Project 4 Report

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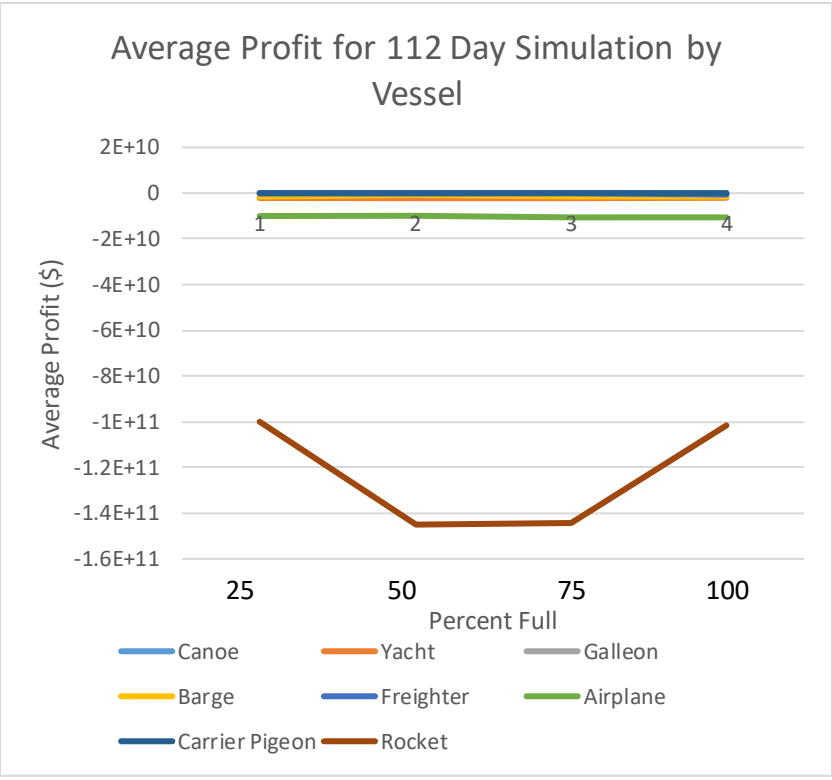
Report

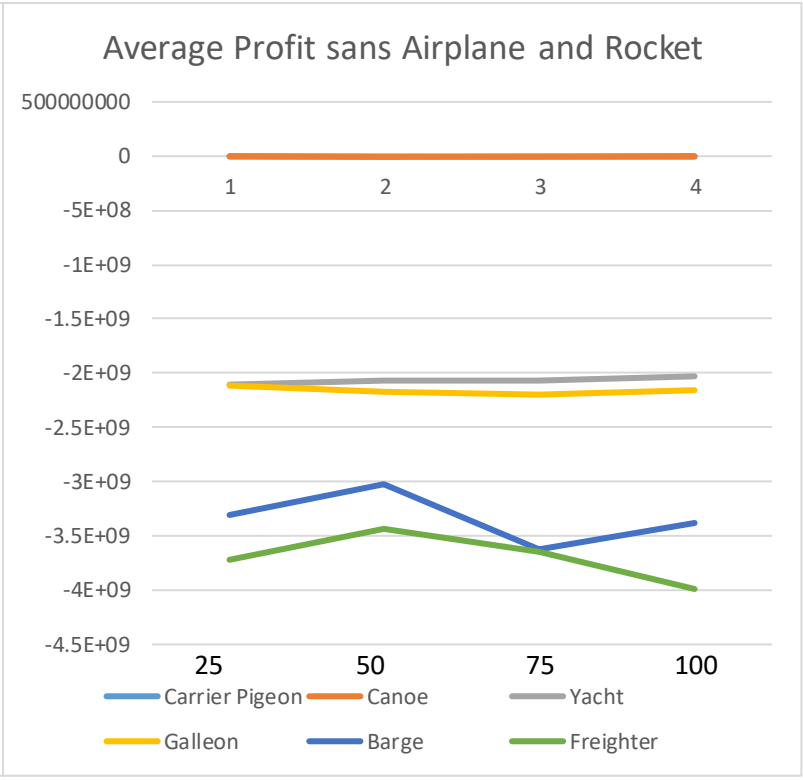
Goldy Gopher has employed us to compile a report to give him test data about his shipping company to determine the optimal way to run his business. The data will tell him things such as the best transports to use, the amount each ship should be filled before leaving port, and the time that each ship should wait before leaving port. To generate the appropriate amount of data, we created a discrete event simulator that simulates the 10 ports that Goldy wants to ship to and the possibility to run tests on 10 different types of vessels from canoes to rocket ships. The simulator also allows for the user to test different parameters such as how much the vessel needs to be filled before it leaves ship or how much time it will wait before leaving a port. In running the simulations, we concluded that the most crippling factor is the fuel costs, and the vessels that balance minimizing fuel costs with performing lots of voyages made the most money.

To collect data, we ran the simulation for a 112-day simulated interval, periodically changing parameters. For each instance of changing a parameter, we ran at least three trials. Then, we put the results of those trials in Excel and took the average of those. Graphs were then made and analyzed. The first data we gathered was the average profit of each vessel in the

simulation versus the given percentage the vessel must be filled before it is ready to leave port. This was done to determine if a vessel should leave without being totally full to complete more voyages or wait to become more full to save on gas.

Graph of Average Profit during the simulation vs. amount vessel must be filled before leaving:

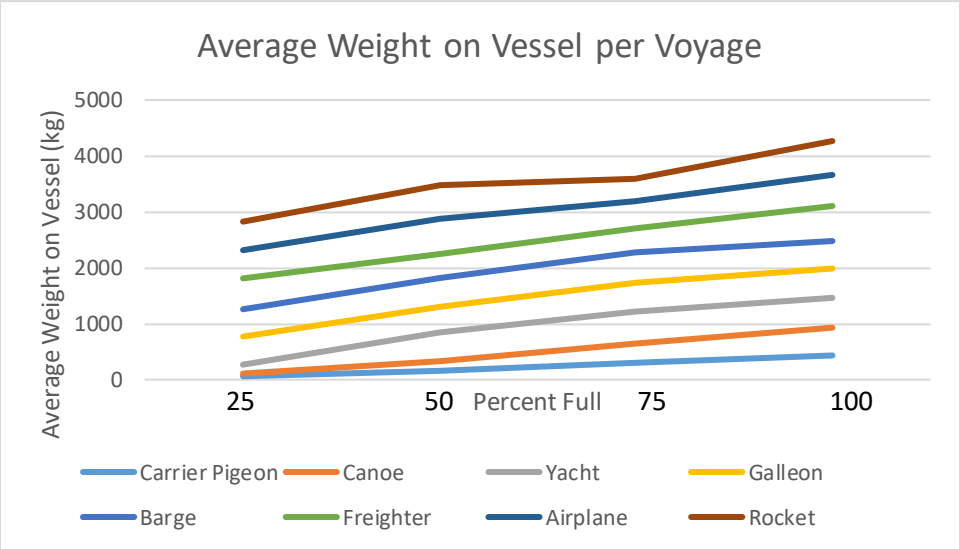




To better see the other vessel data, it was necessary to produce a second graph without the Rocket and Airplane to see the trends in the other data. This is because they were not even close to ever making a profit. One can see that the rocket lost less money while waiting until it was 25% full or 100% full; this could be because of a couple of reasons. One reason is that, because it can move quickly, it can do a lot of voyages when it only needs to be filled 25% of the way. For the other vessels, it seemed to not vary too much in how much profits were gained/lost when changing fill requirements. If a boat has a large capacity, it is more likely to be

able to load new shipments on and more shipments are needed to reach its fill capacity; thus, it will wait until the maximum time to fill up to the capacity if it must wait a long time. The Barge and Freighter both have very large carrying capacities, thus they waste a lot of time waiting at port when waiting for 75% and 100% full cargo, which means they make the least number of voyages possible. Combined with their slow movement times, one can see that they lose money when they must fill up their cargo longer. The canoe and pigeon lose the least amount of money because they only take one or two shipments before they launch. Because shipments are between 1-1000 kg, and they both have carrying capacities of 1000kg, they take an average of 1 shipment at the 25% and 50% full capacity requirements, and an average of 2 at the 100%. Combined with their low (or nonexistent, in the Pigeon team case) cost of shipping, they can churn out a lot of voyages, taking in a good amount of money without losing too much to fuel costs.

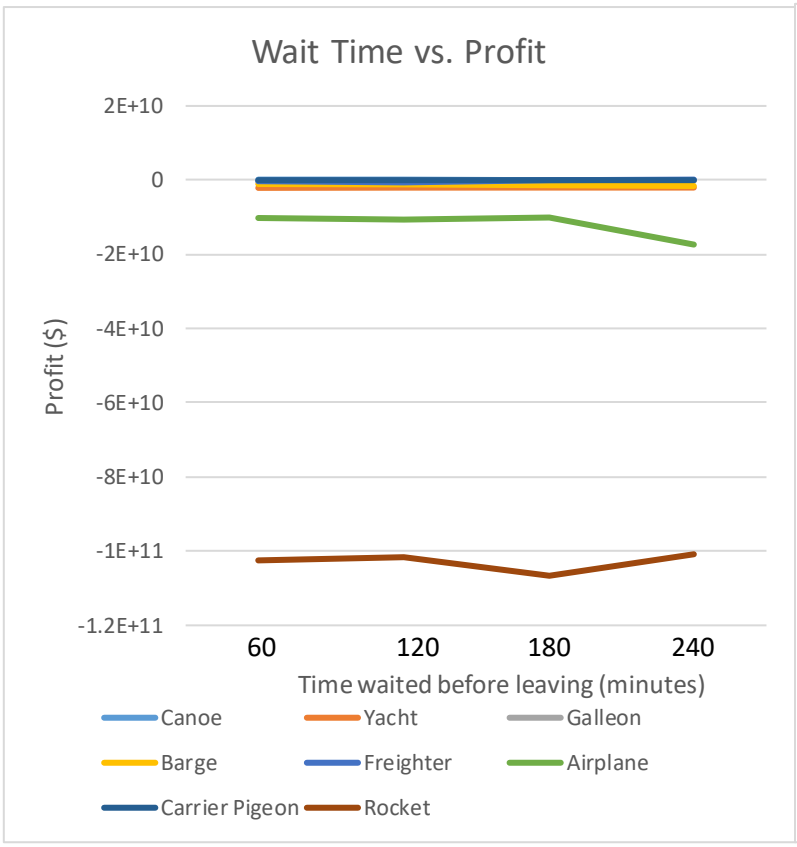
Graph of average weight on the vessel during a voyage:

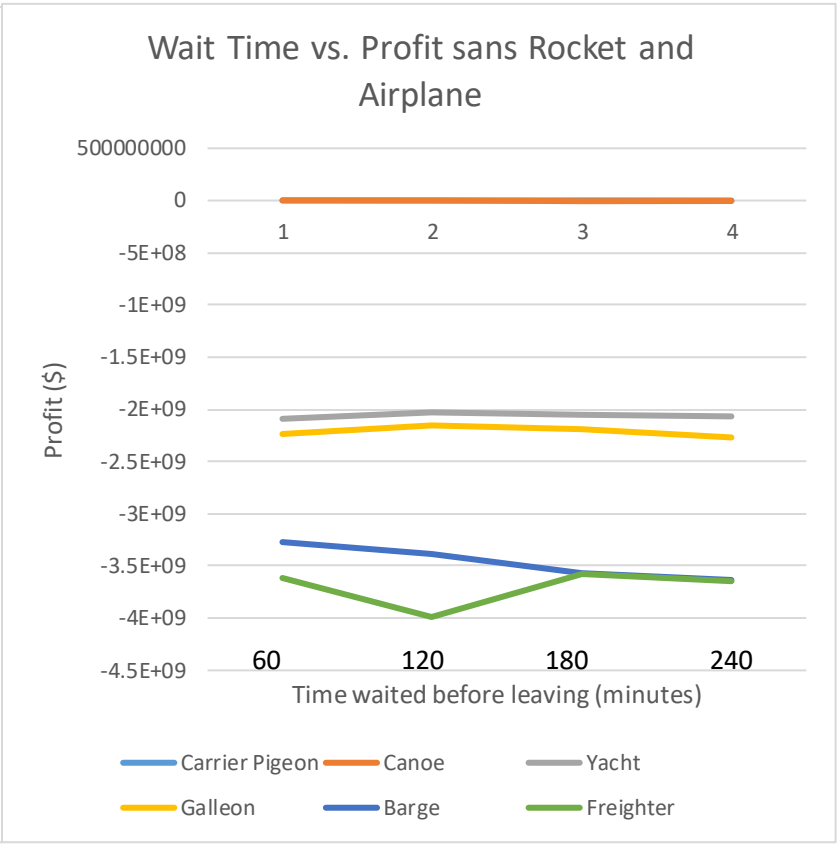


The graph above directly correlates with how much each vessel usually made. As one can see, the two vessels

with the highest average weights, Rocket and Airplane, both lost the most money while moving. Similarly, Canoe and Carrier Pigeon vessels had the lowest average weight but also lost the least money.

Graph of average profit during the simulation vs. time vessel will wait before leaving:





The graphs above are important because they explore at what point the vessel should just up and leave. If Goldy wants to make as many shipments as possible as to not disappoint customers, that is not too drastic in terms of hurting his profits. In vessels where they take a long time to fill up the vessel anyways, it is not important that there is a long wait time and, as shown in the first graphs, it can hurt profits to wait too long to leave. The rocket does not seem to be affected too much by the wait time, and there is an unexpected dip in the 120-minute data for the freighter. Overall, the general trend is that waiting too long hurts profit.

The proof of correct results includes data in the attached Excel files. The numbers presented make sense because the vessels that had the highest fuel costs lost the most money in the simulation. This makes sense because the shipment value doesn't scale with shipment costs, so the vessels that cost the most to run lost the most money.

In conclusion, the vessels that cost the least to operate made the most money. For example, if the rocket costs $100,000 to operate *per KM*, and the rocket travels thousands of kilometers, it wastes millions of dollars compared to the *maximum* $50,000 shipment value, especially if the shipments aren't generated fast enough for the rocket to wait around long enough to get fully loaded. In addition, there is some merit to having a lot of vessels delivering shipments. Canoes and Pigeons have the most vessels available, and combined with the cheaper cost allow for a lower operation cost compared to income. There is also a moment where the time it takes to load certain vessels to a point matches the wait time, which means that it doesn't matter if Goldy increases either value.