

# **Production and Inventory Optimization Report**

## **Introduction**

This project aims to optimize production and inventory planning to minimize costs while meeting demand through workforce management, overtime, subcontracting, and stockout mitigation. The optimization model incorporates real-world constraints such as capacity limits, promotional effects, and pricing strategies to maximize profitability.

## **Objectives**

1. Minimize total costs, including hiring, layoffs, overtime, production, inventory holding, subcontracting, and stockout costs.
2. Meet demand across periods while maintaining inventory and workforce stability.
3. Evaluate the impact of promotional pricing on demand and profitability.

## **Methodology**

1. **Model Definition:**
  - Created a Gurobi optimization model with decision variables for workforce size, production, subcontracting, overtime, inventory, stockouts, and demand.

2. **Objective Function:**
  - Minimized total costs, accounting for various operational expenses.
3. **Constraints:**
  - Workforce balance constraints (hiring and layoffs).
  - Demand fulfillment with promotion effects.
  - Inventory balance to ensure minimum stock levels and avoid stockouts.
  - Capacity limits and overtime restrictions.
4. **Scenario Analysis:**
  - Evaluated the impact of promotional pricing on demand and revenue.

## **Results**

### **Key Metrics:**

1. **Costs:**
  - Minimum total cost: \$422,660.00
2. **Revenue:**
  - Total revenue: \$640,000.00
3. **Profit:**
  - Total profit: \$217,340.00

## Insights:

- **Promotion Impact:** Promotional pricing significantly increased demand during the promotional period, boosting overall revenue but requiring additional capacity to meet demand.
- **Production Planning:** Subcontracting and overtime were utilized effectively to manage peak demand while minimizing workforce volatility.
- **Inventory Management:** Ending inventory levels met required thresholds, avoiding stockouts and ensuring demand satisfaction.

## Visualizations

1. **Aggregate Plan:**
  - Displays trends for production, inventory, demand, and stockouts over time.
2. **Cost Breakdown:**
  - Highlights the contribution of different cost components to total expenses.

## Conclusion

This optimization model demonstrates the effectiveness of integrated production and inventory planning to minimize costs while meeting demand and maximizing profitability. By incorporating pricing strategies and promotion effects,

businesses can achieve operational efficiency and financial success.

## **Recommendations**

1. Implement the model's suggested production and inventory plans to achieve cost savings and profitability goals.
2. Use scenario analysis to evaluate future promotional campaigns' impact on demand and capacity planning.
3. Regularly update the model parameters to reflect changing market conditions and operational constraints.