Product Proposal

Linear Optimisation Perspective

Business Proposal Statement & Objectives

Problem Statement

This is a linear optimisation problem with the overall aim of determining the feasibility of developing a new product that offers better services for a bigger market segment and generates higher profit per unit compare to our exiting product.

Objectives

- To determine the feasibility of producing any of Type X and Type Y and sell them
- To determine whether it is better to produce only Type X or Type Y or both types
- To determine the proportional combination of Type X and Type Y that guarantees maximum

Method Selection & Justification

Method Simplex Linear Programming

Justification

- It helps to determine the feasibility of the proposed product in terms of profit

- It provides various feasibly profitable proportional combinations of the proposed and existing products and then suggests the one that assures maximum profit.

- Most importantly, it will provides various alternatives that can be explored considering market uncertainties or peculiarities that may be difficult to capture mathematically.

Procedure

MODEL	
Objective Function:	$\$25*x + \$30*y$
Hour_Per_Unit Constraint	$(1/200)*x + (1/400)*y <= 40$
Weekly Production Constraint (x)	$x <= 6000$
Weekly Production Constraint (y)	$y <= 4000$

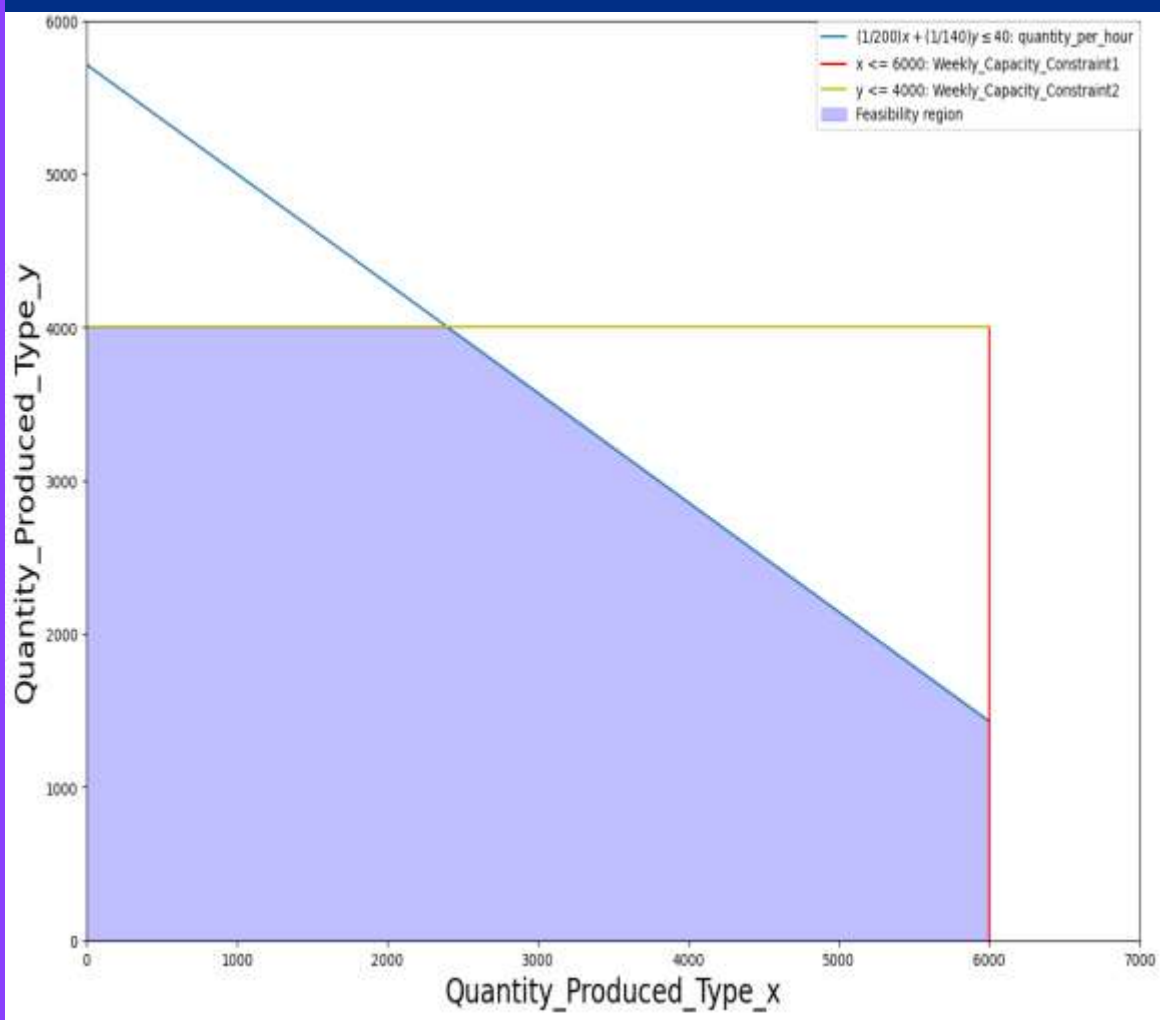| SOLUTION TOOLS	
The solutions were provided using the following tools:	
Tools	Justification
• Excel (Solver) • AMPL (Simplex) • Graphical Method • Python (Revised Simplex)	• What if analysis • Easy and fast • Feasible solution region • Validation of optimal solution

RESULTS VISUALISATION

FEASIBLE SOLUTION REGION

SIMPLEX LINEAR PROGRAMMING SOLUTION

			MODEL		
		Products	Type X	Type Y	Available Resources
		# to Produce	6000	1400	
	Constraints	Time (hour)	30	10	40
		Production per week (X)			6000
		Production per week (Y)			1400
Objective FXN	Max	Profit	150000	42000	192000

SCENARIO ANALYSIS

	Type X Only	Type Y Only	Both X & Y	
			Type X	Type Y
Weekly Production (Units)	6000	4000	6000	1400
Profit Per Unit	$25	$30	$25	$30
Time (h)	30	29	30	10
Time Slack	10	11	0	0
Profit	$150000	$120000	$150000	$42000
			$192000	

Profits

Key Outcomes

- It is feasible to produce any of Type X and Type Y with expected profits of $150,000 and $12000 respectively, subject to machinery, person-hour and capacity of specialist available. Both have time slack of 10 and 11 hours respectively.

- However, the maximum profit of $192000 is guaranteed when both types are produced in the proportional combination of 6000 and 1400 respectively.

ANTICIPATED CHALLENGES

Challenges	Likely Issues	Solutions
Competition	• Competition from incumbent giants • Competition from new entrant • Composite demand for type y causing decrease in demand for type x • Competition from substitute products	• Gathering adequate market intelligence e.g. PEST & VUCA analysis • Getting customers' feedback • Provide competitive price for the customer • Maintaining direct communication channel with the customers • Develop a unique value e.g. free health tips, free medical test, free software update, self-servicing, warranty, replacement, etc. and promote through rigorous marketing campaign
FDA Regulation	• Meeting the condition for market entrance	• Premarket notification to FDA • Premarket approval from FDA • Market listing • Quality System (QS) regulation
Overselling	Overselling could lead to: • Queue • Delay in delivery	• Capacity expansion • Digitised inventory management • Efficient forecasting models
Underselling	• Difficulty with usage • Lack of trust in the effectiveness and efficiency of the new product	• This is expected for a new product in an existing market. Agile methodology that involves improvement of the product based on the customers' feedback could be used.
Defeat	• User interface defect • Quality defect	• Total quality management approach based on six sigma • Pilot testing

CONCLUSIONS

- A weekly production of 6000 type x and 1400 type y guarantees a maximum profit of $192000 based on our current capacity.

- However, type y with higher profit per unit and improved services that offer pre-diagnosis monitoring promises a potentially bigger market and could generate higher return if necessary investment can be made on marketing and production capacity expansion.

FOLLOWUP QUESTIONS

- How much is the company willing to spend on market penetration campaign?

- Does the company have immediate plan to expand its capacity?

MODEL

		Products	Type X	Type Y	Available Resources
		# to Produce	6000	1400	
	Constraints	Time	30	10	40
	Constraints	Production per week (X)			6000
	Constraints	Production per week (Y)			1400
Objective FXN	Max	Profit	150000	42000	192000

```
AMPL                                    var x >= 0;
ampl: option solver minos;              var y >= 0;
ampl: model capstone.mod;
ampl: solve;                            maximize profit: 25*x + 30*y;
MINOS 5.51: optimal solution found.     subject to typex: x <= 6000;
2 iterations, objective 192000          subject to typey: y<= 4000;
ampl: display x.slack;                  subject to x_per_hour: 1/200 * x + 1/140 * y <= 40;
x.slack = 0

ampl: display y.slack;
y.slack = 1400

ampl: |
```
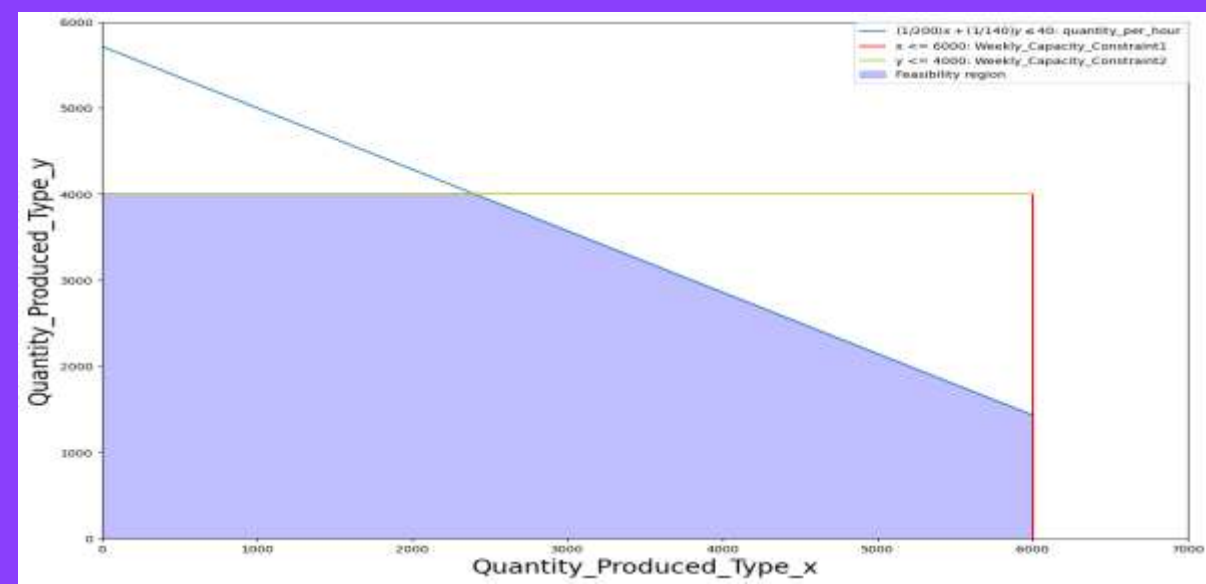
```
In [7]: import numpy as np
        import matplotlib.pyplot as plt
        import warnings
        warnings.filterwarnings('ignore')
        from scipy.optimize import linprog

In [8]: profit = np.array([25, 30])
        LHS_constraints = np.array([[0.005, 0.007], [1, 0], [0, 1]])
        RHS_constraints = np.array([40, 6000, 4000])
        production = linprog(-profit, A_ub = LHS_constraints, b_ub = RHS_constraints,
        production

Out[8]:     con: array([], dtype=float64)
            fun: -192857.14285714284
        message: 'Optimization terminated successfully.'
            nit: 3
          slack: array([  0.      ,    0.       ,   2571.42857143])
         status: 0
        success: True
              x: array([6000.        ,  1428.57142857])
```

Thank You!