Imperfect Information in Health Care Markets

Exercise Session

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Why do people struggle with this course?

- Prerequisites for this course:
  - High school level math knowledge
- Problem: Students often lack important knowledge about basic math concepts (or forgot it over the years)
- This deflects them from the (economic) concepts taught in class

Suggested work flow for the process of understanding the lectures

- After each lecture, you will typically not understand the whole content directly (which is perfectly normal)
- This is why you need to study it carefully afterwards
- As a first step, try to identify all the mathematical steps/tools that are used within this lecture
- Recall these mathematical concepts and make sure you fully understand them (again)
- Once this is done, have a second look at the lecture and try to understand what was taught to you (not being distracted by mathematics that might have scared you off before)
- If you still have difficulties with the understanding, discuss the topic with your peers (or ask a concrete question in the exercise session in case you can formulate one)
- Repeat this procedure every week before the next lecture

Suggested work flow for the process of understanding the lectures (cont.)

- The exercises are also helpful in understanding the lecture material
- To get the most out of the exercise sessions, try to solve the exercises that are going to be discussed on your own or in groups
- This way, you will understand the correct solutions quicker, even if you have not reached these solutions yourself
- The final exam will be based on understanding of the lecture and you WILL be asked to transfer your built up knowledge to new exercises
- Therefore, it does not pay off to learn some exercises or lecture material by heart without understanding them!

Exercise 1

1. Recall the notion of a random variable and how to compute the expected value of discrete and continuous random variables.
2. Let X and Y be two random variables with $Y \sim \mathrm{U}([0,1])$ and X taking a value of 1 with the probability 0.4 and a value of 0 with the probability 0.6. Calculate $\mathbb{E}(X)$ and $\mathbb{E}(2Y)$.

Exc. 1.1

A random variable X is a map $X: \Omega \to \mathbb{R}$

Ω → greek "Omega"

↳ the "universe" of a random experiment

= set of events that can occur in this experiment

How to compute the expected value of a random variable?

i) discrete random variables: number of possible outcomes/events is countable, that means finite or countably infinite.

$$\Rightarrow \mathbb{E}(X) = \sum_{i=1}^{n} x_i \cdot \mathbb{P}(X = x_i)$$, where $x_1, x_2, \ldots, x_n$ are the values that X can take

↳ expected value

ii) continuous random variable: there are uncountably infinitely many possible outcomes

→ this usually happens when possible values are in some interval of real numbers

Expected value of a continuous random variable X defined on the interval $[a,b]$:

$$\Rightarrow \mathbb{E}(X) = \int_a^b x \cdot \rho(x) \, dx$$, where $\rho(x)$ is the density function of X

↳ greek rho

Exc. 1.2

$$\mathbb{E}(X) = \sum_{i=0}^{1} i \cdot \mathbb{P}(X=i) = 0 \cdot 0{,}6 + 1 \cdot 0{,}4 = 0{,}4$$

$$Y \sim U([0,1]) \quad \Rightarrow \quad f(y) = 1 \text{ for } y \text{ in } [0,1]$$

↳ distributed as

$$\Rightarrow \mathbb{E}(Y) = \int_0^1 y \cdot f(y)\, dy = \int_0^1 y \cdot 1\, dy = \left[\frac{1}{2} \cdot y^2\right]_0^1 = \frac{1}{2} \cdot 1^2 - \frac{1}{2} \cdot 0^2 = \frac{1}{2}$$

$$\Rightarrow \mathbb{E}(2Y) = \int_0^1 2y\, f(y)\, dy = \int_0^1 2y\, dy = \left[y^2\right]_0^1 = 1^2 - 0^2 = 1$$

Exercise 2

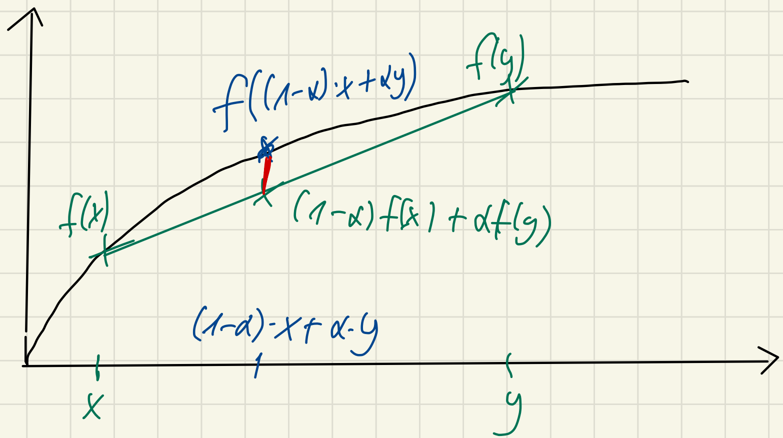
1. Recall the definition of concave functions in one real variable.
2. Compute $\max_{x \in \mathbb{R}} g(x)$ with $g(x) = -2x^2 + 32x + 7$.

→ maximized for $x = 8$

⇒ $g(8)$ is maximum

Concave functions

- informal definition: A function is concave if the straight line connecting two points on its graph will always be <u>below</u> the graph



Mathematical definition:

f is concave if $f((1-\alpha)\cdot x + \alpha\cdot y) \geq (1-\alpha) f(x) + \alpha\cdot f(y)$ for all $\alpha \in [0,1]$

for differentiable functions: f concave $\Leftrightarrow f'' \leq 0$

Here are some of the mathematical concepts you should master:

- rearranging terms
- computing the average of two (or more) numbers
- binomial formulas
- basic algebraic notations, such as $x^{\frac{1}{2}} = \sqrt{x}$ and $x^{-a} = \frac{1}{x^a}$, as well as rules of calculation with fractions, exponents and (square-)roots
- extreme value problems (maximizing a function under some constraints)
- integration, e.g. $\int_0^1 \sqrt{x} dx =?$
- differentiation, in particular product rule, quotient rule and chain rule
- understanding and interpreting graphs and functions, computing points of intersection of two curves
- In the course schedule, you will find mathematical prerequisites for the chapters