UBC Dining Hall Waste Trends

Final Report

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Amy Wheeler[1], Thomas Chan[2], Fardin Kabir[2], Sarir Parvizi[3], Jonathan Graves[4], Felix Doucet[5], Sarah Jaberi[5], Meejung Kang[5], Ariya Kosavisutte [5], Leo Lee[5], Pingxun Li[5], Zoey Luo[5], and Hanqi Qiu[5]

[1]Report and Primary Analysis
[2]Secondary Analysis
[3]Presentation
[4]Supervisor and Corresponding Author: jonathan.graves@ubc.ca
[5]Primary Analysis

Abstract

UBC dining hall food waste decreased over the course of the first 2023W semester. This effect was driven by changes in dinner food waste. Additionally, introducing new menu items led to a brief, small uptick in food waste. We recommend creating waste reduction strategies that target dinner waste, such as reducing the serving size of new dinner menu items, as well as creating anti-waste messaging that is communicated to diners as early in the semester as possible.

1 Background

From September to December 2023, UBC Food Services recorded daily food waste data for each of UBC's first year dining halls: *Feast*, *Open Kitchen*, and *Vanier*. This data set included information on waste weight (measured in kilograms), including the source of the food waste within the dining hall, and the meal (breakfast, lunch, dinner). This data was supplemented by details of the menu, outlining what food was served, and the number of diners as measured by card-swipes (called "covers"). Most of the analyses considered each dining hall, meal, and day as a distinct observation.

As a part of their final course work, students from Dr Jonathan Graves' ECON 326 (Econometrics II) class investigated the trends in this food waste data set, and produced research papers describing the results. This report is based on a summary of these research papers. The process of converting the papers into this report is depicted in Figure 1, and was as follows:

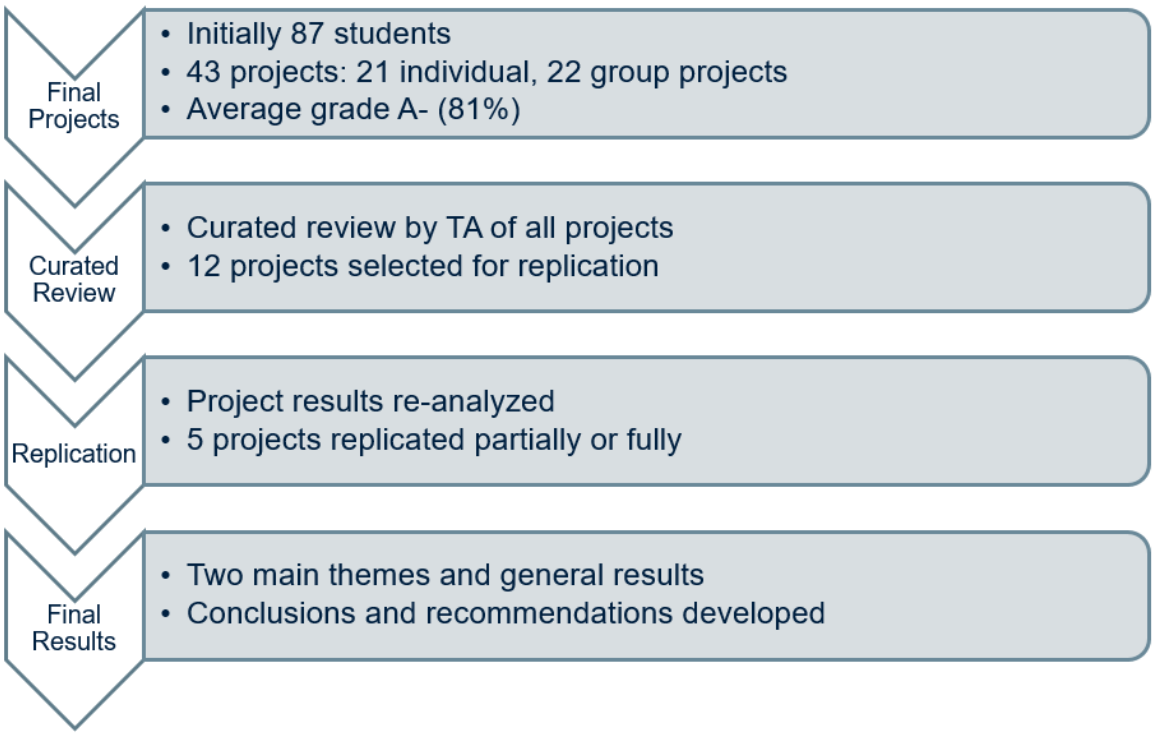

Figure 1: Report creation and validation process

- After the projects were submitted, the teaching assistant, PhD candidate Thomas Chan, reviewed and curated the projects to identify themes for the results, and exemplar reports that best-illustrated those findings.
- This resulted in 12 projects being selected for further analysis. The project results were re-analyzed by the authors of this report, and 5 projects were identified as having robust and representative results.

- From these papers, we identified the themes and recommendations discussed in this report.

The objective of this process was to summarize the results of the many individual projects, particularly those results which were most robust and interesting. There were a number of other papers which explored other research questions, but did not find significant results. We mention some of these in this report, but the details are omitted.

1.1 Research Questions and Organization

The projects discussed in this report focused on three research questions:

1. What are the primary contributors to food waste at UBC's dining halls?
2. What time trends are associated with higher levels of food waste?
3. Does the variability of the menu influence food waste levels?

The remainder of this report is structured as follows. In Section 2, we discuss the trends over time of food waste. In Section 3, we discuss menu variability. Section 4 provides recommendations and conclusions. The appendix, Section 6, contains technical details.

2 Time Trends

Understanding how food waste and the number of diners varied throughout the semester time period was a key research question in this investigation. However, there were two main issues with this data: outliers and missing observations.

2.1 Outliers and Missing Observations

In the waste data, there were some days on which no data was recorded, mainly at the start of the term. However, the more serious issue was the presence of outliers in the data.

As shown in Figure 2, there were two large "spikes" in food waste observed:

- At dinner on 2023-12-11 in *Open Kitchen*, from the "Preparation" waste channel.
- At lunch on 2023-09-23 *Feast*, from the "Preparation" waste channel.

Both of these spikes in food waste were several orders of magnitude higher than normal for the data. From discussions with the chef, it is possible that these represent either disposal (typically, donation to charity) of excess perishable food products or data entry errors. Since in either case these represent different sources of food waste than normally described by the data, in this report we have omitted these observations.

A second issue concerns missing observations, primarily in in the covers data. This represents a situation where the number of card swipes was not reported. This is depicted in Figure 4, where the lines are "broken" indicating a missing day or series of days. This was particularly an issue for *Vanier* which led many of the student reports to focus on either *Feast* or *Open Kitchen* since the data was more complete and reliable.

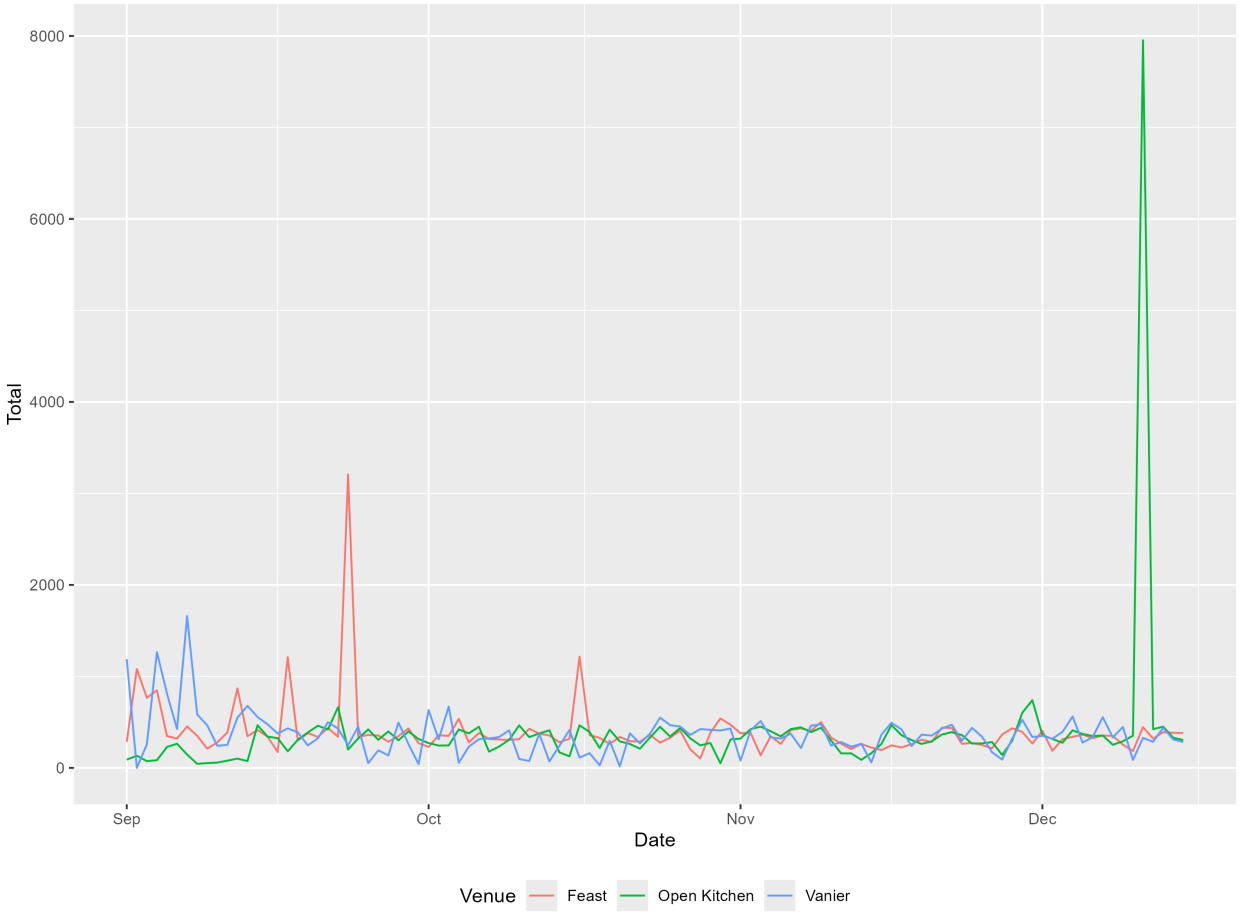

Figure 2: Outliers in food waste (kg) data

2.2 Food Waste and Covers

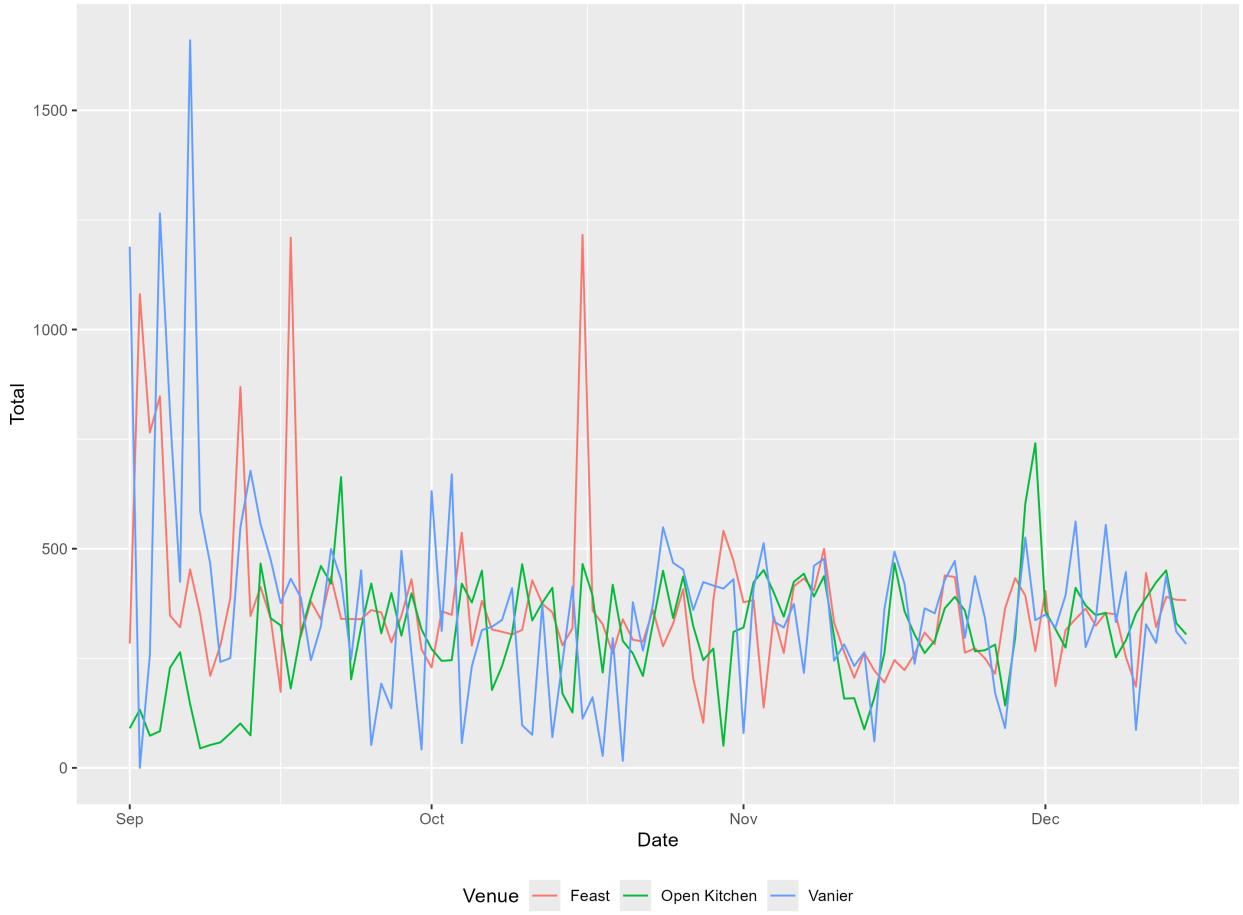

Figure 3: Food waste (kg) over time

As pictured in Figure 3, total daily food waste, in all three dining halls, decreased over time. It was highest in September and lowest at the end of the semester. The spikes and dips in the graph follow a regular pattern, likely due to effects specific to the day (e.g., food waste on the weekend versus on a typical Wednesday).

Students analyzed this data using different statistical models, mainly linear regression. A linear regression decomposes changes in an outcome variable of interest (e.g., daily plate waste) into effects attributable to a set of explanatory variables (e.g., different measures of time).

In general, average daily plate waste decreased by approximately 5.25 kilograms per week, or about 0.75 kg per day. This was mainly associated with a reduction in dinner waste. This agrees with results taken from the venues with the most complete data, which found a decline of 5.5 kg per week. On a per-cover basis, waste fell by about 2.1 kg per 1000 diners per week (0.3 kg per 1000 diners per day). Long weekends and other academic breaks (e.g., Reading

Week) did not influence average daily plate waste. These results were generally robust across different dining halls, channels of waste production, and categories of waste.

The number of diners over time is pictured in Figure 4. While the total number of diners shows regular patterns, corresponding to the days of the week, students did not find underlying trends for the number of diners over time. The number of diners did not seem to have a general trend upwards or downwards.

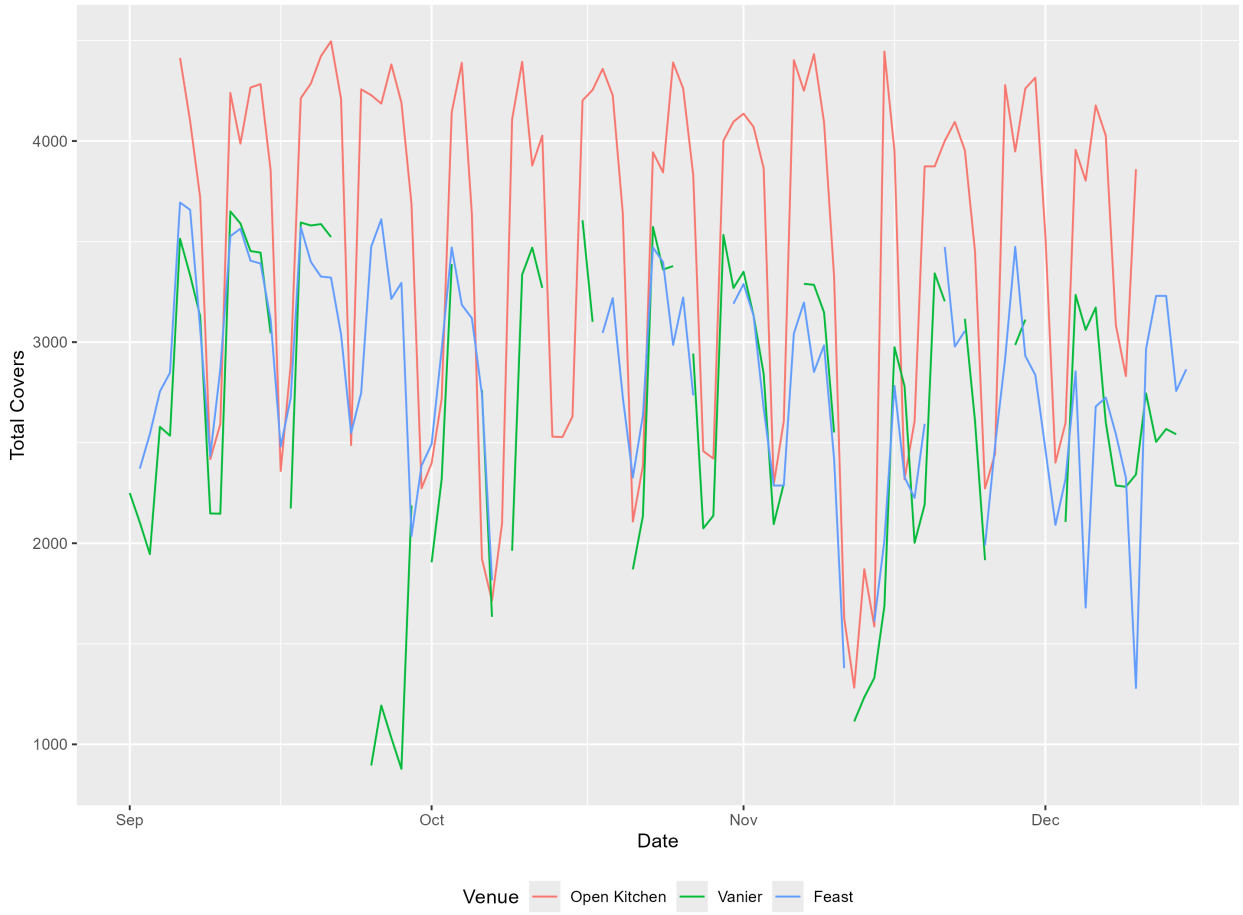

Figure 4: Number of diners (covers / card swipes) over time

The amount of waste per diner is pictured in Figure 5. It is more consistent over time after September, and is similar across dining halls. The one exception is *Vanier*, but this dining halls has more inconsistent covers data, making the comparison difficult.

3 Menu Changes and Food Waste

One theory that may explain the decrease in food waste over time has to do with the menu of food being served. If different food items are more or less popular, this may result in more

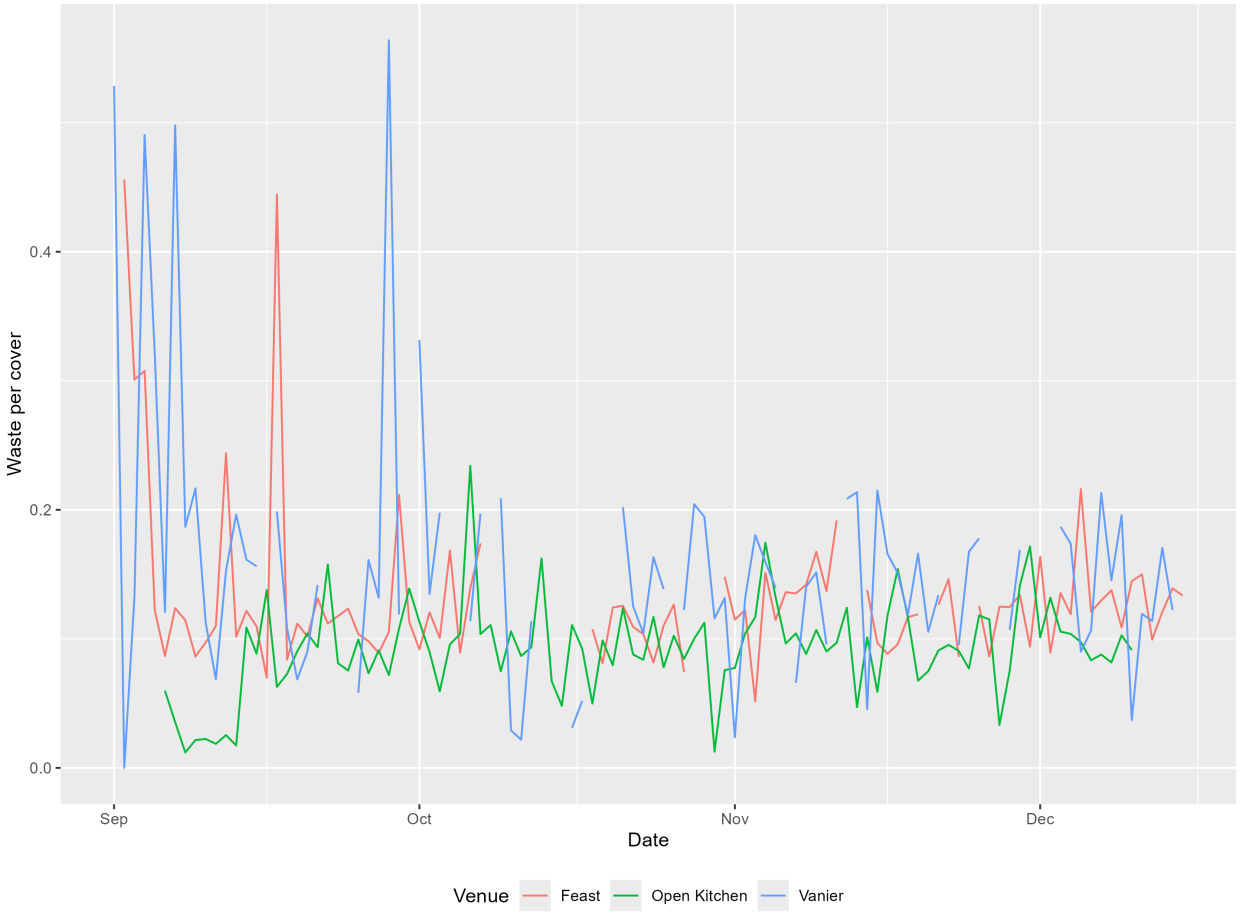

Figure 5: Waste per diner (cover over time)

or less waste. If the patterns of food being served changes over time, this could create the trends we observed in food waste.

A number of students investigated this issue. However, none of them found any particular relationship between the type of food being served and waste. This included both the cuisine being served (e.g., American, Asian, etc.) and the dietary type (e.g., Vegetarian).

However, one set of investigations identifiifed an alternative: menu *variability*. What if food waste was due to experimentation with different types of food? The hypothesis was that when a new food item is introduced, diners may try it out of curiosity. As diners learn their food preferences, they take less of what they dislike, which leads to less food waste.

The rate of this decline would depend both of the tastes of students for different kinds of food, and the rate of variation in the menu. One contributor to this report, Pingxun Li, looked at this in detail, and simulated different profiles that could result, depicted in Figure 6.

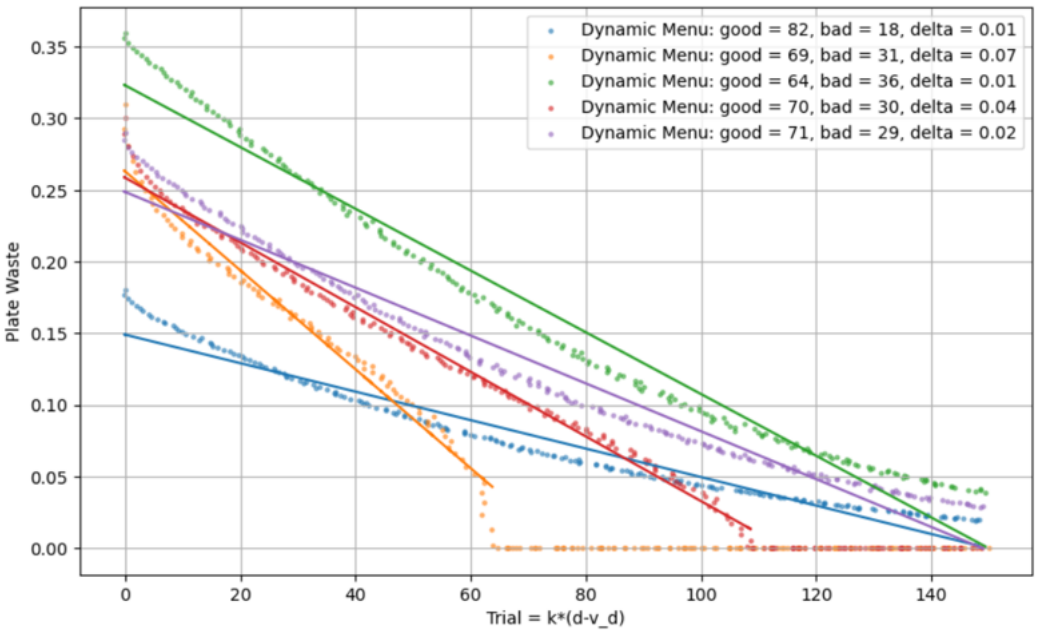

Figure 6: Simulations of different per-person waste trends (credit: Pingxun Li)

There some evidence to support this theory. Based on a regression analysis, introducing a new menu item increased food waste by about 2-4 kg per 1000 diners. This equates to about 10 kg of waste in total per day for a typical dining hall, per item. However, the strength of this effect depended on how the analysis was set up, implying that this not definitive evidence in favour of this hypothesis.

4 Conclusions and Next Steps

Based on the findings of this report, we recommend the following waste-reduction strategies:

- **Prioritize dinner waste reduction**. Dinner was the most wasteful meal of the day. For overall improved sustainability, it would be most effective to reduce evening food waste. Targeted strategies, such as advertising, could be implemented during dinner service.
- **Communicate waste reduction strategies to diners in September**. Food waste was highest in September. Communicate to students the importance of not wasting food in order to reduce this effect. There is also a chance that early messaging may lead to a more sustainable semester generally.
- **Study the effect of menu changes in more detail**. There is weak evidence for the impact of menu changes on food waste. Further research and data collection on this effect is required to understand this impact fully.
- **Reduce the portion sizes of new menu items**. When a new menu item is introduced, initially serve smaller portions of it. This way, if a diner dislikes the food and decides to throw it out entirely, less food will be wasted.

5 References and Acknowledgements

The findings of this report were taken from the following students' projects:

- Doucet, F. (2024). *Labour Skill and Food Waste in Kitchens at UBC.* Methods of Empirical Research in Economics, The University of British Columbia.
- Kosavisutte, A., & Lee, L. (2024). *A cultured relation: Analyzing cuisine impacts on food waste.* Methods of Empirical Research in Economics, The University of British Columbia.
- Li, P. (2024) *Dynamic Menu Composition and Plate Waste Generation.* Methods of Empirical Research In Economics, The University of British Columbia.
- Luo, Z., Jaberi, S., Qiu, H., & Kang, M. (2024). *The Effects of Weekends of UBC First Year Food Waste.* Methods of Empirical Research in Economics, The University of British Columbia.
- Wheeler, A. (2024) *Totem Temporal Trash Trends.* Methods of Empirical Research in Economics, The University of British Columbia.

The authors of this report were responsible for:

- *Secondary Analysis*: Thomas Chan, Fardin Kabir.
- *Presentation*: Sarir Parvizi.
- *Report*: Amy Wheeler.
- *Supervision*: Jonathan Graves (Instructor)
- *Primary Analyses*: Felix Doucet, Sarah Jaberi, Meejung Kang, Ariya Kosavisutte, Leo Lee, Pingxun Li, Zoey Luo, Hanqi Qiu, Amy Wheeler.

6 Appendix

6.1 Time Trends Analysis

Table 1

	Dependent variable:			
	'Waste per cover'		Total	
	(1)	(2)	(3)	(4)
Date	−0.0003**	−0.0003**	−0.746**	−0.702**
	(0.0001)	(0.0001)	(0.339)	(0.346)
Venue: Open Kitchen	−0.041***		−59.667**	
	(0.010)		(25.371)	
Venue: Vanier	0.022**		0.164	
	(0.011)		(25.310)	
Weekend	0.015		−71.436***	
	(0.010)		(23.003)	
Constant	5.953**	6.062**	15,040.880**	14,142.920**
	(2.754)	(2.937)	(6,662.056)	(6,806.098)
Observations	270	270	316	316
R^2	0.144	0.015	0.065	0.013
Adjusted R^2	0.131	0.011	0.052	0.010
Note:				*p<0.1; **p<0.05; ***p<0.01

6.2 Plate Waste Analysis

Table 2

	Dependent variable:			
	Plate/'Total Covers'			
	(1)	(2)	(3)	(4)
Number of New Items	0.002***	0.002***	0.0002	0.0002
	(0.001)	(0.001)	(0.001)	(0.002)
Lunch			0.005	0.005
			(0.014)	(0.014)
Dinner			0.033**	0.034**
			(0.014)	(0.014)
Date				0.0001
				(0.0001)
Weekday Fixed Effects	No	Yes	Yes	Yes
Observations	127	127	127	127
R^2	0.116	0.305	0.525	0.527
Note:				*p<0.1; **p<0.05; ***p<0.01