NYC Food Orders

Dereje Pollock, Kaylee Wu, Elijah Pilhe

Abstract

A 150 word abstract.

The number of restaurants in New York is steadily increasing, reflecting the city's fast-paced lifestyle and the growing reliance on dining out or ordering in. With so many options available, understanding what factors influence the cost of a meal is essential for both restaurant efficiency and customer satisfaction. Our project aims to explore how specific restaurant characteristics contribute to the cost of an order.

Background and Significance

Type background and significance section here.

Data

We are using a multilevel dataset titled "NYC Restaurants Data - Food Ordering and Delivery." This dataset contains variables such as order_id, restaurant, cuisine_type, WeekendOrWeekday, rating, delivery_time, and prep_time. The dataset is structured into two levels: level 2 variables include restaurant, WeekendOrWeekday, and cuisine type. While level 1 variables include rating, cost, prep_time, order_id, and delivery_time.

Key Variables Considered

Response Variable

• **cost**: Total price of the order.

Predictors

- **prep_time**: Time taken to prepare the order (numeric).
- rating: Customer rating of the restaurant (numeric).
- cuisine_type: Type of cuisine (categorical: Italian, Chinese, etc.).
- WeekendOrWeekday: Whether the order was placed on a weekday or weekend (binary).
- restaurant: Random effect to account for differences across restaurants (factor)

Type data section here. Include captions with tables and graphs. Examples:

Table 1: The First 10 observations

order_id	restaurant	$cuisine_type$	cost	${\it WeekendOrWeekday}$	rating	$prep_time$	${\tt delivery_time}$	$total_time$
1476547	Bareburger	American	6.84	Weekend	5	22	24	46
1476583	Bareburger	American	17.03	Weekend	5	35	21	56
1476715	Bareburger	American	16.30	Weekday	NA	20	28	48
1476821	Bareburger	American	12.18	Weekend	NA	33	18	51
1476911	Bareburger	American	8.63	Weekend	4	21	22	43
1477003	Bareburger	American	32.93	Weekend	NA	29	24	53
1477172	Bareburger	American	19.35	Weekday	4	33	27	60
1477708	Bareburger	American	6.07	Weekend	4	23	15	38
1477823	Bareburger	American	5.63	Weekend	4	32	30	62
1477836	Bareburger	American	12.08	Weekend	NA	29	20	49

First 10 Observations in our dataset

Prep Time vs Cost

We can use a scatterplot to understand the relationship between the time it takes to prepare an order, and the cost of the order.

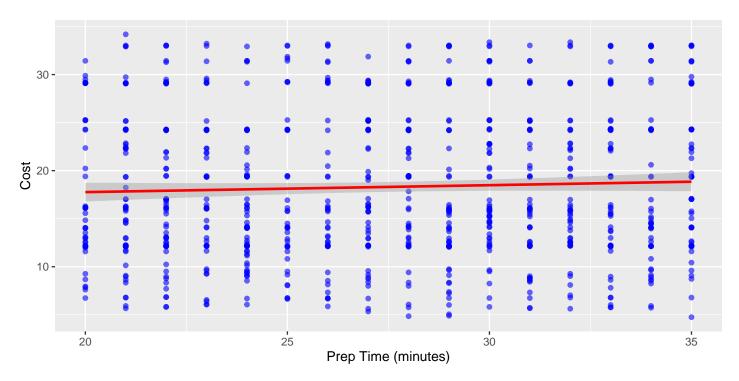


Figure 1: Cost vs. Prep Time

we can see a positive correlation between prep time and cost of an order. This correlation does not apear to be dramatic, but if we separate orders by their cuisine type, we can hopefully see clearer trends.

Prep time vs Cost by Cuisine

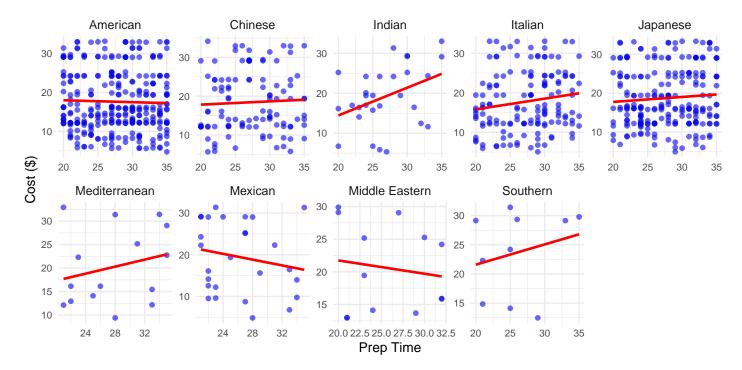
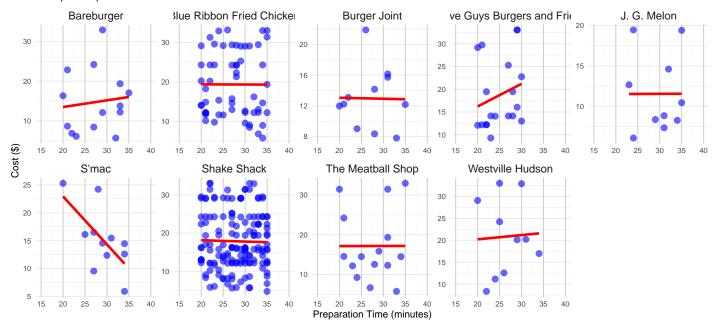


Figure 2: Cost vs. Prep Time

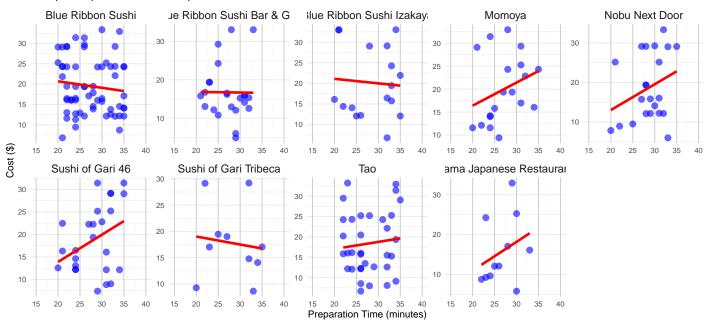
Cost vs Prep Time for American Cuisine by Restaurant

Each panel represents a different American cuisine restaurant



Cost vs Prep Time for Japanese Cuisine by Restaurant

Each panel represents a different Japanese cuisine restaurant



Methods

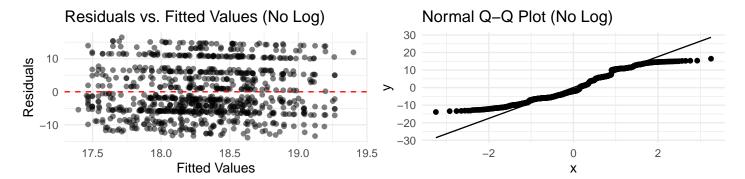
M1

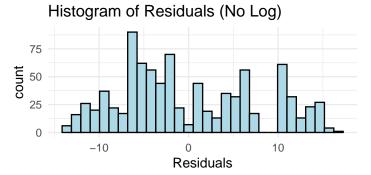
Consider Y_{ij} to be the cost of the j-th order, in the i-th restaurant.

$$Y_{ij} = \beta_0 + \alpha_1 \text{cuisineType}_i + \beta_2 \text{prepTime}_{ij} + u_i + \epsilon_i j$$

where $u_i \sim \mathcal{N}(0, \sigma_u^2)$ and $\epsilon_{ij} \sim \mathcal{N}(0, \sigma^2)$

```
# Linear mixed model fit by REML. t-tests use Satterthwaite's method ['lmerModLmerTest']
# Formula: cost ~ prep_time + (1 | restaurant)
    Data: FoodOrdersNYC
# REML criterion at convergence: 6036.9
# Scaled residuals:
     Min
              1Q Median
                              30
 -1.8081 -0.7616 -0.2614 0.7832 2.1464
# Random effects:
                         Variance Std.Dev.
 Groups
          Name
 restaurant (Intercept) 0.4086 0.6392
 Residual
                         58.9305 7.6766
# Number of obs: 872, groups: restaurant, 30
# Fixed effects:
                                       df t value Pr(>|t|)
              Estimate Std. Error
# (Intercept) 16.26660
                          1.57969 821.48717 10.297
                                                      <2e-16 ***
# prep_time
              0.07546
                          0.05654 866.93661
                                            1.335
                                                       0.182
# Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
# Correlation of Fixed Effects:
           (Intr)
# prep_time -0.982
```





Type methods section here. Write your final model in equation form, like this:

$$\begin{split} Y_{ij} &= [\alpha_0 + \alpha_1 \text{Orch}_i + \beta_0 \text{LargeEns}_{ij} + \beta_1 \text{Orch}_i \text{LargeEns}_{ij}] \\ &+ [u_i + v_i \text{LargeEns}_{ij} + \epsilon_{ij}] \end{split}$$

where,

$$\left[\begin{array}{c} u_i \\ v_i \end{array}\right] \sim N\left(\left[\begin{array}{cc} 0 \\ 0 \end{array}\right], \left[\begin{array}{cc} \sigma_u^2 & \rho_{uv}\sigma_u\sigma_v \\ \rho_{uv}\sigma_u\sigma_v & \sigma_v^2 \end{array}\right]\right)$$

and $\epsilon_{ij} \sim N(0, \sigma^2)$.

Results

Write your results section here. Include the fixed and random effects tables, as below.

From the model output, most variables are not statistically significant. However, the p-value for food preparation time (0.057) is very close to the conventional significance threshold, suggesting a potential relationship between preparation time and cost. Specifically, for every additional minute of preparation time, the cost is expected to increase by 0.072, assuming all other factors remain constant. While this result is not definitively significant at the 0.05 level, it indicates a possible trend that longer preparation times may contribute to higher order costs. More analysis will be added.

Discussion and Conclusions

Type discussion section.

Conclusion

- 1. what does the result indicate about the restaurants in NYC
- 2. What customers and owners can learn
- 3. The limitations of the model

References

References in APA format. For example:

Sadler, M. E., & Miller, C. J. (2010). Performance anxiety: A longitudinal study of the roles of personality and experience in musicians. Social Psychological and Personality Science, 1(3), 280-287.

Lin, M. C. (2019). An Investigation Of Music Performance Anxiety In Taiwanese Pianists, Vocalists, String And Wind Instrumentalists At The College Level.

Stoeber, J., & Eismann, U. (2007). Perfectionism in young musicians: Relations with motivation, effort, achievement, and distress. Personality and Individual Differences, 43(8), 2182-2192.

Roback, P., & Legler, J. (2021). Beyond Multiple Linear Regression: Applied Generalized Linear Models And Multilevel Models in R. CRC Press.

Appendix (optional)