BA 352: Project Management Take Home Exam 2

Due: Before you enjoy the first sweet second of Spring Break.

On Take Home Exam 1, we simulated how long a thirteen-step project would take – factoring in that the *schedule* is random (or stochastic, if you want to use a more sophisticated word). That simulation is available online on the course webpage. But what about the *budget*? Surely, the preliminary budget for a large project is at best a good guess, and the final cost is quite hard to predict. Let’s try to do just that. This is one of the key deficiencies of Microsoft Project, in my opinion – it does not allow for random times or budgets, all times and costs are deterministic.

In Section 6.5.2.4 of the PMBoK, simulation is listed as one of the data analysis techniques. Section 11.4 of the PMBoK is called Perform Quantitative Risk Analysis. More specifically, in Section 11.4.2.4, Modeling and Simulation of the budget are discussed, with a cool graph of the total project cost in Figure 11-13 (on page 433).

So, for the data in Take Home Exam 1, assume that most activities have variable costs, discussed below. Further, the overall project earns a bonus if it’s early and penalties must be paid if the project is late (details below). **Your objective:** Simulate the overall cost of the project (at least 5000 times) and then answer lots of questions about it.

**Activity Costs**

1. $30000, plus $1000 per day for any day (or fraction of a day) over 32 days. If A takes 34.7 days, it should cost $33000 for being 3 days over 32.
2. $800 per day (including fractions). If B takes 8.5 days, it costs 8.5\*$800 = $6800
3. Always $5000.
4. $1000 per day (or fraction of a day). If D takes 12.4 days, it costs $13000 for taking 13 days rounded up.
5. Normally distributed with mean $5000 and sd $1000.
6. $8000, plus $1200 per day for any day (or fraction of a day) over 10 days. If B takes 11.3 days, it costs $8000 + $1200\*2 = $10,400.
7. Always $2000.
8. $1500 per day (including fractions).
9. Equally likely to be $8000 or $12000.
10. Normally distributed with mean $7000 and sd $2000.
11. Always $15000.
12. Normally distributed with mean $1000\*number of days and sd $100\*number of days.
13. Always $4000.

**Project Bonuses and Penalties**

1. The project is early if it takes less than 38 days. You earn a bonus of $12000 per day (including fractions) for every day early. If the project takes 35.5 days, you earn 2.5\*$12000 = $30000, i.e. your cost decreases by $30k.
2. The project is late if it takes more than 45 days, at $7500 per day (including fractions). If the project takes 51.5 days, there is an additional cost of $7500\*6.5 = $48750.

**The Total Cost of the Project = The sum of A through M minus any bonus plus any penalty.**

**Calculations**

1. Assume that every activity finishes exactly on the most likely time. This follows question **2)** of THE1. What is the anticipated total project cost? For the normally distributed costs, assume they are exactly at the mean. Average the equally likely activity cost.
2. Assume that every activity finishes on the optimistic time. This follows the first half of question **3)** of THE1. What is the anticipated total project cost? For the normally distributed costs, assume a z-score of -3. Use the lower equally likely activity cost. Factor in any bonus you may receive.
3. Assume that every activity finishes on the pessimistic time. This follows the second half of question **3)** of THE1. What is the anticipated total project cost? For the normally distributed costs, assume a z-score of +3. Use the higher equally likely activity cost. Factor in any penalties assessed.

**Calculations based on the Simulation.** This follows question 7) from THE 1. The Excel file is online.

1. What is the average total cost of the project?
2. How about the median cost?
3. On average, how much over budget is the simulated project total cost compared to part a.?
4. What is part f. as a percentage?
5. How often (as a percentage) is the total cost less than or equal what you got in part a.?
6. Assume that you hope to make a profit of $40000 on this project, based on your estimate from part a. How often (as a percentage) is the total cost of the project $40000 more than part a.? In other words, how often do you not only not make a profit but actually lose money on this project?
7. What total project cost is the top 1%?

**Graphs based on PivotTable**

1. Insert a PivotTable of the 5000+ simulated total costs. Group the data into groups of size 5000 or 10000 (I can’t decide which is better). Draw a bar graph of what the total cost distribution looks like. Is it symmetric or skewed to one side or the other?
2. Now draw a cumulative line graph of the PivotTable data. First calculate the cumulative frequency of each group then draw it as a line. It should like something like Figure 11-13 from the PMBoK.

**BA 352: Project Management, Take Home Exam 1**

**(10 points)**

Due: TBA

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Act | I.P. | a | m | b | µ | σ | α | β |
| A | --- | 25 | 30 | 50 |  |  |  |  |
| B | --- | 8 | 10 | 16 |  |  |  |  |
| C | --- | 5 | 7 | 18 |  |  |  |  |
| D | B | 9 | 12 | 15 |  |  |  |  |
| E | B | 4 | 5 | 8 |  |  |  |  |
| F | C | 5 | 6 | 17 |  |  |  |  |
| G | F | 1.5 | 2 | 5 |  |  |  |  |
| H | F | 8 | 12 | 24 |  |  |  |  |
| I | D | 4 | 5 | 9 |  |  |  |  |
| J | E,G | 5 | 6 | 8 |  |  |  |  |
| K | H,I,J | 7 | 10 | 14 |  |  |  |  |
| L | H | 10 | 12 | 16 |  |  |  |  |
| M | K | 2 | 3 | 6 |  |  |  |  |

1. Draw the PERT/CPM network.
2. Solve the network using CPM and the most likely times (column m).
   1. What are the critical path, completion time and slack times?
   2. Draw a **Gantt chart** of the project. We didn’t do this in class, so look it up online. Then either draw it by hand or find a free program to do so online or figure out how to draw it in MS Excel.
3. Using the optimistic times (a), what is the fastest conceivable time that this project will take? Using the pessimistic times (b), what is the longest conceivable times that it will take?
4. Solve the network using the average times (column µ).
   1. What is the new completion time? How much longer is this critical path compared to **2)**?
   2. Is the critical path the same as **2)** or different?
5. Using PERT, estimate:
   1. The standard deviation of the project completion time.
   2. The probability the project is done “early:” in 38 days or less.
   3. The probability the project is takes 50 days or more.
   4. When will the project will be done with 99% certainty?
6. Now assume that the entire project completion time follows a Big Beta distribution with m = your answer from **2)** and a and b your answers from **3)**. Repeat parts **a. – d.** of **5)**.
7. Using Simulation (with thousands of simulations), what is the average completion time for the project? Also, re-estimate parts **a. – d.** of **5)**.
8. Graph the distribution of project completion times for **7)** using a PivotTable. Compare these to the distributions of **5)** and **6)** using the =norm.dist() and beta.dist() functions in Excel (and choosing “false” instead of “true”). Put all three of these on one clearly labeled graph. This part is hard, ask me for help if you need it!
9. Prepare a table that:
   1. Summarizes all the completion time estimates from **2), 3), 4),** and **7)**.
   2. And summarizes all the probability estimates from parts **a. – d.** of **5), 6),** and **7)**.
10. Executive Summary: (One page, typed.) Assume that you have an idiot boss (picture me?) that insists that this project should take exactly 40 days, no ifs ands or buts about it. Carefully explain why the only thing that’s certain about a real project is uncertainty. Paint a clear picture for your boss about what the actual completion time/distribution will look like and make him/her understand the project well enough that he could explain it to the client who is paying for it. Put together the results from **1) – 9)** to make your case.

**Extra Credit)** To be discussed in class.