***IS6055***

***Core Assumptions and Project Logic***

**Core Assumption 1: Each type of Crude Oil must be used to produce any refined product.**

We are working off of the assumption that we must blend all 4 types of crude oil in order to make any equal amount of product. We developed this assumption because it is clearly stated in the problem statement, pictured below.

A white background with black text

Description automatically generated

We are also given the different characteristics of the 4 types of crude oil, indicating that each oil is unique and therefore classed as a different “type” of crude oil based on its API gravity and sulphur content.

A table with text on it

Description automatically generated

**Core Assumption 2: 4 Barrels of Crude Oil = 4 Barrels of Refined Product**

We haven’t been given a ratio explaining what percentage of each crude oil is needed to produce each of our refined products, therefore we are assuming they must be blended in equal measure. If we must blend all 4 types of crude oil in equal measure in order to make our refined product, then our output will have to be 4 barrels of 1 specific refined product. The reasoning behind this assumption is an article we found when researching crude oil refining which indicates that scientific processes such as hydrotreating can be used to manipulate, and indeed lower, the sulphur content of refined products. [Add link]

This assumption lets us disregard the API gravity and sulphur contents of each product and gives us an idea of how many barrels we will need for purchasing. Since we need equal amounts of each product, our next step was to look at our monthly supply quotas.

A screenshot of a screen

Description automatically generated

As seen above, our lowest monthly supply quota is 550,000 barrels of Laguna. This means that in order to maximize our profits, we need 550,000 barrels of each product, coming to 2,200,000 barrels total. However, we needed to ensure we had the production capacity across all of our plants to produce this amount. The actual plant where our refined product was produced did not matter, as the production cost was a flat $19 per barrel. The only relevant information here was that we had to meet our production quota in each refinery.

A screenshot of a white table with numbers and text

Description automatically generated

When we added up the total oil capacity of all of our refineries, this gave us a figure of 2,300,000, which meant that we had adequate capacity to maximize our output given our above assumption. The only other relevant piece of information here is that any excess production is sold with a 7% discount, which doesn’t have any real impacts on us. It will only affect our overall product. Since we are working off the assumption that all 4 oils must be blended in equal measure, then our shipping costs (I will cover in the next assumption) must be incurred regardless, meaning that the optimal way for us to maximize our profit is to maximize production. That way, even if our assumption about API gravity and sulphur manipulation is off, it won’t matter because we will still have enough raw crude oil at each location to be blended in whatever ratios are needed.

**Core Assumption 3: All Classes of Boats Can Be Considered**

This part of the question threw us a little. We began by only considering LR1 and LR2 boats because the AFRA Scale categorizes these boats as “crude oil,” however since our assumption requires all 4 types of crude oils to be shipped to all 4 locations this meant that we needed 16 boats. LR1 and LR2 only come to 8 boats total, so we decided to consider all boats and assume the “crude oil” tag was just a weight capacity classification as it is the heaviest type of oil and these boats had the heaviest capacities available. As a result, we considered all boats and all costs associated with these boats, from fuel costs, rates and port charges & commissions to the deadweight tonnage limitations. We then built a model to pick us the cheapest 16 boats after factoring in every variable. At this point, we still weren’t sure how best to spread out the excess, as max capacities in Greece & Poland were lower than the base 550,000 figure we were considering. After much deliberation, we discovered that our optimal production would be if we filled our refineries in the opposite direction than we were given: UK-Spain-Poland-Greece. This way we were able to hit our maximum production target of 2,200,000 while still at **least** meeting demand across all of our refineries. This also opened up the cheapest possible GPT boats to Greece, as their deadweight tonnage was less than the number of barrels we were producing there (84,000>75,000). If we maxed out production in Greece, we would have had to take a more expensive boat and then we would have needed less room in boats to the UK so we would not have been optimizing our supply in relation to our shipping costs. By taking the approach we have, we have assured that every factor from purchasing to shipping and production is optimized.

**Model Findings**

Our first 2 models measured our maximum and minimum profit, based off selling only Diesel Fuel and Jet Fuel as our excesses. We built these models disregarding shipping & transportation costs. These models factored in the cost price of each of our crude oils multiplied by the amount of barrels of each we were taking to give us our total cost. They then calculated the profit we got from each individual product by meeting our quotas and then calculated our excess production based on our lowest and highest refined product sales price, Jet Fuel ($61.25) and Diesel Fuel ($101.64), sold at a 7% discount for our excess production amount of 501,000.

Next, we looked at our minimum and maximum profit figures and we took the optimal shipping costs that we got from our third model and subtracted that from our profits. We found that no matter what refined product we produced, we were guaranteed to be in profit so long as we hit our production figure of 2,200,000. This gave us justification for disregarding API gravity and Sulphur content. We proved that if we only produced our cheapest product, with the method we have chosen we would still be turning a profit after meeting our demands so it would make sense. No matter the restraints API gravity and sulphur content would have on what we could produce, we can guarantee that we turn a profit of minimum $1.8m and maximum $20m, as indicated by the table below.

