

HANKEN Svenska handelshögskolan
Institutionen för finansiell ekonomi
och ekonomisk statistik

INTRODUCTORY EXAM

22.9.2014

Tools allowed: Basic calculator

Time: 1h 45min.

Jan Antell

EMPIRICAL METHODS IN FINANCE (1725)

All answers must be justified and motivated and **all calculations must be shown in detail, intermediate steps included**. If you fail on this, you will get no points for the question. An answer in the spirit of a simple Yes or No is never an answer. A clear, readable writing style is warranted. Highlight the most important parts of your answer.

1. (1.5 points.) Shortly answer the following questions.
 - a) What is meant by academic dishonesty?
 - b) The portfolio variance can be traced from the variance-covariance matrix of the individual securities in the portfolio. The variance-covariance matrix must be *positive definite*. What is meant by that?
 - c) Are hypotheses tested concerning the actual values of the coefficients (e.g., β) or their estimated values (e.g., $\hat{\beta}$) and why?
2. (4 points.) The variance-covariance matrix and return vector in *decimal format* for three securities are given by

$$\mathbf{V} = \begin{bmatrix} 0.160 & 0.015 & -0.003 \\ 0.015 & 0.040 & 0.008 \\ -0.003 & 0.008 & 0.010 \end{bmatrix} \text{ and } \bar{\mathbf{R}} = \begin{bmatrix} 0.10 \\ 0.06 \\ 0.03 \end{bmatrix}.$$

Conveniently, it is also known that

$$\mathbf{V}^{-1} = \begin{bmatrix} 6.66270 & -3.45033 & 4.75907 \\ -3.45033 & 31.54868 & -26.27404 \\ 4.75907 & -26.27404 & 122.44696 \end{bmatrix}.$$

- a) How would you verify that \mathbf{V}^{-1} is the inverse matrix of \mathbf{V} ? (0.5 p.)
- b) What is the rank of the matrix \mathbf{V} ? (0.5 p.)
- c) Mrs. Bellulus Fortunatis is a wealthy investor with a risk aversion coefficient of $\gamma=4$. She will divide her wealth in two parts: part 1 is the risk-free security with a return of 2 per cent (use 0.02 in your calculations), and part 2 is the tangency portfolio formed of the three securities mentioned above. This refers to *Case 5* in the lecture material. The formulas are:

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$$A = \mathbf{R}^T \mathbf{V}^{-1} \mathbf{1} = 3.93456276,$$

$$C = \mathbf{1}^T \mathbf{V}^{-1} \mathbf{1}.$$

The weight vector of the tangency portfolio part (i.e., part 2) of the whole portfolio which maximizes the investor's utility is given by

$$\mathbf{w}_{p, \max U} = \frac{A - CR_f}{\gamma} \cdot \underbrace{\frac{\mathbf{V}^{-1}(\bar{\mathbf{R}} - R_f \mathbf{1})}{\mathbf{1}^T (\bar{\mathbf{R}} - R_f \mathbf{1})}}_{\mathbf{w}_{\text{tang}}} = \frac{\mathbf{V}^{-1}(\bar{\mathbf{R}} - R_f \mathbf{1})}{\gamma}.$$

Hint: The above formula gives the proportion of Mrs. Fortunatis' portfolio allocated to the three risky securities. The part which is not allocated to the risky securities is invested in the risk-free investment vehicle.

- i. Compute the value of C . (0.5 p.)
 - ii. Compute the weights in the portfolio that maximizes her utility. (0.75 p.)
 - iii. Compute the portfolio return and volatility given the four weights you calculated in the previous part. Matrix formulas must be used. (1.5 p.)
- d) Shortly comment on your results, both with respect to matrix algebra and finance theory. (0.25 p.)
3. (4.5 points.) A researcher by the name Callidus Theoreticus is fascinated by the connection between the dividend policy of US publicly listed companies (S&P 500 in 2010), and the growth prospects of the companies. He sets up the following linear regression model: $DY_i = \alpha + \beta AG3Yr_i + \varepsilon_i$, $i = 1, \dots, N$, where DY is the dividend yield in percentage format (i.e., not in decimal format), while $AG3Yr$ is the asset growth in percentage format over the preceding three years. In his database, Mr. Theoreticus has given the name *DivYield* for DY and *Assets3YrCAGR* for $AG3Yr$. The following table shows some descriptive statistics (in %).

	Mean	Median	Minimum	Maximum
<i>DivYield</i>	2.0552	1.3505	0.000	140.62
<i>Assets3YrCAGR</i>	6.9225	4.6600	-29.028	112.00

General questions.

- a) The OLS estimator is consistent. What is meant by that? (0.5 p.)
- b) What is the difference between the OLS estimator and the OLS estimate? (0.5 p.)

The rest of the questions refer to the specific dividend model stated above, and the computer output from the freeware econometrics program *gretl* below.

- c) Discuss the finance logic of the model. State a *financial* research hypothesis. (0.5 p.)
- d) Compute the dividend yield predicted by the model, given that the asset growth is 50%. (0.5 p.)
- e) State the sum of squared residuals. What does it refer to? (0.5 p.)

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- f) (2 p.) Consider the computer output. Do the following:
- State the relevant *statistical* hypotheses.
 - Compute* the test statistics.
 - Draw statistical conclusions.
 - Make a conclusion with respect to the finance research hypothesis/question.

gretl: model 2

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Model 2: OLS, using observations 1-500 (n = 493)

Missing or incomplete observations dropped: 7

Dependent variable: DivYield

	coefficient	std. error	t-ratio	p-value	
const	2.48670	0.334525	7.434	4.74e-013	***
Assets3YrCAGR	-0.0627468	0.0208284	-3.013	0.0027	***
Mean dependent var	2.052337	S.D. dependent var	6.757104		
Sum squared resid	22056.28	S.E. of regression	6.702323		
R-squared	0.018148	Adjusted R-squared	0.016149		
F(1, 491)	9.075512	P-value(F)	0.002724		
Log-likelihood	-1636.445	Akaike criterion	3276.889		
Schwarz criterion	3285.290	Hannan-Quinn	3280.188		

Lycka till – good luck!

Dr Jan

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