**BUSINESS ANALYTICS INDIVIDUAL REPORT**

**BUSN9410**

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# ANSWER 1: SHIPPING OPTIMISATION

1. The lowest shipping cost amounts to $51,510, and this optimal cost is realized in the provided Excel solution (refer to Appendix 1.1).
2. The optimized solution maximizes the utilization of Milwaukee and Salt Lake City distribution centres’ full capacities. Despite having a high capacity, Atlanta is underutilized, shipping to Tucson (3700), Fayetteville (5000), Birmingham (16000), and Orlando (4200). Lexington, operating at nearly half its unit capacity, ships to Denver (1700), Charlotte (7500), Cleveland (3700), and Philadelphia (4500). Milwaukee fully utilizes its 15,000 unit capacity by shipping 5,000 units to Seattle, 4,200 units to Las Vegas, 2,800 units to Denver, and 3,000 units to Minneapolis. Salt Lake City operates at its full 16,000 unit capacity by shipping 16,000 units to San Francisco. The variance in capacity utilization underscores the significance of certain distribution centres in achieving overall cost efficiency based on supply-demand dynamics.
3. According to the Sensitivity Analysis (refer to Appendix 1.2), the supply constraint in Salt Lake City is associated with the highest shadow price, standing at -$1.3. This substantial negative value implies that enhancing capacity in Salt Lake City would result in a more significant reduction in system-wide shipping costs compared to expanding any other distribution centre. To be specific, the analysis suggests that incorporating an additional 500 units of capacity in Salt Lake City could lead to an overall cost reduction of 500 \* $1.3 = $650. Currently operating at full capacity, shipping 16,000 out of 16,000 available units, Salt Lake City has the potential to efficiently utilize the added capacity. Consequently, the sensitivity analysis clearly highlights that allocating an extra 500 units of supply to Salt Lake City would yield the highest value, producing $650 in cost savings and facilitating additional shipments to the constrained San Francisco market.
4. At present, the most efficient solution involves transporting 16,000 units from the Atlanta distribution centre to the Birmingham retail store, incurring a unit cost of $0.35 and resulting in a total shipping cost of $5,600 for this specific route. According to the sensitivity report, the Atlanta to Birmingham route has an "Allowable Increase" of $0.25, indicating that the shipping cost on this route could rise by up to $0.25 per unit without affecting the optimal shipping quantities. As the actual increase is $0.10 ($0.45 - $0.35), which is below the allowable limit, the optimal quantity shipped from Atlanta to Birmingham remains unchanged. However, since the rate itself has increased, the new cost for shipping 16,000 units on the Atlanta-Birmingham route is $7,200 ($0.45 per unit). This represents a $1,600 increase from the previous cost of $5,600. In essence, the sensitivity analysis highlights that the cost change has a minimal impact on the optimal shipping quantities, but the higher rate on the 16,000 units shipped results in an additional cost estimated at $1,600.

To summarize, the sensitivity analysis indicates that the optimal shipping quantities are not significantly affected by the cost change. However, the increased rate on the 16,000 units elevates the total cost, leading to an estimated rise in the optimized minimum shipping cost from $51,510 to $53,110 (refer to Appendix 1.3).

1. In the revised optimized model aimed at decreasing Greenhouse Gas Emissions, substantial alterations in routes become apparent. Despite maintaining the consistent total volume of shipments, there are notable shifts in the specific paths connecting supply and demand when minimizing emissions, resulting in a minimum emission of 12,758kg CO2e (refer to Appendix 1.4).
2. In a scenario where the primary focus is on optimizing costs in the supply chain, the routing solution achieves a total cost of $51,510 with associated greenhouse gas emissions amounting to 15,101kg CO2e. On the other hand, if the goal is solely to minimize environmental emissions, the optimized solution reduces total carbon emissions to 12,758kg CO2e but substantially raises shipping costs to $81,790. This translates to a 15.5% decrease in emissions but a notable 58.8% increase in financial costs. For a profit-driven distribution organization like Shafer Office Supplies, prioritizing cost performance aligns strategically with the imperatives of fiscal growth and maximizing shareholder value. Therefore, it is recommended to maintain the emphasis on cost minimization in Shafer Office Supplies' distribution planning rather than shifting to an emissions-focused paradigm, despite the marginal environmental benefits. Unless explicit carbon emission reduction requirements are mandated by regulatory compliance or corporate social responsibility initiatives, the economic burden of over a 50% cost increase is deemed too significant. However, exploring sustainability-oriented distribution optimizations allows for quantitatively informed strategic decisions that consider the diverse interests of stakeholders in future scenarios.

# ANSWER 2: DECISION ANALYSIS

1. Generated a Treeplan model in Excel (refer to appendix 2.1).
2. According to the Excel model, the recommended course of action is to perform extra animal testing before making a decision on advancing to human trials.
3. Advantages of opting for animal testing prior to conducting human trials.
   1. Further validation of vaccine efficacy could mitigate the risk of costly failures in human trials. In cases where animal testing indicates suboptimal results, it has the potential to prevent the expenditure of funds on unsuccessful human trials, avoiding financial waste.
   2. The likelihood of success in human trials increases to 20% from 10% if positive results are obtained from animal testing, thereby reducing the overall risk.
   3. Opting for animal testing requires a lower initial investment of £2 million compared to the £20 million needed for direct human trials, making it a financially less risky choice.

Disadvantage:

1. The timeline for bringing the vaccine to market is extended due to the necessary additional animal testing, resulting in a delay in realizing profit potential.
2. There remains a 25% probability that animal testing will yield the desired positive efficacy results necessary for advancing to the next stage.
3. The effectiveness observed in animal trials may not consistently align with the actual efficacy demonstrated in human trials. There is a risk that positive outcomes in animal studies may not necessarily translate to successful results in human trials.

In the comparison between the risk associated with animal testing and direct human trials, opting for animal testing entails a lower overall financial risk owing to a reduced initial investment requirement. The likelihood of costly failures in human trials is also diminished when animal testing can validate efficacy based on projected probabilities. Nevertheless, there is no assurance that positive outcomes in animal testing will necessarily translate to successful human trials. Therefore, there remains a risk related to development timelines and regulatory approval when choosing to conduct additional animal testing before proceeding to human studies. Despite the extended timeline, the decreased financial risk and the potential to enhance the likelihood of success in human trials support the recommendation for additional animal studies before moving on to human trials.

1. According to the sensitivity analysis (refer to Appendix 2.2), when the likelihood of success in animal testing is less than 15%, opting for immediate human trials yields a higher expected value compared to additional animal testing. Within the range of 15% to 22.5% probability of success in animal testing, the preferable decision with the highest expected value shifts towards conducting extra animal testing. Specifically, at a 17.5% probability of success, animal testing emerges as the favoured option, with an expected value of £2.025 million compared to £1.5 million for direct human trials. As the probability surpasses 22.5%, the expected value of choosing animal testing consistently increases, reaching £21 million at a 100% probability of success.

The recommendation to prioritize animal testing before human trials holds strong for probabilities between 15-25%. In line with the original analysis assumptions, there exists a substantial range where the inclusion of animal testing adds value over opting for immediate human trials. However, if the probability of success in animal testing drops below 15%, then direct trials become the more favourable choice.

1. The company's choice depends on its risk tolerance and strategic considerations. While pursuing independent vaccine development could yield positive expected values, the rival company's offer emerges as an enticing opportunity. Accepting this offer enables cost and risk sharing, coupled with higher expected values in both human trials and additional animal testing scenarios. Collaborating with the rival company allows for the mitigation of financial exposure and an improvement in the overall risk-return profile. Ultimately, the decision to accept the offer hinges on the company's risk management strategy, financial standing, and willingness to share the outcomes of the venture. Finding the right equilibrium between risk and reward through collaboration may prove advantageous, showcasing a pragmatic approach to navigating the complexities of Variant vaccine development (refer to Appendix 2.3).APPENDICES

**APPENDIX 1.1**



**APPENDIX 1.2**



**APPENDIX 1.3**

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**APPENDIX 1.4**

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**APPENDIX 2.1**

**A diagram of a diagram

Description automatically generated with medium confidence**

**APPENDIX 2.2**



**APPENDIX 2.3**

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