

Problem Setup:

With this project, the task is required to create a recommendation system for a group of restaurant owners focused on consumers throughout Marlborough, Massachusetts. The following recommendation system will be used by applying the following technologies such as Alpine.js and Tailwind regarding the front end. For the backend, GraphQL API and the Go web servers will be used to complete the backend. The dataset that will be utilized will be from Yelp reviews, where over 1,000 restaurants will be utilized, and updated monthly. The development team will consist of a project manager, front-end developer, back-end developer, data engineer, and data scientist. Each of these roles will play a crucial role in completing different tasks throughout the project.

The Excel sheet provided sixteen tasks which included tasks such as software design, coding, testing, and system packaging. Each of these tasks has been assigned a best-case, expected, and worst-case scenario, with the roles and responsibilities being assigned.

Throughout this project, many of these tasks will require them to be finished to proceed to the following step. For example, task C which is the design brochure task can only begin until task A is completed. This also goes for the same aspects of the coding tasks that include, coding (D4), system design (D3), and software design (D2), which will be completed after the first task which is requirement analysis (D1). These tasks include a specific timeline to follow each step. Some steps such as marketing strategy (B) and surveying the potential market (E) can be worked in a parallel atmosphere, which will help reduce the project duration.

Throughout the project, some situations may arise due to the variation of time schedules. As the team members are working as individual contractors, it can be difficult that the hours may change significantly from the best-case and worst-case scenarios. Additionally, new technologies may create a learning curve for both GraphQL and Go causing a delay in

schedule. Furthermore, team members may work full-time on the project, which may not be the case in all scenarios, leading to another delay in the schedule.

Model Specification:

To minimize the total time and total cost, linear programming will be utilized for this project. Throughout this project, the objective function will be based on finding the minimum time spent on the project which will also correlate to the price, which is dependent on the hourly rate of all the individual contractors.

In this model, the variable that will be included is the time required for each contractor to finish each of the tasks using both the best to worst case scenario, which is represented in the Excel file. Furthermore, other constraints depend on the tasks that need to be completed first before other tasks begin. Moreover, both the front-end and back-end developers are limited as two tasks cannot be worked on simultaneously.

Results:

The results will uncover three cases which include the best case, expected case, and the worst case scenario on the total amount of time and costs to finish all sixteen tasks. The linear program created has optimized the solution to figure out and ensure that all task dependencies were complete for all cases. The results in this situation help demonstrate the variations through the overall project to identify the duration and costs to uncover the possible outcomes under different scenarios.

For the best-case scenario, the total cost of the project yielded \$23,232, which completed the project in about 108 days. The timeline this created is optimized as it starts from Task A with the starting day set to 0 and ending on Day 4. Throughout the task list, it progresses quickly without any sort of delay. This means that with each task it will create a more optimized solution and shorter duration for all tasks. For example, by looking at Task D, it can be seen that it is completed in 40 days but first completes Task D1 before it moves on to Task D2. This

situation is ideal as it will create a smooth progression for project as well yielding a low cost and quickest. delivery.

For the expected case scenario, the total price came out to \$33,632, with the project duration coming out to 154 days. When comparing it to the best-case scenario, it can be seen that it takes more money and time. This scenario leads to a more realistic timeline as it has some delay throughout the project, which is bound to happen. As seen in Task D it takes about 60 days which also leads to Task D4 extending to about 92 days. Due to this delay in the task, ultimately delays Task D8 and Task F. This timeline is more realistic for the project as the team undergoes normal conditions without any exceptional performance or unexpected delays.

For the worst-case scenario, the total cost yielded \$45,966 with a project delivery of 212 days. This scenario is presumed to have many delays throughout the execution of the project. For example, unexpected issues or unexpected setbacks may arise, causing delays. For example, with Task D, it can be seen that it took 80 days to complete, while also task D4 took about 126 days to complete. Due to this, it caused a delay in Task H, and one of the reasons right why it ended on day 212. This form of scenario is expected to have the most delays and result in more money spent creating a more cautionary estimate for the project. Furthermore, this also helps the team anticipate any potential cost overruns and delays.

Conclusion:

For the project, the product prototype covers many different phases such as required analysis, system design, coding, testing, and packaging. As those cover the technical aspects of the project, market research implementation planning, and client proposals are also estimated in the timeline. The best-case scenario is estimated to finish in 108 days, the expected-case scenario is estimated to finish in 152 days, and the worst case to finish in 212 days. The project will likely be delivered somewhat between the expected and worst-case scenarios as many different scenarios can cause a delay in one of the tasks. Furthermore, without the addition of Cloud licenses, the costs would vary between \$15,000 and \$20,000 depending on the scenarios

listed above. If more additional contractors were present, like more front-end and back-end developers, it could balance the workload rather than dumping all the work on a person. This also helps with scenarios when one developer will be busy, where the other developer can pick up from where the other developer left off. This aspect will change the course of the project as it will decrease in time and can vary in payment. With the addition of more resources, the likelihood that the project will be completed from 108 days to 152 days is more likely to happen comparatively to 152 days to 212 days.