

# Members

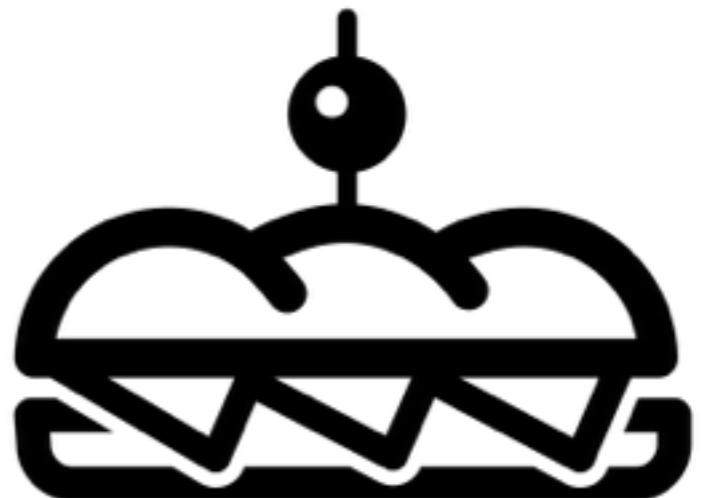
**Courtney** Chow  
**Jeyda** Kaynatma  
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# IEORganizers

# About SF Soup Co.

- *17 Locations* in the bay area
- One location is in *Berkeley* on Bancroft Avenue. This locations is *unique* because it experiences considerably *higher traffic*
- *Sells* - Sandwiches, Salads, and Soups (depending on location)
- *Store Types* - Catering, In-Store, and Third Party



# Two Project Areas

## 1. Demand Forecasting

Evaluated and built a demand forecasting model for forecasting the demand for soup, salads, and sandwiches

## 2. Conduct Preparation Time Analysis

Study and evaluate the preparation times for store preparation tasks and subtasks in order to bring insight to the amount of time and labor force needed.

# Demand Forecasting

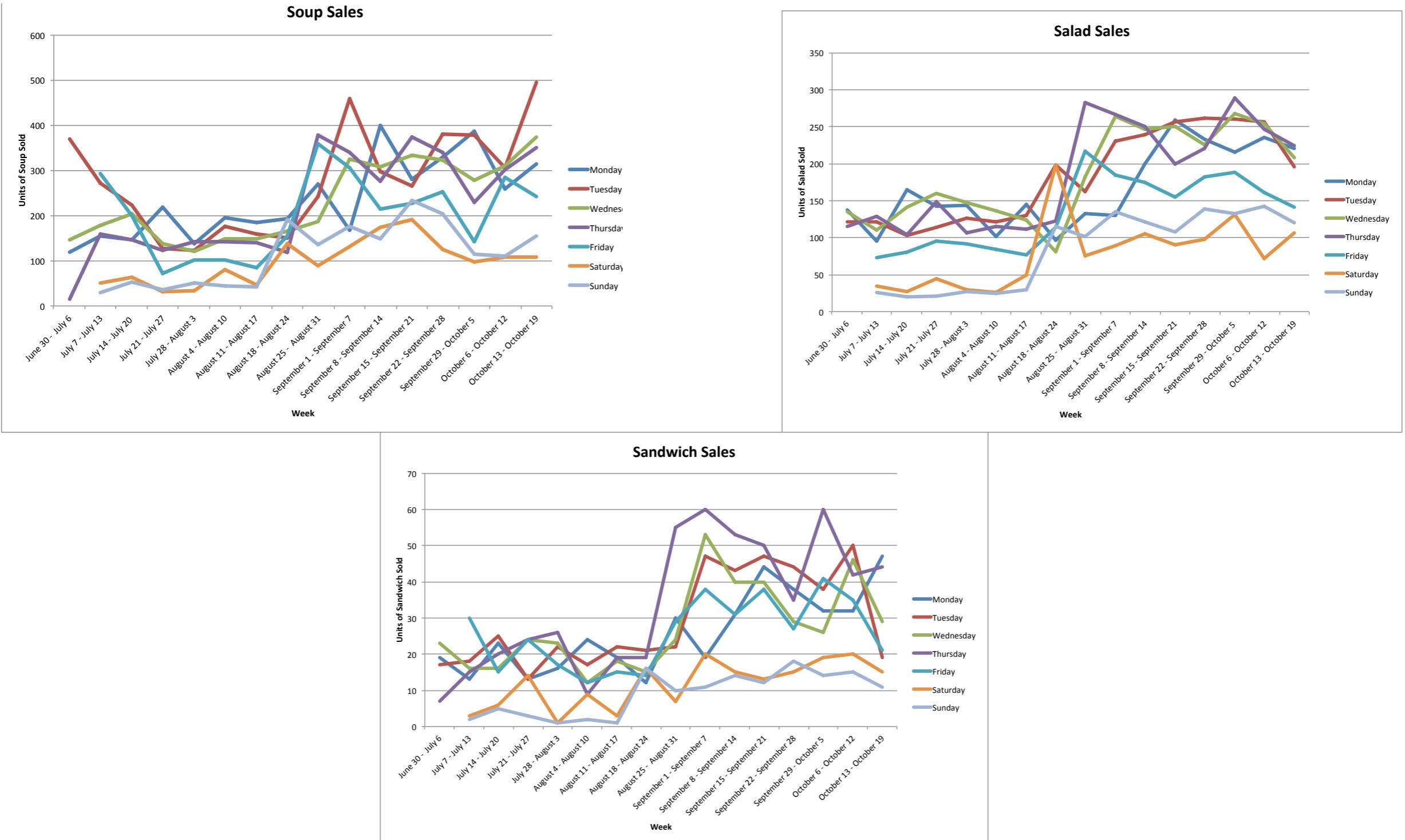
## Problem Statement

Inaccurate demand prediction results in wasted food or lack of food, which hurts profits by over producing or under producing.

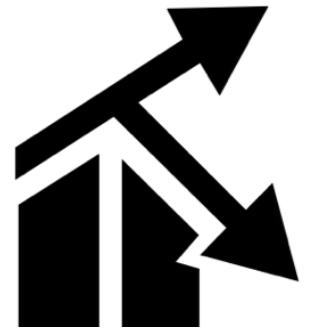


# Demand Forecasting

## Initial Analysis



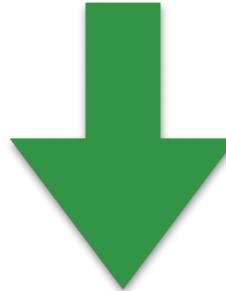
# Demand Forecasting



## Initial Analysis

### *Hypothesis*

Number of units sold depends on the day of the week



### *Highest Sales*

Monday, Tuesday,  
Wednesday, Thursday

### *Mid-Range Sales*

Friday

### *Lowest*

Saturday, Sunday

### *Higher Sales*

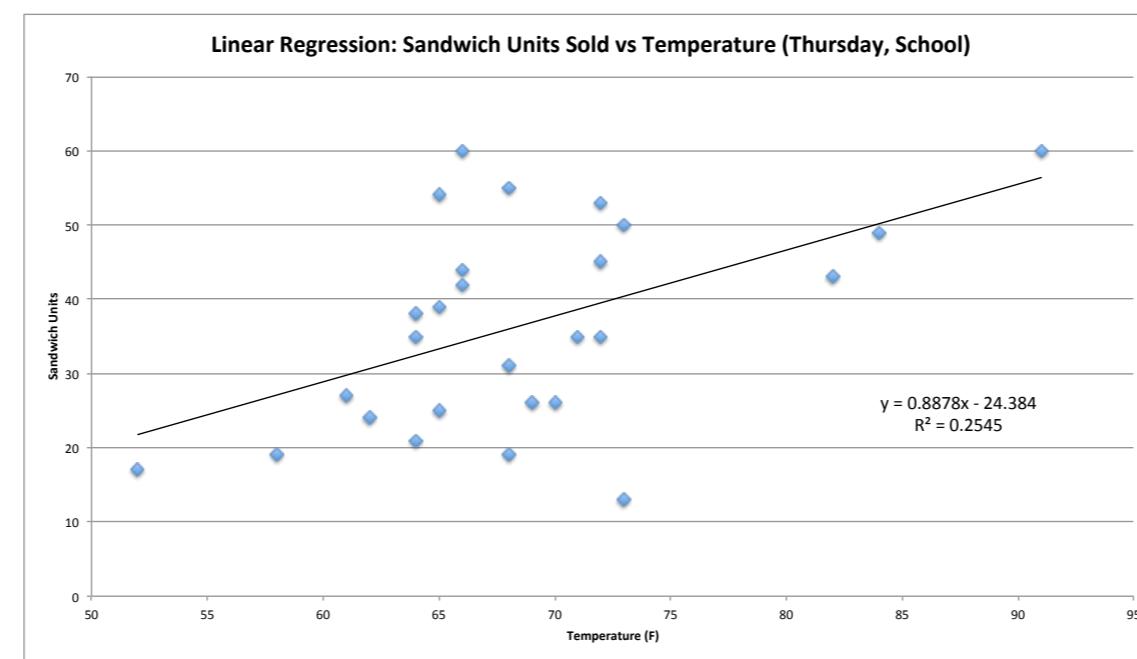
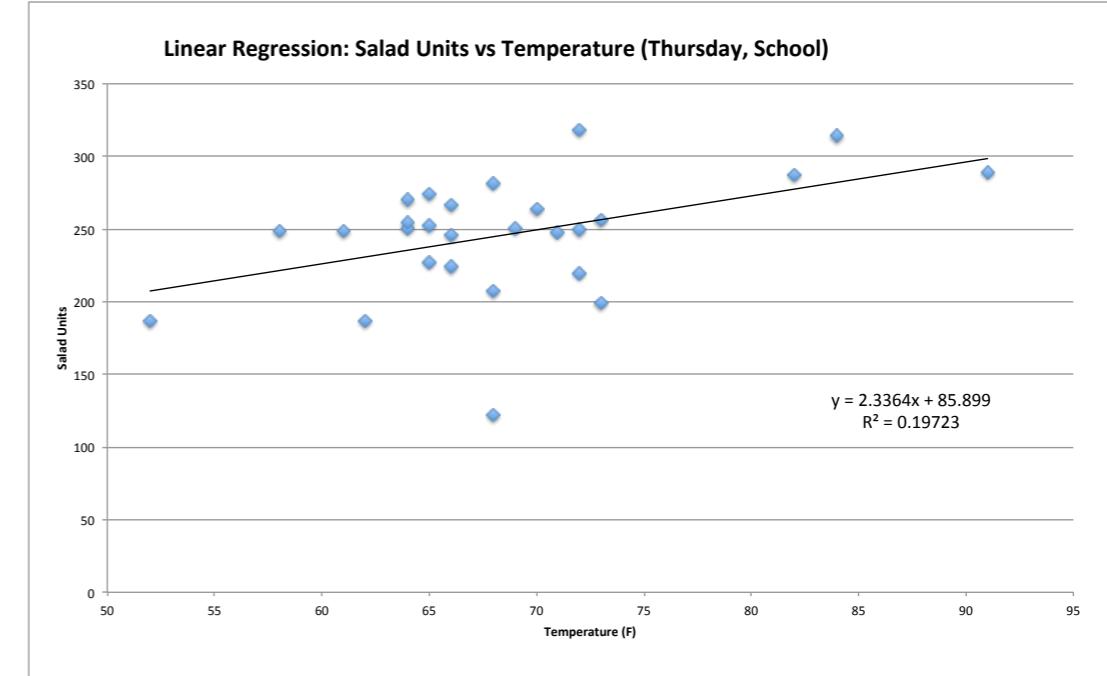
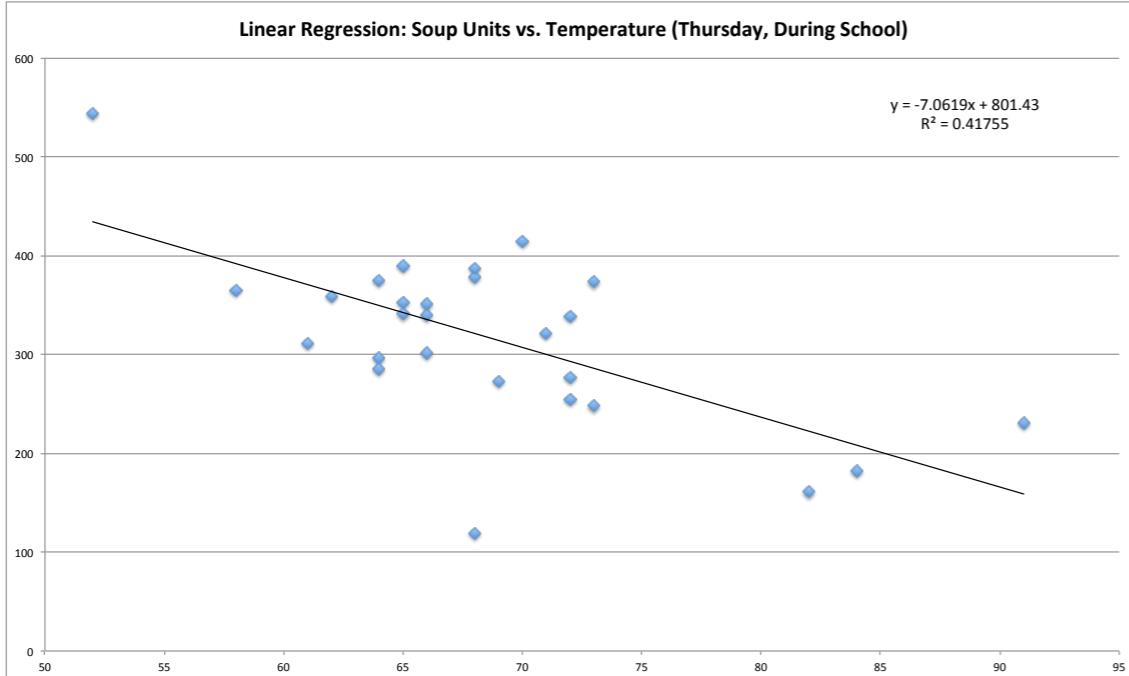
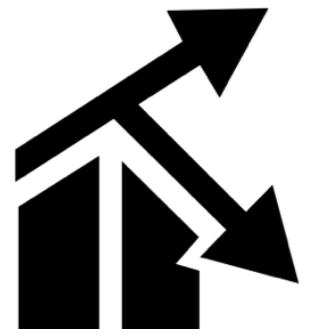
School

### *Lower Sales*

No School, Sunday

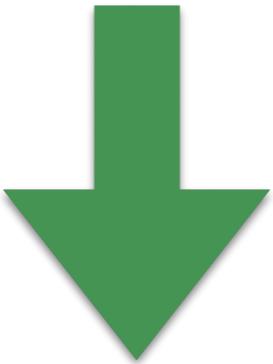
# Demand Forecasting

## Initial Analysis



## Hypothesis:

Temperature is an important factor for soup sales.



## Validating:

Run linear regressions of Temperature vs  
Soup Sales holding seasonality and day of  
the week constant.

# Linear Regression Results

## Temperature vs Units of Soup Sold

Day of the Week	Seasonality	Constant	Coefficient	R^2
Monday	School	981.31	-9.8906	0.44043
Monday	No School	223.01	-1.1588	0.01088
Tuesday	School	1033.3	-10.087	0.5185
Tuesday	No School	614.32	-6.4306	0.08237
Wednesday	School	926.56	-8.8685	0.61285
Wednesday	No School	289.84	-2.2775	0.11324
Thursday	School	801.43	-7.0619	0.41155
Thursday	No School	262.02	-1.8018	0.02091
Friday	School	749.79	-7.3691	0.38474
Friday	No School	213.37	-1.2068	0.00736
Saturday	School	464.55	-4.6338	0.38724
Saturday	No School	257.76	-3.0071	0.2332
Sunday	School	439.72	-3.7343	0.40238
Sunday	No School	206.57	-2.3135	0.10489

HIGHER R<sup>2</sup>

shows significant  
linear relationship

# Multiple Linear Regression

## Soups During School

Soup ↑ Temp ↓

SOUP DEMAND =

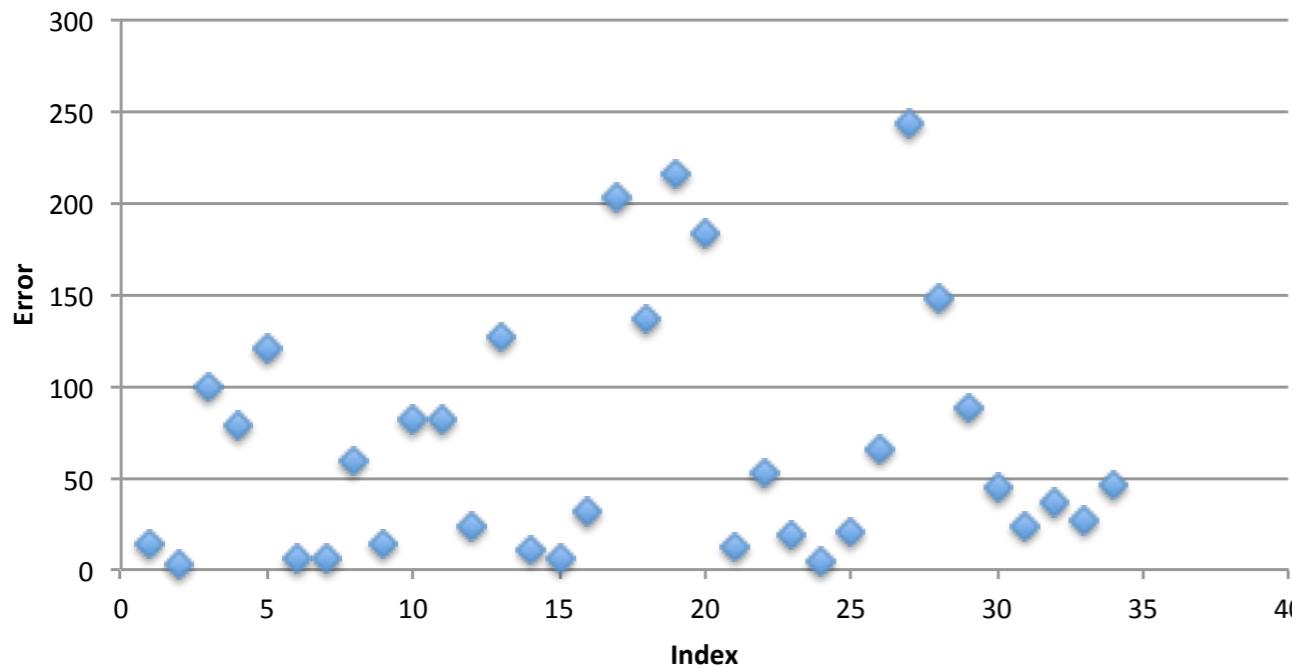
$$718.12 - 7.65 * \text{Temperature} + 110.92 * \text{Monday} + 151.63 * \text{Tuesday} + 125.09 * \text{Wednesday} + 123.89 * \text{Thursday} + 50.42 * \text{Friday} - 51.22 * \text{Saturday} - 13.5771 * \text{Sunday}$$

Sat. & Sun. Slowest Days

# Error Analysis

## Soups During School

Multiple Linear Regression (Soups, School)



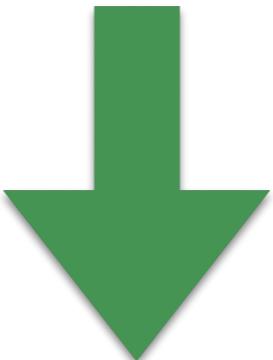
MAD	68.55323529
St. Dev.	67.12513638
Max	242.25
Min	3.4071

- 50% of the time, the error is less than 69 Soup Units (20% production)
- 84% of the time, the error is less than 136 Soup Units (40% production)

Used data from 2014 (during school) before November to predict Soup Sales in November (34 days).

## Hypothesis:

Salad, sandwich, and soup sales when school is not in session would be less correlated with temperature because of lesser demand.



## Validation:

Run linear regressions of Temperature vs Soup Sales holding seasonality and day of the week constant.

# Moving Averages

Soups (Winter-break, Summer), All Salads, and All Sandwiches



*We asked, should we use exponential smoothing?*

**No because time had no noticeable effect on sales when we plotted sales over time.**



*How many observations should we use for our moving average?*

**There was no best number of observations. When we tested 3 through 8 observations we found there was no clear number of observations which would minimize error.**

# Error Analysis

## Soups During School

Type	<b>50% of the time error is &lt;</b>	<b>84% of the time error is &lt;</b>
Soups/No School/Summer	68.0 Units (52.7% of total)	122.6 Units (95.2% of total)
Sandwich/No School/Summer	07.5 Units (53.7% of total)	12.8 Units (91.4% of total)
Sandwich/School	07.2 Units (36.6% of total)	12.8 Units (64.7% of total)
Salad/No School/Summer	44.5 Units (50.3% of total)	71.4 Units (80.7% of total)
Salad/School	56.6 Units (37.2% of total)	94.7 Units (62.3% of total)

# Preparation Time Analysis

## Problem Statement

The amount of time an employee takes to perform each task within store prep time is unknown. As a result of this uncertainty, overstaffing and understaffing for store prep time can lead to wasteful cost and time usage.

# Preparation Time Analysis

## Data Gathering Methodology

1. Created a Prep Time Template for stores to record task times
  - A. Preliminary store visits to observe practices and refine template
2. For the dates of Oct 14 - Oct 19, prep tasks times were recorded for all 17 SF Soup Co stores:
  - B. 5 IEORganizers and 2 SF Soup Co. District Managers oversaw prep time task recording on Wednesday Oct 15
  - C. Templates were sent daily to IEORganizers

# Preparation Time Analysis

## Template Used For Data Collecting

San Francisco Soup Company: Morning Preparation Time Document								
Store Location	Today's Date		Break (if applicable)	Time In	Time Out			
Your Full Name:	Time Arrival to Store							
<b>Directions:</b> Hey Crew Member! Please fill out this sheet by writing down each task that you do in the morning along with the time you started and stopped. Only fill out things that you personally do in the morning before the store opens. Also, only include the time you spent working on a task, not the total time it takes to prepare. For example, if you spend 20 minutes putting the soups into the steamer, only include those 20 minutes and not the couple hours it takes to heat. Thanks for your help!								
<b>Salad Bar Tasks</b>	Start Time	Stop Time	<b>Premade Salads Tasks</b>	Start Time	Stop Time			
Prepare Salad Ingredients (cut vegetables, boil eggs, etc.)			Make Package Salads					
Set Up Salad Bar			Load Salads in Display					
Cut and Wash Romaine			Portion Dressings					
Fill Dressing			Other:					
Portion Lettuces			Other:					
Other:			Other:					
Other:			Other:					
Other:			Other:					
<b>Sandwiches Tasks</b>	Start Time	Stop Time	<b>Manager Tasks</b>	Start Time	Stop Time			
Prepare Sandwich Ingredients			Count Safe and Drawers					
Make Sandwiches (all types)			Assign Drawers					
Display Sandwiches			Set Specials					
Other:			Confirm Specials On-line					
Other:			Complete Orders					
Other:			Assign Tasks to Crew					
Other:			Restaurant Check					
Other:			Emails					
Other:			Other:					
<b>Quantity Types (Manager Only)</b>	In-Store Units	Other:	<b>Soup Tasks</b>	Start Time	Stop Time	<b>Other Tasks</b>	Start Time	Stop Time
Pre-made Salad (Number of Salads Made)			Example Task	7:02 AM	7:24 AM	Put Away Commissary Order (Refrigerated)		
Sandwiches (Number of Sandwiches Made)			Round 1:			Put Away Commissary Order (Dry Goods)		
Salad Bar (Expected Number of Salads for the Day)			Load Soups in Steamer			Set Up Utensil Display		
Soups (Gallons/Bags Prepared)			Load Soups in Warmer (Holding Cabinet)			Fill Ice in Soda Machine		
Number of Third Pans of Leftover Soup			Fill Bain Maries with Soup			Set Up Drink Display		
Number of Breakfast Customers (if applicable)			Round 2: (optional)			Set Up Cash Register		
			Load Soups in Steamer			Change Soup Display Menu		
			Load Soups in Warmer (Holding Cabinet)			Prepare Rice and Noodles		
			Fill Bain Maries with Soup			Cut Bread		
			Round 3: (optional)			Set Up Bread Display		
			Load Soups in Steamer			Prepare Rice and Noodles		
			Load Soups in Warmer (Holding Cabinet)			Prepare and Display Parfait		
			Fill Bain Maries with Soup			Prepare and Display Fruit Cups		
			Round 4: (optional)			<b>Breakfast Tasks</b>	Start Time	Stop Time
			Load Soups in Steamer			Number of Breakfast Customers		
			Load Soups in Warmer (Holding Cabinet)			Prepare Oatmeal		
			Fill Bain Maries with Soup			Prepare Coffee		
			Set Up Quality and Temp Checklist			Prepare Frittata		
			Other:			Set Up Coffee Creamers		
						Stock and Display Sugar		
						Prepare Oatmeal Toppings		
						Steam Table for Frittatas/Oatmeal		
						Fill Main Steam Tables		
						Prepare/Display OJ		
						Wrap & Display Pastries/Bagels		
						Breakdown Breakfast		
						Other:		
						Other:		

# Preparation Time Analysis

## Data Analysis Methodology

1. Data Cleaning for outliers
2. Classified each task as variable timed tasks and fixed timed tasks
  - A. Variable Timed Tasks are tasks that depend on quantity produced
  - B. Fixed Timed Tasks are tasks that do not depend on quantity produced
3. *Store Task Averages*: Averaged each store's task times across the entire week of data
4. *Chain Task Averages*: Averaged each of our store averages of fixed time tasks and variable rates (to weigh each store evenly)
5. Summed tasks into their major category— salad bar, sandwich, pre-made salads, soup, other, manager, and breakfast

# Preparation Time Analysis

## Data Analysis Methodology

### Fixed Timed Tasks

Salad Bar Tasks	Other Tasks	Manager Tasks
-----------------	-------------	---------------

TOTAL PREP TIME =

$$\begin{aligned} & (\text{time / sandwich}) * (\# \text{ of sandwiches}) + \\ & (\text{time / premade salad}) * (\# \text{ premade salads}) + \\ & (\text{time / gallon}) * (\text{gallons of soup}) + \\ & (\text{breakfast time}) * (\text{breakfast binary}) + (\text{other time for fixed tasks}) \end{aligned}$$

### Variable Timed Tasks

# Preparation Time Analysis

## Results

**Sandwiches Tasks (Variable Timed Task):**

2.08 minutes per sandwich

**Premade Salad Tasks (Variable Timed Task):**

3.47 minutes per premade salad

**Soup Tasks (Variable Timed Task):**

1.85 minutes per gallon of soup

**Salad Bar Tasks (Fixed Timed Task):**

196.85 minutes

**Manager Tasks (Fixed Timed Task):**

63.14 minutes

**Other Tasks (Fixed Timed Task):**

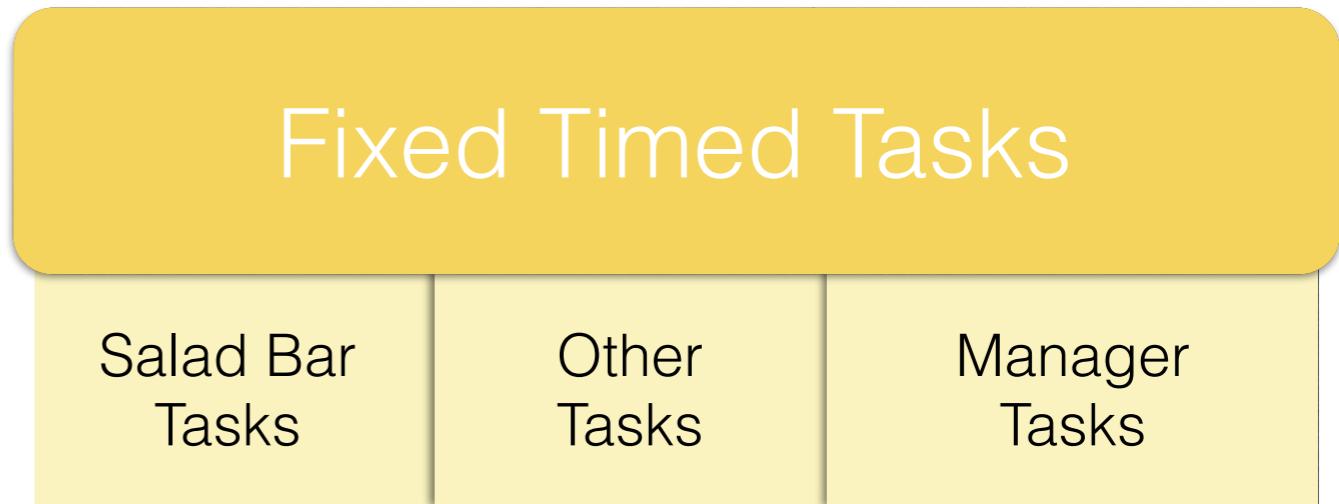
125.54 minutes

**Breakfast Tasks (Fixed Timed Task):**

91.8 minutes

# Preparation Time Analysis

## Results



TOTAL PREP TIME =

$$(2.08) * (\# \text{ of sandwiches}) +  
(3.47) * (\# \text{ premade salads}) +  
(1.85) * (\text{gallons of soup}) +  
(91.83) * (\text{breakfast binary}) + (196.85 + 125.54 + 63.14)$$

Variable Timed Tasks

# Preparation Time Analysis

## Best Practices Analysis

In order to incentivize each store to spend only as many hours preparing as the most efficient stores do, we look into the task time “best practices.”

TOTAL PREP TIME =

$$(1.29) * (\# \text{ of sandwiches}) +  
(1.51) * (\# \text{ premade salads}) +  
(1.12) * (\text{gallons of soup}) +  
(90.34) * (\text{breakfast binary}) + (133.49 + 72.85 + 35.22)$$

Variable Timed Tasks

Fixed Timed Tasks

Salad Bar  
Tasks

Other  
Tasks

Manager  
Tasks

Using only the six fastest average store values for each task, we create a “lean model” with the following formula:

# Preparation Time Analysis

## Best Practices Analysis

	Crocker	Fremont	Oakland
Gallons of Soup Prepared:	30	21	40
Number of Sandwiches made:	45	56	66
Amount of Pre-made Salads Made:	38	40	45
Amount of Hours Suggested by Formula:	11 hours 22 minutes	11 hours 34 minutes	12 hours 43 minutes
Amount of Hours Suggested by “Best Practices” Formula:	8 hours 11 minutes	8 hours 18 minutes	9 hours 0 minutes
Actual Hours Worked by Store:	11 hours 0 minutes	6 hours 0 minutes	5 hours 0 minutes

# Sources of Error

## Preparation Time Analysis

### Method of Data Collection

Errors in the recording of task times could have resulted from the way we were forced to collect data.

### Overestimation of Task Time

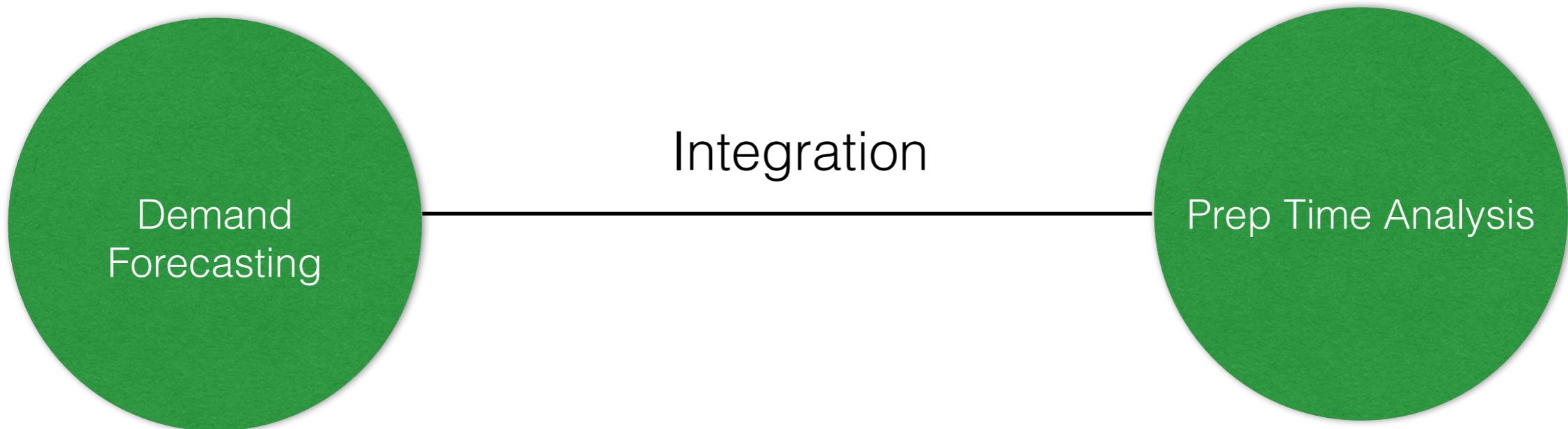
Some stores not needing to perform every task.

Influx of catering orders that were separated from quantities recorded but were not separated when recording task times

Linearity assumption for our prep time model

# Conclusion

We then integrated the results of both of these projects--demand forecasting and prep time analysis--into an algorithm that managers could use in their daily planning of schedules and food quantities.



# Interface: MSEExcel

## Morning Preparation Time and Daily Demand Forecast

Answer the questions in the gray boxes and a suggestion for the number of worker hours to allocate for morning preparation will appear in the green box. This is only a suggestion, as a manager, you know your store best and can adjust accordingly.

Average Preparation Time Estimation		Hours	Minutes
Amount of Time to Allocate:		10	16
"Best Practices" Preparation Time Estimation		Hours	Minutes
Amount of Time to Allocate		8	9



Morning Prep Time Allocation Input	
How many gallons of soup are being prepared?	30
How many sandwiches are you making?	5
How many pre-made salads are you making?	11
Does your store have breakfast?	Yes
Does your store have a salad bar?	Yes

Forecasting Recommendations	
Forecasted Sandwiches	2.8
Forecasted Salads	43.2
Forecasted Soups	85.8



Forecast Input	
Day Of The Week	Saturday
Time Of The Year	Winter Break or Spring Break or Thanksgiving Break
Temperature (Fahrenheit)	63

**Find Forecast**

# Thank you!

Special Thanks to Professor Kaminsky and  
Clayton Chan!