Examiner: Dr. rer. pol. Ian M. Langella Date: 30 July 2008

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, where X is any other language) dictionary (book, not electronic) without any handwritten entries.

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

Questions:

1. What are the two different kinds of *objectives*? How exactly are they organized (use the words *networks*, *hierarchies*, and *levels*)? (4)

2. Describe a hypothetical decision problem faced by a firm and sketch an influence diagram for the problem. The diagram should include at least one of each of all four major elements. (4)

3. You are investigating breakdowns of Machine X at your manufacturing facility. For ten days, you measured the number of breakdowns occurring in each day. The following data resulted: 2, 4, 5, 3, 2, 4, 6, 3, 5, 4. (4)
   a. Depict the resulting data in a histogram.
   b. Draw the chance node of a decision tree and indicate how you would represent this in a decision tree. You should include outcomes and probabilities!

4. Big Bad Oil Company is deliberating investing in production on a specific lease of land. The profit of the project will be $\pi = p \cdot o - I$, where p is the price of oil, o is the output of the field, and I is the investment amount. The following table provides base case, minimum and maximum values for the uncertain price, output, and investment, where M means millions. (12)

	Min	**Base**	**Max**
Output	1.0M	1.4M	2.0M
Price	100	150	200
Investment	170M	200M	220M

Construct a tornado diagram including all three variables.

5. A farmer must decide which crop to plant for the coming season, crop A or crop B. The profit for the farmer will be dependent on both the weather (which influences yield of the harvest) as well as the exchange rate (which influences its global demand), and is given by the following table (where WG stands for Good Weather, and ERB stands for Bad Exchange Rate): (25)

Crop	Weather	Exchange rate	Profit
A	WG	ERG	5
		ERB	4
	WB	ERG	2
		ERB	1
B	WG	ERG	5
		ERB	2
	WB	ERG	3
		ERB	2

You believe the probability of a good or bad exchange rate to be even, and that the probability of good weather is 0.6.

a) Draw a decision tree and indicate its preferred alternative using the above notation.
b) Draw risk profiles and cumulative risk profiles for both options.
c) What is the Expected value of perfect information (EVPI) for weather in the problem?
d) What is the EVPI for the exchange rate?

6. An investor is facing an investment decision. She can invest her money into either Enron stock, SAP stock, or in a Money Market account. She has $1,500 to invest for one year and her return will depend on how she invests it and how well the market does. We will assume that she intends to invest the entire amount in only one of the three alternatives. The following table summarizes the (gross) returns from the $1,500 investment depending on how she invests and how the market turns out. (30)

	Bull	Neither	Bear
Enron	3000	1500	0
SAP	2000	1500	1000
Money Market	1600	1600	1600

She judges the probability that the market will be bear, bull, or neither to be 0.2, 0.4, and 0.4, respectively.

a) Formulate the problem as a decision tree including all information.
b) Solve the decision tree. Indicate the preferred alternative.
c) Suppose Alvin the Economist can help by providing advise. The following table summarizes Alvin's prediction (e.g. "Bull") given the true state of the market (e.g. Bull):

	Bull	**Neither**	**Bear**
"Bull"	0,8	0,2	0,1
"Neither"	0,1	0,6	0,2
"Bear"	0,1	0,2	0,7

What is the expected value of imperfect information for Alvin's advise. Show all calculations and the decision tree. Round probabilities to three decimal places. Use notation where B=Bull N=Neither and R=Bear, e.g. P("R") is the probability that Alvin says it will be a Bear market.

7. In lecture, we discussed the *four phases of the creative process* according to Wallas (1926). Name and describe what happens in each of the four phases. (4)

8. When eliciting expert opinion, one should follow the 7 steps of the so called *protocol for expert assessment*. Name and explain briefly the 7 steps. (14)

9. Sketch a typical utility function for monetary gains and losses. (1)

10. An investor is deliberating a gamble where he can win or lose \$10 with equal probability (e.g. a fair coin toss). He chooses based on his exponential utility function of $U(x) = 1 - e^{-x/R}$, with $R = 40$ and $e = 2.7183$. (20)

    a. If he currently has \$20 in wealth, calculate the expected monetary value (EMV), expected utility (EU), certainty equivalent (CE), and risk premium (RP) of the gamble.
    b. Recalculate EMV, EU, CE, and RP for \$40 in wealth.
    c. Explain the difference between the RP's from part a and b. Why is this expected? What is this called?

11. Which theoretical probability distribution would be likely supposed if we were measuring the time between the arrival of two successive customers at a bank? Choose the best answer. (1)
    a. Normal
    b. Poisson
    c. Exponential
    d. Fair share

12. Which theoretical probability distribution would be likely supposed if we were measuring the number of arriving customers per unit time at a bank? Choose the best answer. (1)
    a. Normal
    b. Poisson
    c. Exponential
    d. Fair share

End of Exam!