SysEng 6103 Systems Life Cycle Costing - Summer 2020
Final Exam
Assigned: July 22, 2020 **Due:** July 29, 2020 until midnight CST

Remark 1: This is an individual exam, no collaboration is allowed.

Remark 2: Please show all your work and reasoning, as partial credit may be given for certain problems for legible, but inaccurate work. If I cannot easily decipher your work, it will be marked wrong.

Remark 3: The total of 100 points are distributed as shown in brackets before the questions.

Question:	1	2	3	Total
Points:	40	35	25	100

Submission Guidelines

- Submissions should be in **PDF** file format for some questions/parts, and in Microsoft Excel file format for others (indicated on the question/part line in bold letters). Both files (1 pdf, 1 Excel file with multiple sheets for each relevant question and part) should be submitted through Canvas, before the due date and time.
- Filenames should start with the course code, your own name and a reference to the assignment, such as "SysEng6103_Doe_Jane_FinalExam..."
- Use 1 Excel sheet per 1 exercise, and label sheet tabs with: Exercise#, and highlight answers in the sheet.

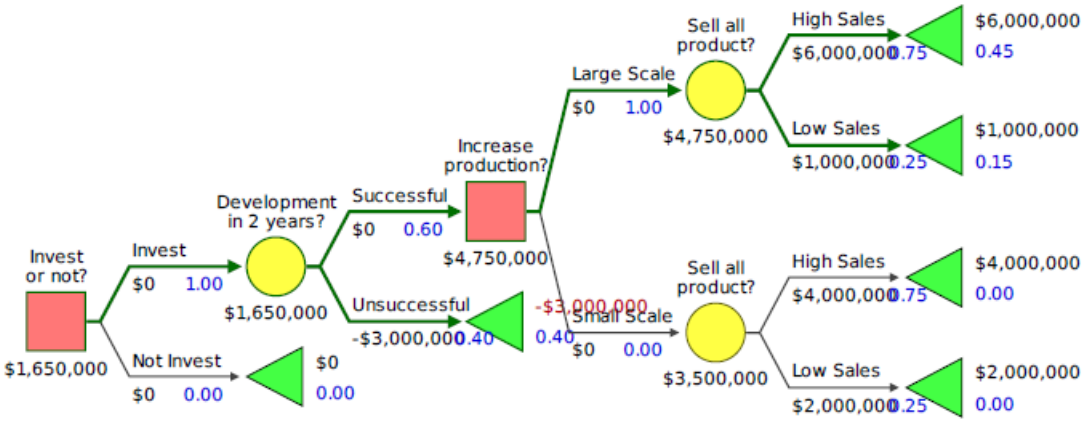
1. [40 points]
[Submit in the PDF file. Use SilverDecisions package (see http://silverdecisions.pl/ and include a snap-shot of the tree diagram in the PDF file. You need to make sure that you label every node and every branch appropriately so that one can understand and read your tree without referring to the text. Also, you need to explain the conclusion, i.e., the whole path of decision(s) together with chance events that may occur.]

A company has to decide whether to invest money in the development of a microbiological product. The company's research director has estimated that there is a 60% chance that a successful development could be achieved in two years. However, if the product had not been successfully developed at the end of this period, the company would abandon the project, which would lead to a loss in present value terms of $3 million.

In the event of a successful development, a decision would have to be made on the scale of production. The returns generated would depend on the level of sales which could be achieved over the period of the product's life. For simplicity, these have been categorized as either high or low.

- If the company opted for large-volume production and high sales were achieved then net returns with a present value of $6 million would be obtained. However, large-scale production followed by low sales would lead to net returns with a present value of only $1 million.
- On the other hand, if the company decided to invest only in small-scale production facilities then high sales would generate net returns with a present value of $4 million and low sales would generate net returns with a present value of $2 million.

The company's marketing manager estimates that there is a 75% chance that high sales could be achieved. Assuming that the company's objective is to maximize its expected returns, determine the policy that it should adopt using a decision tree.



Solution/Explanation:

Each decision alternative, chance node, can be evaluated for its expected monetary value.

The expected monetary value of each decision node = max(EMV)

1, 2, and 4 represent chance nodes in the tree (1 – sell all product at large scale, 2- sell all product at small scale, 4 – Development in 2 years?); 3 and 5 represent decision nodes (3 – Increase production?, 5 – Invest or not?).

EV(1) = $6,000,000(0.75) + $1,000,000(0.25) = $4,750,000

EV(2) = $4,000,000(0,75) + $2,000,000(0.25) = $3,500,000

The decision that gives the max value is chosen at decision node 3:

EV(3) = max(EMV) = max{4,750,000, 3,500,000} = $4,750,000

EV(4) = $4,750,000(0,6) + (-3,000,000)(0,4) = $1,650,000

EV(5) = Max{1,650,000, 0} = $1,650,000

THEREFORE, we would invest in this project because it gives an EMV of $1,650,000 as seen in the decision tree.

2. [35 points]

[Please submit both parts in the PDF file only.]

(a) [25 points] [Do hand solution and submit the required table (see the question) in the PDF file only. Remark: You need to show all your work in a concise manner in the table, not outside.]

You have been asked to estimate the per unit selling price of a new line of products. Pertinent data are as follows:

Direct labor rate	$15/hr
Raw material	$375,000 per 100 products
Factory overhead	125% of direct labor
Packaging costs	75% of direct labor
Desired profit	20% of total manufacturing cost

Past experience has shown that an 80% learning curve applies to the labor required for production. The time to complete the first unit has been estimated to be 1.76 hours. Use the estimated time to complete the 50th unit as the standard time for the purpose of estimating the unit selling price. You will need to fill in the below table:

Element	Calculation Details	Result of Calculation
Standard time (hr/unit)	$Z_u=K(u^n)$ -> $Z_{50}=1.76(50^{(\log 0.8/\log 2)})$ = $1.76(50^{-0.322})$ = 1.76x0.283827 -> Z_{50}=0.5 hours	0.5 hours
Direct labor cost ($/unit)	Factory Labor = Direct labor rate * Time required= $15/hr x 0.5hr/items = $7.50/item	$7.50/item
Direct material cost ($/unit)	Material cost = Total Charge/No. of items= $375,000/100 = $3750.00	$3750.00
Overhead cost ($/unit)	Factory overhead cost = 125% of factory labor cost= 1.25 x $7.50 = $9.38/item	$9.38/item
Packing cost ($/unit)	Packaging cost = 75% of factory labor cost= 0.75 x $7.50/item = $5.625/item	$5.63/item
Manufacturing cost ($/unit)	Total manufacturing cost = Factory Labor + Production Material + Factory Overhead + Packaging= $7.50 + $3750 + $9.38 + $5.625 = $3772.50/item	$3772.50/item
Desired profit ($/unit)	Desired Profit = (Desired Profit Percentage) * Manufacturing Cost= 0.20 x $3772.50 = $754.50/item	$754.50/item
Selling price ($/unit)	Unit Selling Price = Desired Profit + Total Manufacturing Cost= $754.50 + $3772.50 = $4527.00/item	$4527.00/item

(b) [10 points] [Do hand solution and submit the required table (see the question) in the PDF file only. Remark: You need to show all your work in a concise manner in the table, not outside.]

In addition to the unit selling price, you have also been asked to determine the demand forecasts for each of: current month July, and next two months (August and September) using simple exponential smoothing with $\alpha = 0.3$. Demands for May, June and July are available and given in the table below. Fill in the required parts.

The required parts…

Month	Demand data (units)	Forecast (calc. details and result)
1. May	850	850
2. June	900	=0.3(900)+0.7(850) = 865
3. July	885	=0.3(885)+0.7(865) = **871**
4. August	885	=871+0.3(885-871) = **875.2**
5. September	885	=875.2+0.3(885-875.2) = **878.14**

3.

[25 points] [Please use Excel for your answers in all parts of this question.]

In the packaging department of a large aircraft parts distributor, a fairly reliable estimate of packaging and processing costs can be determined by knowing the weight of an order. Thus, the weight is a cost driver that accounts for a sizable fraction of the packaging and processing costs at this company. Data for the past 1O orders are as follows:

Packaging and processing costs ($)	Weight (pounds)
97	230
109	280
88	210
86	190
123	320
114	300
112	280
102	260
107	270
86	190

(a) [15 points] Develop a simple linear regression model choosing the independent and dependent variables appropriately using Regression in the Analysis Toolpak add-in of Excel and write the resulting mathematical regression model in terms of actual names of the dependent and independent variables. **Remark: You need to provide the regression results report of Excel but you will not examine the appropriateness or fit of the model or verify that assumptions for regression model are satisfied since they have been already verified by the personnel.**

(b) **[10 points]** How much should it cost to package and process two separate orders of 250 lb and 180 lb?