Operational Plan for the Amazonoff Company

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A report submitted The Amazonoff Company

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Contents

Chapter 1

Executive Summary

Objective: This report's objective is to document the modelling and simulation completed on behalf of the Amazonoff Company. This report also outlines changes that we feel could improve operating efficiency, whilst minimising costs.

Findings: Section 2.1 describes the cost-minimising assignment of customers to facilities so that we satisfy each customer's demand. We find the optimal operating cost to be 238.56, even after we account for the capacity of each facility. We also suggest methods which allow the company to balance loads between facilities. In Section 2.2 we construct optimal routes for the delivery vehicles to follow. We show that the two processes discussed above can be modelled separately, and therefore are easily actionable. Our routing implementation offers an additional cost of just 100.37, using just one delivery vehicle. We believe it is important to consider uncertainty in our research and in Section 2.3, we offer insights into how we can factor this into the internal running of the depot. Finally, in Section 2.4, we simulate the next 12 months for your insurance subsidiary. It should be noted that we estimate the probability of legal issues for the company to be just over half. To help remedy this, we further estimate the value of your capital holdings to a high degree of certainty and find it to be in the region of 27375.34. We, therefore, suggest a small increase in the monthly rate you charge customers, or sourcing a capital injection before the next year begins.

Conclusion: Following our research, if our suggestions are implemented, we find a short-term operations cost of 338.93. In the longer term, we suggest following the advice laid out in the rest of the report so as to avoid legal issues.

Chapter 2

Management Report

In this chapter, we lay out a more detailed analysis of your operations, and offer distinct guidelines on how to fulfil your warehousing, routing and e-commerce requirements.

2.1 Warehousing

The Amazonoff Company operates in the space of a 21×21 grid, in which exist the entire customer base and potential facilities. We suggest only opening a subset of these facilities, as we give a satisfactory assignment of all 60 of your customers with just 12 facilities, allowing the firm to save expenditure on unnecessary rent. We recommend leaving out facilities 1, 2, and 12. Outlined in Table 2.1 are the assignment and respective facilities we consider to be optimal, and we refer the reader to xxx for a technical discussion of our modelling process.

We find that even upon factoring in the demands of each client, the facilities are easily able to hold the required stock, and as such our allocation remains optimal. It may seem odd to the reader we suggest opening so many facilities, but upon consideration of the costs for opening facilities, the motivation becomes clear. As the index of the facility increases, the cost to open it decreases exponentially, and as such it incurs a minimal cost to open an extra facility. With this in hand, it makes sense to open many facilities, so we can truly minimise the distance between them and the clients.

In Table 2.2, we observe the demand faced by each facility. It is clear that the distribution is extremely unbalanced, with facility 3 facing 219 units, and facility 5 facing just 8. As such, we refer the reader to xxx for a modelling approach that allows the firm to control this difference.

We calculate the cost of this approach 238.56 if implemented correctly.

Facility	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**13**	**14**	**15**
Customers Assigned	1	4	10	25	34	28	27	47	44	43	45	49
	2	7	22	33	38	29	30	51	52	48	53	50
	3	11		35	42	39	31			60	54	55
	5	12		36			37				56	57
	6	17		40			41					58
	8	18					46					59
	9	23										
	13	24										
	14	32										
	15											
	16											
	19											
	20											
	21											
	26											

Table 2.1: Assignment of customers to facilities

Facility	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**13**	**14**	**15**
Demand Faced	219	137	8	69	25	51	84	13	36	43	35	77
Capacity	300	400	500	600	700	800	900	1000	1100	1300	1400	1500

Table 2.2: Demands faced by each facility

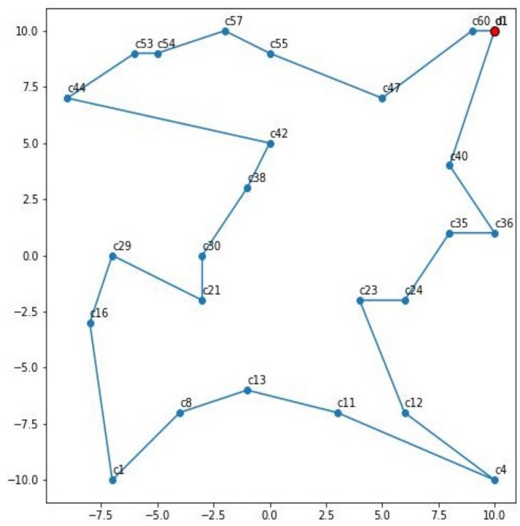

Figure 2.1: Suggested delivery route

2.2 Vehicle Routing

We next tackle the routing operation. The company has 25 *composite* clients whose deliveries are to be prioritised. There is a single depot and the delivery vehicles have no capacity limit. In our modelling, we considered using one delivery vehicle or three and found that the cost of using either is the same, that being 100.37. This is to be expected since all routes must return to the depot, and if we used more vehicles, we would pay unnecessary costs on the return leg. In Figure 2.1 we outline the optimal route, where the depot is highlighted in red and labelled `d1`. Each composite client is then labelled by their index and prefixed with a `c`.

2.3 Internal Depot Transportation with Uncertainty

Given the nature of the company, it is important to factor in uncertainty when modelling, specifically in the internal depot operations. In this section, we propose two models that allow the firm varying degrees of control. The first is a *robust* model, meaning regardless of the dimensions of each item, there will always be some way to pack the electric vehicle. The second allows the firm some control over the likelihood that the vehicle cannot be packed. We, therefore, label this model as the *non-robust* formulation. We briefly discuss both models in the following subsections, but for a more detailed description, we refer the reader to xxx.

2.3.1 Robust Formulation

A key assumption of the robust model is that we can, prior to production, garner some information about the maximum volume and weight of each item. With this data in hand, we simply consider the problem using only these maximum weights. In doing this, we have essentially removed the uncertainty from the problem. Despite this, we can imagine a situation where the volume and weight of a given item can vary drastically, so if we pack an item using only its maximum weight, then there is a good chance there is a lot of empty space on the vehicle. As such, we are not effectively maximising the profit garnered on each vehicle. To account for this loss, we recommend implementing the second model, which we now turn our attention to.

2.3.2 Non-Robust Formulation

Our next model allows the firm to retain some control over the uncertainty. More specifically, we add a notion of risk control. Once again we assume we can garner some information about the volume and weight of each item. In this case, we want to consider the average volume and weight, along with the variation of these estimates. We suggest performing some data analysis on the items to acquire these values. Then, we model the problem using the expected volumes and weights. For this situation, however, we require a further parameter to be set, that being some tolerated level of risk, which refers to the probability that we cannot fit the items on the vehicle. Using this approach, we better utilise the space on each vehicle. Of course, there is a small chance that the allocation of goods will not fit on the vehicle, but this can be remedied with the appropriate setting of the risk level. Running simulations on this situation will inform this decision, and with this, we hypothesise that the overall profit would be higher in this model.

The choice between these two approaches will depend largely on the needs of the company. If the consequences of allocating too many items to one vehicle are large, then we recommend the robust approach. Otherwise, we suggest the second model since the profit per vehicle would certainly be higher. It is our opinion that the firm would be better off implementing the second.

2.4 Product Specific Insurance

We now bring our attention to the insurance subsidiary of the company. In particular, we wish to simulate the next 12 months of your operations and deduce meaningful estimates of key values, so as to inform your decision-making in the next year. The key values we considered are the likelihood of legal issues for your firm, and the expected capital stock at the end of the term.

Based on your data, we run the simulation with a starting capital stock of $50,000$ and a fixed monthly incoming fee of 300. By then considering the entry and leaving rates of your service, and the rate at which customers lodge claims, we can generate estimates of these values in the long run.

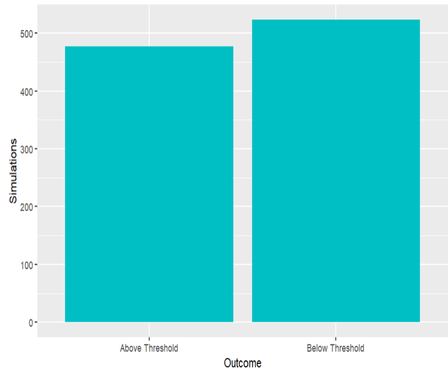

Figure 2.2: Distribution of outcomes (1000 simulations)

2.4.1 Liklehood of Legal Issues

We first wish to estimate the probability that your firm encounters legal issues. After running the simulation 1000 times, we return with a probability of 0.523, which we feel is very high. The breakdown of our results is described in Figure 2.2

2.4.2 Estimation of Capital Stock

Chapter 3

Technical Appendices