Question 1 Decision Analysis

(a) Discuss the differences among decision making under certainty, under risk and under complete uncertainty.

(b) Bikram Shrestha is considering investing some money that he inherited. The following payoff matrix gives the profits that would be realised during the next year for each of the investments that Bikram is considering.

	Good Economy	Poor Economy
Share market	$80,000	($20,000)
Bonds	30,000	20,000
Real estate	25,000	15,000

Answer the following questions. Each answer must be supported with appropriate **calculations and/or a table of figures**, and **you must state for questions 1 to 4 which alternative would be selected**.

1 Which alternative would an optimist choose?
2 Which alternative would a pessimist choose?
3 Which alternative is indicated by the criterion of regret?
4 Assuming probability of a good economy = 0.3 using expected monetary values what is the optimum action?
5 What is the expected value of perfect information?

Answer

A) Decision making environments can be discussed under three main scenarios.
- Decision making under certainty
- Decision making under uncertainty
- Decision making under risk

Decision making under certainty

In this scenario, decision maker (DM) knows with certainly the consequences of every alternatives. Therefore DM can easily choose alternative which will maximize the benefit. However it is very difficult to get all information and knowledge to know accurately the consequences of every alternatives.

Decision making under uncertainty

In this scenario, DM does not have any knowledge of the likelihood of occurrence of the various alternatives. Decision maker need to take a decision based on selection of the "best" action. There are number of proposed criteria to select the best action.
- Maximax criterion – complete optimist approach
- Maximin criterion – complete pessimist approach

- Criterion of regret – opportunity loss approach

Selection of criterion is depend on decision maker's personal preference and attitude towards risk.

Decision making under risk

This is also referred as a partial uncertainty. Decision maker knows the probabilities of various outcomes. So DM can calculate the expected values of the different outcomes and select the highest expected value.

- Objective probabilities – probabilities based on evidences such as historical data.
- Subjective probabilities – probabilities based on DM's experience and the guess.

1.

Action	Maximum payoff
Share market	$80,000
Bonds	$30,000
Real states	$25,000

Optimistic aspects, Bikram selects to invest in share market.

2.

Action	Minimum payoff
Share market	($20,000)
Bonds	$ 20,000
Real states	$ 15,000

Pessimistic aspect, Bikram decides to invest in bonds.

3.

Action	Regret matrix	
	Good economy	Poor economy
Share market	0	$40,000
Bonds	$50,000	0
Real states	$55,000	$5,000

Maximum regret for each action

Action	Maximum regret
Share market	$ 40,000
Bonds	$ 50,000
Real states	$ 55,000

Bikram selects share market option since it is the action with the minimum maximum.

4.

	p(s1) = 0.3	p(s2) = 0.7
	Good Economy	**Poor Economy**
a1.Share market	$80,000	($20,000)
a2. Bonds	30,000	20,000
a3. Real estate	25,000	15,000

Expected monetary values

E(U|a1) = 80* 0.3 – 20*0.7 = 10
E(U|a2) = 30*0.3 + 20*0.7 = 23
E(U|a3) = 25*0.3 + 15*0.7 = 18
Largest expected monetary value is $ 23,000. So optimum action is investing on bonds.

5. Expected value of perfect information (EVPI) = Expected value with perfect information – expected value without perfect information (Maximum EMV)

   EVPI = (80* 0.3 + 20* 0.7) – 23 = 15

   $ 15,000

Question 2 Value of information

Show all calculations to support your answers. You may follow the methods shown in the mp4 on Value of info for a way to answer this question if you wish, but however you do the calculations you must specifically provide answers to the 4 questions.

DO NOT ROUND probability calculations with Round Function. You may display them to 2 decimal places if you like but do not round in memory.

Jerry is thinking about opening a bicycle shop. He can open a large shop (a1) or a small shop (a2). He believes that a large shop would earn a profit of $80,000 if the market is good (s1) but would lose $40,000 if the market is poor (s2). A small shop would return $30,000 profit in a good market and a loss of $10,000 in a poor market. Jerry believes that there is a 50-50 chance that the market will be good.

(a) What should Jerry do? Show calculations.

A friend would charge him $3,000 for some market research providing.one of two signals, that the market is favorable or unfavorable. His past record is such that 80% of the time he would correctly provide a favorable market prediction when the market is good and 60% of the time he would correctly provide an unfavorable market prediction when the market is poor.

(b) Revise the prior probabilities in light of his friend's track record.

(c) What is the posterior probability of a good market given that his friend has provided an unfavorable market prediction?

(d) What is the expected net gain or loss from engaging his friend to conduct the market research? Should his friend be engaged? Why?

Answer

	P(s1) = 0.5	P(s2) = 0.5
	Market is good (s1)	Market is poor (s2)
Large shop (a1)	$ 80,000	($40,000)
Small shop (a2)	$30,000	($10,000)

a) E(U|a1) = 80(0.5) - 40(0.5) = 20
E(U|a2) = 30(0.5) - 10(0.5) = 10

Highest expected utility is $ 20,000 for large shop. So jerry will decide to open large shop.

b)

y1 = Market is favorable
y2 = market is unfavorable

p(y1|s1) = 0.8 p(y2|s2) = 0.6
p(y2|s1)= 0.2 p(y1|s2)= 0.4

if signal y1 received

Si	p(si)	p(y1|si)	p(si,y1)	p(si|y1)
s1	0.5	0.8	0.4	**0.66**
s2	0.5	0.4	0.2	**0.33**
			p(y1) =	**0.6**

Revised prior probabilities if friend has provided a favorable market prediction (y1)

Market is good (s1) = 0.66

Market is poor (s2) = 0.33

if signal y2 received

Si	p(si)	p(y2|si)	p(si,y2)	p(si|y2)
s1	0.5	0.2	0.1	**0.25**
s2	0.5	0.6	0.3	**0.75**
			p(y1) =	**0.4**

Revised prior probabilities if friend has provided an unfavorable market prediction (y2)

Market is good (s1) = 0.25

Market is poor (s2) = 0.75

c) 0.25

d) Revised payoff matrix, if signal (y1) received

	P(s1) = 0.66	P(s2) = 0.33
	Market is good (s1)	Market is poor (s2)
Large shop (a1)	$ 80,000	($40,000)
Small shop (a2)	$30,000	($10,000)

E(U|a1,y1) = 80 * 0.66 – 40*0.33 = 39.6

E(U|a2,y1) = 30 * 0.66 – 10*0.33 = 16.5

Therefore a1 is optimal upon receiving signal y1, with a conditional expected utility of $39,600

Revised payoff matrix, if signal (y2) received

	P(s1) = 0.25	P(s2) = 0.75
	Market is good (s1)	Market is poor (s2)
Large shop (a1)	$ 80,000	($40,000)
Small shop (a2)	$30,000	($10,000)

E(U|a1,y1) = 80 * 0.25 – 40*0.75 = -10

E(U|a2,y1) = 30 * 0.25 – 10*0.75 = 0

Therefore a2 is optimal upon receiving signal y2, with a conditional expected utility of 0.

Expected utility with a friend's information

39600 *0.6 + 0 * 0.4

= $ 23,760

Expected value of sample information

23760 – 20000

= $ 3760

Net gain of conducting market research = $ 3760 - $ 3000

= $ 760

Jerry need to engage with his friend.

There is a net gain of conducting market research even though it is marginal. It helps to Jerry to open new shop with higher confidence.

Question 3 Monte Carlo Simulation

Tully Tyres sells cheap imported tyres. The manager believes its profits are in decline. You have just been hired as an analyst by the manager of Tully Tyres to investigate the expected profit over the next 12 months based on current data.

- Monthly demand varies from 100 to 200 tyres – probabilities shown in the partial section of the spreadsheet below.
- The average selling price per tyre follows a discrete uniform distribution ranging from $60 to $80 each. This means that it can take on equally likely integer values between $60 and $80 – more on this below.
- The average profit margin per tyre after covering variable costs follows a continuous uniform distribution between 20% and 30% of the selling price.
- Fixed costs per month are $1500.

(a) Using Excel set up a model to simulate the next 12 months to determine the expected average monthly profit for the year. You need to have loaded the Analysis Toolpak Add-In to your version of Excel. You must keep the data separate from the model. The model should show only formulas, no numbers whatsoever.

You can use this template to guide you:

Tully Tyres

DATA

Prob	Cum prob	Demand		Selling	Price	$60	$80
0.05		100		Monthly	Fixed cost	$1,500	
0.10		120		Profit	Margin	20%	30%
0.20		140					
0.30		160					
0.25		180					
0.10		200					
1.00							
MODEL							
			Selling		Profit	Fixed	
Month	RN 1	Demand	Price	RN 2	Margin	Costs	Profit

• The first random number (RN 1) is to simulate monthly demands for tyres.
• The average selling price follows a discrete uniform distribution and can be determined by the function =RANDBETWEEN(60,80) in this case. But of course you will not enter (60,80) but the data cell references where they are recorded.
• The second random number (RN 2) is used to help simulate the profit margin.
• The average profit margin follows a continuous uniform distribution ranging between 20% and 30% and can be determined by the formula
=0.2+(0.3-0.2)*the second random number (RN 2). Again you do not enter 0.2 and 0.3 but the data cell references where they are located. Note that if the random number is high, say 1, then 0.3-0.2 becomes 1 and when added to 0.2 it becomes 0.3. If the random number is low, say 0, then 0.3-0.2 becomes zero and the profit margin becomes 0.2.
• Add the 12 monthly profit figures and then find the average monthly profit.

Show the data and the model in two printouts: (1) the results, and (2) the formulas. Both printouts must show the grid (ie., row and column numbers) and be copied from Excel and pasted into Word. See Spreadsheet Advice in Interact Resources for guidance.

(b) Provide the average monthly profit to Tully Tyres over the 12-month period..

(c) You present your findings to the manager of Tully Tyres. He thinks that with market forces he can increase the average selling price by $20 (ie range from $80 to $100) without losing sales. However he does suggest that the profit margin would then increase to range from 22% to 32%.

He has suggested that you examine the effect of these changes and report the results to him. Change the data accordingly in your model to make the changes and paste the output in your Word answer

Then write a report to the manager explaining your conclusions with respect to his suggestions. Also mention any reservations you might have about the change in selling prices.

The report must be dated, addressed to the Manager and signed off by you.

a)

					Selling price			$60	$80
PROB	DEMAND	CUM PROB	DEMAND		monthy fixed cost			$1,500	
0.05	100	0	100		profit margin			20%	30%
0.1	120	0.05	120						
0.2	140	0.15	140						
0.3	160	0.35	160						
0.25	180	0.65	180						
0.1	200	0.9	200						
1									

MONTH	RN1	DEMAND	SELLING PRICE	RN2	PROFIT MARGIN	FIXED COST	PROFIT
1	0.4760	160	66	0.24	24%	1500	1064.072
2	0.0214	100	68	0.28	28%	1500	392.8929
3	0.9435	200	61	0.26	26%	1500	1697.257
4	0.8505	180	74	0.21	21%	1500	1328.792
5	0.9035	200	61	0.28	28%	1500	1976.406
6	0.7054	180	63	0.22	22%	1500	1021.988
7	0.5805	160	64	0.20	20%	1500	556.607
8	0.8712	180	73	0.24	24%	1500	1630.067
9	0.9880	200	71	0.27	27%	1500	2281.204
10	0.1853	140	71	0.21	21%	1500	634.6304
11	0.5309	160	61	0.21	21%	1500	509.3777
12	0.6126	160	73	0.29	29%	1500	1861.688
					Ave. monthly profit		**1246.249**

					Selling price		60	80
PROB	DEMAND	CUM PROB	DEMAND		monthy fixed cost		1500	
0.05	100	0	100		profit margin		0.2	0.3
0.1	120	=(C3+A3)	120					
0.2	140	=(C4+A4)	140					
0.3	160	=(C5+A5)	160					
0.25	180	=(C6+A6)	180					
0.1	200	=(C7+A7)	200					
=SUM(A3:A8)								

MONTH	RN1	DEMAND	SELLING PRICE	RN2	PROFIT MARGIN	FIXED COST	PROFIT
1	=RAND()	=VLOOKUP(B14,$C$3:$D$8,2)	=RANDBETWEEN(60,80)	=0.2+(0.3-0.2)*RAND()	=0.2+(0.3-0.2)*RAND()	1500	=((C14*D14)*F14)-G14
2	=RAND()	=VLOOKUP(B15,$C$3:$D$8,2)	=RANDBETWEEN(60,80)	=0.2+(0.3-0.2)*RAND()	=0.2+(0.3-0.2)*RAND()	1500	=((C15*D15)*F15)-G15
3	=RAND()	=VLOOKUP(B16,$C$3:$D$8,2)	=RANDBETWEEN(60,80)	=0.2+(0.3-0.2)*RAND()	=0.2+(0.3-0.2)*RAND()	1500	=((C16*D16)*F16)-G16
4	=RAND()	=VLOOKUP(B17,$C$3:$D$8,2)	=RANDBETWEEN(60,80)	=0.2+(0.3-0.2)*RAND()	=0.2+(0.3-0.2)*RAND()	1500	=((C17*D17)*F17)-G17
5	=RAND()	=VLOOKUP(B18,$C$3:$D$8,2)	=RANDBETWEEN(60,80)	=0.2+(0.3-0.2)*RAND()	=0.2+(0.3-0.2)*RAND()	1500	=((C18*D18)*F18)-G18
6	=RAND()	=VLOOKUP(B19,$C$3:$D$8,2)	=RANDBETWEEN(60,80)	=0.2+(0.3-0.2)*RAND()	=0.2+(0.3-0.2)*RAND()	1500	=((C19*D19)*F19)-G19
7	=RAND()	=VLOOKUP(B20,$C$3:$D$8,2)	=RANDBETWEEN(60,80)	=0.2+(0.3-0.2)*RAND()	=0.2+(0.3-0.2)*RAND()	1500	=((C20*D20)*F20)-G20
8	=RAND()	=VLOOKUP(B21,$C$3:$D$8,2)	=RANDBETWEEN(60,80)	=0.2+(0.3-0.2)*RAND()	=0.2+(0.3-0.2)*RAND()	1500	=((C21*D21)*F21)-G21
9	=RAND()	=VLOOKUP(B22,$C$3:$D$8,2)	=RANDBETWEEN(60,80)	=0.2+(0.3-0.2)*RAND()	=0.2+(0.3-0.2)*RAND()	1500	=((C22*D22)*F22)-G22
10	=RAND()	=VLOOKUP(B23,$C$3:$D$8,2)	=RANDBETWEEN(60,80)	=0.2+(0.3-0.2)*RAND()	=0.2+(0.3-0.2)*RAND()	1500	=((C23*D23)*F23)-G23
11	=RAND()	=VLOOKUP(B24,$C$3:$D$8,2)	=RANDBETWEEN(60,80)	=0.2+(0.3-0.2)*RAND()	=0.2+(0.3-0.2)*RAND()	1500	=((C24*D24)*F24)-G24
12	=RAND()	=VLOOKUP(B25,$C$3:$D$8,2)	=RANDBETWEEN(60,80)	=0.2+(0.3-0.2)*RAND()	=0.2+(0.3-0.2)*RAND()	1500	=((C25*D25)*F25)-G25
					Ave. monthly profit		**=AVERAGE(H14:H25)**

b) Ave monthly profit = **$ 1246.25**

c)

To – Manager

From – Analyst

Date – 15th Sep 2017

Subject – Ave. monthly profit of Tully tyres

Average profit margin based on revised sales price and profit margin is mentioned below table.

MONTH	RN1	DEMAND	SELLING PRICE	RN2	PROFIT MARGIN	FIXED COST	PROFIT
1	0.4760	160	95	0.30	30%	1500	3132.2801
2	0.0214	100	80	0.24	24%	1500	437.729
3	0.9435	200	100	0.26	26%	1500	3755.2017
4	0.8505	180	80	0.27	27%	1500	2436.4771
5	0.9035	200	96	0.27	27%	1500	3626.9689
6	0.7054	180	80	0.26	26%	1500	2175.2821
7	0.5805	160	85	0.26	26%	1500	1990.5418
8	0.8712	180	98	0.31	31%	1500	3927.1567
9	0.9880	200	95	0.27	27%	1500	3939.5728
10	0.1853	140	81	0.29	29%	1500	1826.8163
11	0.5309	160	82	0.25	25%	1500	1827.8973
12	0.6126	160	99	0.29	29%	1500	3101.8775
					Ave. monthly profit		**2681.4834**

According to revised data Ave. monthly profit is $ 2681.50. Compare to previous data, Ave monthly profit has been increased by 115%. So there is a significant impact to monthly profit by increasing selling price by $20.

However price increasing could be led to decrease the demand. Therefore it is better to conduct a proper market research before take a decision. As per the result of market research we can decide whether increase the selling price or not.

Best regards,

Question 4 Regression Analysis

Belinda, the accountant at Murray Manufacturing Company wants to identify cost drivers for support overhead costs. She has the impression that the staff spend a large part of their time ensuring that the equipment is correctly set up and checking the first units of production in each batch. Deborah has collected the following data for the past 12 months:

Month	OH Cost	MH	Batches
1	$80,000	2,200	300
2	40,000	2,400	120
3	63,000	2,100	250
4	45,000	2,700	160
5	44,000	2,300	200
6	48,000	3,800	170
7	65,000	3,600	260
8	46,000	1,800	160
9	33,000	3,200	150
10	66,000	2,800	210
Total	530,000	26,900	1,980

(a) Using the high-low method to estimate support overhead costs based on machine hours, what would be the estimated support overhead costs (to the nearest $) for a month in which 3,000 machine hours were used?

(b) Using Excel, perform three regression analyses to regress Overhead Cost against Machine Hours, then against Batches, then against both of them simultaneously. Paste your results into Word. State the cost equation from each. Analyse and comment on the results of each regression as you perform it and determine the best one to use as a basis for future use.

(c) If you had to settle for the results of a simple regression, which one would you use and why?

(d) Using the best regression result determine the projected Overhead Cost in a month in which there were 2000 machine hours worked and 150 batches produced.

Answer

a)

$$b = \frac{48000 - 46000}{3800 - 1800}$$

$$= 1$$

$$y = a + bx$$

$$48000 = a + (1 * 3800)$$

$$a = 44200$$

$$y = 44200 + 1 * 3000$$

$$= \textbf{\$ 47,200}$$

b) Regression – OH Cost against MH

Month	MH	OH Cost			
1	2200	80000		Correlation - OH Cost against MH	-0.10424
2	2400	40000			
3	2100	63000			
4	2700	45000			
5	2300	44000			
6	3800	48000			
7	3600	65000			
8	1800	46000			
9	3200	33000			
10	2800	66000			
Total	26900	530000			
Linest	-0.00472	2939.896		For every increase in 1 MH, OH cost will decrease by 0.00472	
	0.015906	871.4711		When MH = 0 , OH cost is 2939.896	
	0.010865	698.7572			
	0.087877	8		The accurcy or determination = r^2	0.01
				OH Cost = 2939.896-0.00472*MH	

OH Cost = 2939.896-0.00472*MH

For every increase in 1MH, OH Cost decreases by 0.00472 and when MH =0, OH Cost is 2939.896. The determination (r^2) of the regression model is 0.01 which means that only 1% of the OH cost variation can be explained by the MH. Hence, the accuracy of the model is only 1%.

Regression – OH Cost against Batches

Month	Batches	OH Cost
1	300	$80,000
2	120	40,000
3	250	63,000
4	160	45,000
5	200	44,000
6	170	48,000
7	260	65,000
8	160	46,000
9	150	33,000
10	210	66,000
Total	1,980	530,000

				Correlation	0.911766618		
	0.003544	10.1658			For every increase in 1 batch, OH cost will increase by 0.003544		
	0.000564	30.92497			When batches = 0, OH cost is 10.1658		
	0.831318	24.79606					
	39.42662	8			The accuracy or determination = r^2	0.83	
	24241.24	4918.756					
					OH Cost = 10.1658+0.003544*Batches		

OH Cost = 10.1658+0.003544*Batches

For every increase in 1 Batch, OH Cost increases by 0.003544 and when Batches =0, OH Cost is 10.1658. The determination (r^2) of the regression model is 0.83 which means that 83% of the OH cost variation can be explained by the number of batches. Hence, the accuracy of the model is 83%.

Regression – Simultaneously

Month	MH (x1)	Batches (x2)	OH Cost
1	2,200	300	$80,000
2	2,400	120	40,000
3	2,100	250	63,000
4	2,700	160	45,000
5	2,300	200	44,000
6	3,800	170	48,000
7	3,600	260	65,000
8	1,800	160	46,000
9	3,200	150	33,000
10	2,800	210	66,000
Total	26,900	1,980	530,000
	x2	x1	
	233.827453	-0.93066677	9205.658
	39.8202902	3.421799934	12704.92
	0.8330823	6783.92168	#N/A
	17.4684179	7	#N/A
	1607848846	322151153.5	#N/A

OH Cost = 9205.658-0.9306*MH+233.8274*Batches

OH Cost = 9205.658-0.9306*MH+233.8274*Batches

When it comes to the multiple regression model which considers both MH and Batches simultaneously, the determination or the accuracy of the model remains same at 83%. Hence, considering both variables will not enhance the accuracy of the regression model, rather it has increased the error of the estimation.

Therefore, as a conclusion, it can be said that the second regression model (i.e. OH Cost against Batches) would be ideal for the future predictions of the OH Cost which has a higher accuracy of 83% at a minimum error.

c)

If I had to settle for the results of the simple regression, I would definitely chose the OH Cost against Batches model because it has a higher determination (accuracy) of 83% compared to 1% accuracy of the other model. This means that 83% of variation in OH Cost can be explained by the number of batches. Hence, it's more accurate to use that model to predict the OH Cost.

d)

OH Cost = 9205.658-0.9306*MH+233.8274*Batches

= 9205.658- (0.9306*2000) + (233.8274*150)

= 9205.658 – 1861.2 + 35074.11

= 42418.568

Question 5

Show all calculations to support your answers.

A manufacturer can make two products, A and B. The following data are available:B

Product	A	B	Total
Sales price per unit	$10	$20	
Variable cost per unit	$5	$12	
Total fixed costs			$4,000

(a) Calculate the unit contribution margin for each product.
(b) This month the manufacturer will specialise in making only Product B. How many does he need to sell to break even?
(c) If they specialise in making only A what is the breakeven sales volume for the month in sales dollars?
(d) He now decides to manufacture both A and B this month in the ratio of 2 A to 1 of B.
(i) How many of each product must be sold to earn a profit of $5,000 before tax for the month?
(ii) How many of each product must be sold to earn a profit of $21,000 after tax (of 30c in the dollar) for the month?

Answer

a) product A

Unit contribution margin = $ 10 - $ 5
= **$ 5**

Product B

Unit contribution margin = $ 20 - $ 12
= **$ 8**

b) BEP = $4000/ $8
= 500 Products

c) Product A BEP = 4000/ 5
= 800
Breakeven sales = 800* 10
= **$ 8000**

d) A:B = 2:1

Average CM = 2/3 * 5 + 1/3 * 8
= 6

i. No of Products = 4000 + 5000
6
= 1500

product A = 1000

product B = 500

ii. No of products = 4000 + 21000 /(1 – 0.3)
6

= 5667

product A = 1888

product B = 3779