Minimal requirements for MSE

Academic Year 2015-2016

http://mse.ec.unipi.it

The successful student of the MSE program has a strong quantitative attitude and a versatile potential. A solid background in Economics, Finance and Actuarial Sciences, Mathematics and Statistics is recommended.

It is therefore crucial that, in the case of admission, you carefully check this list in order to fill any gap in these key disciplines. References will be provided below, in any case you can contact MSE secretariat to get more information.

If these prerequisites are not met, it may be very difficult for you to profitably attend the first year courses.

1 Minimal requirements in Economics

1.1 Microeconomics

The student should have a background that is provided in a standard introductory course to microeconomics. In particular, the student should be familiar with the approach and basic concepts in individual decision-making, consumption, production and equilibrium theory. Mathematical tools required are limited to basics in logical reasoning and constrained maximization. Minimum requirements can be fulfilled by studying: A. Schotter, Microeconomics: A Modern Approach, ch. 2, 3, 4, 8, 9, 10, 11, 12, 14, 15, 17, 19. New York: Cengage Learning.

The student should be able to answer questions such as:

- Which are the effects on consumer choices of an income increase? And of a price increase?

- Which are the effects on producer choices of an output price increase? And an input price increase?

- What is the marginal rate of substitution? What is the marginal rate of technical substitution?

- What is price-taking behavior? Can you draw supply and demand curves and identify graphically the equilibrium in a single market?

1.2 Macroeconomics

It is supposed you have a complete understanding of the issues discussed in the first twenty chapters of Blanchard, O. (2012), Macroeconomics, Pearson.

In particular, the student should be able to answer to questions as:

- which is the effect on the equilibrium level of output of an increase of public expenditure in the IS-LM model?

- Could you provide a graphical analysis of the effects of such policy in the IS-LM chart?

- Which are the effects of an increase in the stock of money in the IS-LM model?

- Could you provide a graphical analysis of the effects of such policy in the IS-LM chart?

2 Minimal requirements in Statistics

Pre-requisites: working knowledge in basic calculus (elementary functions, optimization, basic integration). Textbooks references. It is assumed you have a familiarity with Chapters 1-4 of Wasserman L, All of statistics, available on-line at
http://research.rmutp.ac.th/research/A%20Concise%20Course%20in%20Statistical%20Inference.pdf.
Students should have understanding and working ability with basic descriptive statistics (basic statistical measures for 1- and 2-variate observations, such as mean, median, percentiles, variance and standard deviation, chi square, correlation coefficient, and least square regression), basic probability (basic notions on events, basic rules on probability, basic notions on random variables, especially the binomial and the normal distribution), and statistical inference (basic notions of interval estimation and testing). Working knowledge of electronic sheets (e.g. Excel or Calc) is highly recommended as a tool for non trivial implementation and visualization of concepts.

3   Minimal requirements in Mathematical Methods in Economics

Students are supposed to be familiar with the topics usually taught in basic course on Calculus and Linear Algebra. Knowledge on differential and difference equations is also advised. More precisely, students have to be well prepared on the following topics.

3.1   Calculus

Univariate calculus: Definition of a function, limit, continuity, derivative and differentiable, Weierstrass Theorem, Intermediate Value Theorem, Rolle Theorem, Mean Value Theorem, high orders derivatives, concave and convex functions, graph of a function. Local and global maximum and minimum point: definitions and optimality conditions. Indefinite integral. Integration by part and by substitution. Definite Integral. Average Value Theorem. Fundamental Theorem of Calculus. Improper integrals.

Calculus of several variables: partial differentiation (first and second order derivatives), first and second order optimality conditions, level curves).

Reference: M.Hoy, J. Livernois, C. McKenna, R. Rees, T. Stengos, (2001), Mathematics for economics, MIT press , Cambridge (Mass.), ISBN 0-262-58207-4 (pbk.) Chapter 1-6, 11-13.

3.2   Linear Algebra

Matrices (Definition, Sum, Product, Product by a scalar, Elementary row operations, Determinant, Rank of a Matrix). Linear system (Definitions, Homogenous system, Solution Methods, Linear systems and matrices)

References: S. Liptschutz, M. Lipson, Schaum's Outline of Linear Algebra, Fourth Edition, (2009), McGraw Hill, ISBN 978-0-07-154352-1. Chapters 2-3 R. Bronson, Matrix methods second Edition, (1991), Academic Press, Boston 1991. (Chapters 1,2,3,4)

Basic knowledge of differential equations, difference equations, trigonometric functions, and complex numbers is also useful. These mathematical methods will be used also in microeconomic and macroeconomic courses.

Reference: K. Sydsaeter, P. Hammond, A. Seierstad, A. Strom, Further Mathematics for Economic Analysis, II edition, (2008), Prentice Hall, ISBN 978-0-273-71328-9 (Chapters 5,6,7,11 and Appendix B)

Students should have no problems in solving exercises on the above mentioned topics. In the following some exercises on these topics:

- Compute the first and second order derivatives of the following functions: $f(x) = \log(2x + 4)$, $g(x) = e^{3x-5}$, $h(x) = (x3 - 7x)/(x2 - 9)$;

- Sketch the graph of the following functions: $f(x) = x3 + 4x2 - 5x - 8$, $g(x) = (x - 1)e^{1/(1-2x)}$, $h(x) = (x + 1)^2 \log(x + 1)$, $f(x) = (x3 + 10x)(x2 + 1)$;

- Find the gradient and the Hessian matrix of the following functions: $f(x, y) = x^3 y^2$, $f(x, y, z) = \log(xy) + z^3$;

- Find the local and global maximum and minimum points of the following functions: $f(x, y) = x^2 y$, $f(x, y) = x2 - 6x + (y - 4)^3$, $f(x, y) = x \log x + y^2$, $f(x, y, z) = 6x + 4y - x2 - y4 - e^{z^2 - 4z}$.

- Find the following indefinite integral: $\int e^{-x}(e^{-x} + 4)^3 dx$, $\int x^2 e^{-x}$, and $\int (8x + 5)/(4x + 3)dx$.

- Find the rank of the following matrices:

$$\begin{bmatrix} 2 & 1 \\ -2 & 0 \end{bmatrix}, \begin{bmatrix} -1 & 2 & 1 \\ 3 & 0 & 3 \\ 5 & -1 & 4 \end{bmatrix}, \text{and} \begin{bmatrix} 2 & 4 & -2 & 0 \\ 1 & 2 & -1 & 0 \end{bmatrix} \qquad (1)$$

- Solve the following linear systems:

$$\begin{cases} x + y & = & 3 \\ 2x - 4y & = & 0 \end{cases}, \text{and} \begin{cases} 7x + y - z & = & 0 \\ 6x + 5y - 3z & = & 9 \end{cases}. \qquad (2)$$