ANSWER SHEET (SHEET 1 of 7)

Question 1: (7 points)

a. DSS is defined as "model-based set of procedures for processing data and judgments to assist a manager (decider) in his decision making." What does the term "model" mean in this context? **(1 point)**

b. What is the difference between OLAP and OLTP databases? **(2 points)**

c. We learned about data cube materialization in class. What does materialization mean? **(1 point)**

d. Mention with explanation at least two factors that should be considered when we decide what materialization possibilities to use, i.e., materialize the whole data cube, no materialization, or partial materialization. **(2 points)**

   a. ……., explanation:

   b. ……., explanation:

e. One of features of data warehouses is that they are "integrated", i.e., the data comes from different, heterogeneous sources. What are some examples of such data sources? **(1 point)**
   a. ……
   b. ……
   c. ……

Question 2: Problems in Data Warehousing. (9 points)

Let us consider a data warehouse of a Bookstore system with three dimensions: *Publisher, Time, Category,* and one measure *sum_sales*. The dimension *Publisher* contains information about the publishing house (دار النشر). The hierarchy of the dimension category contains *sub_category* → *main_category*. The dimension *Time* records data about *day* → *month* → *year*.

a. Give a full snowflake schema for the Bookstore system. (3 points)

b. Give an example of a roll-up query. (2 points)

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c. How many cuboids are in the cube? Show your calculation steps. (2 points)

Remember: $T = \prod_{i=1}^{n} (L_i + 1)$

d. Consider the data table "bookstore" below:

publisher	*day*	*subcategory*	*sales*
pub01	D01	A01	10
pub01	D01	A01	15
pub01	D01	A02	20
pub01	D02	A01	10
pub01	D02	A01	30
pub02	D01	A01	3
pub02	D02	A01	2
pub02	D02	A02	5

What would be the results of the query below? Show in tabular format. **(2 points)**

```
SELECT publisher, subcategory, SUM (sales)
FROM bookstore
CUBE BY publisher, subcategory
ORDER BY publisher, subcategory
```

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Question 3: Problems in Decision Analysis. (9 points)

Assume that Ahmed has inherited $1000, and he has to decide how to invest the money for one year. A broker has suggested five potential investments:

- Gold
- Company A
- Company B
- Company C
- Company D

The return on each investment depends on the (uncertain) market behavior during the year. Below is the payoff table to help make the investment decision. You may drop the decision alternatives that are dominated by other decision alternatives.

Decision Alternatives	States of Nature		
	Rise	No Change	Drop
Gold	-100	100	0
Company A	200	75	-100
Company B	300	50	-200
Company C	150	75	-200
Company D	250	25	-250

a. What would be the optimal decision(s) under the Maximin criterion? Pessimistic or conservative approach. (1 point)

b. What would be the optimal decision(s) under the Maximax criterion? Optimistic and an aggressive decision maker. (1 point)

c. What would be the optimal decision(s) under the Insufficient Reason criterion? Assume all the states of nature are equally likely to occur. (1 point)

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Now, assume Ahmed knows the prior probability of each state of nature as in the table below.

Decision Alternatives	States of Nature		
	Rise	No Change	Drop
Gold	-100	100	0
Company A	200	75	-100
Company B	300	50	-200
Company C	150	75	-200
Company D	250	25	-250
Prior Prob.	0.2	0.4	0.4

d. What would be the expected value of each decision? You may drop the decision alternatives that are dominated by other decision alternatives. (1 points)

e. **Bayesian Analysis (3 points).** Ahmed can purchase econometric forecast results for $50. The forecast predicts "negative" or "positive" econometric growth. Find the expected payoff with forecast assuming that:
   a. P(B= "positive" | A):
      - P(forecast predicts "positive" | rise in market) = 0.75
      - P(forecast predicts "positive" | drop in market) = 0.1
      - P(forecast predicts "positive" | no change) = 0.3

Remember:

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

A: state of nature

B: forecast prediction

a. First (0.5 points), you would need to find P(B= "negative" | A), i.e.,
   - P(forecast predicts "negative" | rise in market)
   - P(forecast predicts "negative" | drop in market)
   - P(forecast predicts "negative" | no change)
b. Second (1 point), find the joint probability values, i.e., P(B|A) * P(A).
c. Third (1 point), find the posterior probability, i.e., P(A| B).
d. Then (1.5 points), calculate the expected values based on the revised probability payoff table, i.e., EV(A| B)

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f. Based on e., what would be the optimal decision if the forecast is "positive"? And what would it be if the forecast is "negative"? (1 point)

g. What is the expected gain from buying the forecast? (1 point)