Project 2 - Implement CAPM Model in Python and Excel

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1 Data Download

Oracle stock data and S&P500 index values were downloaded from Yahoo Finance. Period: March 25, 2015 – June 25, 2015

Regarding python, required data has been downloaded using next python function:

```
from pandas_datareader import data as pdr
pdr.get_data_yahoo()
```

2 Daily Stock and Index Returns

Daily return can be calculated using the equation below:

$$daily\_return(in\%) = \frac{today\_price - yesterday\_price}{yesterday\_price} * 100\%$$

In python daily returns can be calculated using pandas **pct_change(1)** function.

3 Capital Asset Pricing Model (CAPM)

CAPM shows a linear relationship between risk and expected return and that is used in the pricing of risky securities. The security market line of the CAPM is defined as

$$R_{i,t} - R_{f,t} = \alpha_i + \beta_i(R_{M,t} - R_{f,t}) + \epsilon_{i,t}$$

So, the regression implemented in the project is linear with explained variable Oracle stock returns minus risk-free rate and explanatory variable S&P500 index return minus risk-free rate.

4 Regression in Python

To implement a regression in python **statsmodels** package can be used:

```
import statsmodels.api as sm
sm.add_constant()
model =sm.OLS()
model.fit()
```

This is ordinary least squares model.

5 Regression in Excel

To implement regression in Excel Analysis ToolPak is used.

6 Regression Results

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.536312776
R Square	0.287631394
Adjusted R Square	0.276141578
Standard Error	0.010705328
Observations	64

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	0.002868951	0.002868951	25.03359398	4.93126E-06			
Residual	62	0.007105451	0.000114604					
Total	63	0.009974402						

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-0.000812155	0.001346545	-0.603139339	0.548616102	-0.003503861	0.001879551	-0.003503861	0.001879551
X Variable 1	1.116279975	0.223106145	5.00335827	4.93126E-06	0.670297146	1.562262804	0.670297146	1.562262804

```
                            OLS Regression Results
==============================================================================
Dep. Variable:              Adj Close   R-squared:                       0.288
Model:                            OLS   Adj. R-squared:                  0.276
Method:                 Least Squares   F-statistic:                     25.03
Date:                Sun, 21 Jan 2018   Prob (F-statistic):           4.93e-06
Time:                        23:50:04   Log-Likelihood:                 200.57
No. Observations:                  64   AIC:                            -397.1
Df Residuals:                      62   BIC:                            -392.8
Df Model:                           1
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const         -0.0008      0.001     -0.603      0.549      -0.004       0.002
Adj Close      1.1163      0.223      5.003      0.000       0.670       1.562
==============================================================================
Omnibus:                       59.411   Durbin-Watson:                   1.837
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              510.445
Skew:                          -2.406   Prob(JB):                    1.44e-111
Kurtosis:                      15.972   Cond. No.                         167.
==============================================================================
```

Regression results are fairly the same:

1. $R^2 = 0.2876$. This means that only approximately 29% of Oracle returns data can be explained by S&P500 index returns data.

2. T-test and p-values say that intercept in the model is not significant, however the second parameter of the model is significant at significance level = 0.05.

3. Based on Skewness, Kurtosis and Jarque-Bera test the hypothesis that the residuals are normally distributed cannot be accepted.

Regarding the meaning of the model results, the market is efficient, since alpha is not significant. This coefficient indicates how an investment has performed after accounting for the risk it involved. Since model's beta is greater than 1 one can conclude that the Oracle stock price is more volatile than the market. However, as was mentioned before $R^2 = 0.2876$ is rather small.