Global Agritech

Annual Analytic Assembly

COAST-TO-COAST CONSULTANTS

Dear Dr. Allen Miller, Head Analyst Decision-Maker (DM);

Thank you for selecting us to be one of the consulting firms to help Agritech executives come to important corporate decisions this year. We have analyzed the problems you have provided for us and modeled solutions to each. We hope this summary illuminates some of the possible decisions Agritech can make in order to grow its enterprise.

Agritech R&D

For this problem, you wanted to optimize your research and development department that produces drones. The information given included available resources for labor and material for both extended and basic models of drones. We formulated a goal programming model to determine how to best meet the five goals Agritech wants to meet: (1) produce approximately 40 units of the rugged product, (2) produce approximately 70 units of the basic product, (3) achieve a profit over $425,000, (4) consumer less than 150 hours of labor, and (5) consumer less than 200 ounces of material. We used two analysis methods to obtain more informed recommendations for you. First we used labor, material, and profit as hard constraints; for this method the solution we obtained was to produce 12 extended units, 57 basic units, use 150 hours of labor per unit, 126 ounces of material per unit, and obtain a profit of $426,000. Next, we analyzed the problem using multiple objectives and determined the optimal solution to be to produce 11 extended units, 58 basic units, use 149 hours of labor per unit, 127 ounces per unit of material, and obtain a $425,000 profit. The two solutions are clearly similar, but we recommend going with the first solution because of the larger profit and same overall number of units produced.

New Recreational Facilities

We were then tasked with optimizing the problem of the best amenities to include in the new recreational facilities that Agritech intends to build. The proposed facilities include a swimming pool, recreation center, basketball court, and baseball field. If the pool is built, lockers for it must be built in the recreation center, and there is only enough flat land for either the basketball court or the baseball field. We are also constrained by budgeting and land limitations of $400,000 and 14 acres, and our goal is to choose facilities that will be used by the most people primarily. We formulated an ILP for this problem and obtained an optimal solution that uses all of the budget and only 10 acres of land, with a total usage of the facilities of 1100 people. This optimal situation is obtained by building a swimming pool, recreation center (with lockers) and baseball field, which is our recommendation for Agritech's course of action on this project. We found that building the basketball court instead of the baseball field would exceed the budget, although would gain more usage.

Construction Project in Kansas

In addition to building recreational facilities, Agritech is also beginning a construction project in Kansas. This project requires 250,000 tons of material to be delivered over a three-week period and three modes of transportation are available: trucking fleet, railway delivery, and air cargo transport. Each of these transports has a cargo limit and cost per 1000 tons. The project requires 120,000 tons delivered in the first week, 80% of the total delivered in the second, and the entire amount delivered by the end of the third, with contracts dictating that the material must be split among the transportation methods as follows: at least 45% of the total by trucking, at least 40% by railway, and up to 15% by air. In order to solve this logistics problem, we formulated an LP model to optimize the cargo usage and minimize shipping costs. We determined the optimal solution to be as follows: for the first week, ship 45,000 tons of material by truck, 60,000 by railway, and 15,000 by air; for the second week, 50,000 by truck and 30,000 by railway, 0 by air; and for the third week, 17,500 tons by truck, and 32,500 by railway, for a total cost of $45,650. We also recommend delaying the start of this construction project approximately six months, due to COVID-19. The construction project is located in Sedgwick County, which has the highest total number of cases in Kansas; the six month delay will push the project out of flue season and allow adequate time for a vaccine to be more widely received, without delaying the project excessively.

Plant Expansion

Agritech is also planning a plant expansion and needs to determine whether to build a large or small plant. The large plant would cost $5 million to build, and the small $1 million. This decision depends on the payoffs for the plant, which depend on the level of consumer demand for the company's products. Agritech believes that there is a 72% chance that demand for their products will be high and a 28% chance that it will be low. They can also pay a market research firm to survey consumer attitudes towards the company's products in order to better determine consumer demand; there is a 76% chance that the survey will be favorable (customers will like the products). Agritech believes that if the survey is favorable, there is an 87% chance that demand will be high for the products, whereas if the survey is unfavorable there is only a 25% chance that the demand will be high. In order to guide Agritech's decision for this problem, we drew a decision tree for the situation when the survey is performed before the plant size decision is made. We came to the conclusions that Agritech should pay the marketing research team to conduct the product survey in order to gain that additional insight into the issue. If the survey is favorable, Agritech should build a large plant, and a small one if it is unfavorable, because in this situation there is a very small chance there will be high demand and it is not worth the cost to build a large plant after paying for the survey with such small chances of it paying off. Additionally, a small plant with high demand will have more payoff than a large plant with low demand. The alternative choice is to not conduct the survey, in which case we recommend simply being conservative and constructing a small plant, for the reasons outlined above.

Agritech Gift Shop

This task was to help Agritech predict quarterly sales in its headquarters' gift shop. We were presented with three years of sales data from the shop and were asked to analyze the data using the multiplicative seasonal method, as well as using a Holt-Winter's method to forecast sales. We also considered a quadratic model. For the first method, we obtained an MSE of 85,564. This method is typically best for stationary data, and therefore not the best approach for forecasting the data we

were provided, since it is nonstationary with an upward trend. For the Holt-Winter's method, we obtained a smaller MSE value of 53,412, which is a better fit and therefore a better method for nonstationary data such as ours. Finally, with the quadratic trend model, we obtained actually the smallest MSE value of 49,702, making it the best method for our non-stationary data forecasting. Thus we recommend using the quadratic trend model to forecast sales of the gift shop for the next four quarters, due to its smallest average squared difference between forecasted and actual sales (MSE).

Global Agritech Problem Parts

Finally, Global Agritech has been receiving a lot of complaints on how it supports excavators around the world. We were presented with data from the last fiscal year to try to discern any patterns or useful information to address these problem parts. The data includes the number of incidents where a foreman had to special order a part for the heavy equipment and how many hours the machinery was down waiting on the part. The data also includes the technician who received the call and entered the data. We used Tableau to analyze this problem. We first found a relationship in the data that the part number in the problem parts was equal to the part number in the financial data. We also determined that the Hyundai model seems to be much more reliable when looking at the number of broken parts. When looking at how many hours each model is down, Hyundai is still more reliable; the number of hours down for the Caterpillar model is 2,479,938, compared to Hyundai's 178,084. We can also compare incidents for each model; the incidents for Caterpillar are much higher than for Hyundai (14,959 to 632, respectively). We also found that parts 1560ND08, 16600125, 58650149, 59950118, 61500152, and 80100133 drive hours down substantially more than the other parts. These parts drive down over 5,000 hours each. Another analyst informed us the average dollars lost per down hour is $1,823. Knowing this information, we determined that Agritech should be willing to expedite all the parts at a cost of $63 per ship weight pound in order to decrease the money loss for the company.

We also built three regression models with hours down as the dependent variable, and included incidents, part cost, and shipping as respective independent variables. The best model to use appears to be the one of using country of use as the dimension and incidents as the independent variable, because it provides a lot of data points and a high R-squared value, making it more accurate. We determined from these regression models that it is most expensive to operate each model in Europe based on Part Cost and Hours Down. If Agritech wanted to expand into another country, it should be Monaco or Singapore because their part cost and hours down are zero for both models. In terms of consistency, JCD has the lowest hours down and CN has the lowest incidents. If we based on consistency off of hours down, JCD would be the most consistent, if we based consistency off of number of incidents, CN would be the most consistent. OEM is the least consistent in both number of incidents and hours down because it has the highest values for both.

We recommend going to Caterpillar parts suppliers to influence them to provide faster service because their hours down per incident value is very high. If we convince them to provide faster service, we will not have to wait as long for replacement parts when an incident occurs. An additional recommendation we have for Agritech is to provide a key with explanations for each term (header) used inside of the document being analyzed for ease-of-use. Additionally, financial data should be included about all of the problem parts. There are also many parts that have been repeated under the column problem parts, making the data more excessive than necessary. An explanation of this would be helpful to explain why the same part is being documented multiple

times. This data could be compiled to reduce the number of rows of data in the document for easier analysis.

We hope that we have provided sufficient insight into each of these problems for you to be able to come to sound decisions with the other executives from Agritech. Thank you again for choosing Coast-to-Coast Consultants for your optimization and decision-making analysis needs, and please let us know if you have any further questions or requests. We wish you at Agritech the best of luck in all the company's endeavors.

Sincerely,

COAST-TO-COAST CONSULTANTS

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