

1. A company can set production for the coming quarter at one of three levels H (High), M (medium), or L (low). Market demand may similarly be at one of three levels with probabilities as shown. The profit or loss made in \$(million) has been estimated (and is shown) for each of the possible combinations of levels of demand and production.

Production	Market Demand		
	H	M	L
H	100	50	-40
M	60	60	-10
L	20	25	20
Probability	0.5	0.3	0.2

Under each of Maximax, Maximin, Minimax Regret, Hurwicz with $\alpha = 0.3$, expected profit, and expected regret what level of production should the management choose? What is the value of perfect information?

Would any of the decisions change if the probabilities of market demand being H, M or L were instead estimated to be 0.2, 0.4 and 0.4 respectively?

2. A farmer in Georgia must decide which crop to plant next year on his land: corn, peanuts, or soyabeans. The return from each crop will be determined by whether a new trade bill with Russia passes the Senate. The profit the farmer will realize from each crop given the two possible results on the trade bill as shown in the following payoff table. Determine the best crop to plant using the following decision criteria.

Crop	Trade Bill	
	Pass	Fail
Corn	\$35000	\$8000
Peanuts	18000	12000
Soyabeans	22000	20000

- (a) Maximax
 (b) Maximin
 (c) Minimax regret
 (d) Hurwicz ($\alpha = 0.3$)
 (e) Equal likelihood
3. An investor is going to purchase one of three types of real estate. The investor must decide between a condominium, an office building and a warehouse. The profit that will result from each alternative will be determined by whether the economic or political climates will decline, remain the same or improve. The following payoff table shows the profit or loss that could result from each investment.

Investment	Economic/Political Climate		
	Decline (0.3)	Same (0.4)	Improve (0.3)
Condominium	- \$80,000	\$150,000	\$200,000
Office	\$20,000	\$80,000	\$60,000
Warehouse	\$60,000	\$60,000	\$50,000

- (a) Determine the best decision using the following decision criteria.
- Maximax
 - Maximin
 - Hurwicz ($\alpha = 0.4$)
 - Minimax Regret
 - Comment on the decision maker's personality in applying (i) and (ii).
- (b) Determine the best decision using expected value and expected opportunity loss.
- (c) Compute the expected value of perfect information.
4. The owner of the Columbia Construction Company must decide among building a housing development, constructing a shopping center, or leasing all the company's equipment to another company. The profit that will result from each alternative will be determined by whether material costs remain stable or increase. The profit from each alternative given the two possibilities for material costs is shown in the following payoff table. Determine the best decision using the following decision criteria.

Decision	Material costs	
	Stable	Increase
Houses	\$70000	\$30000
Shopping center	105000	20000
Leasing	40000	40000

- Maximax
 - Maximin
 - Minimax regret
 - Hurwicz ($\alpha = 0.2$)
 - Equal likelihood
5. A machine shop owner is attempting to decide whether to purchase a new drill press, a lathe, or a grinder. The return from each will be determined by whether the company succeeds in getting a government military contract. The profit or loss from each purchase and the probabilities associated with each contract outcome are shown in the following payoff table. Compute the expected value for each purchase and select the one.

	Contract	No Contract
Purchase	0.40	0.60
Drill press	\$40,000	\$8,000
Lathe	20,000	4,000
Grinder	12,000	10,000

6. A wholesaler sells trays of 50 loaves of bread, which cannot be split. Loaves of bread cost him \$25 each to buy and he sells them at \$55. Any leftover are sold to a local farmer at \$10 per loaf. Calculate the profit per tray if sold to a customer and the loss per tray if sold to the farmer.

Determine the number of these trays of loaves the wholesaler should have in stock on a daily basis under each of the seven decision rules met previously (using $\alpha = 0.6$ for the Hurwicz criteria) given the following expected daily demand distribution:

Demand (no. of trays)	0	1	2	3
Probability	0.1	0.4	0.3	0.2

7. The manager of a book store is considering her order for New Year cards. The cost of each pack of cards is \$3; each pack will be sold for \$5 during the New Year season. After New Year, the cards will be sold for \$2 a pack. The manager believes that all leftover cards can be sold at that price. The estimated demand during the New Year season for the New Year cards, with associated probabilities, is shown as follows.

Demand (packs)	Probability
25	0.10
26	0.15
27	0.30
28	0.20
29	0.15
30	0.10

- Develop the payoff table for this decision situation.
 - Compute the expected value of each alternative, and select the best decision.
 - Construct the opportunity loss table and determine the best decision.
 - Compute the expected value of perfect information.
8. The luggage department of a store is considering a promotion day on a particular brand of luggage and the manager of the department needs to determine how many items of this brand to have in stock. The cost of each item of luggage is \$26 and the store is planning to sell the luggage for \$43 per item. Any unsold luggage will be sold to a convenient store for half the cost price. His estimate of the probable sales based on the past is

Demand (luggage items)	Probability
33	0.24
34	0.15
35	0.20
36	0.17
37	0.13
38	0.11

- Develop the payoff table for this decision situation.
- Compute the expected value of each alternative, and select the best decision.
- Compute the expected value of perfect information.

9. The Palm Garden Greenhouse specializes in raising carnations that are sold to florists. Carnations are sold for \$3.00 per dozen; the cost of growing the carnations and distributing them to the florists is \$2.00 per dozen. Any carnations left at the end of the day are sold to local restaurants and hotels for \$0.75 per dozen. The estimated *cost* of customer ill will if demand is not met is \$1.00 per dozen. The expected daily demand (in dozens) for the carnations is shown as follows.

Daily Demand	Probability
20	0.05
22	0.10
24	0.25
26	0.30
28	0.20
30	0.10
	1.00

- (a) Develop the payoff table for this decision situation.
- (b) Compute the expected value of each alternative number of carnations that could be stocked, and select the best decision.
- (c) Construct the opportunity loss table and determine the best decision.
- (d) Compute the expected value of perfect information.
10. A firm buys identical components from three suppliers as shown below. A component is selected at random. Find the probability that the component is defective. Given that these components are sold in boxes of 200, how many faulty items per box can be expected?

Supplier	A	B	C
% supplied	40	30	30
% defective	2	4	10

11. A company has choice of investing in two types of machinery A and B and would like to know the expected life time of each. Given the following information, determine the expected life of each machine.

Lifetime years)	2	3	4	5	6
Machine A probability	0.05	0.2	0.4	0.2	0.15
Machine B probability	0.1	0.2	0.4	0.3	-

12. A maintenance company that offers breakdown cover for large machinery has two schemes available where all parts and labour are included. The first scheme has a one-off \$1000 contract fee per year and then charges according to the number of callouts during the year with the first callout costing \$1500, the second costing \$1200, the third \$1000, and all subsequent callouts costing \$750. The second scheme costs \$4000 per year with unlimited callouts. Alternatively, the company will provide maintenance on demand where the cost of each callout is the actual costs of parts and labour. A firm purchases a piece of large machinery and is considering how best to insure against breakdown. Past evidence has shown that for large machinery like this, the total number of breakdowns per year and their associated likeliness of occurrence are as follows:

Number of breakdowns	0	1	2	3	4	5
Probability	0.05	0.1	0.25	0.3	0.2	0.1

Past experience has also shown that the expected cost for such machinery in terms of parts and labour is \$1400 per breakdown. Based on expected cost per year, what breakdown insurance approach should the firm undertake with the maintenance company to protect its new machinery?

13. A firm is trying to decide whether to build a small plant or a large plant at a nearby location. Demand will be either high or low, with probabilities of 0.65 and 0.35, respectively. If a large plant is built and demand is high, the firm is expected to earn a net present value of RM 500,000. If demand is low, the loss with the large plant will be RM120, 000.

If a small plant is built and demand is low the net present value is RM60, 000, after deducting the costs to build and equip the plant. If demand proves to be high, the firm can maintain the small plant or expand it. Maintaining the small plant has a present value of RM85, 000; expanding it has a present value of RM250, 000.

- (i) Draw a decision tree for this problem
- (ii) Determine what's the firm policy should be in your opinion?

14. You have been retained by Amalgamated Pencil Sharpeners (APS) Inc. to help determine whether the company should export its new sharpener model XT-S to Brazil. If APS does export, there are three foreseen possibilities. First, there is a 25% probability that the product will sell well, earning the company (after startup costs) \$280,000. Second, there is a 40% probability that the sharpeners will have only modest performance, earning the company a net of only \$15,000. Lastly, the product might be rejected, causing the company to lose its startup costs of \$175,000. The probability for this is 35%. If the company decides not to export the sharpeners, it could invest the startup money with a 90% probability of making a net of \$18,000 and a 10% probability of losing a net of \$27,000. What should the company do?

- (i) Draw a decision tree for this problem and label the tree with probabilities and payoffs.
- (ii) Determine what the company decision should be, in your opinion.

15. The Americo Oil Company is considering making a bid for a shale oil development contract to be awarded by the federal government. The company has decided to bid \$110 million. The company estimates that it has a 60% chance of winning the contract with this bid. If the firm wins the contract, it can choose one of three methods for getting the oil from the shale. It can develop a new method for oil extraction, use an existing (inefficient) process, or subcontract the processing to a number of smaller companies once the shale has been excavated. The results from these alternatives are given as follows.

Develop new process:

Outcomes	Probability	Profit (\$ million)
Great success	0.30	600
Moderate success	0.60	300
Failure	0.10	-100

Use present process:

Outcomes	Probability	Profit (\$ million)
Great success	0.50	300
Moderate success	0.30	200
Failure	0.20	-40

Subcontract:

Outcomes	Probability	Profit (\$ million)
Moderate success	1.00	250

The cost of preparing the contract proposal is \$2 million. If the company does not make a bid, it will invest in an alternative venture with a guaranteed profit of \$30 million. Construct a sequential decision tree for this decision situation and determine whether the company should make a bid.

Answers:

- H, L, M, L, expected profit = \$57million (H), expected regret = \$15million (H), \$15million, Expected profit = \$22million (M), expected regret = \$20million (M)
- (a) Corn (b) Soyabeans (c) Corn (d) Soyabeans (e) Corn
- (a)(i) Condo (ii) Warehouse (iii) Warehouse (iv) Condo or Office
(b) EV: Condo, EOL: Condo (c) \$42000
- (a) Shopping center (b) Leasing (c) Shopping center (d) Leasing
(e) Shopping Center
- \$20800, \$10400, \$10800, Drill press
- \$1500, -\$750
Maximax = 3, Maximin = 0, Minimax Regret = 2, Hurwicz = 3, Equal likelihood = 3, EV = 2, EOL = 2
- (ii) \$50, \$51.70, \$52.95, \$53.30, \$53.05, \$52.35: 28 packs
(iii) \$4.90, \$3.10, \$1.95, \$1.60, \$1.85, \$2.55: 28 packs (iv) \$1.60
- (b) \$576.1, 35 luggage items, \$21.11
- (b) \$22.5, 26 dozens (c) \$3.1, 26 dozens (d) \$3.1
- 0.05, EV(A)=4, EV(B)=3, EV(C)=4
- 4.2 years, 3.9 years
- EV(Scheme 1) = \$4345 EV(Scheme 2) = \$4000 EV(Old Scheme) = \$3920, Decision: Old Scheme
- EV(Large) = RM283kEV(Small) = RM238.75k
Firm policy = built a large plant
- Export
- Make a bid, EV = \$114..398 million