Examination: 5072 Management II (Decision Theory) Winter Semester 2010/11

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:

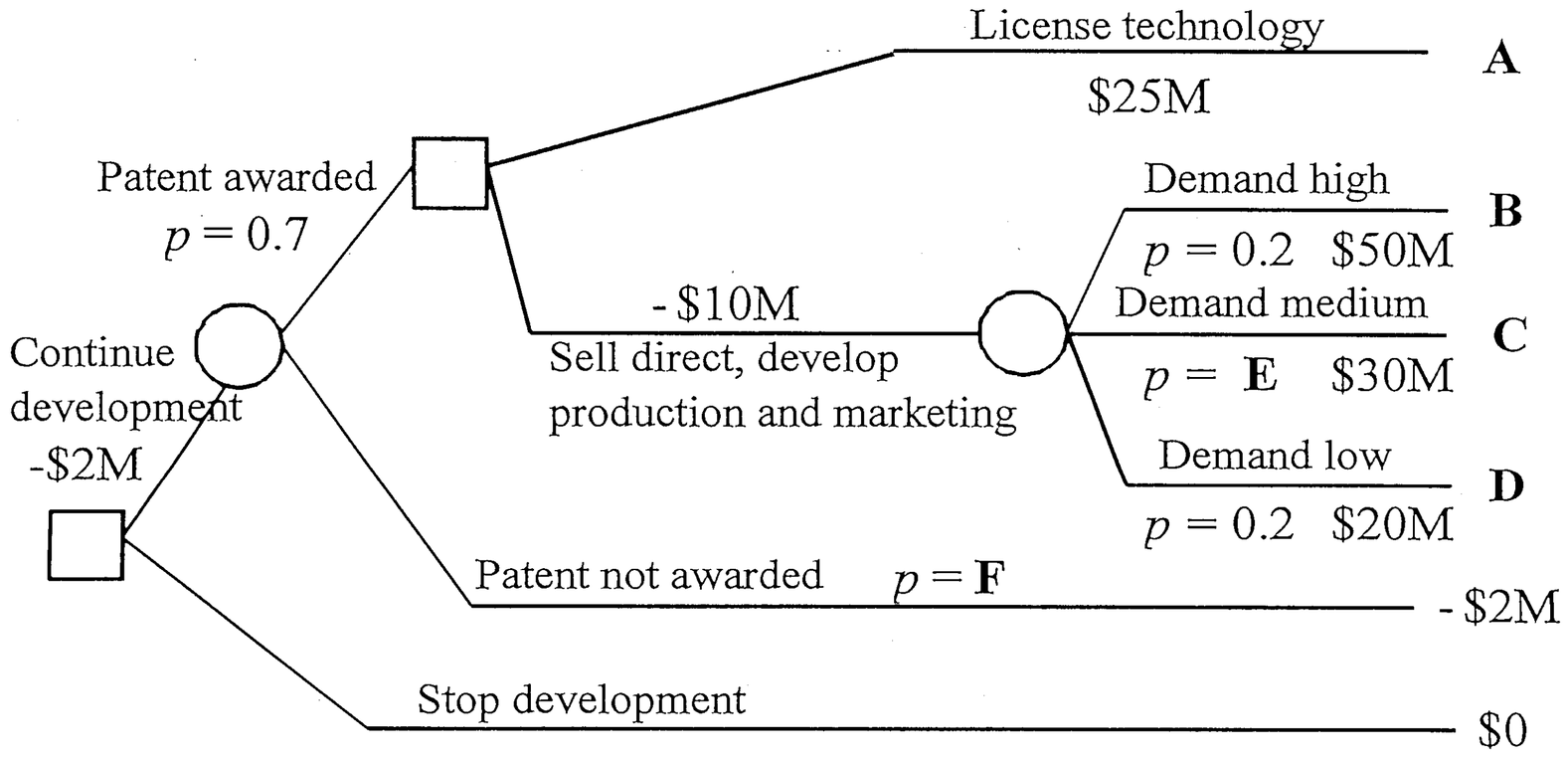
(1) Why are some decisions hard to make? (Hint: Name and shortly explain **four** sources.) **(8)**

(2) Name all four elements of decision problems. **(4)**

(3) What are the two different kinds of objectives? How exactly are they organized? (Use the words network, hierarchies, and levels.) **(6)**

(4) 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)**

(5) You are facing the following incomplete decision tree for the product research and development decision problem. Immediate consequences of decisions/chance events are shown at each node. The objective is to maximize the EMV of the project.



a. Complete the decision tree and determine values for **A**-**F**. **(3)**
b. Solve the tree and give the optimal EMV and the optimal (dynamic) strategy. **(4)**
c. Construct a cumulative risk profile for the optimal strategy. **(5)**
d. You are unsure whether you can license your technology for $25M. Perform a Sensitivity Analysis regarding this amount. **(4)**

(6) Consider the payoff table as shown below, in which the entries are net dollar returns. Assume that this is a decision under uncertainty.

	States of Nature		
Decision	S1	S2	S3
A	20	-60	80
B	40	-20	40
C	30	20	50

a. What do we mean when referring to "uncertainty" in this context? **(2)**

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

b. Minimax Regret **(4)**
c. Hurwics criterion with the Coefficient of Optimism equal 0.2 **(4)**
d. Laplace criterion **(4)**

e. Which criterion would be used by a very optimistic decision maker, which one by a very pessimistic one? **(2)**

(7) If an athlete is tested for a certain type of drug usage (steroids, say), the test result will be either positive or negative. However, these tests are never perfect. We assume that 5% of all athletes use drugs, 3% of all tests on drug-free athletes yield (false) positive results, and 7% of all tests on drug users yield (false) negative results.

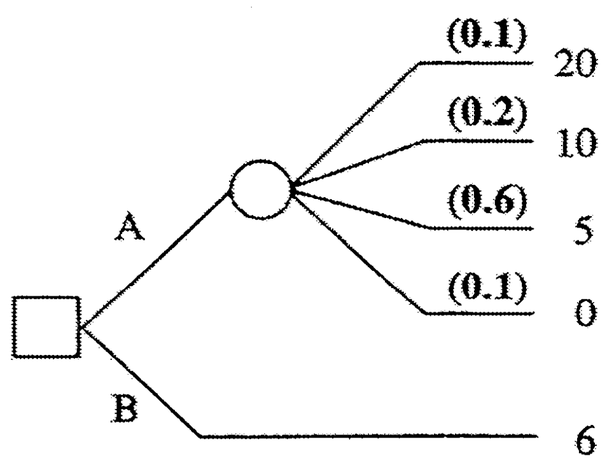
a. What is the probability of observing a positive test result? **(4)**
b. If an athlete tests positive, what is the probability that he is a drug user? **(6)**

(8) In capacity planning for call centers the number of incoming calls per minute often is modeled by using the Poisson Distribution. Explain this by checking the assumptions of the Poisson Distribution. **(6)**

(9) 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 normally distributed with mean 5.85 in. and a standard deviation of 0.04 in. If a card is longer than 5.95 in., it will not fit into a 6-in. envelope.

a. Find the probability that a card will not fit into a 6-in. envelope. **(4)**
b. Cards are sold in boxes of 10. Which theoretical distribution function appropriately describes the number of non-fitting cards in a box and why? **(3)**
c. What is the probability that all cards in a box will fit into 6-in. envelopes? **(4)**

(10) Calculate the EVPI for the decision tree shown below. The objective is to maximize the EMV. **(8)**



(11) Name all 7 axioms which, if hold in a particular situation, yield decisions consistent with maximizing the expected utility. Shortly explain 3 of the mentioned axioms. **(10)**

(12) Another decision maker with an exponential utility function $\mathbf{U(x) = 1 - e^{-x/a}}$ shows a risk tolerance of \$1000.

a. Find the expected utility for an investment that has the following final wealth distribution:
P(-\$500) = 0.2 P(\$500) = .5 P(\$1000) = .3 **(4)**

b. Find the certainty equivalent and the risk premium! **(6)**

c. In which direction does the risk premium change when adding \$1000 to the initial wealth of the investor? How do we call such behaviour? **(3)**

(13) An undergraduate student evaluating weather outcomes for the upcoming end-of-semester party has concluded that a sunny day would be twice as good as a cloudy day, and a cloudy day would be three times as good as a snowy day. Use these assessments to calculate utilities that range from 0 to 1 for sunny, rainy, and snowy days. **(4)**

Normal Distribution: Cumulative Probabilities

z	P(Z ≤ z)	z	P(Z ≤ z)	z	P(Z ≤ z)	z	P(Z ≤ z)
-3.50	0.0002	-1.75	0.0401	0.00	0.5000	1.75	0.9599
-3.45	0.0003	-1.70	0.0446	0.05	0.5199	1.80	0.9641
-3.40	0.0003	-1.65	0.0495	0.10	0.5398	1.85	0.9678
-3.35	0.0004	-1.60	0.0548	0.15	0.5596	1.90	0.9713
-3.30	0.0005	-1.55	0.0606	0.20	0.5793	1.95	0.9744
-3.25	0.0006	-1.50	0.0668	0.25	0.5987	2.00	0.9772
-3.20	0.0007	-1.45	0.0735	0.30	0.6179	2.05	0.9798
-3.15	0.0008	-1.40	0.0808	0.35	0.6368	2.10	0.9821
-3.10	0.0010	-1.35	0.0885	0.40	0.6554	2.15	0.9842
-3.05	0.0011	-1.30	0.0968	0.45	0.6736	2.20	0.9861
-3.00	0.0013	-1.25	0.1056	0.50	0.6915	2.25	0.9878
-2.95	0.0016	-1.20	0.1151	0.55	0.7088	2.30	0.9893
-2.90	0.0019	-1.15	0.1251	0.60	0.7257	2.35	0.9906
-2.85	0.0022	-1.10	0.1357	0.65	0.7422	2.40	0.9918
-2.80	0.0026	-1.05	0.1469	0.70	0.7580	2.45	0.9929
-2.75	0.0030	-1.00	0.1587	0.75	0.7734	2.50	0.9938
-2.70	0.0035	-0.95	0.1711	0.80	0.7881	2.55	0.9946
-2.65	0.0040	-0.90	0.1841	0.85	0.8023	2.60	0.9953
-2.60	0.0047	-0.85	0.1977	0.90	0.8159	2.65	0.9960
-2.55	0.0054	-0.80	0.2119	0.95	0.8289	2.70	0.9965
-2.50	0.0062	-0.75	0.2266	1.00	0.8413	2.75	0.9970
-2.45	0.0071	-0.70	0.2420	1.05	0.8531	2.80	0.9974
-2.40	0.0082	-0.65	0.2578	1.10	0.8643	2.85	0.9978
-2.35	0.0094	-0.60	0.2743	1.15	0.8749	2.90	0.9981
-2.30	0.0107	-0.55	0.2912	1.20	0.8849	2.95	0.9984
-2.25	0.0122	-0.50	0.3085	1.25	0.8944	3.00	0.9987
-2.20	0.0139	-0.45	0.3264	1.30	0.9032	3.05	0.9989
-2.15	0.0158	-0.40	0.3446	1.35	0.9115	3.10	0.9990
-2.10	0.0179	-0.35	0.3632	1.40	0.9192	3.15	0.9992
-2.05	0.0202	-0.30	0.3821	1.45	0.9265	3.20	0.9993
-2.00	0.0228	-0.25	0.4013	1.50	0.9332	3.25	0.9994
-1.95	0.0256	-0.20	0.4207	1.55	0.9394	3.30	0.9995
-1.90	0.0287	-0.15	0.4404	1.60	0.9452	3.35	0.9996
-1.85	0.0322	-0.10	0.4602	1.65	0.9505	3.40	0.9997
-1.80	0.0359	-0.05	0.4801	1.70	0.9554	3.45	0.9997
-1.75	0.0401	0.00	0.5000	1.75	0.9599	3.50	0.9998
-1.70	0.0446	0.05	0.5199	1.80	0.9641		