Aggregate planning at green mills

IS610 Business Data Analysis

Under the guidance of Dr. Ming Chen

Team 03

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## 1. Introduction and Problem Description:

### Businesses frequently struggle to match their production plans with shifting consumer demands in the dynamic world of lumber production. Optimizing a timber company's production operations in the face of fluctuating monthly demand is the main goal of this investigation. The business is evaluating three different approaches: the Level plan, the Chase strategy, and an optimal strategy that incorporates a wide range of controllable factors.

### 1.1 Problem Statement:

The following is an outline of the three strategies:

1.1.1 Chase Strategy:Production Method: Every month, produce precisely what is anticipated in demand.   
Employees: Only base production on normal hours. No use of the spot market or overtime.

1.1.2 Level Strategy: Production Strategy: Keep the workforce at a steady level (20 in this example).   
Workforce: Make use of the 20 people that are currently on board, work overtime if needed, and buy from the spot market if demand outpaces regular production.

1.1.3 Optimal Strategy: Take into account every element that can be controlled, including hiring, firing, regular time, shipping, inventory holding, overtime, and spot market purchases.   
staff: Make the most of your staff by hiring or firing workers as necessary.

1.1.4 Optimization and Simplex Linear Programming:

Optimization is the process of fine-tuning statistical models or parameter values to minimize errors within specified limitations and produce the best possible result. The Simplex technique is a popular approach in the field of linear programming. In simplex LP, a linear objective function must be optimized while navigating through a viable zone of variable values and linear restrictions.

### 1.2 Key Cost Factors:

Five cost criteria are taken into account in order to evaluate and contrast the three strategies:   
The labor cost for regular time is $200 per thousand board feet.   
The cost of overtime labor, which is limited to 25% of regular working hours, is $250 per thousand board feet.   
Costs associated with hiring and firing employees are $4,000 and $2,000, respectively.   
The cost of keeping inventory is $25 per thousand board feet.   
Spot Market Purchasing Cost: Treat the spot market pricing as $350 per thousand board feet, excluding shipping expenses.

## 2. Analysis:

### 2.1 Assumptions:

### Our analysis is guided by the following presumptions: Demand is provided on a monthly basis. At the start of every month, choices are taken regarding production. For the sake of this analysis, the one-month lead time for harvesting and exporting is disregarded. To reduce the constraints, shipping capacity is not taken into account in the computations.

### 2.2 Spreadsheet Structure:

Every approach (Chase, Level, and Optimal) has its own sheet in the Excel spreadsheet that contains the analysis. The spreadsheet's clear labels and documentation make it easy to use.

### 2.3 Data Input:

Relevant data, such as monthly demand, expenses, and employee-related data, can be entered in this section.

### 2.4 Formulas and Calculations:

Formulas are applied to each cost component based on the given cost structure. Regular time, overtime, hiring, laying off, inventory holding, and spot market purchasing costs are computed to determine the total cost for each strategy.

**Chase Strategy:** Hiring cost is calculated by multiplying the number of employees hired by the cost per hire, while firing cost results from multiplying the number of layoffs by the cost per layoff. Regular time cost is derived by combining regular time production and hiring costs, multiplied by the cost per board feet. Overtime cost is determined by multiplying the overtime production per board feet by the difference between stock produced and regular time production. Shipping cost remains constant each month. Total cost is the sum of hiring, firing, regular time, overtime, and shipping costs, with the annual cost representing the cumulative total of monthly expenses.

**Level Strategy:** The Regular Time Cost for the month is calculated by multiplying the regular time cost per thousand board feet by the total production. The Overtime Cost for the month is included when demand exceeds maximum production, calculated based on overtime per thousand board feet and the excess production. Spot Market Cost applies when demand surpasses production limits, determined by multiplying the spot market cost per thousand board feet by the spot market quantity. Shipping Cost is obtained by multiplying the shipping rate by the shipped quantity, while Holding Cost is derived by multiplying the holding cost by the total inventory. Total costs for each month combine these factors, offering a clear view of production-related expenses, including overtime, spot market transactions, shipping, and inventory holding. The annual cost provides a complete summary of yearly expenses.

**Optimal Strategy:** Input data for the production planning sheet includes initial workforce numbers, regular and maximum overtime production per worker per month, hiring and firing costs, regular and overtime wages, and additional costs such as shipping, holding, and spot market expenses. The production plan details monthly expected regular and overtime production in board feet while adhering to maximum overtime limits. The shipping plan outlines shipped stock, end-of-month total inventory, and spot market supply. The monetary output section provides a cost breakdown for hiring, firing, regular and overtime wages, holding, shipping, and spot market expenses, resulting in an annual total of $5,026,250.

### 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 shows lower holding and hiring costs but may result in higher overtime and spot market purchasing expenses.
* The analysis emphasizes the importance of aligning workforce and production strategies with demand to manage costs effectively.
* Focusing on regular working hours instead of overtime, optimizing workforce management, and enhancing production efficiency can help achieve cost savings.
* Continuous monitoring and adjustments are vital for ensuring long-term financial sustainability.

**The Level strategy**

* By maintaining a fixed workforce, this strategy minimizes hiring and layoff costs but may incur higher overtime and spot market costs.
* Inventory management is efficiently handled, reducing excess inventory and maximizing its utilization.
* The strategic reduction of overtime employees toward the year’s end reflects an adaptable workforce approach.
* Spot market purchases during periods of high demand contribute significantly to the annual costs.

**Optimal strategy**

* This strategy aims to achieve balance by considering all key variables, offering opportunities for cost savings.
* It provides valuable insights into production and financial strategies, identifying areas for potential improvement and optimization.
* Regular monitoring and periodic adjustments are crucial to align the strategy with shifting 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 ways to meet demand within standard working hours to minimize overtime expenses.
* Assess the hiring and firing processes to improve workforce management efficiency.
* Implement inventory management strategies to lower holding costs.

#### Level Strategy:

* Continuously monitor market demand and adjust production plans to optimize overtime usage and spot market costs.
* Regularly review and update production plans in response to market trends and demand fluctuations.

#### Optimal Strategy:

* Optimize workforce management to reduce hiring and firing expenses.
* Enhance demand forecasting to improve the accuracy of production planning.
* Periodically review and refine the financial model based on actual performance outcomes.

## 4. Appendix:

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

[BDA Project fINAL.xlsx](https://csulb-my.sharepoint.com/:x:/g/personal/priyank_palshetkar01_student_csulb_edu/EVmIDp82oQNPq7IeC3MKQEkBzTDsHoHtcbkPreb5PHCUIA?e=bOq4pn)

## 5. Conclusion:

This report provides a thorough analysis of production strategies for the lumber company, focusing on the Chase, Level, and Optimal approaches from a financial perspective. Our goal is to offer the company valuable insights to support informed decision-making amidst fluctuating market demands. The accompanying Excel spreadsheet delivers a detailed cost breakdown for each strategy, enabling a clearer understanding of the impact and implications of each approach.