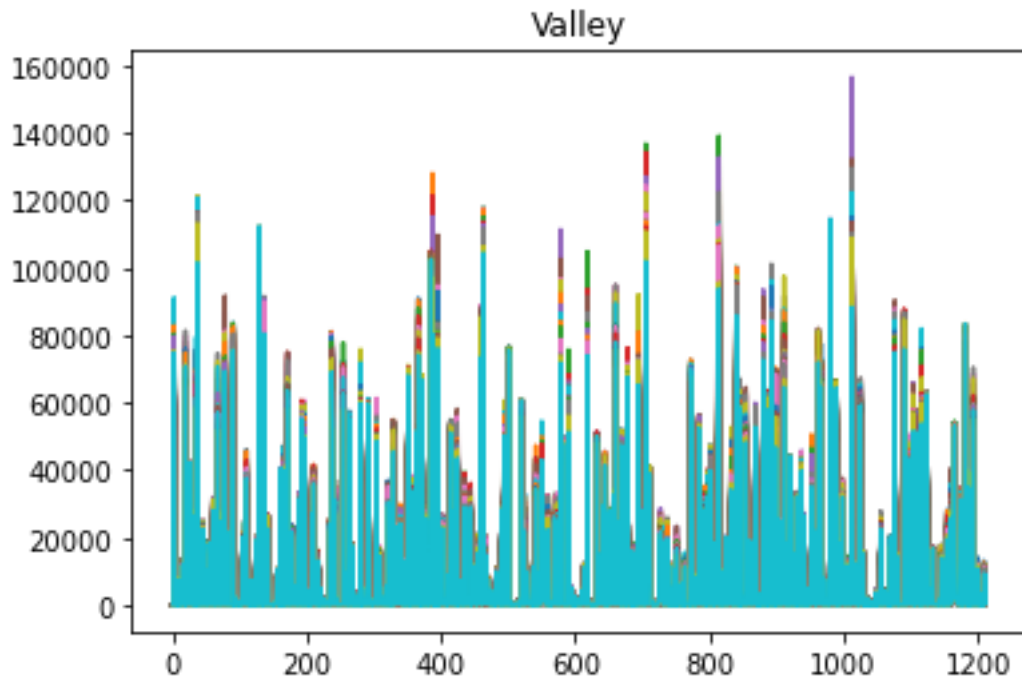
	V8	V9	V10	...	V91	V92	V93 \
0	39.53	38.81	38.79	...	37.57	36.62	36.92 1 1.70 1.75 1.78 ...
	1.71	1.80	1.79				
2		73268.61	74465.84	72503.37	...	69384.71	73438.88 71053.35
3		37668.32	40980.89	38466.15	...	47653.60	42625.67 40684.20
4		5.38	5.34	5.87	...	5.52	5.17 5.67
...
1207	13.33	13.63	14.55	...	12.89	12.48	12.15
1208	48.65	48.63	48.61	...	47.45	46.93	49.61
1209	10202.28	9152.99	9591.75	...	10413.41	9068.11	
		9191.80					
1210	32.48	35.63	32.48	...	33.18	32.76	35.03
1211	8967.24	8635.14	8544.37	...	7747.70	8609.73	
		9209.48					

	V94	V95	V96	V97	V98	V99	V100
0	38.80	38.52	38.07	36.73	39.46	37.50	39.10 1 1.77 1.74 1.74 1.80
	1.78	1.75	1.69				
2		71112.62	74916.48	72571.58	66348.97	71063.72	67404.27
		74920.24					
3		46960.73	44546.80	45410.53	47139.44	43095.68	40888.34
		39615.19					
4		5.60	5.94	5.73	5.22	5.30	5.73 5.91
...
1207	13.15	12.35	13.58	13.86	12.88	13.87	13.51
1208	47.16	48.17	47.94	49.81	49.89	47.43	47.77
1209	9275.04	9848.18	9074.17	9601.74	10366.24	8997.60	
		9305.77					
1210	32.89	31.91	33.85	35.28	32.49	32.83	34.82
1211	8496.33	8724.01	8219.99	8550.86	8679.43		
		8389.31	8712.80				

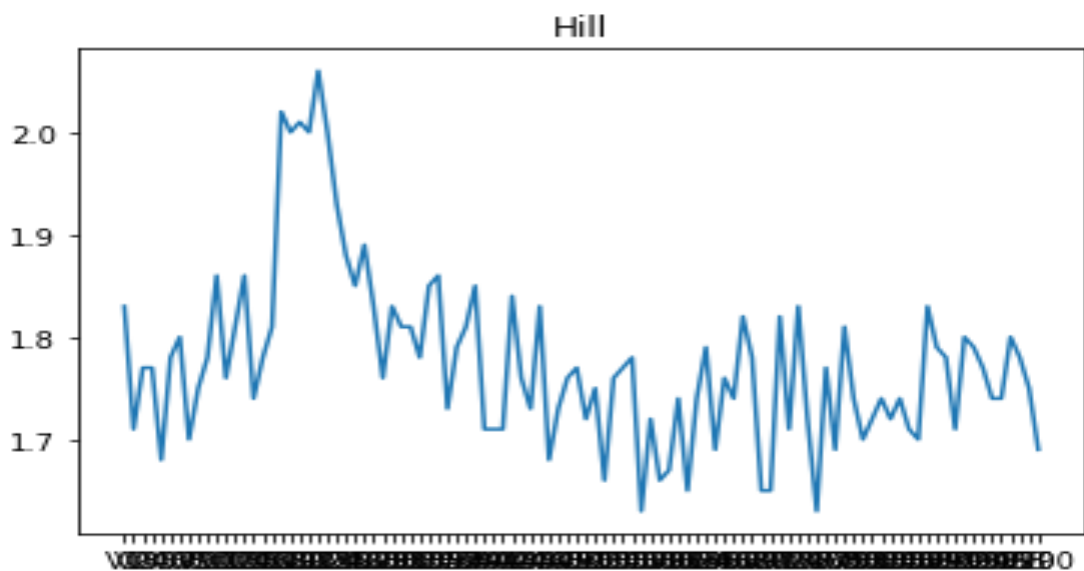
[1212 rows x 100 columns]

```
[19]: #data visualization
import matplotlib.pyplot as plt
```

```
[20]: plt.plot(X.iloc[0,:])
plt.title('Valley');
```



```
[21]: plt.plot(X.iloc[1,:])
plt.title('Hill');
```



```
[22]: #train test split
      from sklearn.model_selection import train_test_split

[23]: X_train, X_test, y_train, y_test= train_test_split(X,y, test_size=0.3,
      ↪stratify=y,random_state=2529)

[24]: X_train.shape, X_test.shape, y_train.shape, y_test.shape

[24]: ((848, 100), (364, 100), (848,), (364,))

[25]: #modelling
      from sklearn.linear_model import LogisticRegression

[49]: LR=LogisticRegression(max_iter=5500)

[50]: LR.fit(X_train,y_train)

[50]: LogisticRegression(max_iter=5500)

[51]: #model prediction
      y_pred=LR.predict(X_test)

[52]: y_pred
[52]: array([0, 1, 0, 1, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 1,
0, 0, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0,
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0, 1, 1, 1, 1, 0, 0, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1,
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1, 0,
```

```

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0, 0,
0, 0, 1, 1, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 0,
0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 1, 1, 1, 1], dtype=int64)

```

```
[53]: y_pred.shape
```

```
[53]: (364,)
```

```
[54]: LR.predict_proba(X_test)
```

```

[54]: array([[1.00000000e+000, 0.00000000e+000],
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```

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```

```
[55]: #model evaluation
      from sklearn.metrics import confusion_matrix, classification_report
```

```
[56]: print(confusion_matrix(y_test,y_pred))
```

```
[[176   6]
 [  6 176]]
```

```
[57]: print(classification_report(y_test,y_pred))
```

	precision	recall	f1-score	support
0	0.97	0.97	0.97	182
1	0.97	0.97	0.97	182
accuracy			0.97	364
macro avg	0.97	0.97	0.97	364
weighted avg	0.97	0.97	0.97	364