EC2104 Quantitative Methods for Economic Analysis summary

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Contents

AY21/22 Semester 2

Preface

This note is meant to be complementing EC2104 lecture and tutorials. The content is not the official lecture material and there might be errors that I do not foresee. Please refer to the lecturer content for the final explanation.

Introduction

What do I need to know

EC2104 is meant to cover the mathematics (linear algebra and calculus) needed for undergraduate economics study. The contents covered in this module is representative of the main contents covered in 5 mathematics modules. Therefore, the module is heavily focusing on applied and not proving.

In a layman term: you need to know how to use the tools but you are not expected to know how are those tools built.

Using an analogy: if this module is a microwave (those you have at home), what you need to know is what kind of food can be put inside the microwave (e.g. eggs should not be placed in microwave) and how to operate the timer, intensity of the microwave. Bonus might be to understand basic theory behind how microwave functions to make your own decisions on if an unknown food item can be placed in the microwave. However, you are not expected to work out the engineering logic behind the microwave. For example, how to design the circuit board to minimise possibility of short-circuit (I don't know much about engineering).

If you are interested to know how the definitions and theorems are derived, I strongly recommend you to audit or take the following modules for credit.

Content	Module
Single Variable Calculus	MA2002 Calculus
Multi-Variable Calculus	MA2104 Multivariable Calculus OR MA2311 Techniques in Advanced Calculus
Linear Algebra	MA2001 Linear Algebra I
Multi-Variable Optimization (Linear problems)	MA3252 Linear and Network Optimisation
Multi-Variable Optimization (Non-Linear problems)	MA3236 Non-Linear Programming

How do I master what I need to know

Since EC2104 emphasis on applied mathematics, the best way to ace this module and the content is to… apply them. One shall not ponder too long on why those methods works but focus on how to apply those methods in different context.

For the purpose of this method, it might be less useful to understand why limits are called limits than to solve the $\lim_{x\to\infty} x^2/e^x$ If you are interested in knowing the why, please refer to What do I need to know section on the modules offered by mathematics department.

Something to know before reading this summary

This summary is meant to provide a comprehensive view of the content (so you know what's being taught here after the semester) and hopefully to provide some easier to understand explanation in case the mathematics notation is unfamiliar to you. I will use the term `Layman` achieve this.

In contrast to `Layman`, a definition is a statement of exact meaning of a word, or simply: in order for you to use this word, you must satisfy every single words (!) in this definition. In this summary I will use `Layman` to indicate that what I'm trying to say is not a `Definition`. `Layman` means that there might be situation where the statement is not entirely correct but `Layman` will be useful in explaining the terms.

I might also have a section on `terminology`, which is just some technical or special terms used to describe some observations/facts.

Single Variable Calculus

Functions

Layman: learning functions helps us to quantify the relationship between different quantities. For example, if bank offered me a 5% annual interest rate, what will happen to my 100 dollar savings next year? $f(savings) = savings + savings \times 5\%$

Layman Definitions

Type	Layman
Functions	a rule that maps input (domain) onto a unique output (range)
Composite Functions	applying functions sequentially of each other
Inverse Functions	the reverse of the function

Terminology

Terms	Layman
Domain	input to the function
Range	output of the function
Codomain	the bigger space output exists

Layman: the biggest confusion might be between `Range` and `Codomain`. Think of `Codomain` as the superset of `Range`, or simply: `Codomain` contains more values than `Range`. For example, if we have a `Domain` of all real numbers, and a function of $f(x) = x^2$. The `Codomain` is also all the real numbers. However, the `Range` is a smaller subset containing values $\{0, 1, 2, 4, \cdots\}$.

Testing if a function is invalid

1. Show by numerical example that function violates the one-to-one mapping
2. Plot and show that vertical-line test failed. Meaning the vertical line cuts x-axis with more than one intersection.

Type of functions

Note: it is very important to identify the domain and range of a function. For example, given a function $f(x) = x + 1$ with a restricted domain of $x \geq 0$, then the range can only be values larger than or equals to 1 (or $f(x) \geq 1$).

Another example: consider function $f(x) = \frac{3x-1}{x+4}$, the domain will be the real values except for -4 (or $x \in \mathbb{R}, x \neq 4$). The range will be all the real values.

Type	Form	Example	Domain	Range
Polynomial	$f(x) = a_n x^n + a_{n-1} x^{n-1} + \cdots + a_1 x + a_0$ with real coefficients.	$f(x) = 2x^2 + x - 5$	$x \in \mathbb{R}$	$f(x) \in \mathbb{R}$

Type	Form	Example	Domain	Range
Power	$f(x) = Ax^r$ where r, A are constants. For this module: $x > 0$	\	\	\
Exponent				

Logarithmic |

Limits

Single variable optimization

Integration

Multi-Variable Calculus

Multi-variable calculus

Comparative Statistics

Linear Algebra

Matrix Algebra

Determinant and Inverse for Matrices

Multi-Variable Optimization

Multi-Variable Optimization

Constrained Optimization

Optimization with Inequality Constraints