Optimization and Sensitivity Analysis for Production Planning Using Excel Solver

Portfolio Project | Entry-Level Data Analyst

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Overview:

PCM Manufacturing Company produces three circuit board products—SP1, SP2, and SP3. Each product requires specific amounts of three production parts (Part 1, Part 2, and Part 3) that are limited in supply. This project applied linear programming to determine the most profitable combination of products that can be produced weekly while staying within the available resource limits.

Objective:

To develop a linear programming model using Excel Solver that maximizes total profit while meeting all production and material constraints, including the requirement that SP1 and SP2 be produced in equal quantities.

Tools Used:

- Microsoft Excel
- Excel Solver Add-in

Approach:

1. Defined the decision variables representing the number of units to produce for SP1, SP2, and SP3.
2. Formulated the objective function to maximize total weekly profit.
3. Established constraints for the capacities of Part 1, Part 2, and Part 3, as well as the equality constraint for SP1 and SP2.
4. Used Excel Solver to obtain the optimal solution and generated a sensitivity analysis report.

Results:

• Optimal production plan:
SP1 = 231 units
SP2 = 231 units
SP3 = 0 units
• Maximum weekly profit = $5,769

Managerial Interpretation:

1. Binding Constraints: The capacity of Part 1 and the equality constraint (SP1 = SP2) are fully utilized, meaning any adjustment affects total profit.
2. Shadow Prices: Increasing Part 1 capacity by one unit raises profit by approximately $1.92. Relaxing the SP1=SP2 constraint would increase profit by $1.54 per unit relaxed.
3. Non-binding Constraints: Parts 2 and 3 have shadow prices of zero, indicating they are not limiting production.
4. Reduced Costs: SP3's reduced cost of –2.38 means it is not profitable to produce under current conditions.

Key Learning:

This project deepened my understanding of optimization modeling and managerial decision-making through data analysis. I learned to interpret sensitivity analysis outputs—such as shadow prices and reduced costs—to make data-driven business recommendations.

Conclusion:

The project demonstrates how linear programming and Excel Solver can be applied to production planning to optimize profitability under real-world resource constraints.