

Asset Pricing Models: RMSE Plots in EViews

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1 Introduction

To visualize the performance of asset pricing models predicted mean returns are often plotted against realized mean returns. This manual explains how to produce these plots using the statistical software EViews. The manual will show this by the example of the CAPM. We will reproduce the results of Grammig and Schrimpf (2006)'s estimation of CAPM, which they use as an benchmark model in their paper. The necessary data can be obtained through the homepage of the course "Financial Econometrics".

2 Estimation of the CAPM

The estimation of the CAPM by GMM can be done by a set of orthogonality conditions displayed in the box below. For details on GMM estimation by EViews see Heid (2005): "Estimating Asset Pricing Models by GMM using EViews".

Box 1:

```
(c(1) + c(2) * mkt_r2) * s1b1_r - 1 = 0
:
(c(1) + c(2) * mkt_r2) * s5b5_r - 1 = 0
param c(1) 1 c(2) 1
@inst c
```

Note, that the variable `mktex_r2` is demeaned market return. You can generate this series by clicking on **Quick/Generate Series** and then type the following commands:

```
mkt\_r2 = mkt\_r [Sample: 1963Q1 1998Q3]
mkt_r2= mkt_r2-@mean(mkt_r2).
```

Estimating the system of moment conditions displayed in Box 1 you should receive the following *first-stage* estimation results.

	Coefficient	t-statistic
b_0	0.97	86.39
b_m	0.93	0.53

3 Fitted Mean Returns vs. Realized Mean Returns

To asses the goodness of fit of a model fitted mean returns are plotted against realized mean returns. The predicted returns R^i for each portfolio can be calculated from

$$E(R^i) = \frac{1 - cov(m, R^i)}{E(m)}. \quad (1)$$

To generate this plot in EViews a small program has to be written. For writing programs in EViews you have to click on **File/New/Program**. Then save the program in your folder and give it a name i.e. `GRAPH_XY.prg`.

At the beginning of your program you have to define the sample you are using. You can do this by the command `smp1`. In our case the sample is 1963:1 1998:3. The command `smp1` defines a global sample period, which is valid for all following commands.

To calculate the predicted returns we will need the stochastic discount factor m_{t+1} . In the case of CAPM the stochastic discount factor m_{t+1} equals $b_0 + b_m r^m$, with r^m being the market return. The second line of your program (See Box 2) generates this estimated discount factor for the whole sample and calls this series `md`. To calculate `md` use the coefficients obtained from your GMM estimation.

In the next line of your program the command `matrix (26,3) matr1` generates a 26×3 matrix. You will need this matrix later to collect fitted mean returns and actual mean returns of our 25 portfolios and plot them against each other. At this time you can run your provisional program. To do so click on the button **Run** in the upper left corner. After running the program the new variable `md` should appear in your work file. It should contain the estimated discount factors for all sample periods. Further a 26×3 matrix with blank fields will appear in your work file. Box 2 summarized the steps until now.

Box 2:

```
smp1 1963:1 1998:3
series md = 0.967420 + 0.930442*mkt_r2
matrix (26,3) matr1
```

In the next step you will fill in the elements of the matrix. The first column will contain the 25 realized mean returns. The second column will contain the 25 fitted mean returns calculated by equation (1). The third column will contain 25 values for drawing a 45° line in your plot. To draw this line in your plot you will need an additional 26th row in our matrix `matr1`.

The realized mean returns are simply the means of our 25 sample portfolios. In EViews you can calculate the mean of a series using the command `@mean(.)`. Calculate the realized means element by element and arrange them in the matrix `matr1` like shown in Box 3. Note, that the first line of Box 3 ('---Realized Mean Returns---') is simply a comment. In EViews comments are made by using `'` at the beginning of the line.

Box 3:

```
'--- Realized Mean Returns ---

matrix matr1(1,1) = @mean(s1b1_r) - 1
:
matrix matr1(25,1) = @mean(s5b5_r) - 1
```

Calculate the fitted mean returns according to equation (1) and arrange them in the second column of the matrix `matr1`. Box 4 shows how equation (1) is translated into EViews programming language.

Box 4:

```
'--- Fitted Mean Returns ---  
  
matrix matr1(1,2) = ( 1 - @cov(md, s1b1_r) ) / @mean(md) - 1  
:  
matrix matr1(25,2) = ( 1 - @cov(md, s5b5_r) ) / @mean(md) - 1
```

The third column of `matr1` contains the values to draw the 45° line in our plot. If the asset pricing model fits perfectly, predicted mean returns would equal realized mean returns and therefore would all lie on the 45° line. For this reason calculate the values for the 45° line simply by `@mean(s1b1_r) - 1` and arrange them according to Box 5 into the third column of `matr1`. Finally, an additional data point is needed to draw the 45° line through the origin. This auxiliary point has to lie in the negative area and will “stretch” the 45° line though the intersection of x- and y-axis. This auxiliary data point is written into the 26th row of matrix `matr1`. In our example set all values of the 26th row to -0.01. This data point will later not be visible, since our plot will only show positive values. In Box 5 you see the programming steps until now.

Box 5:

```
'--- Auxiliary Calculation for 45° Line ---  
  
matrix matr1(1,3) = @mean(s1b1_r) - 1  
:  
matrix matr1(25,3) = @mean(s5b5_r) - 1  
  
matrix matr1(26,1) = -0.01  
matrix matr1(26,2) = -0.01  
matrix matr1(26,3) = -0.01
```

The following commands are to generate and formate the graph: First of all, the command `delete graph1*` deletes a possibly existing graph `graph1` in your work file. The command is simply used to overwrite `graph1` if you use the program repeatedly. Therefore if you want to keep your graphic in your work file you will have to rename it. The command `matr1.xy` plots the elements of matrix `matr1` in an xy-plot. The first column C1 of `matr1` will be at the x-axis and the second C2 and third column C3 will be plotted at the y-axis. The command `freeze(graph1)` saves the graphic as `graph1`. With the following commands you can now change the appearance of our newly generated graphic `graph1`. The command `graph1.scale(b) range(0, 0.04)` sets the minimum of the x-axis to 0 and the maximum to 0.04. The `b` in brackets stands for “bottom” and denotes the x-axis. You can proceed in the same way for the y-axis using the letter `l`, which stands for “left”. Now the auxiliary data point to draw the 45° line will not be visible in your graphic.

A grid is added to your graphic by the command `graph1.axis(.) grid`. Again use the letter `b` and `l` for the x- and y-axis.

The data points (elements) in your plot are formatted with `setelem(.)`. The first elements in your plot are the fitted mean returns. `symbol(1)` will produce a small circle for each data point. Deactivate the connecting line with `linepattern(none)`. The second element in your graphic is the 45° line. You can choose color and width of this line by the commands `linecolor(.)` and `linewidth(.)`. The following commands simply add a legend and a caption to your graph. For further details see the “EViews 5 Command and Programming Reference”.

Finally, display the graph by the command `show graph1`. Running your program now should produce a RSME plot like shown in Figure 1.

Box 6:

```
delete graph1*
freeze(graph1) matr1.xy

graph1.scale(b) range(0, 0.04)
graph1.scale(l) range(0, 0.04)

graph1.axis(b) grid
graph1.axis(l) grid

graph1.setelem(1) symbol(1) linepattern(none)
graph1.setelem(2)linecolor(black) linewidth(1)

graph1.name(1) Realized Mean Return
graph1.name(2) Fitted Mean Return
graph1.name(3) 45° Line

graph1.addtext(t) CAPM: Fitted vs. actual Mean Returns

show graph1
```

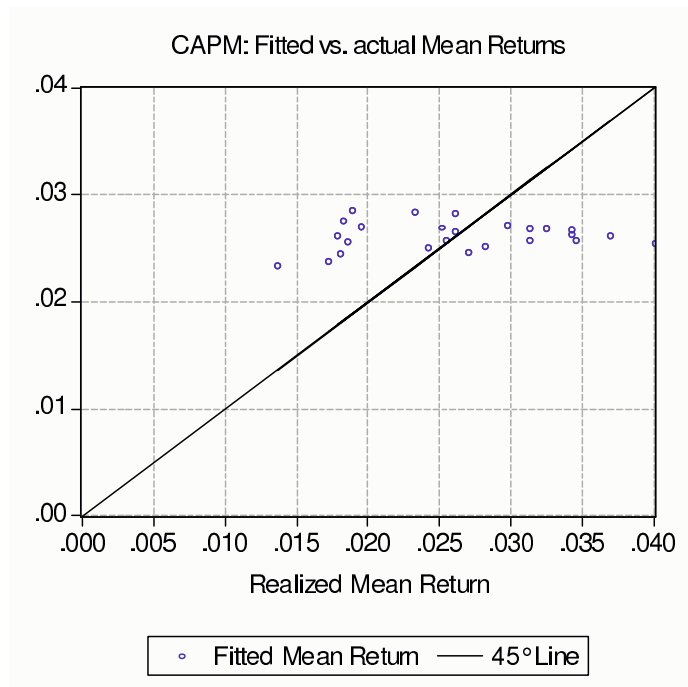


Figure 1: Fitted vs. Actual Mean Returns

References

- GRAMMIG, J., AND A. SCHRIMPF (2006): "Consumption-Based Asset Pricing with a Reference Level: New Evidence from the Cross-Section of Stock Returns," *ZEW Discussion Paper*, No. 06-032.
- HEID, B. (2005): "Estimating Asset Pricing Models by GMM using EViews," Manual of the Department of Statistics, Econometrics, and Empirical Economics (Prof. Dr. Joachim Grammig); University of Tübingen.