MOD PIZZA LABOR MODEL

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1 Project Introduction

Problem Statement
Improve MOD Pizza's ability to optimally schedule their employees given a specific demand

Our project will provide MOD with the amount of labor hours needed to serve a forecasted number of entrees that balances customer wait times, employee utilization, and labor costs.

Real Life Example
Given the forecasted demand distribution X for Store 1 on Monday, Store 1 needs Y amount of customer facing labor hours and Z amount of non customer facing hours during Period III to optimally meet demand.

2 Current Model

Model:
Some functions of the current model worked on a few assumed parameters mentioned below:
- Entrée sales in a Customer Facing hour to earn one employee.
- Entrée sales in a Non-Customer Facing hour to earn one employee.
- Minimum staffing of 2 employees (Safety Requirement)

The excel model graphs the required Customer Facing and Non-Customer Facing needs for employees based on the projected demand for different stores. The managers, using their experience, schedule employees using the graph generated.

Objective:
Update the above mentioned assumed parameters, except Minimum staffing, to optimal numbers.

3 Project Strategy

Simulation Model ⟶ Customer Facing

- Closing Time
- Opening Time
- Non-customer facing variable time

⟶ Non-Customer Facing

Integer Programming Model ⟶ Optimal Scheduling Model

4 Customer Facing Time

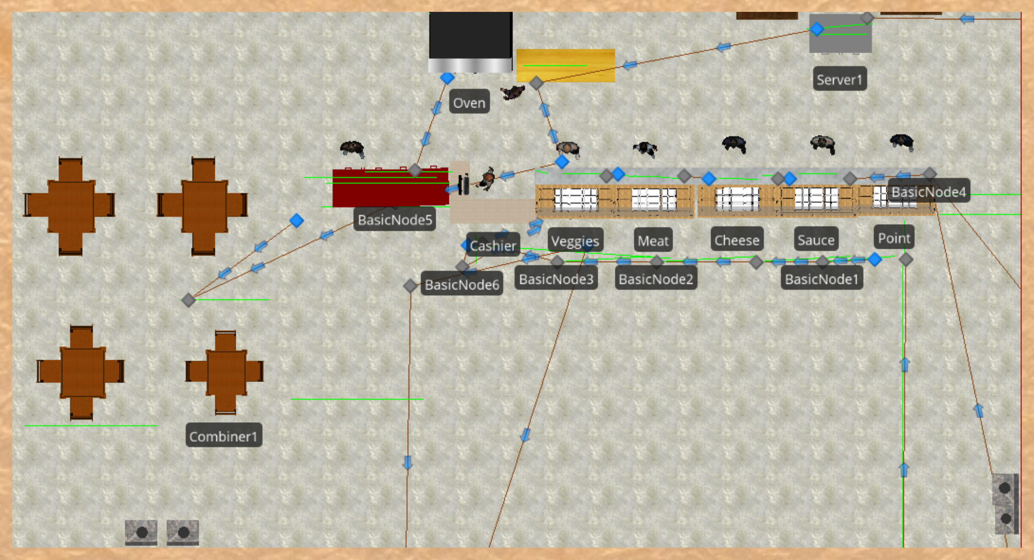
Simulation Model

Current State:
MOD does not have a precise number for the amount of Variable Customer Facing Hours they need.

Objective:
Develop a Simulation Model that can be used to find how many Customer Facing employees are needed for projected entrée sales in an hour.

Assumptions:
- One person does not work both sauce and point at one time. The processing time are kept separate in our model
- People ordering multiple pizzas follow the first pizza through the line.
- The time to move between stations is factored into the utilization
- Families are treated as one customer ordering multiple pizzas

Model:



Pictured above are a 3D and 2D picture of the final model. The model was built using data from both our own findings and MOD's internal numbers.

Output:

Name	OvenType	WorkerCount	InterarrivalTime (Minutes)	AveragePeopleInLine	AverageTimeInLine...	WorkerUtilization	EntreesCompleted	CustomerTimeInSystem...
Scenario1	3	6	0.85					
Scenario2	3	6	0.33					
Scenario3	2	4	1.12					
Scenario4	1	6	1.12					
Scenario5	1	5	1.12					
Scenario6	1	4	1.12					
Scenario7	3	6	1.12					
Scenario8	3	5	1.12					
Scenario9	3	4	1.12					
Scenario10	3	9	0.88					

Model Verification:
The accuracy of the simulation model was verified using hypothesis testing. Dozens of entrées were timed as they were being made and compared to the simulation model. The model was refined as needed until the P-value was within acceptable confidence intervals.

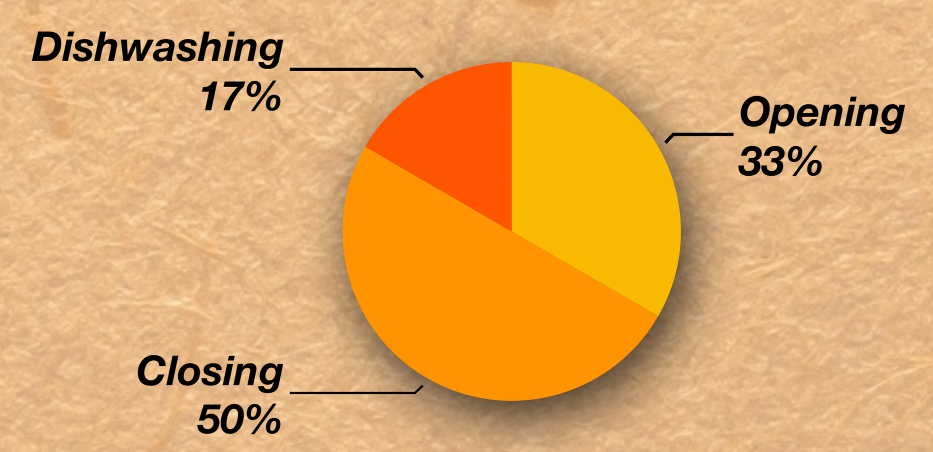
5 Non-Customer Facing Time

Objective:
Capture the labor time needed to do all of the non-customer facing related work.

Fixed Non-Customer Facing:
- Opening
- Closing
- Dishwashing (Fixed)

⟶ **A Fixed Number**

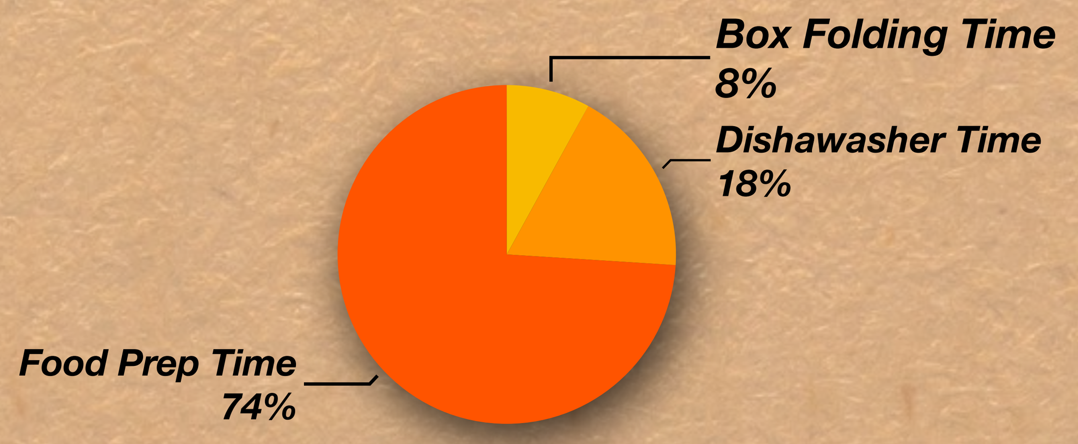
Use a combination of time study of more than 6 MOD locations and surveys with 15 responses to find the average fix non-customer facing time



Variable Non-Customer Facing:
- Food Preparation Time
- Box Folding Time
- Dishwashing (Variable)

⟶ **A Linear Relation Between Number of Entree and labor Hour Needed**

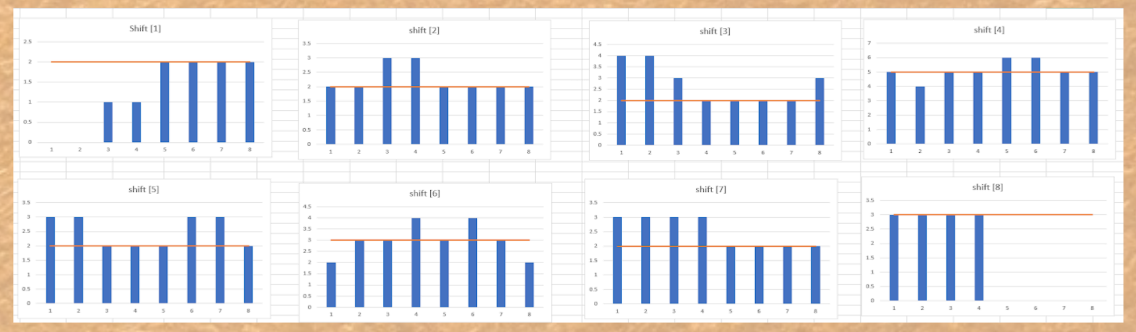
Use food usage frequency, percentage of food that go to waste, average usage, preparation time for each can of the food, % of boxes needed for different amount of entree, dishwasher counts base on entree to create a Adjustable Excel model that let the users change constraints specifically for their location and needs.



6 Integer Programming

Objective
The goal of the integer program was to provide the store managers for each MOD location a recommendation for how many employees to staff for a 2 hour period given demand of employees in 15 minute intervals.

Assumptions:
- We assumed that the optimal shift length was 2 hours
- We assume that the earliest opening time was 8:00am and the latest closing time was at midnight
- We assumed that the shift lengths all had to be the same length
- We assumed that all employees have the same level of skills



Model:

Parameters:

```
param c1;  # cost of overstaffing
param c2;  # cost of understaffing
param s;   # number of 15 min intervals
param w;   # number of 2 hour shifts
param d(i, j);
  # demand for employees in 15 minutes interval i
in shift j, i = 1,…s, j = 1,…w
```

Variables:

```
var x(i) ≥ 0 integer;  # number of employees for
shift i, i = 1 … w
```

$$\text{var } y_{(i,\,j)} = \begin{cases} 1, & \text{if } x_j \geq d_{(1,\,j)} \\ 0, & \text{if } x_j \leq d_{(1,\,j)} \end{cases},\ i=1,\dots s,\ j=1,\dots w;$$

```
# 1 if overstaffing for 15 minutes interval i in
shift j
# 0 if understaffing for 15 minutes interval i in
shift j
```

Objective Function:

$$\text{minimize } \sum \sum \left|d_{(i,\,j)} - x_j\right| \times \left((1 - y_{(i,\,j)}) \times c_1 + c_2 \times y_{(i,\,j)}\right),\ i = 1, \dots s,\ j = 1, \dots w;$$

```
#minimize cost of overstaffing and understaffing
```

Constraints:

$$\text{subject to } x_i \geq 2,\ i = 1,\dots w;$$

```
# minimum staffing of 2 employees for shift i
```

7 Impact

All of this work was compiled to present all of the goals of our project strategy to MOD. It should help them staff more effectively given projected entrée count and have a much greater understanding of how long their processes take.

8 Acknowledgement

We want to thank our project sponsors John Goedert and Jason Landraitis as well as Ivy Harlan for all the help they have given us on this project. They have been a help to us in both providing us guidance for the project and also helping us understand how projects work in general in a professional environment. We would also like to thank Professor Patty Buchanan. She has helped us learn how to manage a project and the necessary skills for good communication. We would not have been able to complete the project without the help of these individuals.

MOD