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Meatco EMPLOYEE scheduling analysis

# Executive Summary

## Overview

Meatco has inquired that BC Consulting minimize cost associated with staffing employees in each of their divisions by shift. Meatco with its current five divisions two shift layout, within various capacities and demand constraints, last yearpaid $2.7 million in costs. With suggested employee staffing implementations presented, Meatco can decrease costs as low as $1.9 million this year.

The cost margin mentioned above is the outcome of minimizing costs relating to employee wages and fixed costs for if a division and/or shift is open. With integration of more divisions and shifts or an e-commerce approach to selling and distributing demands, Meatco could approach even lower costs. *Table 1* represents the recommended staffing of employees for each division and shift for Meatco to minimize their costs. In addition, every division and shift was decided to be used except the 2nd division.

*Table 1*

|  |  |  |
| --- | --- | --- |
| **Cost** | $1,902,467.00 |  |
| **Employees Staffed** | | |
|  | **Shift 1** | **Shift 2** |
| **Division 1** | 120 | 0 |
| **Division 2** | 0 | 0 |
| **Division 3** | 180 | 150 |
| **Division 4** | 100 | 0 |
| **Division 5** | 266 | 0 |

|  |  |  |
| --- | --- | --- |
| **Shifts Selected** | | |
|  | **Shift 1** | **Shift 2** |
| **Division 1** | 1 | 0 |
| **Division 2** | 0 | 0 |
| **Division 3** | 1 | 1 |
| **Division 4** | 1 | 0 |
| **Division 5** | 1 | 0 |

## Recommendation and Future Work

*Table 1* will enable Meatco to reach costs as low as $1.9 million next fiscal year. Demands, pounds of production per employee, employee standards, suppliers, and economic uncertainty are all subject to variability and estimation. In order to account for this, various statistical, stochastic simulation, and predictive modeling techniques can scale this optimization model to forecast demands more accurately, account for uncertainty, and put throttles on inevitable risk that Meatco will see in the future.

# Technical Report

## Methods Used, Recommendation, and Benefits

Meatco has inquired that BC Consulting minimize cost associated with staffing employees in each of their divisions by shift. Meatco with its current five divisions two shift layout, within various capacities and demand constraints last year to pay $2.7 million in costs. With suggested employee staffing implementations presented, Meatco could decrease costs to as low as $1.9 million this year, reducing costs to just 70% of what they currently were. The cost margin mentioned above is the outcome of minimizing costs relating to employee wages and fixed costs for if a division and/or shift is open. *Table 1* represents the recommended staffing of employees for each division and shift for Meatco to minimize their costs. In addition, every division and shift was decided to be used except the 5th division. Methods used to approach conclusions involved: *Linear Modeling* and *Linear Programming*. Tools used in junction with the methods were the *LINGO* software for reproducibility.

## Assumptions

Factors involved in the ability to obtain a consistent profit for fiscal year 2018 include: supplier, cost, political, and economic variance. Supplier variance may occur when costs by week, cost of shipping, maintenance, labor costs, or the ability to obtain new suppliers fluctuate by any degree. Cost variance may be any cost involving the costs themselves, these charges may occur in the event costs or the processes that induce costs change. Examples of cost variability could include uncertainty or risk in the ability for a cost to actually contain the quality the supplier issued or additional costs available for creation and purchase to the general public. Political and economic variance can cause more ripple effects than any, minimum wage standards changes, cost of living, inflation, or any other legal changes that influence the way people can or choose to do commerce with the steel industry. Perhaps the greatest assumption of all is that the costs produced are sold with a consistent demand; no excess, spoilage, inability to sell, or distribution representative of a future change. Any and all of these ripple effects will either directly or indirectly influence the costs, revenues, and profits. All of these varying degrees of risk, change, and influence have been scoped out of the analysis to enable a robust and quantifiable solution on the current problem statement.

## Decision Variables, Sets, Parameters, Constraints, and Objective

After decomposing this problem, we were able to acquire more information about costs, pounds per employee, and employee maxims for each division and shift; pre-requisite information on all data provided in the *Memorandum of Understanding* is listed in *Table 3*. Before beginning, a single tableau was constructed to represent all information to be input into the *LINGO* model, a cost from *LINDO Systems*. Initial efforts involved *Excel Solver*, a cost of *Microsoft Excel*, however this approach was abandoned due to the succinct mathematical representation that LINGO offers for reproducibility. After acquiring sufficient information for the problem, representing decision variables came next. First, we seek to understand how current costs and pounds per employee relate. Alongside costs and pounds per employee, understanding what must change across any given combination of costs and divisions/shifts became essential. Both of these representations are defined in *Table 2*, which will be referred to for the remainder of this report. For additional understanding, parameters are defined in *Table 3* to understand the data elements provided prior to analysis.

*Table 2*: Decisions variables and parameters

|  |  |  |  |
| --- | --- | --- | --- |
| **Decision**  **Variables** |  | Represents the number of employees in division i shift j; for and | |
|  |  | Represents if division i shift j is open(1) or closed(0); for and | |
|  |  | Represents if division i is open(1) or closed(0); for | |
|  |  | |
| **Parameters** |  | Represents the cost for an employee in division i for shift j ; for and | |
|  |  | Represents the maximum number of employees for an employee in division i for shift j ; for and | |
|  |  | Represents the pounds of meat expected from an employee in division i for shift j ; for and | |

|  |  |  |
| --- | --- | --- |
| Employee Max | | |
| div\shift | 1 | 2 |
| 1 | 120 | 100 |
| 2 | 150 | 120 |
| 3 | 180 | 150 |
| 4 | 100 | 75 |
| 5 | 300 | 250 |

*Table 3*: Data elements

|  |  |  |
| --- | --- | --- |
| Cost | | |
| div\shift | 1 | 2 |
| 1 | 2000 | 2200 |
| 2 | 2100 | 2300 |
| 3 | 1900 | 2200 |
| 4 | 2000 | 2100 |
| 5 | 2200 | 2400 |

|  |  |  |
| --- | --- | --- |
| Pounds per employee | | |
| div\shift | 1 | 2 |
| 1 | 3 | 3 |
| 2 | 2.9 | 2.9 |
| 3 | 3.1 | 3.1 |
| 4 | 3.2 | 3.2 |
| 5 | 3 | 3 |

Each constraint, as reflected in *Table 5* illustrates a key component of the realistic situation Meatco is facing. By referencing *Table 1* we can see that division and shift Boolean values must hold for *Constraint 2, 3, 4, 8, 9, 10, 11*. *Constraint 2* states that at least three divisions must be open, which is correct in our optimum. *Constraint 3* states if division 4 is closed, then division 3 must also be closed, which also holds because division 4 is not closed. *Constraint 4* states at least two of the four first divisions should be open, which also holds because shift division 1, 3, and 4 are open. *Constraint 8,* 9, 10, and 11 hold because the values for in *Table 1* if and only if they are greater than zero, is a shift or division one. *Constraint 1* is verified in that first division has 120 employees and the fourth division has 100. *Constraint 5* verified in division three where the only evening shift is preceded by a day shift with *Constraint 6* satisfying minimum requirements and *Constraint 7* meeting demand.

*Table 5:* Constraints against all decision variables and parameters

|  |
| --- |
| **Constraint** |
| (1) | Division 4 must have more employees than Division 4: |
| (2) | At least 3 Divisions must be open: |
| (3) | If Division 4 is closed, then Division 3 must be closed: |
| (4) | At least 2 of the first 3 Divisions must be open: |
| (5) | No evening shift can occur unless a day shift is also occurring: |
| (6) | Total employees for each Division and shift: |
| (7) | Total meat demand across divisions and shifts: |
| (8)-(9) | Force : |
| (10)-(11) | Force : |
| **Objective** |
| (1) | Min cost =  Cost of labor + Fixed Cost If Division Open + Fixed Cost If Shift Open= |

## Model Output, Interpretation, and Sensitivity

After a full run through the *LINGO* software, the output results are reflected in *Table 1*. These results show that we can achieve a cost as low as $1,902,467.00. The most utilized division was division three followed by division 5. We found the most usefulness in the day shift over the night shift.

## Conclusion and Recommendation

Meatco has inquired that BC Consulting to minimize cost associated with staffing employees in each of their divisions by shift. Meatco with its current five divisions two shift layout, within various capacities and demand constraints last year to pay $2.7 million in costs. With suggested employee staffing implementations presented, Meatco could decrease costs to as low as $1.9 million this year.The cost margin mentioned above is the outcome of minimizing costs relating to employee wages and fixed costs for if a division and/or shift is open. With integration of higher more divisions and shifts or an e-commerce approach to selling and distributing demands, Meatco could approach even lower costs. *Table 1* represents the recommended staffing of employees for each division and shift for Meatco to minimize their costs.