



Management II (5072)

Decision Theory

February 14, 2007

Last name: **First name:** **Matriculation No.:**

Examination: Decision Theory

Examiner: Prof. Dr. G. Wäscher

General remarks:

1. Write your name and matriculation number on this cover sheet and on every other sheet that has been issued to you.
2. Leave a minimum of 4 cm as correction space on the outside margin of each page.
3. Make sure that you have a complete copy of the test. The test consists of **7 assignments**, all of which have to be dealt with. It is not permitted to remove the retaining clip; doing so will be treated as fraudulent behaviour.
4. Please write legibly and number the pages which have been used. For each assignment, put down your answers on a separate sheet. Only pens with permanent ink may be used, while correction pens or ink erasers are not permitted. Make sure that you don't write in red.
5. Always make clear how you have determined your solution (solution path). Isolated solutions without traceable origin will not be accepted.
6. The following aids may be used: writing utensils, non-programmable pocket calculators without communicating and/or data processing functions, dictionaries (without any added remarks only).

Assignment # 1 (17 points)

The following table comprises the data of a decision problem with four alternatives (a_1, a_2, a_3, a_4) and four states of nature (s_1, s_2, s_3, s_4). Note that the entries represent costs, which the decision maker wants to **minimize**.

	s_1	s_2	s_3	s_4
a_1	7	12	18	24
a_2	14	8	16	9
a_3	17	22	14	13
a_4	24	21	9	11

- What would be the respective alternative to be chosen if an optimistic, or, alternatively, a pessimistic approach would be applied? What recommendation(s) would result from the application of the LAPLACE- and the MiniMax-Regret-Rule, respectively?
- Give formal definitions of the above-mentioned rules!

Assignment # 2 (9 points)

Assume a multi-attribute decision problem under certainty! With respect to each attribute, the decision maker prefers larger values to smaller ones. Give a formal (mathematical), general definition of the "attribute dominance principle"! Do not forget to define the symbols used!

Assignment # 3 (15 points)

C-Boards Incorporated (CBI) manufactures printed circuit boards for a major PC manufacturer. Before a board is shipped to the customer, two key components must be tested; which can be done in an arbitrary order. If any of the two components fails, the entire board must be scrapped. The costs of testing the two components are provided by the following table, along with the probability of each component failing the test:

Component	Cost of Test	Probability of Failure
X	\$1.75	0.125
Y	\$2.00	0.075

- a) Create a decision tree for this problem that could be used to determine the order in which the components should be tested. Assume that the expected cost of performing the tests should be minimized!

- b) In which order should the components be tested and what is the expected cost of performing the tests in this sequence? Determine the optimal sequence by application of the roll-back procedure!

- c) What is the probability that a board will not fail in the test?

Assignment # 4 (9 points)

Consider the following goal programming model:

$$x_0 = P_1 d_1^+ + P_2 d_2^- + P_3 d_3^- + P_4 (d_4^+ + d_4^-) \rightarrow \text{Min!}$$

$$x_1 + x_2 \leq 150$$

$$x_2 - d_1^+ + d_1^- = 100$$

$$x_1 + x_2 - d_2^+ + d_2^- = 80$$

$$x_1 + d_3^- = 40$$

$$-x_1 + 2x_2 - d_4^+ + d_4^- = 20$$

$$x_1, x_2, d_1^+, d_1^-, d_2^+, d_2^-, d_3^-, d_4^+, d_4^- \geq 0$$

$$P_1 \gg P_2 \gg P_3 \gg P_4$$

Use the graphical method in order to determine an (optimal) solution of the model!

Assignment # 5 (27 points)

Max wants to buy an mp3-player with a internal hard drive of 30 gigabytes. The considered alternatives have a price ranging from 190 to 310 Euros, a weight between 136 and 188 grams, and a battery lifetime between 12 and 33 hours. Max' value functions for the different attributes have been determined as follows:

$$u_{\text{battery lifetime}}(r_{\text{battery lifetime}}) = \frac{r_{\text{battery lifetime}} - 12}{21},$$

$$u_{\text{price}}(r_{\text{price}}) = \frac{310 - r_{\text{price}}}{120},$$

r_{weight}	U_{weight}	r_{weight}	U_{weight}
136	1.00	164	0.22
140	0.83	168	0.17
144	0.69	172	0.12
148	0.57	176	0.07
152	0.46	180	0.04
158	0.37	184	0.01
160	0.29	188	0.00

Max thinks that an mp3-player with 22.5 hours battery lifetime that comes at a price of 280 Euros is just as good as an mp3-player with 26.0 hours battery lifetime and a price of 290 Euros. He further believes that an mp3-player with 29.5 hours battery lifetime and a weight of 176 grams is just as attractive as an mp3-player 26.0 hours battery lifetime and a weight of 148 grams.

- a) Use the given information to determine the scaling factors (weights) for Max' additive value function!
- b) Which of the following mp3-player will Max choose?

mp3-player	battery lifetime [hours]	price [Euros]	weight [grams]
Creative Labs Zen Vision: M	12.0	250	164
Philips GoGear HDD6320	19.0	190	158
Cowon iAudio X5L	33.0	310	188

- c) What is the price for the Apple iPod Video MA146FD (15.5 hours battery lifetime, 136 grams) for which Max no longer prefers this mp3-player to the Philips GoGear HDD6320?

Assignment # 6 (11 points)

Explain the "Sure Thing Principle" and give a short example!

Assignment # 7 (12 points)

Indicate those statements which are **correct** by marking the respective box. (1.5 points for each correct answer – 1.5 points subtracted for each incorrect answer - no answer: 0 points – the minimum number of points for the complete assignment is 0)

- 1) Decision trees involve sequences of decisions and random events. True False
- 2) Decision Theory analyses situations in which the pay-off for the decision maker depends entirely on the chosen action. True False
- 3) One way to deal with decision making in the "complete uncertainty" context is to treat all states of nature as equally likely and to maximize the expected return. True False
- 4) Bayes' decision rule requires to choose the alternative with the largest possible payoff. True False
- 5) A risk seeker has an increasing marginal utility for money (income, revenue). True False
- 6) The expected payoff is the payoff that is most likely to occur. True False
- 7) Goal programming is the only quantitative technique designed for use with models with multiple objectives. True False
- 8) In preemptive goal programming it is assumed that there is a distinct order of importance for all goals, and that no pair of goals is of equal importance. True False