

IE102 Spring 2018 Homework III - Due: May 2, Wednesday 17:00

IMPORTANT: READ BEFORE YOU START WORKING ON THE HOMEWORK

Information on Homework III

- Make sure that you review course material before you start. Cite sources used if any.
- Homework assignment will be conducted in groups of 2. We randomly form the groups. You can find your group member and his/her contact information at the course website. **If you cannot reach your group member by all means, indicate this on the cover page of your submission.**
- Grading Policy: The homework grades will not be only based on the correctness of the answers provided, but on the perceived degree of effort on the returned assignment. There exists no motive for the students to copy the answers from someone else, since even without obtaining the correct answers one can obtain full credit. The grading scale for each question is 2 points (full effort), 1 point (some effort), and 0 (no effort or no submission).
- Academic Dishonesty (taken from IE102 Course Information): **Academic misconduct is not tolerated, and violations will be treated in accordance with the university policy.** For assignments: Discussion of the course material and working in groups are effective ways of learning. However, this does not mean that you can copy the assignment from one of your friends. You can discuss with your friends, but you should be alone, without any written solution in front of you, when you actually prepare your assignment. It is extremely important to understand the value of this exercise in the process of learning. Any violation of the above understanding will result measures outlined in the student rules and regulations.
- Submission Information: An assignment submission box will be placed in front of office EA327 on the morning of the submission date and will be removed at the time of the deadline. You need to put your assignment in the designated box before the submission deadline. **Submission via e-mail is NOT accepted.**

Contact TA Eren Özbay if you have questions related to this HW: eren.ozbay@bilkent.edu.tr

Question 1:

A symptomatic patient who has a condition called hydrocephalus (an abnormal accumulation of cerebrospinal fluid (CSF) within the brain) is seeking your medical attention between deciding the treatment options. Several neurosurgeons agree on the urgency of treating the condition but disagree on the preferred treatment. They can either choose to treat by placing a drainage tube (shunt) or drug therapy.

The neurosurgeons who recommend treatment by placing a shunt in the brain provide these information: If the condition subsides by the time of surgery, they do not need to do any operations on the brain, but since the surgery requires general anaesthesia, there is a risk of operative death, with a probability of 3%. If the condition is continuing by the time of surgery, with a probability of 85%, there is still a risk of operative death with a probability of as high as 10%. If the patient survives the operation, he may recover fully or not recover at all. He recovers fully with a probability of 60%.

The neurosurgeons who recommend drug therapy provide these information: With a probability of 15% the condition may subside after the start of drug therapy and the patient may recover fully or with side effects. He recovers fully with a probability of 80%. If the condition is still present after a 6-month long of drug therapy, the condition may subside with a probability of 80% with side effects or it may have no effect on the condition of the patient.

Given these information and the utility of each outcome (in the table below) answer the following questions.

Possible Outcome	Utility
Complete recovery	1
Recovery with side effects	0.7
No recovery	0.4
Operative death	0

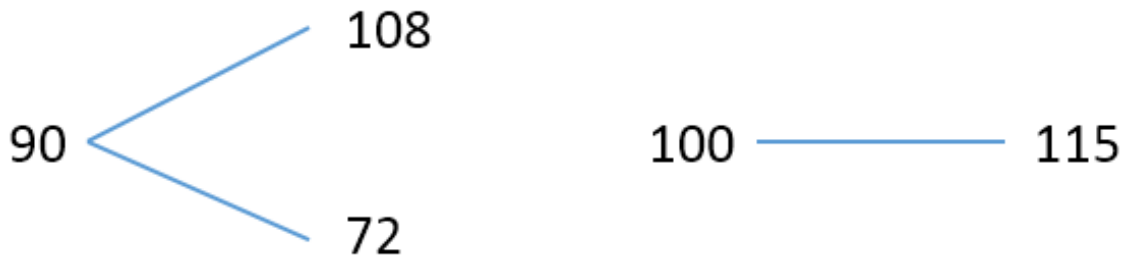
a) Draw the decision tree.

b) Calculate the expected utility of each decision. Which treatment should the patient choose? Why?

c) Perform one-way sensitivity analysis on the utility of “recovery with side effects”. What is the threshold value of the utility of “recovery with side effects”? What is the expected utility of the corresponding threshold value of the utility of “recovery with side effects”? When the patient should prefer surgery over drug therapy? Provide a graphical solution.

Question 2:

Consider a one period binomial model for a stock and a bond with the following price trees:



- a) What are the up factor, down factor and interest rate?
- b) Does the model satisfy the principle of no-arbitrage?
- c) Consider a call option written on the stock with strike price $K = 84$. Find a replicating strategy and the price of this option.
- d) Consider a put option with strike price $K = 84$. Find a replicating strategy and the price of this option. What are the conditions required for the holder of the put to choose to sell a stock for $K = 84$? What is the lower bound on K such that the holder of the put would prefer to sell a stock?