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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 is 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. 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)

2. An oil company faces the following complex decision. The company currently generates profits of $250M (M=million) and is deliberating bidding on a lease which is up for auction from the government. The firm plans to bid $400 M for the lease and that there is a 0.5 chance that the bid is successful. If the bid is successful, the company must decide whether to use an older oil rig or a newer oil rig to extract the oil. A newer rig will cost $250M to move into position whereas the older can be moved into position for $100M. The additional returns from the acquired lease depend on whether the new lease is a "success" or a "failure". A success will generate additional revenue of $1250M whereas a failure will generate only $250M additional revenue. With the older rig, the chance of a success is 0.5 whereas with a newer rig the probability increases to 0.7.
    If the bid is foregone or unsuccessful (i.e. if either you decide not to bid, or your bid is unsuccessful) your company might use some of the cash it would have spent on the bid to maintain producing oil rigs thereby enhancing performance. This will cost $375M and will have an uncertain benefit. If the repairs are successful (with 0.6 chance) additional revenue of $1000M will result, whereas if unsuccessful an additional $150M revenue will ensue. (10)

    a. Formulate this decision problem as a decision tree.
    b. Use the rollback method to arrive at the strategy for this problem.
    c. Give the complete strategy for this problem.

3. Name the four groups of *creativity blocks* and give an example of each block. (8)

4. You are attempting to estimate demand for a new product. Due to the fact that the product is truly innovative, the estimate cannot be based on any previous values. It is also not possible to presume that the product's demand follows any similar products. There are two methods available: A customer survey and a marketing analysis firm. The customer survey will provide some information on the demand, but the marketing analysis will provide much better information. In fact, if we were to do both the survey and the analysis, you would gain no additional

information from the survey, and your estimation of demand would be exactly the same as with just the analysis. This can be mathematically expressed as:
P(High demand | Survey, Analysis) = P(High demand | Analysis)
What is this type of relationship referred to? (2)

5. 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)

6. Another oil company faces a different decision problem. It has two sites (1 and 2), but can only drill one of them. The profit from drilling on each site is uncertain. Site 1 might be dry (loss of $100K, probability 0.2), low (profit of $100K, probability 0.2), or high (profit of $300K, probability 0.6). Site 2 might be low (profit of $150K, probability 0.2), or high (profit of $200K, probability 0.8). (20)

    a. Formulate the decision problem as a decision tree and indicate its solution.
    b. Sketch a risk profile and a cumulative risk profile for each alternative.
    c. Calculate the expected value of perfect information for the problem.

7. You own a piece of land in a beach resort area and are considering what to do with it for the summer months. First, you might consider making it into "Kiddie Park" an amusement park for kids, but this option requires a large investment and a return which depends on the weather during the summer months. A second option is "Boris' Beergarden" a beer garden requiring less investment, with a less uncertain return depending on weather. The safe option is using the lot as a parking lot for cars, with no investment and a safe return of $100K (K=thousands). Weather will either be good (with probability 0.1), medium (with probability 0.8), or bad (with probability 0.1). The amusement park will return $400K, $100K, and $-100K ($100K loss) if the weather is good, medium, and bad, respectively. The beer garden will generate profits of $200K, $100K, and $0K if the weather is good medium, or bad, respectively. (17)

    a. Formulate the decision problem using a decision tree and indicate its solution.
    b. Denoting P(Good weather) as g and P(Medium weather) as m conduct a two way sensitivity with respect to these two variables and depict this in a graph of the two variables and the strategies preferred in each region.

8. Bob "Cookie Monster" Jones has developed a new recipe for chocolate chip cookies and is considering forming a start-up "Eat me cookies" to market his new cookies. The current market leader "Chips Abound" enjoys total 100% market share. Bob estimates that if his cookies are a "Hit" he will win 25% whereas if they are a "Flop" he will only get around 5% market share. He judges each possibility equally likely. Bob is a cautious fellow. He intends to bake 25 cookies and pick 25 random people to test his cookie against the established market leader. In the taste test, 4 people (from 25) prefer his cookie to the competition's. (10)

    a. Using Bayes' theorem and the binomial distribution, calculate the probability that Bob's cookies are a "Hit". Hint: The binomial probability of obtaining r successes in n trials with a probability of success of p is
    $$\left[\frac{n!}{ } p^r (1-p)^{n-r} \right]$$

9. An investor deliberates investing in an uncertain asset requiring a $5000 investment. The asset will either triple in value (so a net gain of $10000, with probability 0.25), return $5000 (so no net gain or loss, with probability 0.35), or return nothing (so a net loss of $5000, with probability 0.4).
    The investor decides based on her logarithmic utility function of $U(x)=ln(x)$, where U represents her utility and x her wealth. (15)

    a. If the investor currently has $20,000 in wealth, would she invest?
    b. If the investor several years later now has $100,000 in wealth, would she invest?
    c. What is the specific name of this phenomenon?

10. Another individual with the logarithmic utility function of $U(x)=ln(x)$, faces the following gamble. A fair coin will be tossed, and if "heads up" the person will receive $80, whereas if "tails up" he will receive $5. (10)

    a. What is the expected monetary value and expected utility of the gamble.
    b. What is the certainty equivalent and risk premium for the gamble. Hint: Euler's constant e can be approximated by 2.718.

11. Suppose someone were offered a choice between the following games, and the utility maximizing decision maker prefers game B reasoning that 5 of 6 payoffs are "better" than game A. (5)

Outcome	1	2	3	4	5	6
Game A	100	200	300	400	500	600
Game B	200	300	400	500	600	100

    a. Illustrate exactly how this preference is inconsistent with utility theory.
    b. What is the name of the axiom that is violated?

12. You are about to select a company to build a restaurant that you are starting. The two criteria on which to base your selection are cost and time to completion. You prefer less cost and less time to completion. You have received the following offers from four contractors. (5)

Contractor	Cost ($1000s)	Time (weeks)
A	104	52
B	101	53
C	100	55
D	102	54

Also, contractor B has offered to complete the project 2 weeks earlier for an additional cost of $3000 and contractor C can expedite completion by 1 week for an additional $3000.
Which contractor should be awarded the job. Explain your reasoning.