Testing Capital Asset Pricing Model

The capital asset pricing model (CAPM) is the equation that describes the relationship between the expected return of a given security and systematic risk as measured by its beta coefficient. Besides risk the model considers the effect of risk-free interest rates and expected market return. The Capital Asset Pricing Model (CAPM) is popular amongst financial analysts, however, few devote time to testing its validity. The CAPM is derived from a set of assumptions. It is an abstraction of the real-world capital markets. Although some of the assumptions are unrealistic, they simplify matters a great deal and make the CAPM more tractable from a mathematical standpoint. The CAPM states that, given the assumptions, the expected return on asset is a positive linear function of its index of systematic risk as measured by beta, β, estimated by the following equation:

$$r_{i,t} - r_{f,t} = \alpha_i + \beta_i(r_{m,t} - r_{f,t}) + e_{i,t}$$

Where, $r_{i,t}$ = observed return for asset i for time t; $r_{f,t}$ = observed return on risk-free rate for time t; $r_{m,t}$ = expected return for the market portfolio for time t; and $e_{i,t}$ = error term for time t.

The purpose of the assignment is to test the validity of the Capital Asset Pricing Model (CAPM). In equilibrium, the CAPM predicts that all investors hold portfolios that are efficient in the expected return-standard deviation space.

PROCESS

To test the Capital Asset Pricing Model , data from official statistics of the Bombay Stock Exchange is used. Here, we analysed 36 companies and calculated the log returns ,simple returns and betas . We are calculating with reference to S&P BSE 500 for the period of 31 months from April 1, 2018 to September 30, 2020 from Yahoo! Finance. This data may be used as a proxy for the market returns (r_m).The data which is used as a proxy for the risk free rate of return is (r_f) monthly yields on Government of India 10-Year Bonds for the period of 31 months from April 1, 2018 to September 30, 2020 from Investing.com

Since , we have already done the first part i.e. calculated the log returns on 36 securities and the betas of these securities. A methodology referred to as a two-pass regression is used to test the CAPM. The first pass involves the estimation of beta for each security from its characteristic line. The betas from the first pass regression are then used to form portfolios of securities ranked by portfolio beta. The portfolio returns, the return on the risk-free asset, and the portfolio betas are then used to estimate the second-pass regression. The portfolio returns is simply the mean of individual returns .

Then we run second-pass regression which is the empirical analogue of the CAPM is estimated:

$$R_p - R_F = b_0 + b_1 \beta_p + e_p$$

where the parameters to be estimated are b_0 and b_1, and e_p is the error term for the regression.

$R_p - R_F$ -- Average excess of returns on asset over the testing period ; b_0 -- Regression intercept ; b_1 regression coefficient; β_p -- Estimated beta of the asset ; e_p -- Random disturbance term.

The average excesses of all assets' returns over the risk-free interest rate will be regressed against their estimated betas.

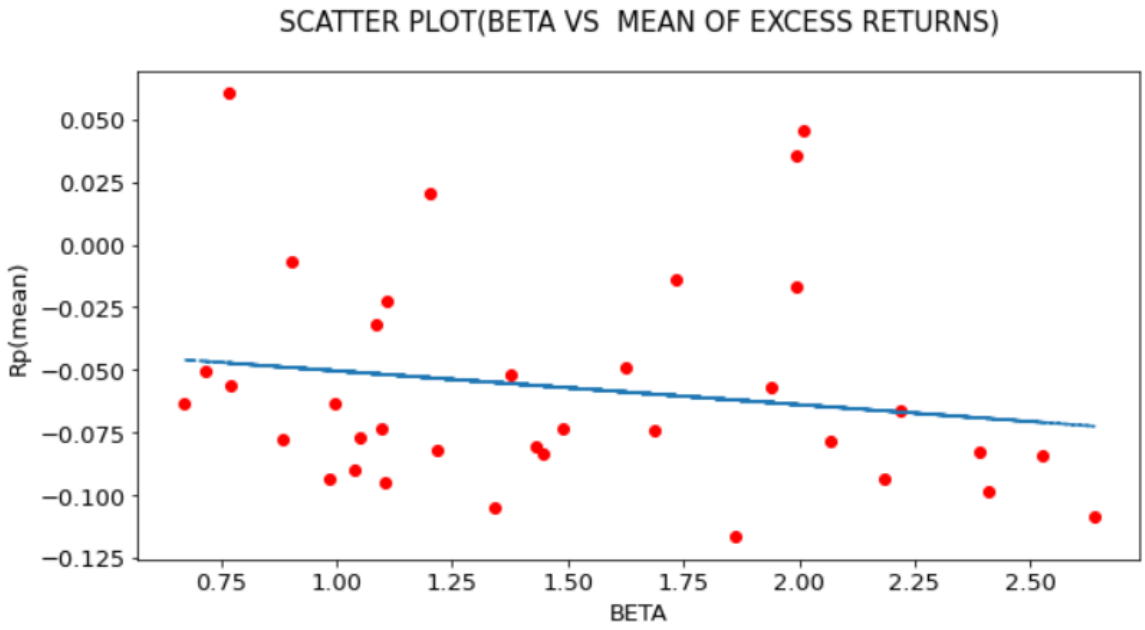
RESULTS

a. Descriptive statistics of the dependent and independent variable.

DESCRIPTICE STATISTICS OF Rp MEAN	
Mean	-0.057199109
Standard Error	0.007330635
Median	-0.073594569
Mode	#N/A
Standard Deviation	0.043983809
Sample Variance	0.001934575
Kurtosis	0.918404331
Skewness	1.230261093
Range	0.177173931
Minimum	-0.116832552
Maximum	0.060341379
Sum	-2.059167931
Count	36

DESCRIPTIVE STATISTICS OF BETA	
Mean	1.498921
Standard Error	0.094957
Median	1.405319
Mode	#N/A
Standard Deviati	0.569741
Sample Variance	0.324605
Kurtosis	-1.02464
Skewness	0.393445
Range	1.970725
Minimum	0.668158
Maximum	2.638883
Sum	53.96114
Count	36

b. Scatterplot with trend line of the dependent and independent variable.



c. Summary of regression results

SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0.174596					
R Square	0.030484					
Adjusted R Squa	0.001968					
Standard Error	0.04394					
Observations	36					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	1	0.002064	0.002064	1.069033	0.308463	
Residual	34	0.065646	0.001931			
Total	35	0.06771				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Constant	-0.037	0.020868	-1.77287	0.08521	-0.0794	0.005413
Beta	-0.01348	0.013036	-1.03394	0.308463	-0.03997	0.013014

d. State the null and alternate hypothesis

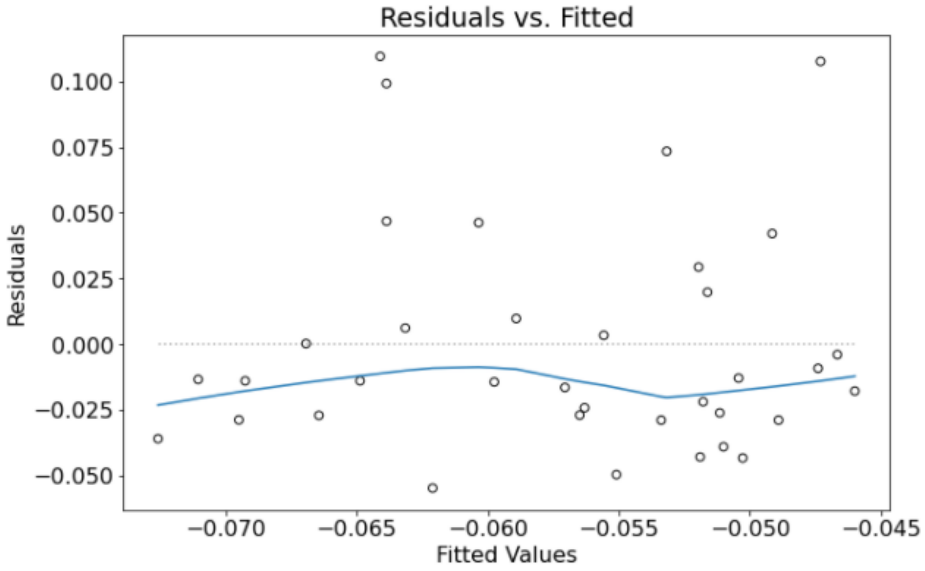
Testing the parameters of the regression equation: b_0 and b_1

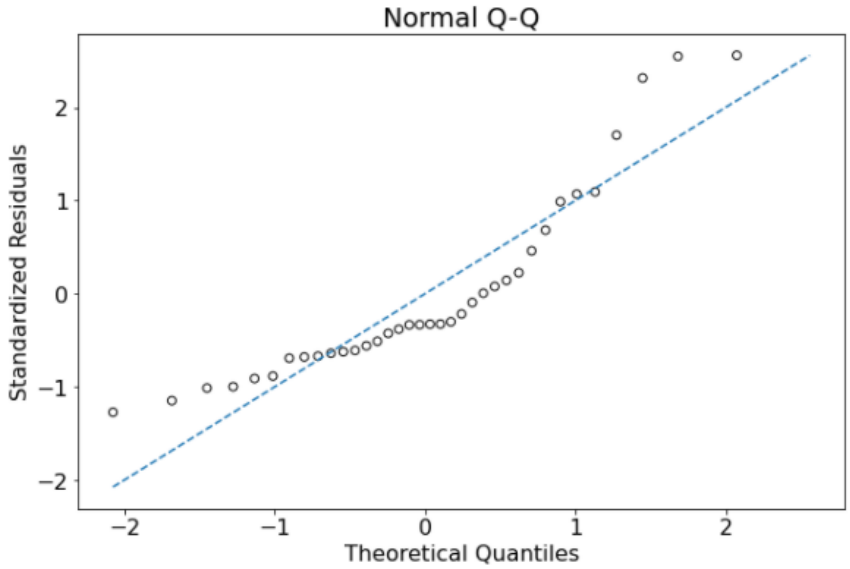
$H_0 : b_0 = 0$ V/s $H_1 : b_0 \neq 0$

$H_0 : b_1 = 0$ V/s $H_1 : b_1 \neq 0$

Both b0 and b1 have a p-value greater than 0.05. Therefore, we fail to reject the null hypothesis in the both the cases. Analysis shows that b0 is 0 but b1 is not significant.

e. Diagnostic plots





Conclusion:

The estimated Security market line has a downward slope which doesn't supports the idea of CAPM that expected returns are positively and proportionally related to beta.

Also, the line intercept is not 0. However, to draw any constructive conclusion, we must examine regression results. Since, both b0 and b1 have a p-value greater than 0.05, hence, we cannot reject the null hypothesis. Therefore, we can say that b0 is equal to 0 but the slope is negative and not significant. Also, R-square value is extremely low suggesting that only a small portion of variation in returns can be explained by beta. These results don’t support the CAPM.