**Operations Analytics**

**Summative Assessment 1 Solution**

**Group 35**

**Question 1**

Platt company makes a total profit of £50,000 based on 25,000units of external hard disks sold.

**Table

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**Table 1:** Inputs variables of the model

**(1a)** Using goal seek and Excel solver, it is evident that Platt company must sell 20,000 units of external hard disks to breakeven.

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**Table 2:** Breakeven analysis

**(1b)** The sensitivity analysis of the Platt firm's profit when the quantity of external hard discs sold fluctuates by 1000-unit intervals shows that the Platt company will begin to profit from the sale of 20,001 hard disks. According to table3, Platt made a profit of £10,000 from the sale of 21,000 external hard disks, and the profit continues to rise as the company expands its production capacity.

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**Table 3:** One Way Table

**(1c)** From the two-way table varying the quantity of external hard disks sold by ± 1000, and its variable cost by ± £1 against Platt company's profit, shows that a lower variable cost of £36 on a lower unit of production of external hard drive of 18,000 where all other inputs (selling price and fixed cost) remain the same, will still yield a profit above the base profit of £50,000. Subsequently, an increase in variable cost will require an increase in quantity sold to the tune of 28,000units to make a profit above the base profit of £50,000.

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**Table 5:** Two Way Table

**(1d)** The one-way data table graph.

**(1e)** The auditing toolbar.

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**Question 2**

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**(2a)**

The optimal solution is where the two constraint lines overlap, forming a feasible region, yielding 225 acres of sugar beet and 875 acres of corn, with a profit of £75,000 per acre.

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**(2b)** The optimal solution from Excel solver aligns with the graphical method, CozyFarm’s profit is maximized at £75,000 when 225 units of sugar beets and 875 units of corn are produced.

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**(2c)** Increase in the water supply to 2500 gives a new mix of 350 acres sugar beet and 750 acres corn and a £5000 profit increase to £80000.

Table

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**(2d)** Reducing the 2000 water requirement to 1999, the solver gives us the relevant crop acreage configuration, Profit (£74,990) and the Loss per acre foot (-£10).

Table

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Going below 1100 to 1099, we discover a second negative threshold: any profit is now impossible, as the loss per acre foot is -£60, which is the same as the cost of producing corn. To break even, CozyFarm's water constraints must never fall below 1100 acre-foot of water usage.

Table

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**Question 3**

Restaurant35 is a restaurant that offers a single menu with a three-course dinner (appetizer, main course, and dessert). The restaurant is opened from 4pm till 11pm. The daily budget of 100kg of ingredients, it takes the chef 26 minutes making the appetizer using 2kg of flour and 1kg of sugar, 40 minutes making the main course using 1.5kg of rice and 500g of pepper and 20 minutes making the dessert using 3kg of flour and 2kg of sugar. The appetiser costs £14, main course costs £18 and dessert costs £15.

All meals are prepared in advance of the restaurant opening hours and preparation takes atleast 2hours. However, the period of the food becoming stale is limited to the preparation and restaurant opening hours. The appetizer becomes stale after two-hours of no sale, the main course becomes stale after three-hours of no sale while the dessert become stale after two-hours of no sale. What quantity of the meal should Restaurant35 make to minimize cost from disposing unsold cooked food?

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According to the sensitivity analysis report, the final value of the unit cost of Appetizer is 21.667, Main Course is 0 and Dessert is 7, resulting in £408.33 [14(21.6667) + 18(0) + 15(7)] as the ideal objective function value for the minimization problem.

The allowable increase and decrease indicate how much the objective coefficient can shift before the ideal solution shifts. The objective coefficient of Appetizer will not change if it is increased up to an upper limit of ∞ and decreased up to a lower limit of 9.

The reduced cost for Main Course of £17 shows the effect of cost increase if a unit of Main Course is included in the product mix, therefore it’s not cost efficient to prepare the main course.

The constraint shows the RHS range of feasibility where the shadow price remains unchanged. If the RHS of Opening hours constraint is between 0 and 20, a shadow price of negative £8.33 will be applied to the amount of increase or decrease between the ranges, so if the RHS decreases within the allowable decrease of 7, the cost will be reduced further and become more favourable, but if the RHS increases, the cost will increase and become less favourable. If the increase or decrease is not within the realm of possibility, the model must be resolved to identify a new minimum cost.

Table

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**Question 4**

**(4a)** Vaccine 1 is an mRNA vaccine that requires ultracold refrigeration at minus 70°C, whereas Vaccine 2 is a recombinant vector vaccine that requires a freezer temperature of 4°C, as denoted by variables x and y, respectively.

To maximize profit from the sale of the vaccines, values were assumed for the input constraints, cost and selling price. The constraints are batch size to be manufactured, labour hours and freight. Using solver, the optimal solution shows that 122units of mRNA and 78units of recombinant vaccines should be produced to maximize profit to the tune of £66,100.

Graphical user interface, text, application

Description automatically generated Application, table

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The permitted increase illustrates how much the profit margin coefficient can rise without affecting the mRNA and recombinant vaccine product mix. As a result, the mRNA coefficient can rise to 450, and any rise over that will necessitate resolving the model.

The constraints show that batch size and labour hours were fully utilised, therefore they are binding, but freight has a slack of 168, resulting in the lower bound. Increases in the RHS of labour hours between 1566 and 1800 will have a positive impact since the shadow price will be applied to the increment, increasing profit, whereas decreases between 1440 and 1566 will diminish profit.

**Table

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**(4b)** The set of constraints to consider in managing the distribution of the vaccine to the entire world are:

* Transportation/Freight cost: The cost incurred in moving the vaccines from one country to another.
* Storage requirement: The availability of the specified refrigeration unit onboard and destination.
* Labour cost: The cost incurred in handling and packaging of the vaccine in production plant/warehouse.

**Appendix**

All questions were solved using graphical method and excel solver, the excel is available on [BEMM462 First assignment final.xlsx](https://universityofexeteruk-my.sharepoint.com/:x:/g/personal/ao439_exeter_ac_uk/EQRj57EwA0NHrZrd0F8fR0kB4D_DKx6zh6uhVL3sXWTk9A?e=paggyA)