HANKEN Svenska handelshögskolan
Institutionen för finansiell ekonomi
och ekonomisk statistik

INTRODUCTORY EXAM

9.9.2016

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.** 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 point.) A term paper is to be produced in the fantastic course *Empirical Methods in Finance* at Hanken. The same topic is used by two or three groups, each consisting of two students. Collaboration between the groups is strictly prohibited. Nevertheless, Mr Ditta and Mrs Datta collaborate with Mr Snopf and Mrs Snipf. Based on Hanken's *Action plan against Academic Dishonesty*,
   a) what actions should the examiner take;
   b) what are the repercussions for the students?

2. (4 points.) Answer the following questions.
   a) Consider two return vectors, $\mathbf{R}_1 = [3\ \ 15\ \ -8\ \ -4\ \ 10]'$ and $\mathbf{R}_2 = [25\ \ -20\ \ 10\ \ 40\ \ -10]'$. Using matrix formulas, compute the variance-covariance matrix of the two return series.
   b) Compute the determinant of the matrix you calculated in the previous part.
   c) Use the following principle to compute the correlation matrix:

$$\mathbf{Corr} = \begin{bmatrix} \frac{1}{s_1} & 0 & 0 \\ 0 & \frac{1}{s_2} & 0 \\ 0 & 0 & \frac{1}{s_3} \end{bmatrix} \begin{bmatrix} s_1^2 & s_{12} & s_{13} \\ s_{21} & s_2^2 & s_{23} \\ s_{31} & s_{32} & s_3^2 \end{bmatrix} \begin{bmatrix} \frac{1}{s_1} & 0 & 0 \\ 0 & \frac{1}{s_2} & 0 \\ 0 & 0 & \frac{1}{s_3} \end{bmatrix} = \begin{bmatrix} 1 & r_{12} & r_{13} \\ r_{21} & 1 & r_{23} \\ r_{31} & r_{32} & 1 \end{bmatrix} = \mathbf{D}_V^{-1/2}\mathbf{V}\mathbf{D}_V^{-1/2}$$

   d) Verify that the following matrix is the inverse matrix to the one you calculated in part a):

$$\mathbf{V}^{-1} = \begin{bmatrix} \frac{9}{335} & \frac{1}{127} \\ \frac{1}{127} & \frac{4}{993} \end{bmatrix}.$$

   e) Compute the weights of the minimum variance portfolio using the formula $\mathbf{w}_{\min} = \dfrac{\mathbf{V}^{-1}\mathbf{1}}{\mathbf{1}^T\mathbf{V}^{-1}\mathbf{1}}$.
   f) Matrix division is not a valid operation. Explain why the calculation despite that could be done in the previous part.
   g) What is meant by a positive definite matrix? Give an example of such a matrix.

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3. (5 points.) Mr Stultus Asinus is convinced that there is a relation between the amount of debt a company has amassed, and the book value of equity. He collects data for constituents of the S&P 500 index. He defines the variable *Debt* as the total debt in million USD, and *EquityBook* as the total book value of equity in million USD. The simple linear regression model is used.

General questions on the linear regression model.

a) What is meant by an OLS estimator?

b) In addition to the vital assumptions behind the linear regression model, also normality is usually assumed. What is meant by normality in the case of a linear regression model, and why is the assumption introduced?

Questions specific to the research design of Mr Stultus Asinus.

c) Comment on the overall research design both from a statistical and a finance point of view.

d) State the *PRF* of the model Mr Asinus is about to use.

e) The model is *linear* both in parameters and in variables. Suggest and justify a model with a nonlinear transformation of the variables.

Questions specific to the estimation results in the table below (*gretl: model 7*).

f) Mr Asinus feels that there should be a one-on-one relation between the debt and the book value of equity. State the statistical null and alternative hypothesis implied by the claim, *compute* the relevant test statistic, test the hypothesis and make conclusions.

g) Mr Asinus concludes: "The true beta coefficient is equal to 2.43713". Comment on this statement.

gretl: model 7

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Model 7: OLS, using observations 1-500 (n = 496)
Missing or incomplete observations dropped: 4
Dependent variable: Debt

              coefficient    std. error    t-ratio    p-value
  ------------------------------------------------------------
  const       -10254.7       2300.57       -4.457     1.03e-05  ***
  EqyityBook      2.43713       0.104128   23.41      4.49e-082 ***

Mean dependent var   13876.26   S.D. dependent var   66447.90
Sum squared resid    1.04e+12   S.E. of regression   45802.84
R-squared            0.525819   Adjusted R-squared   0.524859
F(1, 494)            547.7967   P-value(F)           4.49e-82
Log-likelihood      -6025.914   Akaike criterion     12055.83
Schwarz criterion    12064.24   Hannan-Quinn         12059.13
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