Master of Management Analytics Toronto

Course Number: MMA 2025S
Course Name: MMA 861: Analytical Decision Making

Assignment Name: Assignment 2 Individual
Due Date: July 6, 2024 9am

Team Name: Team Gordon

Student Name	Student Number
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Order of files:

Filename	Pages	Comments and/or Instructions
MMA861Assignment2Individual		

Additional Comments:

Question 2

To minimize costs to approximately $195.89 by proposing to lease out 5 water treatment devices. This analysis was done by optimizing the number of water treatment devices we lease to minimize cost. The decision involves choosing whether to lease 4, 5, 6, or 7 devices. Selecting the appropriate number of devices will help reduce the cost of unprocessed wastewater, which is 10.5 cents per gallon, as well as the leasing cost for each treatment device, which is $33.40.

To minimize cost, we will choose simulation 2, which will be for 5 water treatment devices. This will minimize cost to about $195.89. This was done using @RISK we used 1000 iterations and 4 simulations to find lowest mean total cost. Considering the costs per device, unprocessed water cost and treatment device limitations.

Technical Analysis

1. **Decisions:**
   - 4 Decisions
     - n (number of devices to lease) = 4,5,6,7
     - number of units leased = risksimtable(integer)

     risksimtable(n)

   1. Unit occupancy
   Riskbinomial(143,0.87)

   2. Amount of Waste Water Produced by Unit
   RiskNormal(Units Occupied*22.3,19.2*SQRT(22.3)) We are scaling the variance and mean over the total amount of units.

   3. Processing Limit
   risksimtable(n)*500

   4. Excess Waste Water Not Treated
   max(0, Amount of Waste Water Produced by Unit - Processing Limit)

   5. Lease Cost
   Number of units leased * 33.40

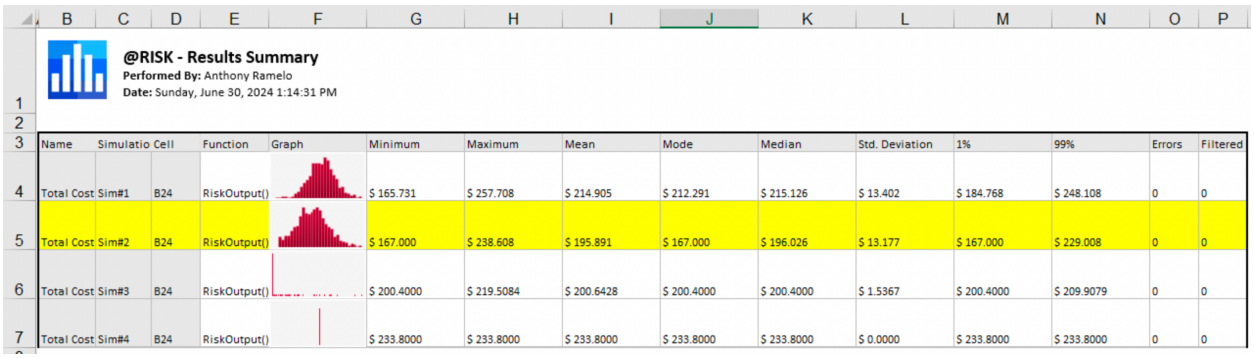
   6. Pollution Cost
   Excess Waste Water Not Treated * 0.105

KPI Tracking

Total Cost = RiskOutput() +Lease Cost + Pollution Cost

	A	B	C	D	E
1	**Problem 2 (Individual): Wastewater Problem**				
2					
3					
4					
5	Number of Time Share Condo	143			**Number of Leasing Treatment Devices**
6	Chance of Being occupied	87%			4
7					5
8	Mean (Gallons)	22.3			6
9	SD (Gallons)	19.2			7
10					
11	Cost Per day	$ 33.40		Device Leased	4
12	Process Waste Water Gallons (Up to)	500		Processing Limit	2000
13	Pollution Fee for ea. Gallon we Pass from Proccess Water	0.105			
14					
15					
16					
17	Units Being Occupied	124			
18	Amount of Water Produced	2765.20			
19	Excess	765.20			
20					
21					
22	Leased Cost	$ 133.60			
23	Excess Cost	$ 80.35			
24	Total Cost	$ 213.95			

	A	B	C	D	E
1	**Problem 2 (Individual): Wastewater Problem**				
2					
3					
4					
5	Number of Time Share Condo	143			**r of Leasing Treatment**
6	Chance of Being occupied	0.87			4
7					5
8	Mean (Gallons)	22.3			6
9	SD (Gallons)	19.2			7
10					
11	Cost Per day	33.4		Device Leased	=RiskSimtable(E6:E9)
12	Process Waste Water Gallons (Up to)	500		Processing Limit	=B12*E11
13	Pollution Fee for ea. Gallon we Pass from Proccess Water	0.105			
14					
15					
16					
17	Units Being Occupied	=RiskBinomial(B5,B6)			
18	Amount of Water Produced	=RiskNormal(B17*B8,B9*SQRT(B8))			
19	Excess	=MAX(0,(B18-E12))			
20					
21					
22	Leased Cost	=E11*B11			
23	Excess Cost	=B19*B13			
24	Total Cost	=RiskOutput()+B22+B23			



@RISK - Results Summary
Performed By: Anthony Ramelo
Date: Sunday, June 30, 2024 1:14:31 PM

Name	Simulatio	Cell	Function	Graph	Minimum	Maximum	Mean	Mode	Median	Std. Deviation	1%	99%	Errors	Filtered
Total Cost	Sim#1	B24	RiskOutput()		$ 165.731	$ 257.708	$ 214.905	$ 212.291	$ 215.126	$ 13.402	$ 184.768	$ 248.108	0	0
Total Cost	Sim#2	B24	RiskOutput()		$ 167.000	$ 238.608	$ 195.891	$ 167.000	$ 196.026	$ 13.177	$ 167.000	$ 229.008	0	0
Total Cost	Sim#3	B24	RiskOutput()		$ 200.4000	$ 219.5084	$ 200.6428	$ 200.4000	$ 200.4000	$ 1.5367	$ 200.4000	$ 209.9079	0	0
Total Cost	Sim#4	B24	RiskOutput()		$ 233.8000	$ 233.8000	$ 233.8000	$ 233.8000	$ 233.8000	$ 0.0000	$ 233.8000	$ 233.8000	0	0

Question 4

We plan to maximize profit by around $37,788.44 by proposing to replace the heating casts after 5 days of use. This will be done by choosing the optimal amount days when the cast should be replaced over a 60-day period.

In our analysis, we will also be looking at the cost to replace the heating cast after 5 days of use (regulation) or if it breaks by itself due to integrity. As well as the cost of the cast if we are not using it during the day.

By using the @RISK add-in on Excel to find the optimal number of days to maximize profit, we can simulate the 5 days. Replacing the cast after 5 days of use gave us the highest profit of $37,788.44.

When looking at the output from @RISK, over the 60 day period we were see that queue exceeding over 10 was at an average of 1.59.

Technical Analysis:

1. **Decisions:**
   - 4 Decisions
     - d (number of days) = 1,2,3,4,5
     - number of days = risksimtable(integer)

   1. **Scheduled Replacement (Binary)** = IF(age of cast > riskinstable({1,2,3,4,5}), 1, 0)

   2. **Unscheduled Failure Replacement (Binary)**
      RiskBinomial(1, vlookup(age of cast, Chance of Failure))

   3. **Casts Received/ Beginning Inventory**
      =IF(RiskPoisson(4.1)

   4. **Casts Processed**
      =IF(Unscheduled Failure Replacement =1,0,5)

   5. **Ending Inventory**
      =MAX(Beginning Inventory - Casts Processed,0)

KPI we are tacking

1. **Profit**
   Revenue = Number of casts completed * $200.00

Waiting Cost = Queue * $40.00
Replacement Cost
Scheduled = Scheduled Replacement * $800.00
Un-Scheduled = Un-Scheduled Replacement * $1500.00

Profit = RiskOutput() + Revenue–(Waiting Cost + Replacement Scheduled Cost + Replacement Un-Scheduled Cost)

2. Queue over 10

$$\sum_{i=1}^{60} \text{if}(\text{Number in Queue before start of day } > 10, 1, 0)$$

Problem 4 (Individual): Heating Element Problem

Replace Cast After	5
Mean Casting for Treatment	4.1
Cost Replacing Heat (working)	$ 800
Cost Replacing Heat (Not Working)	$ 1,500
Cost Cast Waiting	$ 40
Revenue from Finishing Casting per Cast	$ 200.00

Day of Use	Chance of Cast Failure
1	1%
2	7%
3	9%
4	15%
5	25%

Replacement Days	1
Queue Over 10	0

Total Cast Waiting Cost	$ -
Total Replacement Cost	$ 24,000
Revenue	$ 60,000.00
Profit	$ 36,000.00

Day	Scheduled Replace? Binary	Day of Use	Chance Cast Fails	UnScheduled Replace? Binary	Number of Castings Received	Cast Processed	Beginning Inventory	Ending Inventory	Cast Waiting Costs	Replacement Costs	Daily Revenue	Queue Over 10
1	0	1	1%	0	4	5	4	0	$ -	$ -	$ 1,000.00	0
2	1	2	7%	0	4	5	4	0	$ -	$ 800	$ 1,000.00	0
3	0	1	1%	0	4	5	4	0	$ -	$ -	$ 1,000.00	0
4	1	2	7%	0	4	5	4	0	$ -	$ 800	$ 1,000.00	0
5	0	1	1%	0	4	5	4	0	$ -	$ -	$ 1,000.00	0
6	1	2	7%	0	4	5	4	0	$ -	$ 800	$ 1,000.00	0
7	0	1	1%	0	4	5	4	0	$ -	$ -	$ 1,000.00	0
8	1	2	7%	0	4	5	4	0	$ -	$ 800	$ 1,000.00	0
9	0	1	1%	0	4	5	4	0	$ -	$ -	$ 1,000.00	0
10	1	2	7%	0	4	5	4	0	$ -	$ 800	$ 1,000.00	0
50	1	2	7%	0	4	5	4	0	$ -	$ 800	$ 1,000.00	0
51	0	1	1%	0	4	5	4	0	$ -	$ -	$ 1,000.00	0
52	1	2	7%	0	4	5	4	0	$ -	$ 800	$ 1,000.00	0
53	0	1	1%	0	4	5	4	0	$ -	$ -	$ 1,000.00	0
54	1	2	7%	0	4	5	4	0	$ -	$ 800	$ 1,000.00	0
55	0	1	1%	0	4	5	4	0	$ -	$ -	$ 1,000.00	0
56	1	2	7%	0	4	5	4	0	$ -	$ 800	$ 1,000.00	0
57	0	1	1%	0	4	5	4	0	$ -	$ -	$ 1,000.00	0
58	1	2	7%	0	4	5	4	0	$ -	$ 800	$ 1,000.00	0
59	0	1	1%	0	4	5	4	0	$ -	$ -	$ 1,000.00	0
60	1	2	7%	0	4	5	4	0	$ -	$ 800	$ 1,000.00	0

Problem 4 (Individual): Heating Ele

Replace Cast After	5
Mean Casting for Treatment	4.1
Cost Replacing Heat (working)	800
Cost Replacing Heat (Not Working)	1500
Cost Cast Waiting	40
Revenue from Finishing Casting per Cast	200

Day of Use	Chance of Cast Failure
1	0.01
2	0.07
3	0.09
4	0.15
5	0.25

Replacement Days	=RiskSimtable(E4:E8)
Queue Over 10	=RiskOutput("Queue Over 10")+SUM(M22

Total Cast Waiting Cost	=SUM(J22:J81)
Total Replacement Cost	=SUM(K22:K81)
Revenue	=SUM(L22:L81)
Profit	=RiskOutput("Profit")+B15-(B13+B14)

Day	Scheduled Replace? Binary	Day of Use	Chance Cast Fails	UnScheduled Replace? Binary	Number of Castings Received	Cast Processed	Beginning Inventory	Ending Inventory	Cast Waiting Costs	Replacement Costs	Daily Revenue	Queue Over 10
1	=IF(OR(C22>F$10,C22<B$3),1,0)	1	=VLOOKUP(C22,$E$4:$F$8,2)	=RiskBinomial(1,D22)	=RiskPoisson(B$4)	=IF(E22>10,5)	=F22	=MAX(H22-G22,0)	=M22*B$8	=B22*B$6+(E22*B$7)	=G22*B$9	=IF(I22>10,1,0)
2	=IF(OR(C23>F$10,C23<B$3),1,0)	=IF(OR(B22=1,E22>1),LC22+1)	=VLOOKUP(C23,$E$4:$F$8,2)	=RiskBinomial(1,D23)	=RiskPoisson(B$4)	=IF(E23>10,5)	=F23	=MAX(H23-G23,0)	=M23*B$8	=B23*B$6+(E23*B$7)	=G23*B$9	=IF(I23>10,1,0)
3	=IF(OR(C24>F$10,C24<B$3),1,0)	=IF(OR(B23=1,E23>1),LC23+1)	=VLOOKUP(C24,$E$4:$F$8,2)	=RiskBinomial(1,D24)	=RiskPoisson(B$4)	=IF(E24>10,5)	=F24	=MAX(H24-G24,0)	=M24*B$8	=B24*B$6+(E24*B$7)	=G24*B$9	=IF(I24>10,1,0)
4	=IF(OR(C25>F$10,C25<B$3),1,0)	=IF(OR(B24=1,E24>1),LC24+1)	=VLOOKUP(C25,$E$4:$F$8,2)	=RiskBinomial(1,D25)	=RiskPoisson(B$4)	=IF(E25>10,5)	=F25	=MAX(H25-G25,0)	=M25*B$8	=B25*B$6+(E25*B$7)	=G25*B$9	=IF(I25>10,1,0)
5	=IF(OR(C26>F$10,C26<B$3),1,0)	=IF(OR(B25=1,E25>1),LC25+1)	=VLOOKUP(C26,$E$4:$F$8,2)	=RiskBinomial(1,D26)	=RiskPoisson(B$4)	=IF(E26>10,5)	=F26	=MAX(H26-G26,0)	=M26*B$8	=B26*B$6+(E26*B$7)	=G26*B$9	=IF(I26>10,1,0)
6	=IF(OR(C27>F$10,C27<B$3),1,0)	=IF(OR(B26=1,E26>1),LC26+1)	=VLOOKUP(C27,$E$4:$F$8,2)	=RiskBinomial(1,D27)	=RiskPoisson(B$4)	=IF(E27>10,5)	=F27	=MAX(H27-G27,0)	=M27*B$8	=B27*B$6+(E27*B$7)	=G27*B$9	=IF(I27>10,1,0)
7	=IF(OR(C28>F$10,C28<B$3),1,0)	=IF(OR(B27=1,E27>1),LC27+1)	=VLOOKUP(C28,$E$4:$F$8,2)	=RiskBinomial(1,D28)	=RiskPoisson(B$4)	=IF(E28>10,5)	=F28	=MAX(H28-G28,0)	=M28*B$8	=B28*B$6+(E28*B$7)	=G28*B$9	=IF(I28>10,1,0)
8	=IF(OR(C29>F$10,C29<B$3),1,0)	=IF(OR(B28=1,E28>1),LC28+1)	=VLOOKUP(C29,$E$4:$F$8,2)	=RiskBinomial(1,D29)	=RiskPoisson(B$4)	=IF(E29>10,5)	=F29	=MAX(H29-G29,0)	=M29*B$8	=B29*B$6+(E29*B$7)	=G29*B$9	=IF(I29>10,1,0)
9	=IF(OR(C30>F$10,C30<B$3),1,0)	=IF(OR(B29=1,E29>1),LC29+1)	=VLOOKUP(C30,$E$4:$F$8,2)	=RiskBinomial(1,D30)	=RiskPoisson(B$4)	=IF(E30>10,5)	=F30	=MAX(H30-G30,0)	=M30*B$8	=B30*B$6+(E30*B$7)	=G30*B$9	=IF(I30>10,1,0)
10	=IF(OR(C31>F$10,C31<B$3),1,0)	=IF(OR(B30=1,E30>1),LC30+1)	=VLOOKUP(C31,$E$4:$F$8,2)	=RiskBinomial(1,D31)	=RiskPoisson(B$4)	=IF(E31>10,5)	=F31	=MAX(H31-G31,0)	=M31*B$8	=B31*B$6+(E31*B$7)	=G31*B$9	=IF(I31>10,1,0)
50	=IF(OR(C71>F$10,C71<B$3),1,0)	=IF(OR(B70=1,E70>1),LC70+1)	=VLOOKUP(C71,$E$4:$F$8,2)	=RiskBinomial(1,D71)	=RiskPoisson(B$4)	=IF(E71>10,5)	=F71	=MAX(H71-G71,0)	=M71*B$8	=B71*B$6+(E71*B$7)	=G71*B$9	=IF(I71>10,1,0)
51	=IF(OR(C72>F$10,C72<B$3),1,0)	=IF(OR(B71=1,E71>1),LC71+1)	=VLOOKUP(C72,$E$4:$F$8,2)	=RiskBinomial(1,D72)	=RiskPoisson(B$4)	=IF(E72>10,5)	=F72	=MAX(H72-G72,0)	=M72*B$8	=B72*B$6+(E72*B$7)	=G72*B$9	=IF(I72>10,1,0)
52	=IF(OR(C73>F$10,C73<B$3),1,0)	=IF(OR(B72=1,E72>1),LC72+1)	=VLOOKUP(C73,$E$4:$F$8,2)	=RiskBinomial(1,D73)	=RiskPoisson(B$4)	=IF(E73>10,5)	=F73	=MAX(H73-G73,0)	=M73*B$8	=B73*B$6+(E73*B$7)	=G73*B$9	=IF(I73>10,1,0)
53	=IF(OR(C74>F$10,C74<B$3),1,0)	=IF(OR(B73=1,E73>1),LC73+1)	=VLOOKUP(C74,$E$4:$F$8,2)	=RiskBinomial(1,D74)	=RiskPoisson(B$4)	=IF(E74>10,5)	=F74	=MAX(H74-G74,0)	=M74*B$8	=B74*B$6+(E74*B$7)	=G74*B$9	=IF(I74>10,1,0)
54	=IF(OR(C75>F$10,C75<B$3),1,0)	=IF(OR(B74=1,E74>1),LC74+1)	=VLOOKUP(C75,$E$4:$F$8,2)	=RiskBinomial(1,D75)	=RiskPoisson(B$4)	=IF(E75>10,5)	=F75	=MAX(H75-G75,0)	=M75*B$8	=B75*B$6+(E75*B$7)	=G75*B$9	=IF(I75>10,1,0)
55	=IF(OR(C76>F$10,C76<B$3),1,0)	=IF(OR(B75=1,E75>1),LC75+1)	=VLOOKUP(C76,$E$4:$F$8,2)	=RiskBinomial(1,D76)	=RiskPoisson(B$4)	=IF(E76>10,5)	=F76	=MAX(H76-G76,0)	=M76*B$8	=B76*B$6+(E76*B$7)	=G76*B$9	=IF(I76>10,1,0)
56	=IF(OR(C77>F$10,C77<B$3),1,0)	=IF(OR(B76=1,E76>1),LC76+1)	=VLOOKUP(C77,$E$4:$F$8,2)	=RiskBinomial(1,D77)	=RiskPoisson(B$4)	=IF(E77>10,5)	=F77	=MAX(H77-G77,0)	=M77*B$8	=B77*B$6+(E77*B$7)	=G77*B$9	=IF(I77>10,1,0)
57	=IF(OR(C78>F$10,C78<B$3),1,0)	=IF(OR(B77=1,E77>1),LC77+1)	=VLOOKUP(C78,$E$4:$F$8,2)	=RiskBinomial(1,D78)	=RiskPoisson(B$4)	=IF(E78>10,5)	=F78	=MAX(H78-G78,0)	=M78*B$8	=B78*B$6+(E78*B$7)	=G78*B$9	=IF(I78>10,1,0)
58	=IF(OR(C79>F$10,C79<B$3),1,0)	=IF(OR(B78=1,E78>1),LC78+1)	=VLOOKUP(C79,$E$4:$F$8,2)	=RiskBinomial(1,D79)	=RiskPoisson(B$4)	=IF(E79>10,5)	=F79	=MAX(H79-G79,0)	=M79*B$8	=B79*B$6+(E79*B$7)	=G79*B$9	=IF(I79>10,1,0)
59	=IF(OR(C80>F$10,C80<B$3),1,0)	=IF(OR(B79=1,E79>1),LC79+1)	=VLOOKUP(C80,$E$4:$F$8,2)	=RiskBinomial(1,D80)	=RiskPoisson(B$4)	=IF(E80>10,5)	=F80	=MAX(H80-G80,0)	=M80*B$8	=B80*B$6+(E80*B$7)	=G80*B$9	=IF(I80>10,1,0)
60	=IF(OR(C81>F$10,C81<B$3),1,0)	=IF(OR(B80=1,E80>1),LC80+1)	=VLOOKUP(C81,$E$4:$F$8,2)	=RiskBinomial(1,D81)	=RiskPoisson(B$4)	=IF(E81>10,5)	=F81	=MAX(H81-G81,0)	=M81*B$8	=B81*B$6+(E81*B$7)	=G81*B$9	=IF(I81>10,1,0)

@RISK - Results Summary

Performed By: Anthony Ramelo
Date: Friday, July 5, 2024 6:36:03 PM

Name	Simulation	Cell	Function	Graph	Minimum	Maximum	Mean	Mode	Median	Std. Deviation	1%	99%	Errors	Filtered
Queue Over 10	Sim#1	F12	RiskOutput("Queue Over 10"		0.0000	1.0000	0.0120	0.0000	0.0000	0.1090	0.0000	1.0000	0	0
Queue Over 10	Sim#2	F12	RiskOutput("Queue Over 10"		0.0000	1.0000	0.0140	0.0000	0.0000	0.1176	0.0000	1.0000	0	0
Queue Over 10	Sim#3	F12	RiskOutput("Queue Over 10"		0.0000	1.0000	0.0200	0.0000	0.0000	0.1401	0.0000	1.0000	0	0
Queue Over 10	Sim#4	F12	RiskOutput("Queue Over 10"		0.0000	2.0000	0.0280	0.0000	0.0000	0.1769	0.0000	1.0000	0	0
Queue Over 10	Sim#5	F12	RiskOutput("Queue Over 10"		0.0000	2.0000	0.0240	0.0000	0.0000	0.1658	0.0000	1.0000	0	0
Profit	Sim#1	B16	RiskOutput("Profit")		$ 13500.00	$ 36000.00	$ 30316.12	$ 31000.00	$ 31000.00	$ 3675.52	$ 19300.00	$ 36000.00	0	0
Profit	Sim#2	B16	RiskOutput("Profit")		$ 23000.00	$ 44000.00	$ 36921.84	$ 39800.00	$ 37300.00	$ 3895.69	$ 26400.00	$ 44000.00	0	0
Profit	Sim#3	B16	RiskOutput("Profit")		$ 18700.00	$ 48000.00	$ 38177.80	$ 41300.00	$ 38800.00	$ 4201.32	$ 26200.00	$ 46300.00	0	0
Profit	Sim#4	B16	RiskOutput("Profit")		$ 21900.00	$ 48700.00	$ 37216.68	$ 39500.00	$ 37800.00	$ 4588.53	$ 24400.00	$ 46200.00	0	0
Profit	Sim#5	B16	RiskOutput("Profit")		$ 21800.00	$ 48600.00	$ 37448.44	$ 37700.00	$ 37700.00	$ 4361.95	$ 26000.00	$ 46100.00	0	0