Machine Learning in Finance Lab – Week 05

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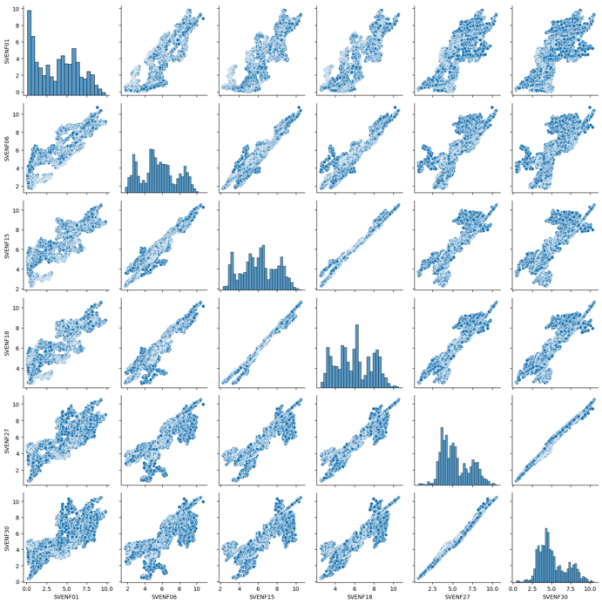
Part 1. EDA:

- **Scatter Plot Metrics:**



- **Shape of Data:**

```
The number of Columns is 31 .
The number of Rows is 8071 .
```

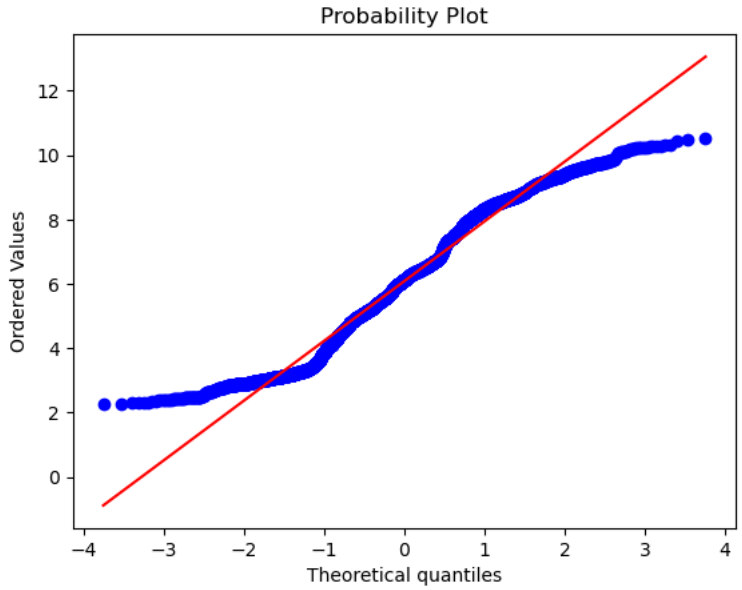
- **Nature (truncated):**

1	SVENF02	8071	0	0
2	SVENF03	8071	0	0
3	SVENF04	8071	0	0
4	SVENF05	8071	0	0
5	SVENF06	8071	0	0
6	SVENF07	8071	0	0
7	SVENF08	8071	0	0

- **Summary of Statistics:**

```
μ = 3.7853113740552597 Var = 7.011351664593713 σ = 2.647895705006848

Boundaries for 4 Equal Percentiles
 [0.0727, 1.14405, 3.9865, 5.9015, 9.8138]

Boundaries for 10 Equal Percentiles
 [0.0727, 0.3326, 0.8002, 1.5379, 2.6503, 3.9865, 4.705, 5.6197, 6.2687, 7.5553, 9.8138]

Unique Label Values
 ['SVENF01', 'SVENF26', 'SVENF07', 'SVENF22', 'SVENF21', 'SVENF06', 'SVENF12', 'SVENF30', 'SVENF15', 'SVENF14', 'SV
ENF17', 'SVENF10', 'SVENF16', 'SVENF04', 'SVENF05', 'SVENF28', 'SVENF13', 'SVENF09', 'SVENF03', 'SVENF24', 'SVENF02
', 'SVENF08', 'SVENF18', 'Adj_Close', 'SVENF29', 'SVENF23', 'SVENF25', 'SVENF20', 'SVENF19', 'SVENF27', 'SVENF11']
```

- **QQ Plot:**



- **Summary of data:**

	SVENF01	SVENF02	SVENF03	SVENF04	SVENF05	\
count	8071.000000	8071.000000	8071.000000	8071.000000	8071.000000	
mean	3.785311	4.258972	4.669363	5.022430	5.318493	
std	2.648060	2.498137	2.341348	2.221632	2.137801	
min	0.072700	0.327300	0.630300	1.013000	1.424500	
25%	1.144050	1.865600	2.536550	3.023050	3.544700	
50%	3.986500	4.393300	4.505500	4.718900	5.051300	
75%	5.901500	6.221250	6.461300	6.626600	6.779550	
max	9.813800	9.887800	10.145600	10.459900	10.649900	

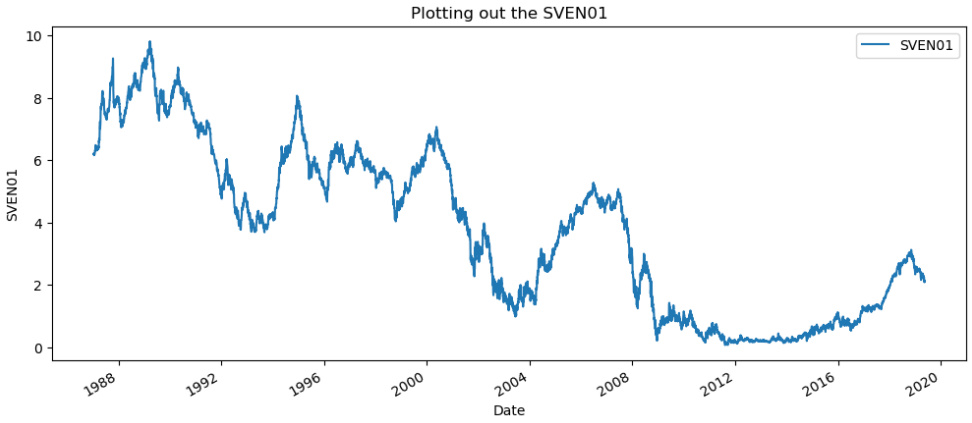
	SVENF06	SVENF07	SVENF08	SVENF09	SVENF10	...	\
count	8071.000000	8071.000000	8071.000000	8071.000000	8071.000000	...	
mean	5.559644	5.750071	5.895135	6.000596	6.072112	...	
std	2.080405	2.040337	2.010786	1.987244	1.966960	...	
min	1.698200	1.807300	1.885000	1.942100	1.988200	...	
25%	4.063300	4.409750	4.644300	4.774550	4.859500	...	
50%	5.394600	5.663700	5.870800	5.993700	6.082400	...	
75%	6.908050	7.049900	7.181600	7.297550	7.393350	...	
max	10.741400	10.766300	10.747500	10.701500	10.640000	...	

	SVENF22	SVENF23	SVENF24	SVENF25	SVENF26	\
count	8071.000000	8071.000000	8071.000000	8071.000000	8071.000000	
mean	5.689046	5.621666	5.554136	5.486943	5.420479	
std	1.801291	1.797858	1.797012	1.798842	1.803390	
min	1.489600	1.283000	1.100800	0.941000	0.801800	
25%	4.177450	4.090550	4.024800	3.982950	3.962100	
50%	5.619600	5.503000	5.369900	5.228000	5.096700	
75%	7.330550	7.233200	7.114900	6.998150	6.871050	
max	10.535100	10.535100	10.535100	10.535100	10.535100	

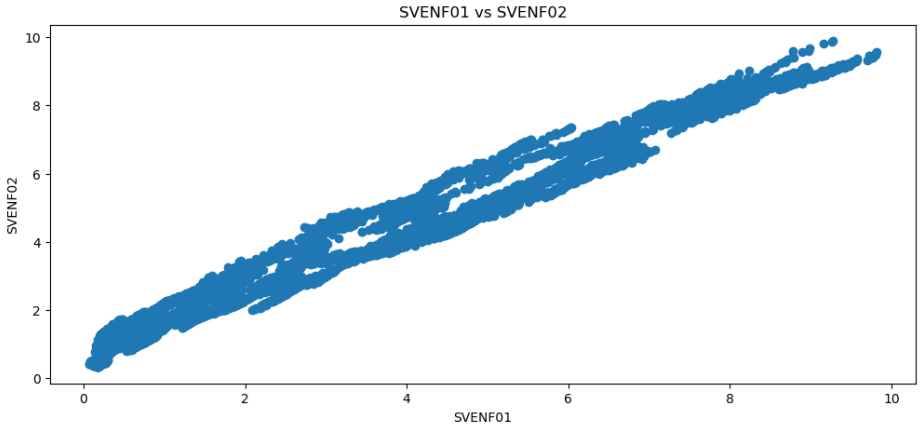
	SVENF27	SVENF28	SVENF29	SVENF30	Adj_Close
count	8071.000000	8071.000000	8071.000000	8071.000000	8071.000000
mean	5.355063	5.290948	5.228333	5.167371	5.509793
std	1.810643	1.820541	1.832984	1.847834	2.491110
min	0.681200	0.577100	0.487600	0.411100	2.801050
25%	3.887150	3.840900	3.825050	3.831350	3.130587
50%	4.979700	4.860800	4.758600	4.669000	4.956219
75%	6.765400	6.650600	6.535450	6.421850	8.051437
max	10.535100	10.535100	10.535100	10.535100	10.150118

[8 rows x 31 columns]

- **Plot out data:**



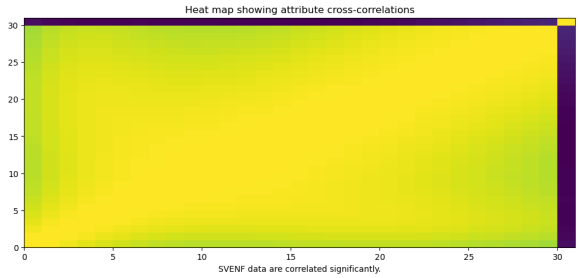
- **Cross Plotting Pairs:**



- **Correlations (truncated):**

	SVENF01	SVENF02	SVENF03	SVENF04	SVENF05	SVENF06	SVENF07	SVENF08	SVENF09	SVENF10	...	SV
SVENF01	1.000000	0.986417	0.958364	0.924637	0.890691	0.860385	0.835864	0.817792	0.805833	0.799116	...	0.8
SVENF02	0.986417	1.000000	0.991325	0.971026	0.945906	0.920994	0.899469	0.882818	0.871309	0.864483	...	0.8
SVENF03	0.958364	0.991325	1.000000	0.993681	0.978891	0.960996	0.943810	0.929497	0.918916	0.912072	...	0.9
SVENF04	0.924637	0.971026	0.993681	1.000000	0.995480	0.985206	0.973186	0.962005	0.952978	0.946523	...	0.9
SVENF05	0.890691	0.945906	0.978891	0.995480	1.000000	0.996934	0.990180	0.982494	0.975478	0.969858	...	0.9
SVENF06	0.860385	0.920994	0.960996	0.985206	0.996934	1.000000	0.998022	0.993749	0.988922	0.984458	...	0.9
SVENF07	0.835864	0.899469	0.943810	0.973186	0.990180	0.998022	1.000000	0.998756	0.996054	0.992905	...	0.9
SVENF08	0.817792	0.882818	0.929497	0.962005	0.982494	0.993749	0.998756	1.000000	0.999202	0.997388	...	0.9
SVENF09	0.805833	0.871309	0.918916	0.952978	0.975478	0.988922	0.996054	0.999202	1.000000	0.999443	...	0.9

- **Correlations Visualization:**



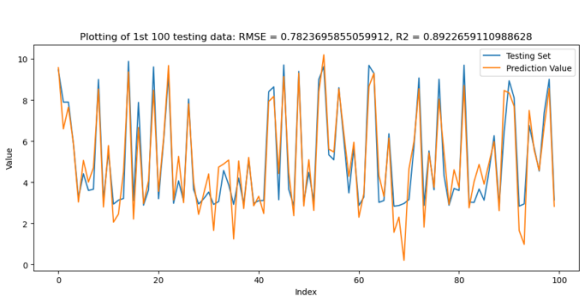
Part 2. PCA:

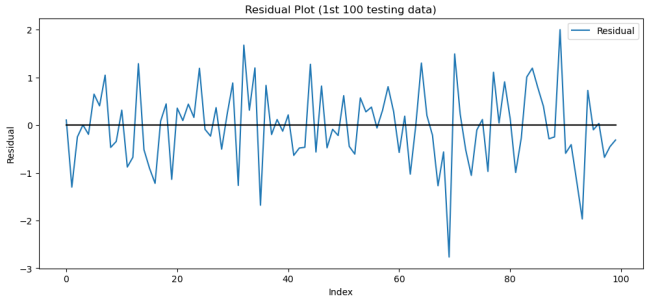
```
Explained Variance Ratio Before PCA:
 [9.25027254e-01 3.77198563e-02 3.11962115e-02 5.11829721e-03
 8.45006479e-04 8.14071111e-05 1.06386900e-05 1.23073879e-06
 8.99497477e-08 7.14094977e-09 4.89071592e-10 3.83422436e-11
 8.63162713e-12 7.54060102e-12 7.44722038e-12 7.41409677e-12
 7.37633844e-12 7.36922042e-12 7.21033060e-12 7.16011018e-12
 7.08499808e-12 7.01615861e-12 6.97953948e-12 6.83297854e-12
 6.78790385e-12 6.76011093e-12 6.68796631e-12 6.63106214e-12
 6.57322725e-12 6.42225375e-12]

Explained Variance Ratio After PCA:
 [0.92502725 0.03771986 0.03119621]

Culmulative Variance Ratio After PCA:
 0.9939433220224664
```

Part 3. Linear Regression VS SVM:

- **Linear Regression with all features:**

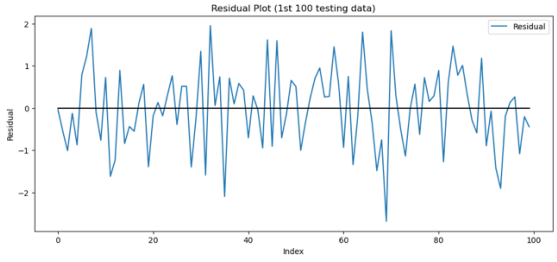
```
Training Set R_Square: 0.8916880358469877
Training Set RMSE: 0.7766533040370089
Testing Set R_Square: 0.8922659110988628
Testing Set RMSE: 0.7823695855059912
```





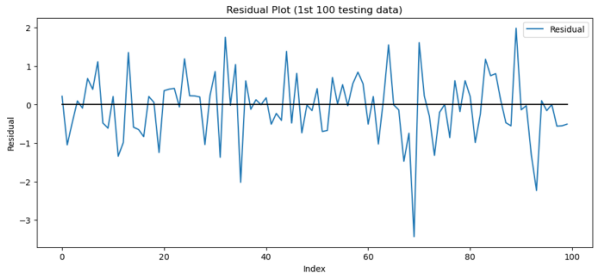
- **Linear Regression with PCA:**

```
Training Set R_Square: 0.8486173333869106
Training Set RMSE: 0.9010775907448826
Testing Set R_Square: 0.8427446713577096
Testing Set RMSE: 0.9331729764617046
```



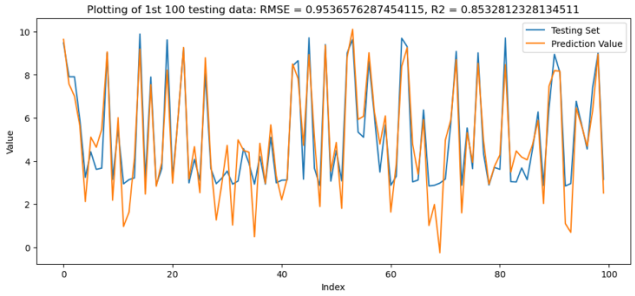
- **SVM with all features:**

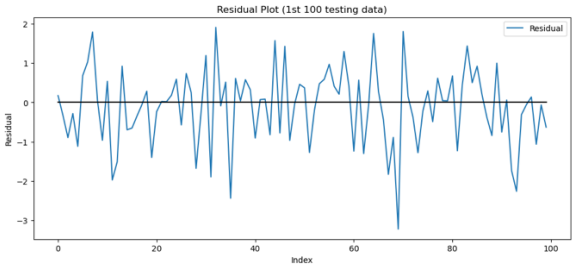
```
Training Set R_Square: 0.8902331608101304
Training Set RMSE: 0.8092306402122806
Testing Set R_Square: 0.8880441537496224
Testing Set RMSE: 0.8299709382195322
```



- **SVM with PCA:**

```
Training Set R_Square: 0.8597318320491025
Training Set RMSE: 0.917069041995177
Testing Set R_Square: 0.8532812328134511
Testing Set RMSE: 0.9536576287454115
```





Part 4. Conclusion:

From the R_square and RMSE, we can notice that, with PCA, the performance of the model **will not necessary be better**. In this case, I think it is because, reducing the features from 30 to 3, we may have as well reduced the pivotal insights of data.

And to compare Linear Regression and SVM, we can notice that **none of them is significantly better**. However, there is **large gap in their learning times (as shown below)**.

As a result, I would still use linear regression if there is no necessity to use SVM, and I would apply best subsets selection instead of directly reduce the features.

	Linear Reg. (all)	Linear Reg. (PCA)	SVM (all)	SVM (PCA)
R_Square (Train)	0.89	0.84	0.88	0.85
R_Square (Test)	0.89	0.84	0.89	0.85
RMSE (Train)	0.77	0.90	0.81	0.91
RMSE (Test)	0.78	0.92	0.82	0.95
Times	323ms	282ms	12.9s	10.9s

Part 5. Appendix:

Github:https://github.com/yu7yu7/IE517_Machine-Learning-in-Finance-Lab/blob/main/IE517_SP23_HW5/ML_Week05_HW.ipynb