平成 25 年度実施

東北大学大学院情報科学研究科

博士課程前期・入学試験問題(2014 年 3 月 4 日)

専門試験科目群第 7・社会科学群

専門科目　問題冊子

注意(Notices)

1. 設問から 3 問題を選択し、解答用紙に解答すること。
   Choose 3 from the 5 questions and write your answer on the answer sheet.
2. 1 つの問題につき 1 枚の解答用紙を使用すること (解答が複数枚にわたってもかまわないが、その場合には問題毎に用紙をかえること)。その際、各解答用紙の上部にある問題番号欄に、対応する問題番号を記入すること。
   Use one answer sheet for each question (Do not use one sheet for different problems although you may use several sheets for one problem.). Write the question number in the upper right box of the answer sheet(s).

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Problem E-1 Explain the following terms:

- Direct utility function and indirect utility function
- Marshallian demand function and Hicksian demand function
- General equilibrium and partial equilibrium
- Substitute goods and gross substitute goods
- Income elasticity of demand

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Problem E-2 Discuss the merits and demerits of citis from the viewpoints of agglomeration economics, public goods, commuting, congestion. Give your opinion on the optimal size of cities.

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Problem E–3 Answer to the following questions regarding the major indices relevant to macroeconomic policies.

(1) Explain the definitions of GDP, GNP, and NNP, emphasizing the distinctions among them.

(2) Explain the way to obtain the real GDP from the nominal one. Illuminate the difference between the deflators used for this purpose and the consumer price index (CPI).

(3) Clarify the distinctions between the nominal interest rate i and the real rate r, and between the nominal bilateral exchange rate e and the real rate R by means of simple mathematical expressions.

(4) The indices for money supply differ from one country to another, and in Japan, the index called M_3 is most commonly used. Briefly explain what are normally included besides the cash currency.

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Problem E–4 Consider function $x_1^2 - 4x_1x_2 + \frac{1}{4}x_2^4 - \frac{2}{3}x_2^3$. (1) Calculate the vector of partial derivatives (gradient) and find all stationary points. (2) Examine whether the stationary points are maximal or minimal points by the matrix of second order derivatives (the Hessian matrix).

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Problem E–5 Consider the following multiple regression model described in a vector form.

$$y = X\beta + u,$$

where y denotes the explained variable, X the explanatory variables, β the parameters, and u disturbances.

(1) When the numbers of explanatory variables and observations are given by k and n, respectively, show the sizes of vectors (or matrix) y, X, and β. Describe the basic assumption that the disturbances u must satisfy in the homoscedastic case.

(2) The residual vector can be written as $e = y - X\hat{\beta}$, where $\hat{\beta}$ denotes the least squares estimator of parameter β. Show the normal equation for the problem, and obtain $\hat{\beta}$.

(3) Under the basic assumption in (1), show that $\hat{\beta}$ becomes the unbiased estimator of β. Also clarify the relationship between the unbiased estimator of error variances, $\hat{\sigma}^2 = E(u'u)$, and the sum of squared errors $e'e$.

(4) How the basic assumption in (1) is modified when the problem is heteroscedastic. Briefly describe the problems associated with heteroscedasticity and the relevant method of parameter estimation.