**THE CITY OF TORONTO, CANADA SINGLE-USE PLASTIC FEES**

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**ABSTRACT**

Society’s dependency on plastic products, especially single-use plastic products such as bags, cups, straws, and cutlery has created significant impacts on our natural environment and is a contributing factor to the plastic pollution problem. To discourage and prevent the use and distribution of single-use plastic items such as bags, many cities, towns, states, and municipalities worldwide have enacted legislation banning these single-use products or imposing additional fees on these single-use products.

Utilizing the survey and poll conducted by the City of Toronto, Canada in 2018 and 2019, respondents’ preferences were analyzed to understand the mean fees for single-use plastic bags, paper bags, and single-use hot and cold cups. Respondents’ average preferred fees for these single-use use bags and hot and cold cups was approximately $0.29 CAD while the average fee for paper bags is approximately $0.15 CAD. These different mean fees highlight how respondents are willing to accept a higher fee for single-use plastic bags for example compared to single-use paper bags. Additionally, respondents’ demographics of age, income, and gender were incorporated into the analysis to identify if the average preferred fee is different between age groups. The younger respondents were identified as willing to accept a higher fee while older respondents preferred a lower fee. Furthermore, in reviewing respondents’ demographic data, age, income, and gender were identified as significant factors when reviewing if respondents supported additional bans on other single-use plastic products such as straws, and cutlery, while only age and gender were identified as significant factors with regards to foam takeaway containers.

In identifying these factors we can see respondents are willing to accept a higher fee for single-use plastic bags than the most common fee identified by Warner (2017) of $0.10 USD or $0.14 CAD. Additionally, in reviewing respondents’ demographic details of age, gender, and income the analysis identified which factors are significant as it relates to the population of individuals willing to support additional bans or fees on other single-use products such as straws and cutlery. Demographic information was also utilized to identify if the different age brackets prefer a similar or different fee for single-use plastic bags, paper bags, and hot and cold cups. With this information along with the other research, more effective decisions can be made regarding the bans and fees of single-use plastic products.

**INTRODUCTION**

Many countries, cities, states, and local municipalities have proposed bans or fees for single-use plastic items such as plastic bags. In the United States, some states have imposed statewide bans on the use of single-use plastic bags while others have imposed restrictions that still allow consumers to continue to purchase single-use bags for a minimum monetary amount. In addition to banning or restricting the use of single-use plastic bags, other single-use plastic items such as straws have also had legislation passed in some states to ban these items as well.

There are many factors to consider when deciding to enact new legislation, especially when it can impact many individuals’ daily lives and the potential to impose hardships on certain groups of individuals, with additional fees or inconveniences. Researching customer preferences, to determine a generally accepted minimum fee for these single-use items is critical to understanding how consumers will react to the new legislation. By understanding customer preferences for the additional fees related to single-use plastic items effective decisions can be made to minimize the impact on consumers. By imposing fees for these various single-use plastic items, according to Rivers et al. these “economic nudges are meant to be highly visible, serving as choice reminders and prompts for behavioral change” p.161. Imposing fees for these single-use plastic items can discourage consumers from utilizing these items, therefore potentially reducing the impacts on our natural environment.

**OBJECTIVES**

The city of Toronto, Canada in 2018 and 2019 conducted various surveys of its residents to determine “which single-use or take away items residents and stakeholders are most interested in addressing and their preferred methods or approaches to reducing these items or promoting additional reuse” (“About Reducing Single Use and Takeaway Items”, 2021). With the goal of reducing the use of single-use plastic items, having an understanding of customer preferences as it relates to the fees imposed on these products, could help drive decisions regarding the appropriate fees for these products while also potentially discouraging customers to purchase and use these single-use products.

The average preferred fee of the respondents for each category, single-use plastic bags, single-use plastic paper bags, and single-use plastic hot and cold cups, along with respondents’ demographics will be examined to identify the average fee the respondents are willing to accept. By understanding consumer preferences, this research can provide insights, and guide effective decisions, when evaluating if new fees should be imposed. Additionally, the research can be compared to the current legislation in place in various localities to identify if there is a potential need to reduce or increase the fees already established.

**OVERVIEW OF STUDY**

Utilizing the survey and poll conducted in the City of Toronto, Canada in 2018 and 2019 the work will be expanded, to examine respondents’ preferences surrounding the potential fees imposed on single-use plastic items, such as single-use plastic bags, single-use paper bags, and drinking cups. Additionally, using the respondent’s demographic information a more detailed analysis will be completed to identify if there is a difference in the accepted fees between the various respondents’ age groups or gender groups for the single-use items. The study aims to identify if respondents prefer a single or similar fee for the various single-use plastic bags, hot and cold cups, and paper bags, or if there should be a different fee for each type of single-use product.

**RESEARCH QUESTIONS AND HYPOTHESES**

The first business question and null and alternative hypothesis developed seeks to examine the respondent’s average thresholds when charging an additional fee for single-use plastic bags, single-use paper bags, and single-use hot and cold cups. When consumer purchase items is the average preference for a single fee across various single-use plastic items or should the different fees be charged depending on which single-use plastic item is being purchased?

**Business Question:** Would consumers prefer a standard single fee, for example, $0.10, for single-use plastic items, such as single-use plastic bags, single-use paper bags, single-use hot cups, and single-use cold cups, or would consumers prefer a different fee for each type of single-use item?

**Null Hypothesis:** There is no difference in the means between fees respondents are willing to accept for single-use plastic bags, single-use paper bags, single-use hot cups, and single-use cold cups.

**Alternative Hypothesis:** There is a difference in the means between fees respondents are willing to accept for single-use plastic bags, single-use paper bags, single-use hot cups, and single-use cold cups.

The second business question and null and alternative hypothesis seeks to address the respondent’s willingness to pay these additional fees for these single-use plastic items by examining if there is a difference in fee preference between the different age groups. Are younger consumers less price sensitive than older consumers? By understanding the fees each age group is willing to pay for these single-use products, there can be a greater understanding of each group’s preferences which will provide the ability to target specific customer segments when implementing the desired change in the market space. Identifying the fees for each age group will help guide decisions when determining if and what fees should be imposed for these single-use products.

**Business Question:** Are younger respondents willing to pay a higher fee for single-use plasticbags, single-use paper bags, single-use hot cups, and single-use cold cups, compared to older respondents?

**Null Hypothesis:** There is no difference in the means of the fees for single-use plastic bags, single-use paper bags, single-use hot cups, and single-use cold cups between the different age groups.

**Alternative Hypothesis:** There is a difference in the means of the fees for single-use plastic bags, single-use paper bags, single-use hot cups, and single-use cold cups between the different age groups.

The third business question and null and alternative hypothesis seek to understand if there is a relationship between age, income, or gender and the respondents who support or oppose fees or bans on single-use plastic products such as utensils, straws, or foam takeaway containers. This analysis aims to identify if any of the demographic variables, age, income, and gender are significant factors when examining if respondents support or oppose the ban or fees of these single-use products.

**Business Question:** Is there a relationship between age, income, or gender and the support or opposition to imposing fees or bans on other single-use plastic products such as utensils, straws, and foam takeaway containers?

**Null Hypothesis:** There is no relationship between age, income, or gender and respondents’ support for fees or bans on other single-use plastic products such as utensils, straws, and foam takeaway containers.

**Alternative Hypothesis:** There is a relationship between age, income, or gender and respondents’ support for fees or bans on other single-use plastic products such as utensils, straws, and foam takeaway containers.

**LITERATURE REVIEW**

Organizations and governments worldwide have been focusing on developing measures to reduce plastic pollution by minimizing the use of unnecessary single-use plastic products. According to Wang (2023) the United Nations Environment Assembly in 2022, “adopted a resolution to initiate an international law-making process to combat global plastic pollution including marine plastic pollution by 2024” (p.1). Measures to discourage the use of these unnecessary single-use plastic items, such as fees and/or bans on single-use plastic products such as plastic bags, and cups are becoming more common in many countries, cities, and states across the globe.

Many countries, cities, states, local municipalities, and organizations are focusing on reducing plastic pollution by banning, replacing, or imposing fees and restrictions on single-use plastic items, most commonly single-use plastic bags. Other single-use products such as straws, cutlery, and hot, and cold cups are being considered to have similar fees or bans imposed as well. According to Baechler et al. (2020), “reducing individual-level consumption of problematic or unnecessary single-use plastic items is another essential component of the solution, as individual actions influence the global waste stream” (p.89). Having an understanding of customer preferences as it relates to the fees imposed on these products, could help drive decisions regarding the appropriate fees for these products while also discouraging customers to purchase and using these single-use items.

There are various approaches local governments can take when attempting to reduce single-use plastic bags such as bans, taxes and fees, consumer education, and mandated retailer take-back programs (Wagner, 2017). Enacting bans and/or imposing fees on single-use plastic products can alter consumer behaviors and result in a reduction in the use of these items. According to Kish in the United Kingdom when fee initiatives were rolled out in Wales this resulted in a ninety-six percent drop in bags given way, and in Northern Ireland, there was a seventy-two percent reduction over the first two years of the programs (Kish, 2018).

Imposing fees on single-use plastic bags has been shown to discourage consumers from using these items, therefore, questions arise regarding what is an appropriate fee to charge consumers. The most frequent fee in the United States, the mode, is $0.10 USD per single-use plastic bag (Wagner, 2017). However, there are many factors that can be considered when attempting to determine a fee for single-use items. Consumer preferences on what fees are appropriate are only one item to consider when evaluating a new fee. In addition, to customer preferences, there are also various costs such as waste management and/or recycling costs, retail costs, and administrative costs, which all can be incorporated into the bag fee calculation (Wagner, 2017). By evaluating the fees consumers are willing to pay, there is the potential for these costs to be absorbed within these plastic bag fees. If consumers are willing to pay a higher fee for the use of these single-use products, these additional fees could help alleviate the burdens placed on the cities’ waste management systems along with discouraging consumers from purchasing these single-use items.

There are, however, concerns about changing consumer behaviors, such as shifting from a less resource-intensive product to produce to a higher resource-intensive product to produce. Alternative products, such as reusable bags may cause additional long-term environmental harm as these items may not be recycled or take longer to decompose. Taylor et al. discusses the example of shifting from plastic to paper bags, as paper bags require more resources and energy to produce than plastic bags. Additionally, when looking at recycling these items, it takes more energy to recycle paper bags than the plastic alternative (Taylor et al., 2015). Additionally, Huang et al. (2022) found that some consumers reuse single-use plastic bags, and if these products are ‘banned or taxed they will seek other alternatives to fulfill their essential plastic bag demand” (p.724) Therefore, evaluating the potential fees for both single-use plastic along with single-use paper bags would be beneficial to the research to determine how price-sensitive consumers would be with these types of potential fees for each of these types of single-use products.

**RESEARCH DESIGN**

**Methodology**

To prepare for the analysis of the business questions and to evaluate the respondent’s fees preferences and the relationships between respondents’ demographics and the support for bans on other single-use-plastic products, the survey and polling datasets from the City of Toronto Canada will be combined into a single dataset. The information between the two datasets will be joined by mapping the questions between the datasets and combing the results of the same questions. The variables will be cleansed to identify any missing information and to prepare the dataset for analysis, for example, by entering a zero value, where respondents identified No Fee should be charged for the various single-use plastic products. Furthermore, the demographic variables, such as income and age variables will also be updated to reflect the same ranges across both the survey and polling datasets.

Utilizing the survey and polling results from the city of Toronto, Canada, the population of the city of Toronto will be examined to understand the preferences on fees or bans on single-use plastic products. In understanding this population, insights can be gathered into the population’s knowledge, and attitude toward the fees and bans of single-use plastic products. By utilizing this pre-existing data, the analysis will focus on a quantitative approach, which can provide a quantifiable examination of this population’s preferences on bans or fees for single-use plastic products.

**Methods**

To address the first two business questions an ANOVA statistical test will be performed along with plotting the various data points and examining the distribution of the fees for the various single-use plastic products. Analysis of variance (ANOVA) is a statistical test to examine the mean differences among different groups. According to Tabachnick et al. (2007), “if a difference between means is statistically significant, the difference is expected (with a certain probability) to reappear if the study is replicated. A nonsignificant difference implies that you cannot rule out the possibility that the mean differences that do exist in the sample data occurred by chance”(p.69).

To address the third business question a logistic regression model will be created to evaluate the respondent’s demographics along with the support and oppose options for the questions pertaining to single-use plastic utensils, straws, and foam takeaway containers. According to Nick et al. (2007), “logistic regression models are defined as statistical models which describe the relationship between a qualitative dependent variable (that is, one which can take only certain discrete values, such as the presence or absence of a disease) and an independent variable” p.273.

**Limitations**

A limitation of the survey and polling dataset utilized for this study is determining if the dataset survey and polls provide a sufficient sample of the population for the City of Toronto to determine the preferences of the residents. The survey was conducted with an online survey that did not provide geographic and demographic restrictions. The online surveys were open to anyone wishing to participate. As the survey was open to the general public would these responses provide a sufficient representation of the residents of the city of Toronto?

**Ethical Considerations**

An ethical consideration for evaluating the fees and bans for single-use fees for plastic products is the potential for additional financial burdens to be imposed on consumers who have limited resources. In addition to the potential inconvenience or burdens the fees may impose on consumers, additional research should be completed to evaluate if there other populations of individuals that may be significantly impacted by the lack of availability of these single-use products.

**FINDINGS**

To address the first business question an ANOVA test was performed on each of the fee variables, single-use plastic bags, single-use paper bags, and, single-use hot and cold cups to examine the means of each of the categories of fees. Table 1 details all the means of each single-use item. According to these results, the respondents prefer a similar average fee for single-use plastic bags and hot and cold cups. However, respondents place a significantly lower value of only $0.15 for paper bags. Based on these results, when examining the four types of single-use products, the null hypothesis can be rejected as there is a difference in respondents’ preferences across these offerings.

**Table 1: Means of Single-Use Products**

|  |  |
| --- | --- |
|  | **Means** |
| **Plastic Bag Fee** | 0.28 |
| **Paper Bag Fee** | 0.15 |
| **Hot Cup Fee** | 0.30 |
| **Cold Cup Fee** | 0.29 |

To address the second business question, each ANOVA test was examined to analyze the least squared means fees for each single-use item across the various age groups. According to Lenth (2016) “in unbalanced factorial experiments, LS means for each factor mimic the main-effects means but are adjusted for imbalance (p.1). Table 2 details all the means of each single-use item within the age groups. According to these results, younger respondents are willing to accept a higher fee for these single-use items compared to their older counterparts. In comparing the different age brackets the average fees decline for each age bracket with the age group 55 – 64 years old having a lower preferred fee as compared to the other age brackets. The age bracket 65 – 74 has a slight increase in preferred fees which continues into the 75 – 84 age brackets before declining again in the 85 – 95 age brackets. This pattern of decline and increase can be seen across the various single-use products, with slight variations as detailed in the example in Figure 1 for single-use plastic bags and Figure 2 for single-use plastic cold cups. As there are differences in the means between the age brackets for each of the single-use products the null hypothesis can be rejected. Having this understanding of the respondent’s preferred fees by demographic age group can support decisions regarding the fees for these single-use products.

**Table 2: Means of Single-Use Products by Age Category**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Plastic Bag Fee** | **Paper Bag Fee** | **Hot Cup Fee** | **Cold Cup Fee** |
| **Under 15 years** | 0.30 | 0.18 | 0.27 | 0.26 |
| **15-24 years** | 0.29 | 0.14 | 0.28 | 0.27 |
| **25-34 years** | 0.25 | 0.13 | 0.27 | 0.26 |
| **35-44 years** | 0.24 | 0.14 | 0.28 | 0.27 |
| **45-54 years** | 0.21 | 0.12 | 0.25 | 0.24 |
| **55-64 years** | 0.20 | 0.11 | 0.22 | 0.22 |
| **65-74 years** | 0.22 | 0.12 | 0.25 | 0.24 |
| **75-84 years** | 0.24 | 0.12 | 0.26 | 0.26 |
| **85-94 years** | 0.22 | 0.10 | 0.24 | 0.27 |
| **95 years and older** | 0.19 | 0.08 | 0.22 | 0.20 |
| **No Response** | 0.27 | 0.16 | 0.26 | 0.25 |

**Figure 1: Single-Use Plastic Bags Least Squared Mean Age Graph**

**Chart

Description automatically generated with medium confidence**

**Figure 2: Single-Use Plastic Cold Cups Least Squared Mean Age Graph**

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To analyze the third business question a binary logistic regression model was completed for each of the variables of utensils, straws, and foam to identify if age, income, and/or gender variables are significant factors when analyzing the respondents who support the reduction and/or bans initiatives for these single-use products. Figure 3 details the results for the single-use Utensils variable, Figure 4 details the results for the Foam variable, and Figure 5 details the results for the single-use Straw variable. In examining the p-value results for the utensils variable, all three variables, age, income, and gender are significant with the gender variable being the most significant as it is significantly less than the 0.05 threshold. In examining the p-value for the foam variable the gender and age variables are significant with the gender variable being the most significant as it is significantly less than the 0.05 threshold. The income variable was not significant as it relates to the foam variable. In examining the p-value results for the straw variable, all three variables, age, income, and gender variables were significant with the gender variable being the most significant as these two variables are significantly less than the 0.05 threshold. As there is a relationship between the age, income, and gender variables and the utensil and straw variables, and there is a relationship between the foam variable and the gender and age variables, the null hypothesis can be rejected. With understanding the relationships between these variables there is a greater understanding of which demographics within the population that would impact the support or opposition of these proposed bans.

**Figure 3: Logistic Regression Utensils** Graphical user interface, table

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**Figure 4: Logistic Regression Foam**

**Graphical user interface, application, table

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**Figure 5: Logistic Regression StrawsGraphical user interface, text, application, Word

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**CONCLUSION**

Society’s reliance on plastic products is impacting the natural environment through pollution and waste. Single-use plastic products contribute to a portion of the overall plastic pollution and waste management problems. Governments, cities, and multiplicities have begun to impose fees and bans on single-use plastic products to discourage consumers from utilizing these products. The survey and polling from the City of Toronto, Canada, were evaluated to understand this population’s preferences for the fees and bans of these products. This analysis detailed respondents’ fee preferences across single-use plastic bags, paper bags, and hot and cold cups. The mean fee for single-use plastic bags was $0.28 CAD, paper bags was $0.15 CAD, hot cups was $0.30 CAD and cold cups was $0.29 CAD. Additionally, across the various age brackets, it was identified different age brackets have different average fee preferences. Overall, the younger age groups preferred a higher fee while the older age groups preferred a lower fee. Additionally, it was identified that income, age, and gender are significant variables for respondents’ support for additional bans on single-use utensils and straws. However, only age and gender were identified as significant variables for the bans on foam containers. With these insights, more effective decisions can be made regarding the types of fees that can be associated with these single-use products. Additionally, having an understanding of how the various demographic factors influence the support or opposition of these bans, outreaches can be targeted to specific groups of individuals to gather further support for these initiatives.

**RECOMMENDATIONS**

The analysis completed as part of this examination can be furthered by examining the fees associated with these single-use products in more detail. Previous research has suggested the most common fee of $0.10 USD per single-use plastic bag, however, the research as part of this examination details that respondents are willing to accept a higher fee of approximately $0.21 USD (approximately $ 0.28 CAD). Therefore, it would be of interest to identify if a higher fee can be charged to consumers for this single-use product. If consumers are accepting of these higher fees, it would also be of interest to identify how these additional fees can aid waste management programs in supporting the reduction or recycling of single-use products. Furthermore, in the potential for increasing the fees, research can be furthered by examining, how/if these higher fees reduce the overall usage of these single-use products. Additionally, with the potential for altering consumer behavior, researchers can examine if these fees and/or bans have motivated consumers to cease using these types of products or if there has been a shift to utilizing more reusable products. If there has been a shift to utilizing more reusable products further research can be conducted to understand how these reusable products are benefiting or potentially harming the environment as some reusable products are more resource-intensive to produce and recycle which could potentially pose additional burdens on the environment.

**REFERENCES**

*About Reducing Single Use and Takeaway Items* (2021, October 21). *About Reducing Single Use and Takeaway Items*. City of Toronto Open Data Portal. Retrieved January 18, 2023, from <https://open.toronto.ca/dataset/reducing-single-use-and-takeaway-items/>

Baechler, B. R., Granek,m E. F., Carlin-Morgan, K. A., Smith, T. E., & Nielsen-Pincus, M. (2020). Aquarium visitor engagement with an ocean plastics exhibit: Effects on self-reported intended single-use plastic reductions and plastic-related environmental stewardship actions. *Journal of Interpretation Research*, *25*(2), 88–117. https://doi.org/10.1177/10925872211021183

Huang, Y.-K., & Woodward, R. T. (2022). Spillover effects of grocery bag legislation: Evidence of bag bans and Bag Fees. *Environmental and Resource Economics*, *81*(4), 711–741. https://doi.org/10.1007/s10640-022-00646-5

Kish, R. J. (2018). Using legislation to reduce one-time plastic bag usage. *Economic Affairs*, *38*(2), 224–239. <https://doi.org/10.1111/ecaf.12287>

Nick, T. G., & Campbell, K. M. (2007). *Logistic regression. Topics in biostatistics*, 273-301.

Lenth, R. V. (2016). Least-squares means: the R package lsmeans. *Journal of statistical software*, *69*, 1-33.

Rivers, N., Shenstone-Harris, S., & Young, N. (2017). Using nudges to reduce waste? the case of Toronto's Plastic Bag Levy. *Journal of Environmental Management*, *188*, 153–162. https://doi.org/10.1016/j.jenvman.2016.12.009

Tabachnick, B. G., & Fidell, L. S. (2007). *Experimental designs using Anova*. Thomson/Brooks/Cole. Retrieved 2023, from https://www.researchgate.net/profile/Barbara-Tabachnick/publication/259465542\_Experimental\_Designs\_Using\_ANOVA/links/5e6bb05f92851c6ba70085db/Experimental-Designs-Using-ANOVA.pdf.

Taylor, R. L., & Villas‐Boas, S. B. (2015). Bans vs. fees: Disposable carryout bag policies and bag usage. *Applied Economic Perspectives and Policy*, *38*(2), 351–372. https://doi.org/10.1093/aepp/ppv025

Wang, S. (2023). International law-making process of combating plastic pollution: Status quo, debates and prospects. *Marine Policy*, *147*, 105376. https://doi.org/10.1016/j.marpol.2022.105376

Wagner, T. P. (2017). Reducing single-use plastic shopping bags in the USA. *Waste Management*, *70*, 3–12. https://doi.org/10.1016/j.wasman.2017.09.003