Rutgers University, Business School/Undergraduate New Brunswick
Operations Management (33:623:386:03)
Spring 2008; Instructor: Adi Ben-Israel

Hourly Exam 3 — April 23, 2008

You have 80 minutes to complete this examination. The exam has 12 pages (the last 2 are scratch.)

Please do not read past this page until instructed to.

Allowed materials:

- A single "cram sheet" in your own handwriting (both sides allowed)
- A dictionary (if English is not your first language)
- A calculator

You may detach any page from the exam form, in which case please write your name on each page. You must turn in all pages at the end of the exam.

Name:	
ID:	
Section No:	03

DO NOT WRITE BELOW

Q1	
Q2	
TOTAL	

Q1: Cars (50 points)

The XYZ car dealership sells two kinds of cars: sedans and vans. In 2009, a sedan will sell for $15,000 and a van for $20,000.

The number of visitors per year to the XYZ showroom is thought to follow a Poisson distribution with mean 1200. The probability that any such visitor is a potential buyer (i.e. actually wants to buy a car) is thought to be 0.25, independently of all other visitors.

The probability that a potential buyer wants a sedan is 0.6, independently of all other potential buyers. The rest of the potential buyers want a van.

XYZ can order 2009 cars from its supplier in two ways: **preorders** (placed on June 2008 at the latest) and **late orders** (placed any time after June 2008.)

XYZ is trying to determine how many 2009 cars to preorder. Cars can be preordered in multiples of 25, and XYZ would like to consider preordering 100, 125, 150, 175 or 200 sedans and 75, 100, 125 or 150 vans (20 policies altogether.)

For preorders, the basic cost of a sedan is $10,000 and of a van is $15,000.

The supplier offers XYZ incentives to preorder in the form of rebates, to be determined after the supplier gets the preorders from all the car dealerships. The rebate is the same for each preordered sedan, and is uniformly distributed between $200 and $500. Similarly, the rebate is the same for each preordered van, uniformly distributed between $500 and $1000. For example, if the rebates turn out to be $328/sedan and $753/van, and if XYZ preorders 150 sedans and 100 vans, then its total rebate is $328*150 + $753*100 = $124,500.

XYZ wants to satisfy all the demand for 2009 cars. If that demand exceeds the number of cars available, XYZ can place late orders for any number of sedans and vans at a cost of $13,000 for sedan and $18,000 for van. There is no rebate on late orders.

Any car unsold at the end of 2009 can be returned to the supplier for a salvage value of $6,000 per sedan and $9,000 per van.

XYZ used simulation in order to determine the optimal policy, and the spreadsheet is shown in p. 5. A part of the simulation report is shown in p. 6.

(a) (20 points) The spreadsheet has 8 Yasai commands (as distinguished from ordinary Excel commands). Write all of them, and the cells in which they appear. Hint: In cell B23 there is a **genBinomial** command.

(b) (20 points) Write all the Excel (non Yasai) commands in all cells below row 22.

(c) (10 points) Determine the best and the second best policy on the basis of the simulation report.

	A	B	C	D	E	F	G	H	I	J
1	Question 1				Preorder Policies					
2					Sedans	Vans				
3	Mean No. of Visitors	1200			100	75				
4	Probability that a visitor is a buyer	0.25			125	100				
5	Probability that a buyer wants a sedan	0.6			150	125				
6					175	150				
7		Sedans	Vans		200					
8	Selling Price	$15,000	$20,000							
9	Preorder Basic Cost	$10,000	$15,000							
10	Minimum Rebate	$200	$500							
11	Maximum Rebate	$500	$1,000							
12	Late Order Cost	$13,000	$18,000							
13	Salvage Value	$6,000	$9,000							
14										
15	Preorder	150	125							
16										
17	Number of Visitors	1184								
18	Number of Potential Buyers	315								
19										
20	Rebate	$455	$556							
21										
22		Sedans	Vans							
23	Demand	199	116							
24	Preorderd Cars Sold	150	116							
25	Late Orders	49	0							
26	Unsold	0	9							
27										
28	Revenue	$5,305,000			Note: The Rebates in B20:C20 have been rounded to the nearest					
29	Total Preorder Basic Cost	$3,375,000			integer, which is why the Total Rebate in B30 may not appear					
30	Total Rebate	$137,684			exactly equal to SUMPRODUCT(B20:C20,B15:C15), but it is.					
31	Net Preorder Cost	$3,237,316								
32	Total Late Orders Cost	$637,000								
33	Total Salvage Value	$81,000								
34	Profit	$1,511,684								

	A	B	C	D	E
10					
11		**Parameter**			
12	**Scenario**	Preorder Sedans	Preorder Vans		
13	1	100	75		
14	2	100	100		
15	3	100	125		
16	4	100	150		
17	5	125	75		
18	6	125	100		
19	7	125	125		
20	8	125	150		
21	9	150	75		
22	10	150	100		
23	11	150	125		
24	12	150	150		
25	13	175	75		
26	14	175	100		
27	15	175	125		
28	16	175	150		
29	17	200	75		
30	18	200	100		
31	19	200	125		
32	20	200	150		
33					
34	**Output Name**	**Scenario**	**Observations**	**Mean**	**Standard Deviation**
35	Profit	1	1000	1216739.118	35686.146
36	Profit	2	1000	1309672.444	38129.814
37	Profit	3	1000	1338525.771	92135.202
38	Profit	4	1000	1227834.098	120627.703
39	Profit	5	1000	1300560.402	36256.242
40	Profit	6	1000	1393493.729	38673.890
41	Profit	7	1000	1422347.056	92376.647
42	Profit	8	1000	1311655.382	120822.557
43	Profit	9	1000	1383996.687	38011.407
44	Profit	10	1000	1476930.013	40325.408
45	Profit	11	1000	1505783.340	93047.687
46	Profit	12	1000	1395091.667	121328.184
47	Profit	13	1000	1446894.971	67926.350
48	Profit	14	1000	1539828.298	69212.356
49	Profit	15	1000	1568681.624	108069.778
50	Profit	16	1000	1457989.951	132421.559
51	Profit	17	1000	1410925.256	115461.441
52	Profit	18	1000	1503858.582	116325.396
53	Profit	19	1000	1532711.909	141938.226
54	Profit	20	1000	1422020.236	160316.786
55					

Q2. Financial Planning (50 points). John Smith, a successful graduate of the Rutgers Business School, has $1,250,000, of which $800,000 are in **Safe Assets**, and $450,000 are invested in **Risky Assets** (such as stocks). He needs a plan to manage his assets for the next 20 years.

The **annual rate of return** of the Safe Assets is known only to be at least 3% and at most 5%. The annual rate of return of the Risky Assets is assumed to be normally distributed with mean 8% and standard deviation 2.3%.

At the end of each year, after the annual returns have been added to the assets, Smith needs to withdraw money from both assets in order to support his lavish life style. His options are to withdraw 4%, 5%, 6% or 7% of the Safe Assets, and $25,000, $30,000 or $35,000 from the Risky Assets (a total of 12 scenarios.) He would like each year to withdraw from both assets at least $68,000 (the **Target**), but this is not always guaranteed.

You have been hired as Smith's financial adviser, and remembering what you learned in **Operations Management**, you ran a simulation of the next 20 years, for each scenario, using the spread sheet in p. 9, and received the simulation report partly reproduced in p. 10.

Smith would like to know for each scenario, (1) the total sum of withdrawals (in the 20 years period), (2) the combined assets at the end of the period (i.e. the end of year 20), and (3) the probability of meeting the $68,000 target in each year.

(a) What commands are in cells F12 and G12, to select a scenario of withdrawing from both assets.

(b) The command in B21 is **=B4**, and is copied to C21. Write the remaining commands in D21:I21, that give the correct results when copied to the 23 rows below.

(c) What commands are in B22:C22, that give the correct results when copied to the 22 rows below.

(d) The target of $68,000 appears in cell G16. Cells J21:J40 report, for each year, whether the target has been met. What command is in cell J21 that is copied correctly to J22:J40.

(e) How many **simOutput** commands are in the spread sheet? Where and what are they? Hint: The probability of meeting the target is estimated by the average of J21:J40.

(f) Using the simulation output in p. 10, and considering the criteria of (1) total withdrawals, (2) ending assets, and (3) probability of meeting the target, which scenario would you recommend? Explain your choice (there is no single "correct" answer, but only well-reasoned answers will be credited.)

Problem 2: Financial Planning

	Safe Assets	Risky Assets	Total
Initial Funds	$800,000	$450,000	$1,250,000
Annual Return			
Min	3%	8%	Mean
Max	5%	2.3%	Standard Deviation

Withdrawal Scenarios	Percentage	Dollars
	4%	$25,000
	5%	$30,000
	6%	$35,000
	7%	

Withdraw From	
Safe Assets	Risky Assets
7%	$35,000

			Total
Sum of withdrawals	$854,029	$700,000	$1,554,029
Ending Funds	$427,017	$502,362	$929,379

	Target
	$68,000
Probability of Meeting	0.85

	Beginning Funds		Annual Return		Ending Funds		Withdrawals From		Target
Year	Safe Assets	Risky Assets	Safe Assets	Risky Assets	Safe Assets	Risky Assets	Safe Assets	Risky Assets	Met?
1	800,000	450,000	$26,938	$49,198	$826,938	$499,198	$57,886	$35,000	1
2	$769,052.02	$464,198	$29,362	$23,710	$798,414	$487,908	$55,889	$35,000	1
3	$742,525.30	$452,908	$30,941	$34,315	$773,466	$487,223	$54,143	$35,000	1
4	$719,323.28	$452,223	$24,023	$33,634	$743,346	$485,858	$52,034	$35,000	1
5	$691,312.23	$450,858	$29,793	$39,599	$721,105	$490,457	$50,477	$35,000	1
16	$471,818.07	$436,618	$17,685	$53,715	$489,503	$490,333	$34,265	$35,000	1
17	$455,237.70	$455,333	$20,851	$52,505	$476,089	$507,838	$33,326	$35,000	1
18	$442,762.60	$472,838	$17,998	$27,231	$460,761	$500,069	$32,253	$35,000	0
19	$428,507.45	$465,069	$14,753	$33,152	$443,261	$498,221	$31,028	$35,000	0
20	$412,232.29	$463,221	$14,785	$39,141	$427,017	$502,362	$29,891	$35,000	0
						Sum	$854,029	$700,000	

	A	B	C	D	E
10					
11		**Parameter**			
12	**Scenario**	Withdraw from Risky Assets	Withdraw from Safe Assets		
13	1	$25,000.00	0.04		
14	2	$30,000.00	0.04		
15	3	$35,000.00	0.04		
16	4	$25,000.00	0.05		
17	5	$30,000.00	0.05		
18	6	$35,000.00	0.05		
19	7	$25,000.00	0.06		
20	8	$30,000.00	0.06		
21	9	$35,000.00	0.06		
22	10	$25,000.00	0.07		
23	11	$30,000.00	0.07		
24	12	$35,000.00	0.07		
25					
26	**Output Name**	**Scenario**	**Observations**	**Mean**	**Standard Deviation**
27	Ending Funds	1	1000	1789451.934	138902.564
28	Ending Funds	2	1000	1564955.289	128031.515
29	Ending Funds	3	1000	1340458.643	117969.375
30	Ending Funds	4	1000	1643861.956	138442.663
31	Ending Funds	5	1000	1419365.310	127527.632
32	Ending Funds	6	1000	1194868.665	117417.123
33	Ending Funds	7	1000	1523398.240	138135.677
34	Ending Funds	8	1000	1298901.595	127190.334
35	Ending Funds	9	1000	1074404.949	117046.379
36	Ending Funds	10	1000	1423925.056	137932.731
37	Ending Funds	11	1000	1199428.410	126966.609
38	Ending Funds	12	1000	974931.765	116799.656
39	Probability of Meeting Target	1	1000	0.000	0.000
40	Probability of Meeting Target	2	1000	0.000	0.000
41	Probability of Meeting Target	3	1000	0.417	0.312
42	Probability of Meeting Target	4	1000	0.000	0.000
43	Probability of Meeting Target	5	1000	0.406	0.073
44	Probability of Meeting Target	6	1000	0.952	0.064
45	Probability of Meeting Target	7	1000	0.357	0.039
46	Probability of Meeting Target	8	1000	0.629	0.048
47	Probability of Meeting Target	9	1000	0.935	0.050
48	Probability of Meeting Target	10	1000	0.481	0.031
49	Probability of Meeting Target	11	1000	0.666	0.034
50	Probability of Meeting Target	12	1000	0.877	0.039
51	Total Withdrawals	1	1000	1155705.431	9883.595
52	Total Withdrawals	2	1000	1255705.431	9883.595
53	Total Withdrawals	3	1000	1355705.431	9883.595
54	Total Withdrawals	4	1000	1243789.393	10936.923
55	Total Withdrawals	5	1000	1343789.393	10936.923
56	Total Withdrawals	6	1000	1443789.393	10936.923
57	Total Withdrawals	7	1000	1312118.031	11641.709
58	Total Withdrawals	8	1000	1412118.031	11641.709
59	Total Withdrawals	9	1000	1512118.031	11641.709
60	Total Withdrawals	10	1000	1364451.419	12073.737
61	Total Withdrawals	11	1000	1464451.419	12073.737
62	Total Withdrawals	12	1000	1564451.419	12073.737

End