

PS3

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Part I

γ_0 is the coefficient of return on a portfolio that is uncorrelated with Market (should be zero under the CAPM assumption) and γ_M is the price of risk of asset (market risk premium)..

```
##      alpha      gamma.M
## 0.004895905 0.089256767

## [1] "The mean of the estimates are:"

##      alpha gamma.M
##      0.808   0.222

## [1] "The SD of the estimates are:"

##      alpha gamma.M
##      6.186   8.323

## [1] "The T-stats of the estimates are:"

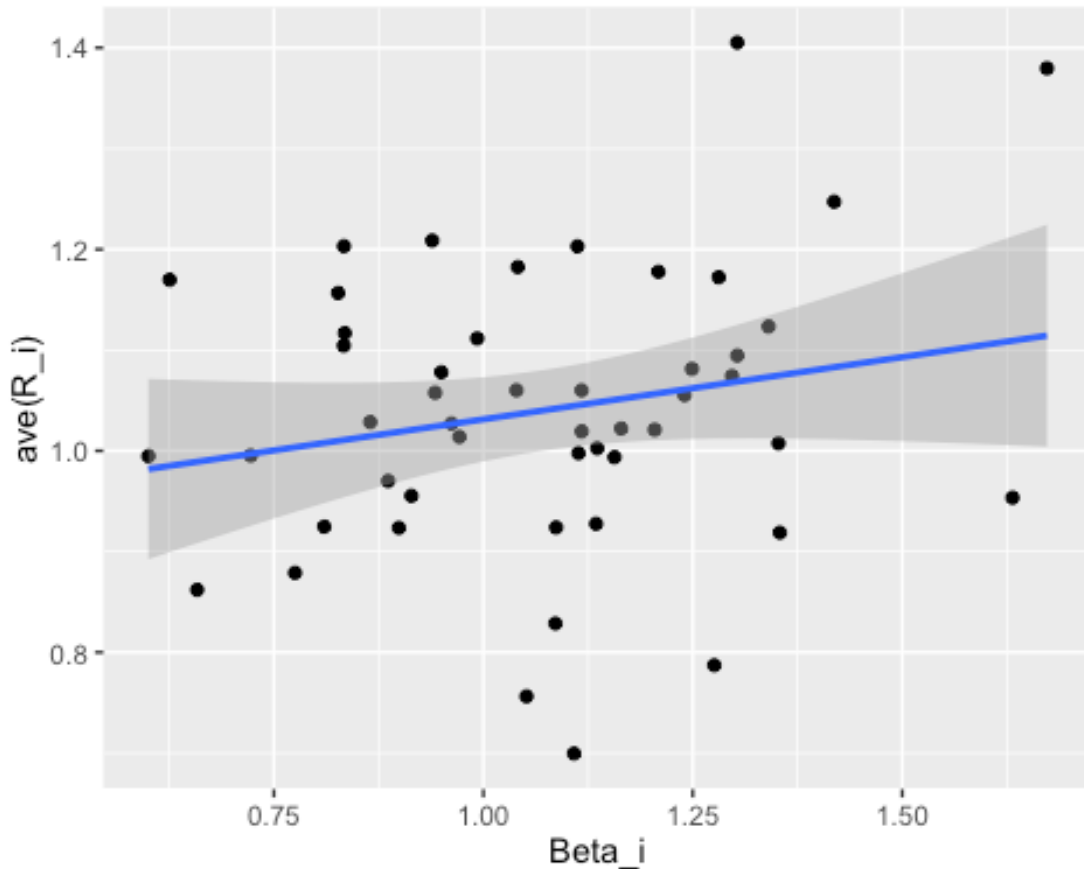
##      alpha gamma.M
##      2.820   1.701

## [1] "P-values of T-test:"

##      alpha      gamma.M
## 0.004895905 0.089256767
```

We can reject the hypothesis that the proxy for the market portfolio is mean variance efficient at 95% confidence level since the p-value for the intercept is much smaller than 0.05, meaning that the CAPM assumptions fail and thus the market is no longer mean variance efficient.

We can see that the regression in section (c) yields similar but different coefficients point estimate (for γ_0 : 0.91 vs. 0.81) and (for γ_M 0.12 vs. 0.22).



Yes, the plot does represent a positive relationship, as we can see from the 1-st order fit (blue). It should also be the case since the coefficients of betas are all positive. However, the plot should look like a straight line (if we ignore gaussian noises) of a slope of γ_M under the assumption of CAPM.

```
##      alpha      beta      ln(size)
## Min.   :-46.157  Min.   :-31.5741  Min.   :-15.93992
## 1st Qu.: -4.792  1st Qu.: -3.0028  1st Qu.: -0.78880
## Median :  1.196  Median : -0.1046  Median : -0.08741
## Mean   :  0.919  Mean   :  0.1739  Mean   : -0.07579
## 3rd Qu.:  6.800  3rd Qu.:  3.1439  3rd Qu.:  0.67692
## Max.   : 56.407  Max.   : 84.3857  Max.   :  6.83719
##      ln(B/M)
## Min.   :-10.0611
## 1st Qu.: -1.8408
## Median : -0.3367
## Mean   : -0.3822
## 3rd Qu.:  0.9839
## Max.   : 14.0282
```

If the CAPM holds, γ_{size} and $\gamma_{B/M}$ should be zero, since the CAPM states that the expected return of an asset is only related to *Beta* (γ_M). We can clearly see here that the values are not zero.

```
##          alpha          beta      ln(size)      ln(B/M)
## 3.251841e-02 2.396858e-02 6.675129e-02 8.775735e-07
```

We can reject the hypothesis that the proxy for the market portfolio is mean variance efficient because the p-values of the hypotheses that the coefficients of $\ln(\text{size})$ and $\ln(\text{BE}/\text{ME})$ are not zero is significant at 95% level.

Part II

```
## [1] "The mean of the estimates are:"

##      alpha gamma.M
##      0.613    0.456

## [1] "The SD of the estimates are:"

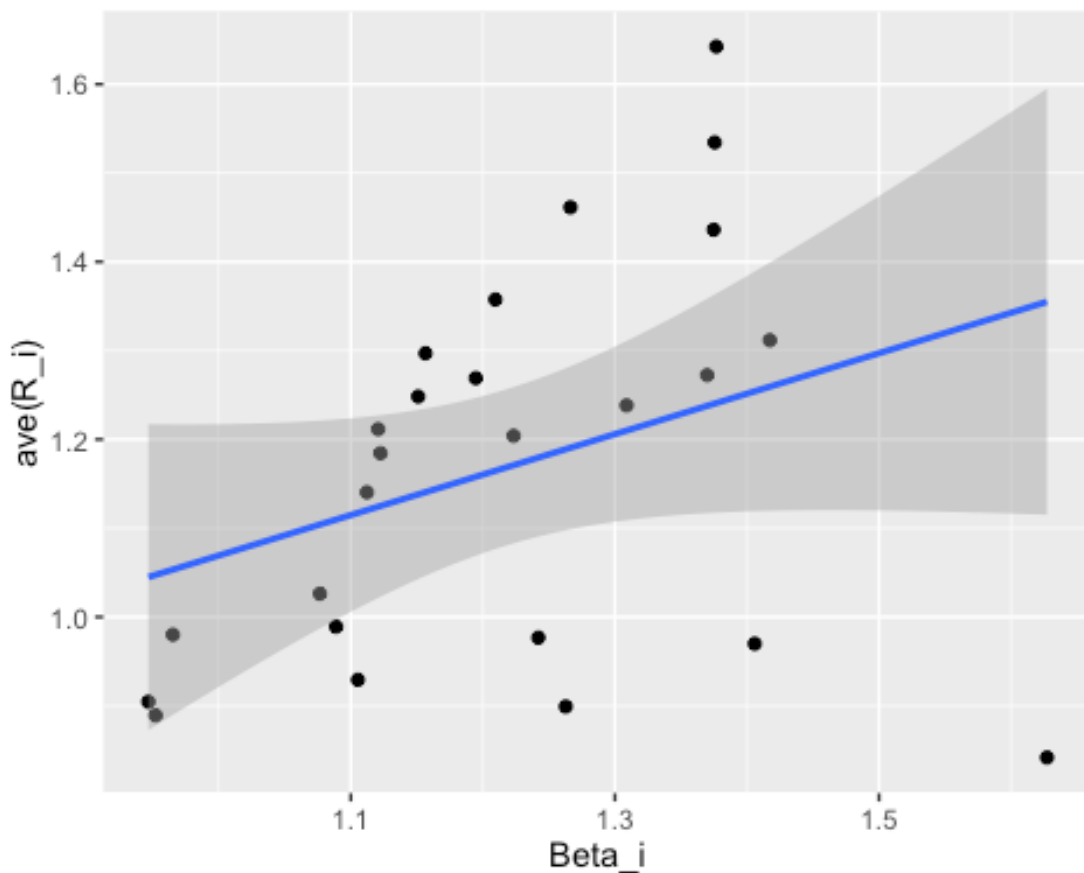
##      alpha gamma.M
##     10.81    11.77

## [1] "The T-stats of the estimates are:"

##      alpha gamma.M
##      1.022    0.547

## [1] "P-values of T-test:"

##      alpha gamma.M
## 0.3069922 0.5842119
```



```
##      alpha      beta      ln(size)      ln(B/M)
## 9.127776e-06 1.013939e-03 1.538110e-02 2.756127e-06
```

```
## [1] "The mean of the estimates are:"
```

```
##      alpha gamma.M
##      0.277    2.575
```

```
## [1] "The SD of the estimates are:"
```

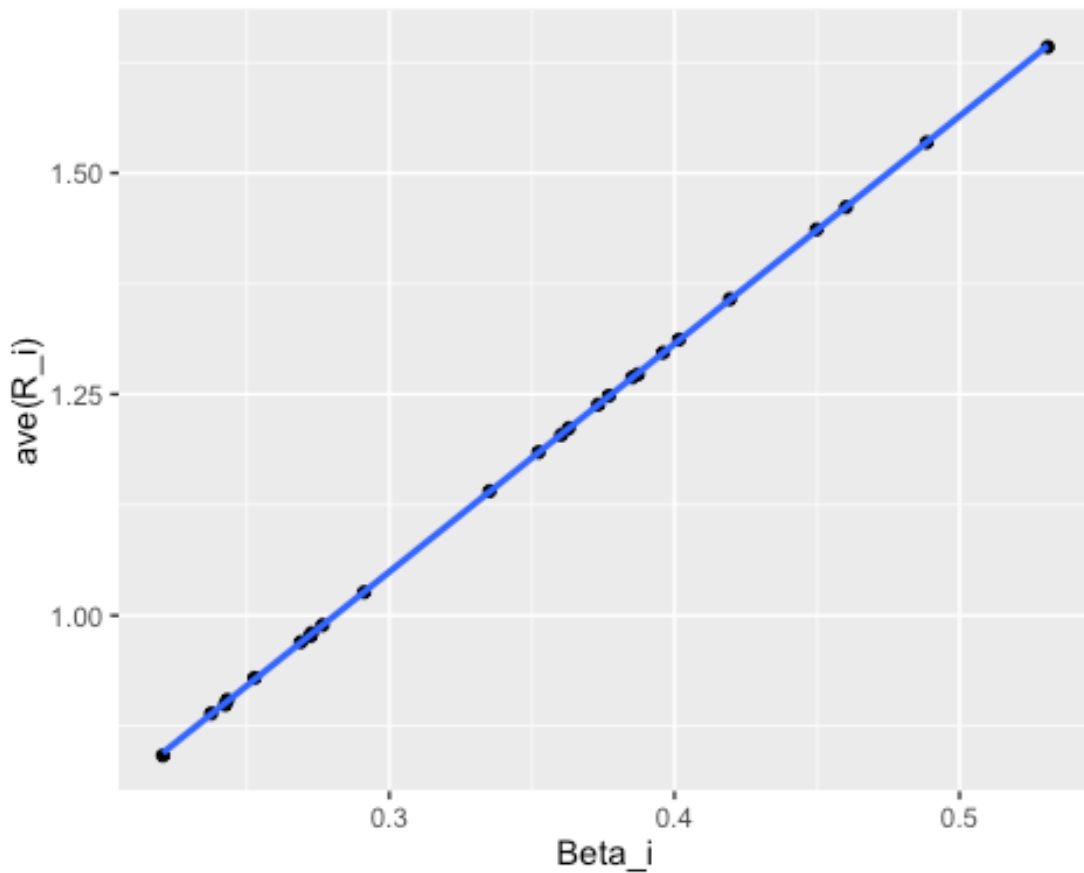
```
##      alpha gamma.M
##      6.444   14.708
```

```
## [1] "The T-stats of the estimates are:"
```

```
##      alpha gamma.M
##      0.006    0.007
```

```
## [1] "P-values of T-test:"
```

```
##      alpha gamma.M
## 0.9954139 0.9941930
```



```
## [1] "The mean of the estimates are:"
##   alpha gamma.M
##   0.365   3.084

## [1] "The SD of the estimates are:"
##   alpha gamma.M
##   6.449  18.089

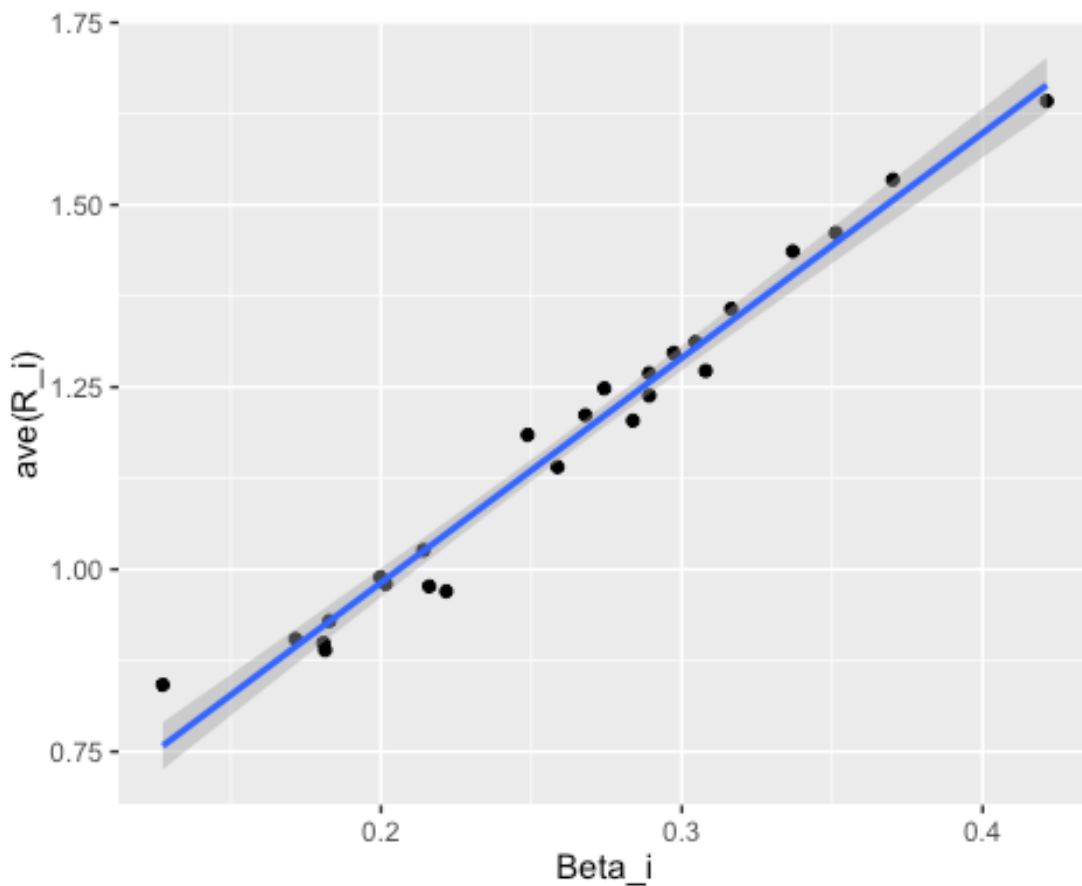
## [1] "The T-stats of the estimates are:"
##   alpha gamma.M
##   0.443   1.687

## [1] "P-values of T-test:"
##       alpha   gamma.M
## 0.65773866 0.09193603
```

This nearly perfect relationship showcases one of the critique of Roll's that there will be a linear relation between

the assets and the efficient portfolio in sample,

regardless of whether the true market portfolio
is mean-variance efficient.



The difference from 2 and 3 illustrates that we can use intra-cross-validation method to avoid creating a perfect linear relationship between the assets and the efficient portfolio in sample.