

MEC 537

Data Analysis, Forecasting & Risk
Analysis

Final Project

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1. The 30 stocks we select and their corresponding codes are shown in the following table.

Stock	Code	Stock	Code
Apple Inc	AAPL	Baidu Inc	BIDU
Forward Industries	FORD	BP p.l.c	BP
International Business Machines	IBM	The Blackstone Group	BX
Bank of America	BAC	Principal Financial Group	PFG
Amazon.com	AMZN	ALLETE Inc.	ALE
AT&T	T	Credit Suisse	CS
Alphabet Inc.	GOOG	Adidas AG	ADDYY
Delta Airlines Inc	DAL	Morgan Stanley	APF
American Express	AXP	UBS Group AG	UBS
Southwest Airlines Co.	LUV	American Electric Power Co.	AEP
Accenture	ACN	Arlington Asset Investment Co.	AI
China Eastern Airlines Co	CEA	Healthcare Trust of America	HTA
AZZ Inc	AZZ	Associated Banc-Corp	ASB
The Goldman Sachs Group, Inc	GS	First American Financial Co.	FAF
Microsoft Co.	MSFT	S&P 500	^gspc
The Boeing Company	BA		

2. The relevant codes for weekly return data are in the first part of final.Rmd. We have 208 observations for the 30 selected stocks as well as the market return (S&P 500) and smd and hml. All those 30 stocks have data available for these 4 years.
3. We set the desired portfolio return level to the market return level, that being said, we want to create a portfolio using the above 30 stocks that have the same return with the market (S&P 500). To compute the average weekly market return, we calculate the geometric return of S&P 500 in these 4 years, which turns out to be 0.001484. We set that value to our target portfolio return level

for the following questions.

4. The structure of our 6 portfolios is shown in the following table:

All Ports	Port 2-6	Port 3-6	Port 4-6	Port 5-6	Port 6
AAPL	T	ACN	BA	ALE	AEP
FORD	GOOG	CEA	BIDU	CS	AI
IBM	DAL	AZZ	BP	ADDYY	HTA
BAC	AXP	GS	BX	APF	ASB
AMZN	LUV	MSFT	PFG	UBS	FAF

where the first column contains stocks in all portfolios, the second contains stocks only in portfolio 2-6, the third contains stocks in portfolio 3-6, and so on.

5. We assume the stock premium is explained by the SURE CAPM model without the intercept and with the Gaussian errors as the question states. Relevant codes are shown in the second part of final.Rmd.
6. The training sample prior for each portfolio is derived by using the trainpriorsureg function. Relevant codes are shown in the third part of the final.Rmd.

For the portfolio that contains 15 stocks, we have prior analysis as follow.

1) Mean of Beta (also in beta0.csv)

Stock	Value	Stock	Value	Stock	Value
AAPL	0.9618	T	0.6374	ACN	1.1931
FORD	0.0635	GOOG	1.0656	CEA	-0.5035
IBM	0.1565	DAL	1.4212	AZZ	1.2332
BAC	1.0352	AXP	1.0497	GS	1.0099
AMZN	0.5554	LUV	1.2358	MSFT	1.0077

Beta0 measures mean of Beta. We can see most means of beta are close to one (the mean of those mean betas is 0.8082), indicating that from the prior data, most stocks in our portfolio have an expected return very close to market return.

2) Variance of Beta (shown in the B0.csv)

B0 measures the variance of Beta, which is shown in the B0.csv generated by R (because it is too large). The mean of those variances are 0.0649, indicating that the real beta moves in a relatively short range within mean of beta. Thus our estimate for the mean of beta is reliable.

3) Tightness (In this case Rho = 20)

Rho measures the tightness of the training sample prior. In this case $\text{Rho} = 20$, meaning that our prior data are more scattered, that being said, more likely to follow a distribution of larger variance.

4) Variance of error term (shown in the Sigma0.csv)

Sigma0 measures the variance of error term. In this case we find the mean of Sigma0 is 0.0001 and standard deviation 0.0005, indicating that the error term for each beta is very small. A small error term means that the estimation is reliable, thus support our prior estimation.

7. The optimal portfolio setting for each portfolio is shown in tables below. Relevant codes are shown in the fourth part of final.Rmd.

1) 5-stock portfolio

Stock	Weight
AAPL	0.1117
FORD	0.0145
IBM	0.2893
BAC	0.0935
AMZN	0.1440

Risk Free	0.3470
Standard Deviation: 0.01515109	

2) 10-stock portfolio

Stock	Weight	Stock	Weight
AAPL	0.1092	GOOG	0.0664
FORD	-0.0045	DAL	-0.0342
IBM	0.0598	AXP	0.1849
BAC	0.0381	LUV	0.0088
AMZN	0.0882	Risk Free	0.4093
T	0.0739		
Standard Deviation: 0.01248201			

(negative sign means short position)

3) 15-stock portfolio

Stock	Weight	Stock	Weight	Stock	Weight
AAPL	0.0166	GOOG	0.0580	AZZ	-0.0301
FORD	0.0021	DAL	0.0398	GS	0.1383
IBM	0.1759	AXP	0.1126	MSFT	-0.0648
BAC	-0.0255	LUV	-0.0653	Risk Free	0.4764
AMZN	0.1023	ACN	0.1051		
T	-0.0418	CEA	0.0002		
Standard Deviation: 0.01181135					

(negative sign means short position)

4) 20-stock portfolio

Stock	Weight	Stock	Weight	Stock	Weight
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AAPL	0.0495	DAL	0.0058	MSFT	-0.0164
FORD	0.0137	AXP	0.0025	BA	0.0009
IBM	0.0505	LUV	0.0686	BIDU	0.0161
BAC	0.0017	ACN	0.0667	BP	0.0850
AMZN	0.0631	CEA	-0.0539	BX	0.0200
T	0.0140	AZZ	0.0657	PFG	-0.0481
GOOG	0.0124	GS	0.0868	Risk Free	0.4952
Standard Deviation: 0.01148251					

(negative sign means short position)

5) 25-stock portfolio

Stock	Weight	Stock	Weight	Stock	Weight
AAPL	0.0344	LUV	-0.0508	BX	-0.0107
FORD	0.0016	ACN	-0.1082	PFG	0.1489
IBM	0.0504	CEA	0.0156	ALE	0.0279
BAC	-0.0766	AZZ	-0.0686	CS	-0.0406
AMZN	-0.0082	GS	0.1151	ADDYY	0.0191
T	0.1191	MSFT	-0.0086	APF	0.0509
GOOG	0.0614	BA	0.0547	UBS	-0.0004
DAL	0.0762	BIDU	0.0024	Risk Free	0.4690
AXP	0.0381	BP	0.0878		
Standard Deviation: 0.01106429					

(negative sign means short position)

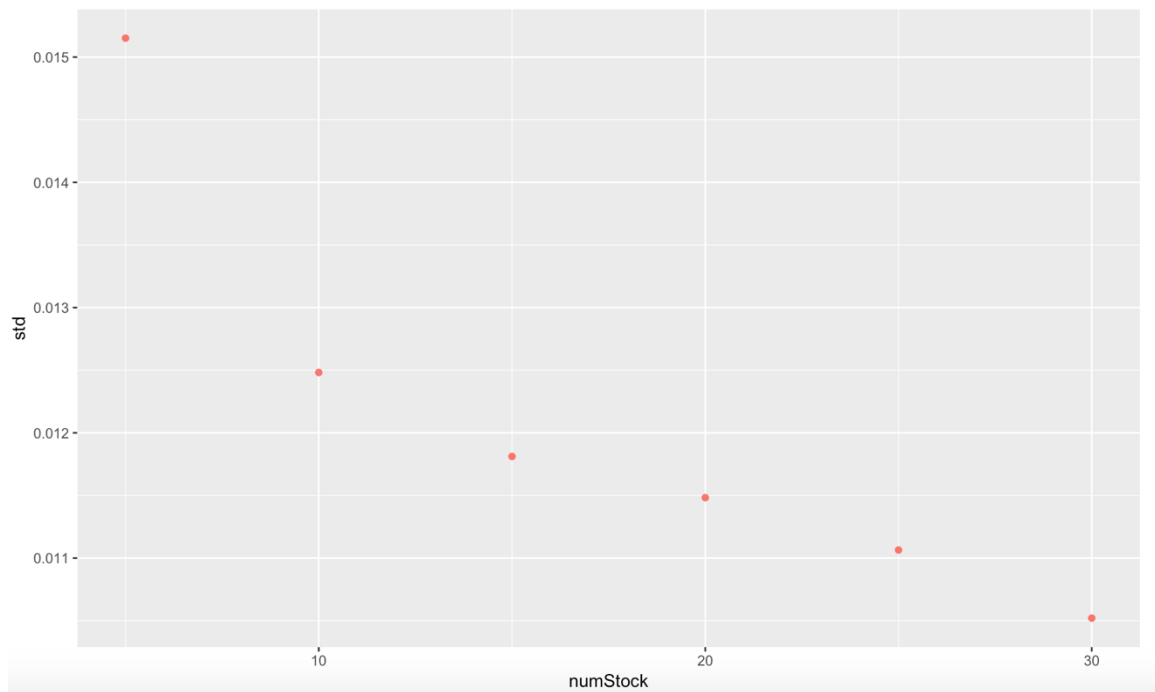
6) 30-stock portfolio

Stock	Weight	Stock	Weight	Stock	Weight
AAPL	0.0461	CEA	0.0016	ADDYY	-0.0258

FORD	0.0088	AZZ	0.0024	APF	0.0531
IBM	0.0263	GS	0.1512	UBS	0.0009
BAC	0.0159	MSFT	0.1099	AEP	-0.1366
AMZN	-0.0095	BA	0.0202	AI	0.0225
T	-0.0067	BIDU	0.0559	HTA	0.1099
GOOG	-0.0007	BP	0.0355	ASB	-0.0846
DAL	0.0265	BX	-0.0748	FAF	-0.0727
AXP	0.0327	PFG	0.0165	Risk Free	0.5839
LUV	-0.0436	ALE	0.0655		
ACN	0.1143	CS	-0.0449		
Standard Deviation: 0.0105206					

(negative sign means short position)

8. The plot is shown below. Relevant codes are shown in the fifth part in final.Rmd.



The red dots show the relationship between the portfolio standard deviation and the number of stocks in the portfolio. We can see that there is a very significant decreasing trend of standard

deviation as the number of stocks increases, that being said, more stocks in a portfolio, less volatile will the portfolio be. This finding supports the portfolio diversification theory to some extent because our data successfully shows that when the portfolio is more diversified, it bears much less risk.