

Aggregate planning at Green mills

Business Data Analysis IS 610 Section 01



Team 03

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## 1. Introduction and Problem Description:

In the dynamic realm of lumber production, companies often grapple with the challenge of aligning their production strategies with fluctuating market demands. The focus of this analysis is to optimize the production operations of a lumber company facing variable monthly demand. The company is considering three distinct strategies: the Chase strategy, the Level strategy, and an Optimal strategy that integrates a multitude of controllable variables.

### 1.1 Problem Statement:

The three strategies are outlined as follows:

1.1.1 Chase Strategy:Production Approach: Produce exactly the forecasted demand each month.

Workforce: Base production on regular time only. No overtime or spot market utilization.

1.1.2 Level Strategy: Production Approach: Maintain a constant number of employees (20 in this case).

Workforce: Utilize current capacity (20 employees), employ overtime if necessary, and purchase from the spot market if demand exceeds regular production.

1.1.3 Optimal Strategy: Production Approach: Consider all controllable variables - hiring, laying off, regular time, shipping cost, holding inventory cost, overtime, and spot market procurement.

Workforce: Optimize the workforce by hiring or laying off employees as needed.

1.1.4 Optimization and Simplex Linear Programming:

Optimization refers to the process of refining statistical models or parameter values to achieve the best possible outcome by minimizing errors within given constraints. In the realm of linear programming, the Simplex method is a widely utilized algorithm. Simplex LP involves optimizing a linear objective function while adhering to linear constraints and navigating through a feasible region of variable values.

### 1.2 Key Cost Factors:

To assess and compare the three strategies, five cost factors are considered:

Regular Time Labor Cost: $200 per thousand board feet.

Overtime Labor Cost: $250 per thousand board feet (limited to 25% of normal working hours).

Hiring and Laying Off Costs: $4,000 and $2,000 per employee, respectively.

Inventory Holding Costs: $25 per thousand board feet.

Spot Market Purchasing Cost: Ignoring shipping costs, treating the spot market price as $350 per thousand board feet.

## 2. Analysis:

### 2.1 Assumptions:

The following assumptions guide our analysis:

Monthly demand is given.

Production decisions are made at the beginning of each month.

The lead time for harvesting and shipping is one month, and it is ignored for this analysis.

Shipping capacity is ignored for the calculations to lessen the constraints.

### 2.2 Spreadsheet Structure:

The analysis is structured within an Excel spreadsheet, where each strategy (Chase, Level, Optimal) is allocated a dedicated sheet. The spreadsheet is designed for ease of use, with clear labels and documentation.

### 2.3 Data Input:

A section is provided for inputting relevant data, including monthly demand, costs, and employee-related information.

### 2.4 Formulas and Calculations:

Formulas are implemented for each cost factor based on the provided cost structure. Regular time, overtime, hiring, laying off, inventory holding, and spot market purchasing costs are calculated to derive the total cost for each strategy.

**Chase Strategy:** Hiring cost is the product of the number of employees hired and the cost per hire while firing cost results from the number of layoffs multiplied by the cost per layoff. Regular time cost combines regular time per board feet and hiring cost, multiplied by regular time per board feet cost. Overtime cost is determined by overtime per board feet multiplied by the difference between stock produced and regular time per board feet. Shipping cost remains constant monthly. Total cost is the sum of hiring, firing, regular time, overtime, and shipping costs. Annual cost is the cumulative total of monthly expenses.

**Level Strategy:** The "Regular Time Cost for the month" is determined by multiplying the regular time cost per thousand board feet by total production. The "Overtime Cost for the Month" is considered only if demand exceeds maximum production, calculating the cost based on overtime per thousand board feet and excess production. The "Spot Market Cost" applies when demand surpasses maximum production, factoring in the cost per thousand board feet and spot market quantity. "Shipping Cost" is calculated by multiplying the shipping cost by the quantity shipped, while "Holding Cost" is obtained by multiplying the holding cost by the total inventory. Totals represent the sum of these costs for each month, offering a comprehensive view of expenses related to production, overtime, spot market transactions, shipping, and inventory holding. The annual cost is also presented for a holistic overview.

**Optimal Strategy:** The input data for this production planning sheet includes information such as the initial number of workers, regular and maximum overtime production per worker per month, hiring and firing costs, regular and overtime wages, as well as various additional costs like shipping, holding, and spot market costs. The production plan outlines the expected regular and overtime production in board feet for each month, considering the maximum overtime production limits. The shipping plan details the shipped stock, total inventory at the end of the month, and the spot market supply. The monetary output section provides a breakdown of costs for hiring, firing, regular and overtime wages, holding, shipping, and spot market costs, totalling $5,026,250 annually.

### 2.5 Total Cost Calculation:

A summary section in the spreadsheet calculates the total cost for each strategy by summing up the individual cost components.

## 3. Conclusion and Discussion:

### 3.1 Findings:

The analysis reveals distinct cost implications for each strategy.

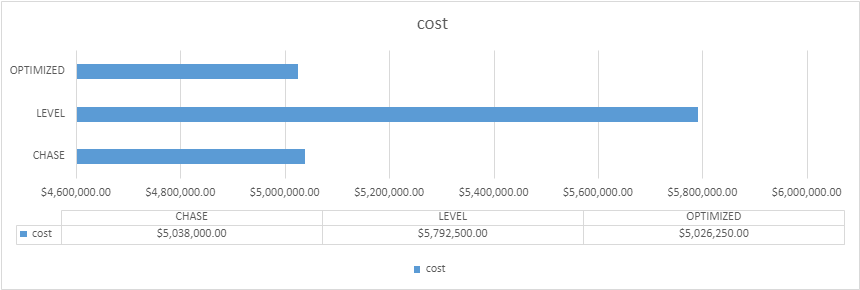


Figure 1: Comparison of total production cost in three strategies

**Chase strategy**

* This strategy exhibits lower holding and hiring costs but may incur higher overtime and spot market purchasing costs.
* This analysis underscores the importance of aligning workforce and production strategies with demand to control costs effectively.
* Prioritizing regular time over overtime, optimizing workforce management, and refining production efficiency can contribute to cost savings.
* Continuous monitoring and adjustments will be essential for long-term financial sustainability

**The Level strategy**

* With its fixed workforce, might mitigate hiring and laying off costs but could face increased overtime and spot market expenses.
* Inventory management is well-handled, minimizing excess inventory and maximizing its utilization.
* The strategic reduction in overtime employees towards the end of the year reflects an adaptive workforce strategy.
* Spot market purchases are significant in months with high demand, contributing to a substantial portion of the annual cost.

**Optimal strategy**

* It aims to strike a balance by considering all variables, providing potential cost savings.
* It provides insights into the production and financial strategy, highlighting areas for potential improvement and optimization.
* Regular monitoring and adjustments are essential to align the strategy with changing market conditions and business performance.

### 3.2 Recommendations: Based on the findings, recommendations will be provided, considering the financial implications, operational efficiency, and risk factors associated with each strategy.

#### Chase Strategy:

* Explore options to meet demand within regular working hours to minimize overtime costs.
* Evaluate the hiring and firing strategy to optimize workforce management.
* Consider inventory management strategies to reduce holding costs.

#### Level Strategy:

* Continuous monitoring of market demand and adjustment of production plans to optimize overtime and spot market costs.
* Regularly review and update the production plan based on market trends and changes in demand.

#### Optimal Strategy:

* Consider optimizing the workforce to minimize hiring and firing costs.
* Consider improving demand forecasting to enhance production planning accuracy.
* Regularly review and adjust the financial model based on actual performance.

## 4. Appendix:

An appendix is included for a more detailed analysis, additional charts, and supporting information.



## 5. Conclusion:

This report serves as a comprehensive guide to optimizing production strategies for the lumber company. By scrutinizing the Chase, Level, and Optimal strategies through a financial lens, we aim to equip the company with insights that will enable sound decision-making in the face of variable market demands. The Excel spreadsheet accompanying this report provides a detailed breakdown of the costs associated with each strategy, facilitating a deeper understanding of the implications of each approach.