ECON 424 Homework 4

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Due: Tuesday, July 18 at 11:59pm via Canvas

Readings

- EZ class slides and book chapters on descriptive statistics, CER model and CER model estimation.
- Ruppert chapter 4 (Exploratory data analysis)
- PerformanceAnalytics and zoo vignettes
- Introduction to the **corrplot** package: http://cran.rproject.org/web/packages/corrplot/vignettes/intro.html

Programs and Data

The following files are located on the class homework page:

- Econ424lab4.r - R script file hints for lab
- descriptiveStatistics.Rmd - R markdown file used for class examples
- CERmodel.Rmd - R markdown file used for class examples
- CERmodelEstimation.Rmd - R markdown file used for class examples

Instructions

In this lab you will use R to:

- Compute univariate, bivariate and time series descriptive statistics
- Estimate parameters of the constant expected return (CER) model, compute standard errors and confidence intervals

Exercises

The following questions require R. On the class Canvas page are the script files econ424lab4.r, and R markdown files descriptiveStatistics.Rmd and CERmodel.Rmd and CERmodelEstimation.Rmd. The former contains hints for completing the assignment, and the latter files contain the code for doing the examples from class. As in lab 3, copy and paste all statistical results and graphs into a MS Word document while you work (and add any comments and answer all questions in this document) or create an R markdown file. **Please do not turn in the assignment without comments!**

In this lab, you will analyze continuously compounded monthly return data on the Vanguard long term bond index fund (VBLTX), Fidelity Magellan stock mutual fund (FMAGX), and Starbucks stock (SBUX). I encourage you to go to finance.yahoo.com and research these assets. The script file econ424lab4.r walks you through all of the computations for the lab. You do not need to show the R commands in your lab write up. You will use the get.hist.quote() function from the tseries package to automatically load this data into R. You will also use several functions from the PerformanceAnalytics package. Remember to install packages before you load them into R.

1. Part I: Descriptive Statistics

I. Historical VaR

1) For each asset compute the empirical 1% and 5% quantiles of the cc returns. Using these quantiles compute the 1% and 5% historical (monthly) VaR values based on an

initial $100,000 investment. Which asset has the highest and lowest VaR values? Are you surprised?

II. Bivariate Graphical Analysis

1) Use the R pairs() function to create all pair-wise scatterplots of returns Comment on the direction and strength of the linear relationships in these plots.

2) Use the functions corrplot() and corrplot.mixed() in the R package corrplot, plot the correlation matrix of the returns on the three assets.

III. Bivariate Numerical Summary Statistics

Use the R functions var(), cov(), and cor() to compute the sample covariance matrix and sample correlation matrix of the returns. Comment on the direction and strength of the linear relationships suggested by the values of the covariances and correlations.

IV. Time Series Summary Statistics

Use the R function acf() to compute and plot the sample autocorrelation functions of each return. Do the returns appear to be uncorrelated over time?

2. Constant Expected Return Model

Consider the constant expected return model (CER):

$$\begin{aligned} R_{it} &= \mu_i + \epsilon_{it},\ t = 1, ..., T \\ \epsilon_{it} &\sim\ iid\ N(0, \sigma_i^2) \\ cov(\epsilon_{it}, \epsilon_{jt}) &= \sigma_{ij} \end{aligned}$$

where R_{it} denotes the continuously compounded return on asset i, i =Vanguard long term bond index fund (VBLTX), Fidelity Magellan stock mutual fund (FMAGX), and

Starbucks stock (SBUX).

(a) Using sample descriptive statistics, give estimates for the model parameters $\mu_i, \sigma_i^2, \sigma_i, \sigma_{ij}, \rho_{ij}$. Arrange these estimates nicely in a table. Briefly comment. Hint: you already computed these estimates in Part I. Just put them in a table.

(b) For each estimate of the above parameters (except σ_{ij}) compute the estimated standard error. That is, compute $SE(\hat{\mu_i}), SE(\hat{\sigma_i^2}), SE(\hat{\sigma_i}), and SE(\hat{\rho_{ij}})$ Briefly comment on the precision of the estimates. Hint: the formulas for these standard errors were given in class, and are given in the lecture notes on the constant expected return model.

(c) For each parameter $\mu_i, \sigma_i^2, \sigma_i, and \rho_{ij}$ compute 95% and 99% confidence intervals. Briefly comment on the width of these intervals.

(d) Using the estimated values of μ_i, σ_i^2 for each mutual fund, compute the normal distribution 1% and 5% monthly value-at-Risk (VaR) based on an initial \$100,000 investment. Compare these values with the historical VaR values computed earlier.