

Examination: 11057 Decision Analysis

Winter Semester 2012/13

Examiner: Dr. Rainer Kleber

**Allowed Aids:** You are allowed to use a pocket calculator, subject to the examination office policy concerning them. You are also allowed to use an English (or English to X / X to English where X is any other language) dictionary (book, not electronic) without any handwritten entries.

**Instructions:** Ensure your name and matriculation number is correctly entered on the examination booklet and use the booklet to record your answers legibly (readably). You are requested to answer all of the questions. The examination has **120 points**, and points for each of the questions are provided in brackets after each question. With respect to rounding, decimal places should be kept until the final answer, and then rounded to an appropriate number of decimal places. **Show all calculations.**

**Good Luck!**

**Questions:**

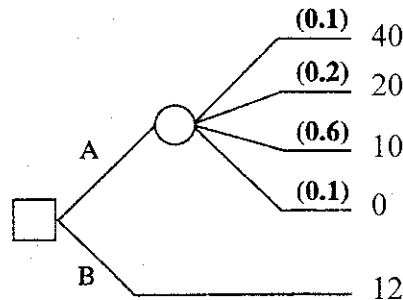
- (1) Name all four elements of decision problems. (4)
- (2) What are the two different kinds of objectives? How are they organized exactly (use the words network, hierarchies, and levels)? (7)
- (3) When using influence diagrams to structure decision problems there are four types of nodes. How does each type look like and for what purpose is it used? (8)
- (4) Warren Buffy is an enormously wealthy investor. He currently has been offered three major investments and he would like to choose one. The first one is a conservative investment that would perform well in an improving economy and only suffer a small loss in a worsening economy. The second is a speculative investment that would perform extremely well in an improving economy but would do very badly in worsening economy. The third is a countercyclical investment that would lose some money in an improving economy but would perform well in a worsening economy. There are three possible scenarios: (1) an improving, (2) a stable, and (3) a worsening economy. However, Warren is not able to determine the respective probabilities. He estimates net payoffs as given in the following table

Alternatives	States of Nature: Economy		
	Improving (S1)	Stable (S2)	Worsening (S3)
A Conservative investment	\$30 million	\$5 million	-\$5 million
B Speculative investment	\$40 million	\$10 million	-\$30 million
C Countercyclical Investment	-\$10 million	0	\$15 million

What is the optimal decision if the following criterion is used:

- a. Maximax (3)
- b. Maximin (3)
- c. Minimax Regret (5)
- d. Hurwicz criterion with a coefficient of optimism of 0.4? (5)
- e. What is meant when referring to “uncertainty” in this context? (3)
- (5) For two events **A** and **B**, the following probabilities are known:  $P(A) = 0.42$ ,  $P(B | A) = 0.6$ , and  $P(B | \bar{A}) = 0.3$ . Use Bayes' Theorem to find the probability  $P(A | B)$  (4)

- (6) A greeting card shop makes cards that are supposed to fit into 6-inch (in.) envelopes. The paper cutter, however, is not perfect. The length of a card is **uniformly** distributed in the interval between 5.8 in. (lower extreme value) and 6.0 in (upper extreme value). If a card is longer than 5.95 in., it will not fit into a 6-in. envelope.
- Find the probability that a card will not fit into a 6-in. envelope. (5)
  - Cards are sold in boxes of 4. Which theoretical distribution function appropriately describes the number of non-fitting cards? Explain your choice by checking validity of the corresponding assumptions? (6)
  - What is the probability that all cards in a box will fit into 6-in. envelopes? (4)
- (7) You live in an area that has the possibility of incurring a massive earthquake, so you are considering buying earthquake insurance at an annual cost of \$1800. The probability of an earthquake damaging your home during one year is 0.01. If this happens, you estimate that the cost of damage will be \$160,000. Your total assets (including your home) are worth \$250,000.
- Draw and properly label a decision tree. Include all payoffs and probabilities. (8)
  - What is the optimal strategy if you are maximizing the EMV? (4)
  - You now have constructed a utility function that measures how much you value having total assets worth  $x$  dollars. This utility function is  $U(x) = \sqrt{x}$ . When maximizing the expected utility, should you take the insurance? (6)
- (8) Name and describe four kinds of value-based blocks to creativity. (8)
- (9) The objective in the following decision tree is to maximize the EMV. Calculate the EVPI. (10)



- (10) Name all 7 **axioms** which, if hold in a particular situation, yield decisions consistent with maximizing the **expected utility**. (7)
- (11) A decision maker with exponential utility function  $U(x) = 1 - e^{-x/a}$  shows a risk tolerance of \$2000.
- Find the expected utility for an investment that has the following final wealth distribution:  
 $P(-\$1000) = 0.2$      $P(\$1000) = 0.5$      $P(\$2000) = 0.3$  (6)
  - Find the certainty equivalent and the risk premium! (6)
  - Does the risk premium change when adding \$2000 to the initial wealth of the investor and how? How do we call such behaviour? (3)
- (12) An undergraduate student evaluating her preferences on colours for her new ipad sleeve has concluded that a yellow sleeve would be four times as good as a red sleeve, and a red sleeve two times as good as a green sleeve. Use the ratio method to calculate utilities that range from 0 to 1 for the colours green, red, and yellow. (5)