University of Washington
Department of Economics

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Eric Zivot

Economics 483

Midterm Exam

This is a closed book and closed note exam. However, you are allowed one page of notes (double-sided). Answer all questions and write all answers in a blue book or on separate sheets of paper. Time limit is 1 hours and 20 minutes. Total points = 110.

I. Return Calculations (30 pts, 5 points each)

1. Consider a one month investment in two Northwest stocks: Amazon and Costco. Suppose you buy Amazon and Costco at the end of September at $P_{A,t-1} = \$38.23,\ P_{C,t-1} = \$41.11$ and then sell at the end of the October for $P_{A,t} = \$41.29,\ P_{C,t} = \$41.74$. (Note: these are actual closing prices for 2004 taken from Yahoo!)

a. What are the simple monthly returns for the two stocks?

b. What are the continuously compounded returns for the two stocks?

c. Suppose Costco paid a $0.10 per share cash dividend at the end of October. What is the monthly simple total return on Costco? What is the monthly dividend yield?

d. Suppose the monthly returns on Amazon and Costco from question (a) above are the same every month for 1 year. Compute the simple annual returns as well as the continuously compounded annual returns for the two stocks.

e. At the end of September, 2004, suppose you have $10,000 to invest in Amazon and Costco over the next month. If you invest $8000 in Amazon and $2000 in Costco, what are your portfolio shares, x_A and x_C.

f. Continuing with the previous question, compute the monthly simple return and the monthly continuously compounded return on the portfolio. Assume that Costco does not pay a dividend.

II. Probability Theory (35 points, 5 points each)

1. Consider an investment in Starbucks stock over the next year. Let R denote the monthly *simple* return and assume that $R \sim N(0.02,(0.20)^2)$. That is, $E[R]=0.02$ and $\mathrm{var}(R)=(0.20)^2$. Let W_0 = \$1,000 denote the initial investment (at the beginning of the month), and let $W_1 = W_0(1 + R)$ denote the investment value at the end of the month.

a) Compute $E[W_1]$, $\mathrm{var}(W_1)$ and $SD(W_1)$.

b) What is the probability distribution of W_1? Sketch this distribution, indicating the location of $E[W_1]$ and $E[W_1] \pm 2 \cdot SD(W_1)$.

c) Approximately, what is $\Pr(W_1 < \$620)$. Hint: How much of the area under the probability curve for W_1 is between $E[W_1] \pm 2 \cdot SD(W_1)$?

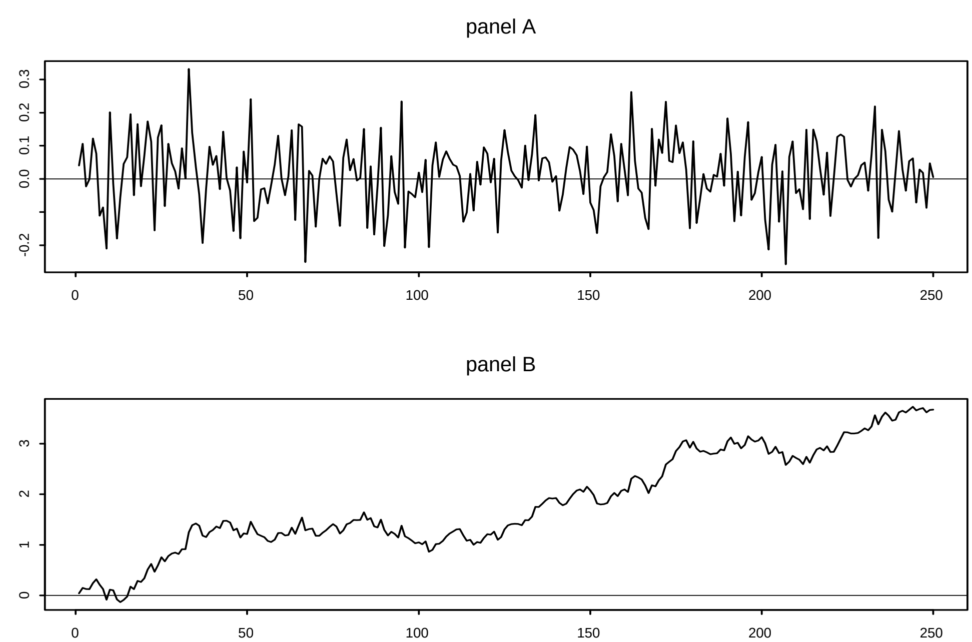
d) Compute the 5% quantile of the distribution for W_1. (Hint: the 5% quantile for a standard normal random variable is -1.645.) Compute how much you would lose over the month if W_1 was equal to the 5% quantile.

e) Compute the 5% quantile of the distribution for R. Using this quantile, compute the monthly 5% value-at-risk ($VaR_{.05}$) of the \$1,000 investment.

2. Let $\{R_t\}_{t=-\infty}^{\infty} = \{\ldots, R_1, \ldots, R_T, \ldots\}$ denote a stochastic process (time series) for returns.

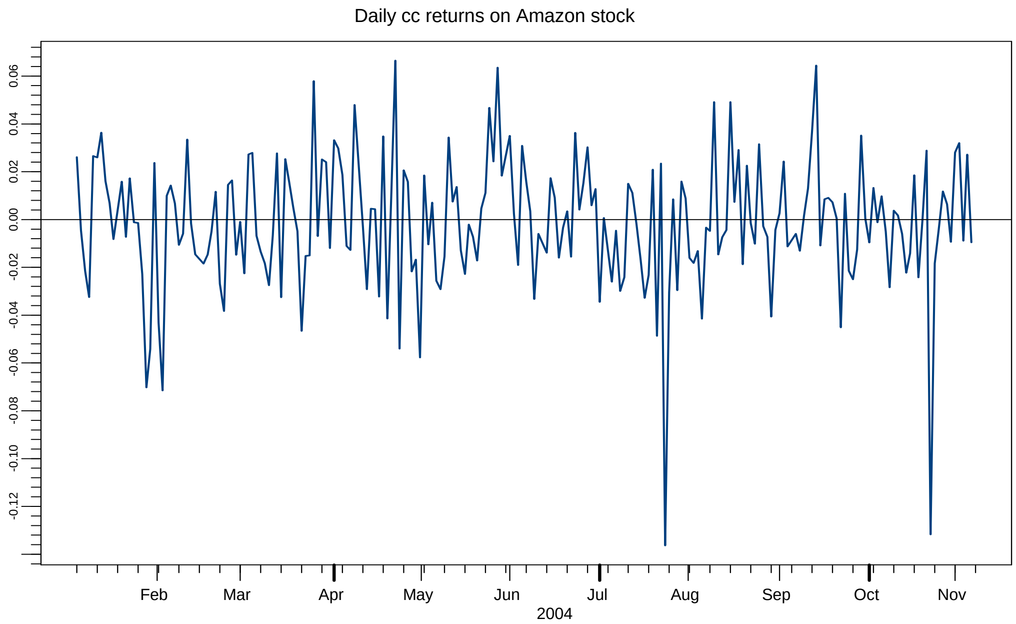
a) What conditions are required for $\{R_t\}_{t=-\infty}^{\infty}$ to be covariance (weakly) stationary?

b) In the figure below, which panel represents a realization of a covariance stationary time series?

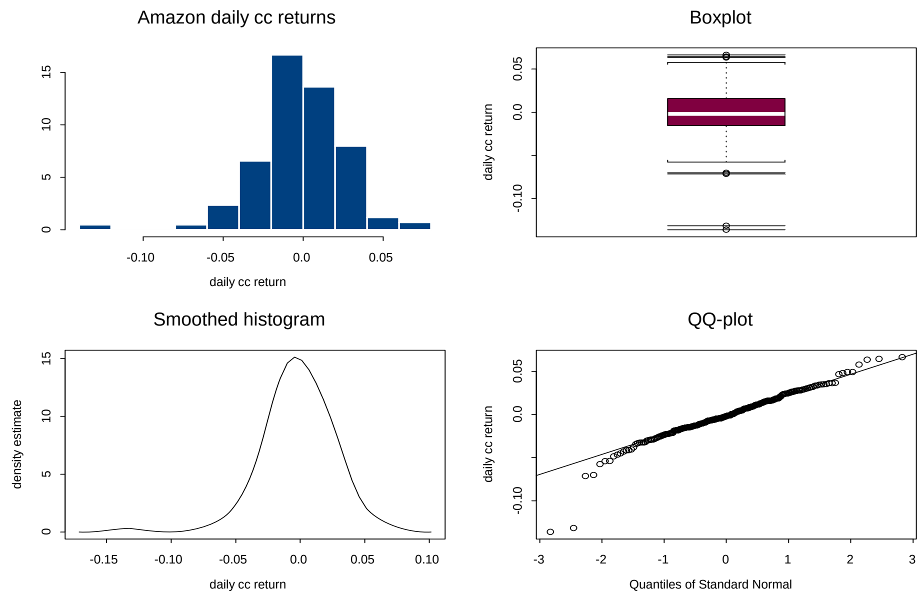


III. Descriptive Statistics (20 points, 5 points each)

1. Consider the *daily* continuously compounded (cc) returns on Amazon stock computed using *daily* closing prices over the period January 5, 2004 – November 5, 2003.



a. Do the daily cc returns appear to be a realization from a covariance stationary stochastic process? Briefly justify your answer.



b. The figure above shows various graphical diagnostics regarding the empirical distribution of the daily cc returns on Amazon. Based on these diagnostics, do you think that the normal distribution is a good model for the underlying probability distribution of the daily cc returns on Amazon? Briefly justify your answer by commenting on each of the four plots.

c. Summary descriptive statistics, computed from S-PLUS, for the daily cc returns are given below. Which of these summary statistics indicate evidence for, or against, the normal distribution model for the daily cc returns.

```
> summaryStats(amzn.ret)

Sample Quantiles:
     min       1Q    median      3Q     max
 -0.1363 -0.01559 -0.002018 0.01577 0.06642

Sample Moments:
      mean     std skewness kurtosis
 -0.001645 0.02746  -0.9524    7.143

Number of Observations:  213
```

d. The empirical 1% and 5% quantiles from the daily cc returns are given below.

```
> quantile(amzn.ret,probs=c(0.01,0.05))
        1%       5%
 -0.071331 -0.04219
```

Using these quantiles, compute the daily 1% and 5% value-at-risk (*VaR*) based on an investment of $100,000.

IV. Constant Expected Return Model (25 points, 5 points each)

1. Consider the constant expected return model

$$R_{it} = \mu_i + \varepsilon_{it},\ \varepsilon_{it} \sim iid\ N(0,\sigma_i^2)$$
$$\operatorname{cov}(R_{it}, R_{jt}) = \sigma_{ij},\ corr(R_{it}, R_{jt}) = \rho_{ij}$$

for the monthly continuously compounded returns on Boeing and Microsoft (same data as lab 5) over the period July 1992 through October 2000. For this period there are 100 monthly observations.

a) Based on the S-PLUS output below, give the "plug-in principle" estimates for $\mu_i, \sigma_i^2, \sigma_i, \sigma_{ij}$ and ρ_{ij} for the two assets.

```
        muhat.vals sigma2hat.vals sigmahat.vals
rboeing   0.012436      0.0057945      0.076121
  rmsft   0.027564      0.0114112      0.106823

   covhat.vals rhohat.vals
rboeing,rmsft -0.000067409  -0.0082898
```

b) Using the above output, compute estimated standard errors for $\hat{\mu}_i,\ \hat{\sigma}_i,\ (i = boeing, microsoft)$ and $\hat{\rho}_{msft,boeing}$. Briefly comment on the precision of the estimates.

c) For Microsoft, compute 95% confidence intervals for μ and σ. Also, compute a 95% confidence interval for ρ. Briefly comment on the precision of the estimates.

d) Briefly describe how you could compute an estimated standard error for the estimated 5% monthly value-at-risk, based on a $100,000 investment, computed using the formula

$$V\hat{a}R_{.05} = (e^{\hat{q}_{.05}} - 1)\cdot 100{,}000,\ \hat{q}_{.05} = \hat{\mu} + \hat{\sigma}\cdot(-1.646)$$

e) Consider a portfolio of Boeing and Microsoft stock with 50% of wealth invested in each asset (that is $x_{boeing} = x_{microsoft} = 0.5$). Using the CER model estimates, compute an estimate of the portfolio expected return, portfolio variance and portfolio standard deviation. That is, compute $\hat{\mu}_p, \hat{\sigma}_p^2$ and $\hat{\sigma}_{\mathrm{p}}$.