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Perishable Food Date Label Best Practices and Consumer Willingness to Reduce Food Waste

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Abstract

Food waste is caused by many factors with consumer confusion among perishable expiration date labels as a contributory factor. A nationally representative survey was created to determine how consumers interpret the perishable labels *Best if Used By*, *Use By*, and *Sell By*; how sight/smell versus label date varies among fruit, vegetables, salads/greens, liquid dairy, solid dairy, meat, and bakery items; how consumers view eating past a label date and the issue of food waste. A series of chi-square tests were performed to determine if the survey results differed among the demographic variables gender, age, race, region, education level, household income, primary grocery shopper, and income percentage spent on groceries. We found the *Best if Used By* and *Use By* labels were interpreted more ambiguously while the *Sell By* label is interpreted more consistently among the demographic variables. Sight/smell versus label date usage among perishable items and eating past a label date did differ among the demographic variables. Age is the only demographic variable that viewed the issue of food waste differently.

Key Words: Food Waste, Food Policy

Introduction

Food waste is the difference between the amount of food produced and the sum of all food used in food or non-food production, including oils, clothing, and energy (Bellemare et al., 2017). Approximately 31% of the total food supply, from farm to fork, is wasted in the U.S. Consumers contribute 21% of the total food waste, while agricultural producers contribute the remaining 10% (Wilson et al., 2017). Wilson et al. (2017) also noted the cost of food waste amounts to \$160 billion annually. At the same time, 14.3% of U.S. households are food insecure (Coleman-Jensen et al., 2014). Along with other factors, consumer lack of understanding about food perishability labels contributes to food waste. For example, one food product could have more than one expiration date printed on it, leading to inconsistent labeling and consumer confusion. Studies demonstrate that the closer a food product is to its flexible expiration date, the less consumers find the product acceptable and safe to consume (Wilson et al., 2017, Wansink and Wright 2006, Newsome et al., 2014). Food that may still be safe to consume ends up being thrown away.

Objectives

1. Determine differences with respect to label interpretation among demographic variables: gender, age, race, region, education level, household income, primary grocery shopper, and income percentage spent on groceries,
2. Determine differences for food acceptability by sight/smell versus label date by category (fruit, vegetables, salads/greens, liquid dairy, solid dairy, meat, and bakery items) among demographic variables,
3. Determine differences with respect to eating past the label date and self-ascribed food waste importance among demographic variables.

Data and Methods

Data were collected via an online survey¹. The survey, distributed by Qualtrics, resulted in a nationally representative sample. Responses totaled 1,050 participants. Incomplete responses totaled 48 and were removed from the data. As a result, responses from 1,002 respondents were analyzed. A summary of the survey demographics can be found in Table 1.

A series of chi-square tests were used to accomplish the three project objectives. For the first objective, chi-square tests on the perishable labels (*Best if Used By*, *Use By*, and *Sell By*) and demographic variables were performed. For the second objective, chi-square tests on how respondents used “*sight/smell*” versus “*label date*” to determine when to discard perishable items across various demographic variables were performed. Lastly, chi-square tests on participant response to “eating past the label date” and self-ascribed importance of food waste across various demographic variables were performed to address the third objective. Figures 1 through 4 offer a visual depiction of responses to the issues addressed via the chi-squared tests.

¹ For brevity, the full survey is not included with this conference paper but can be obtained by contacting the corresponding author (Riley).

Table 1. Summary Statistics of Survey Participant Demographics (N = 1,002)

Variable	Category	Percent
Gender	Male	48.90%
	Female	50.80%
	Other	0.30%
Age	18-24	10.48%
	25-34	20.36%
	35-44	18.96%
	45-54	16.37%
	55-64	17.07%
	65-74	14.47%
	75-84	2.00%
	85-94	0.30%
Race	White	61.18%
	Black or African American	12.48%
	Pacific Islander	0.40%
	Hispanic or Latino	17.07%
	Asian	5.39%
	American Indian	1.50%
	Multi-Race	0.80%
	Middle Eastern	0.30%
	Other	0.90%
Marital Status	Single (never married)	30.94%
	Married	55.59%
	Divorced	10.18%
	Widowed	2.69%
	Prefer Not to Say	0.60%
Region	Northeast	19.56%
	Midwest	21.86%
	South	38.92%
	West	19.66%
Education Level	Some High School	4.69%
	High School Diploma	25.95%
	Some College	21.36%
	Associate's Degree	8.98%
	Bachelor's Degree	21.26%
	Master's Degree	12.57%
	Doctorate Degree	2.20%
	Professional Degree	2.99%

Table 1 (continued). Summary Statistics of Survey Participant Demographics (N = 1,002)

Variable	Category	Percent
Children in Household (under 18)	0	58.18%
	1	19.06%
	2	13.17%
	3	5.59%
	4	2.59%
	5	0.70%
	6	0.40%
	7	0.20%
	12	0.10%
Household Income	Under \$15,000	9.78%
	\$15,000-\$24,999	7.88%
	\$25,000-\$34,999	10.28%
	\$35,000-\$49,999	11.78%
	\$50,000-\$74,999	19.26%
	\$75,000-\$99,999	14.07%
	\$100,000-\$149,999	14.97%
	\$150,000-\$199,999	5.89%
\$200,000+	6.09%	
Primary Grocery Shopper	All of the Grocery Shopping	53.99%
	Most of the Grocery Shopping	28.14%
	Some of the Grocery Shopping	15.67%
	Rarely do the Grocery Shopping	2.20%
Percent of Income Spent on Groceries	0-9	16.87%
	10-19	25.55%
	20-29	24.25%
	30-39	15.67%
	40-49	7.09%
	50-59	6.79%
	60-69	3.79%

Results

The first objective was to determine if label interpretations differed among the demographic variables. The results for this objective are summarized below in Tables 2-4.

Table 2. Chi-Squared Test Outcome Label Interpretation by Demographic Category for “*Best if Used By*” Label Wording

	Must	Should Not	Best FQ	Not Safety
Primary	Same	Different	Same	Same
HH Income	Different	Different	Same	Different
Gender	Different	Different	Same	Different
Race	Different	Same	Same	Same
Region	Same	Same	Same	Different
Education	Different	Different	Different	Different
Grocery Decisions	Different	Different	Same	Different
Age	Different	Different	Different	Different

Same: 12, Different: 20

Table 3. Chi-Squared Test Outcome Label Interpretation by Demographic Category for “*Best By*” Label Wording

	Must	Should Not	Best FQ	Not Safety
Primary	Different	Different	Same	Same
HH Income	Different	Different	Different	Different
Gender	Different	Same	Same	Same
Race	Different	Same	Same	Same
Region	Same	Same	Same	Same
Education	Different	Different	Same	Different
Grocery Decisions	Different	Different	Different	Different
Age	Different	Different	Same	Different

Same: 14, Different: 18

Table 4. Chi-Squared Test Outcome Label Interpretation by Demographic Category for “*Sell By*” Label Wording

	Must	Should Not	Display	Not Safety
Primary	Same	Same	Same	Same
HH Income	Different	Same	Same	Same
Gender	Same	Same	Same	Same
Race	Same	Same	Same	Same
Region	Same	Same	Same	Same
Education	Different	Same	Same	Different
Grocery Decisions	Different	Different	Different	Different
Age	Same	Same	Different	Same

Same: 24, Different 8

The respondents were given four questions to interpret for each label date. The questions asked for the *Best if Used By* and *Use By* label dates focused on when to consume a product. For example, the *Best if Used By* and *Use By* label date means a product must be eaten on or before the label date (Must); a product should not be eaten after the label date (Should Not); a product has the best flavor quality if eaten on or before the label date (Best Flavor/Quality); and the label is not a safety date (Not Safe). The questions asked for the *Sell By* label date focused on when to purchase a product. For example, the *Sell By* label date means a product must be purchased on or before the label date; a product should not be purchased after the label date; the label tells the store how long to display the product (Display); and the label is not a safety date.

In tables 2-4, Same and Different indicate how the label dates were interpreted among the demographic variables. For example, in table 2, Must, Should Not, and Not Safe were interpreted differently among different genders, but the Best Flavor/Quality was interpreted the same among different genders. The *Best if Used By* and *Use By* labels were interpreted more differently than the *Sell By* label. Therefore, the demographic variables view the *Best if Used By* and *Use By* label as more ambiguous and the *Sell By* label as more consistent.

The provided responses for the label interpretation questions were Definitely True, Probably True, Neither True nor False, Probably False, Definitely False. The results were distributed almost equally with probably true and probably false being the top two responses for the *Best if Used By* must and should not questions. For the *Best if Used By* flavor quality question, Definitely True and Probably True were the majority of the responses, and Probably True was the majority response for the *Best if Used By* safety question. These results are summarized in below figures 1-4.

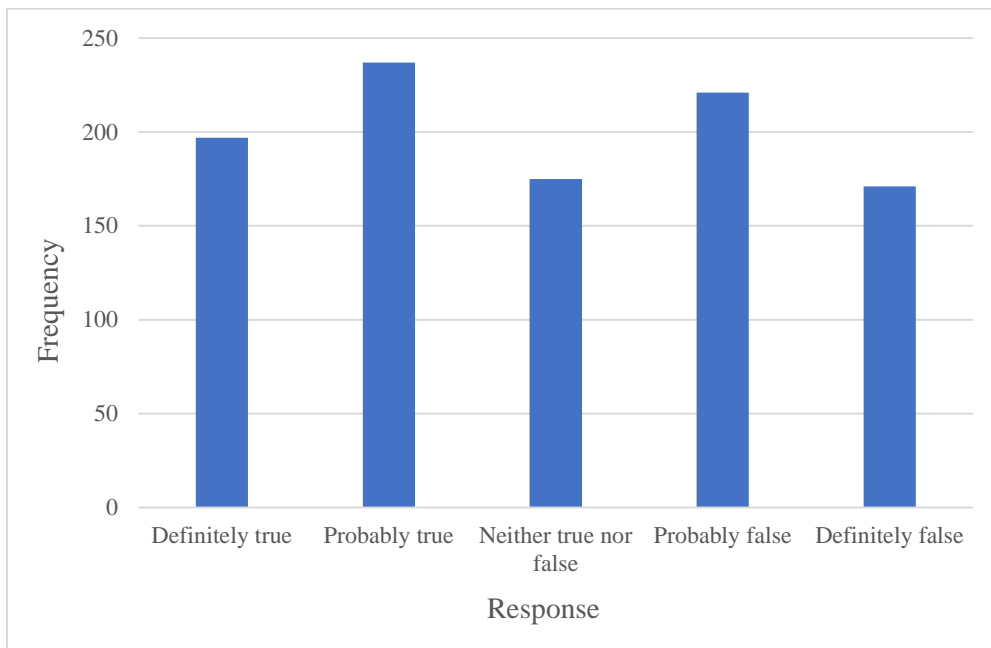


Figure 1. Participant Response to “*Best if Used By*” Label Indicating the Product “*Must be eaten on or before <date>*”

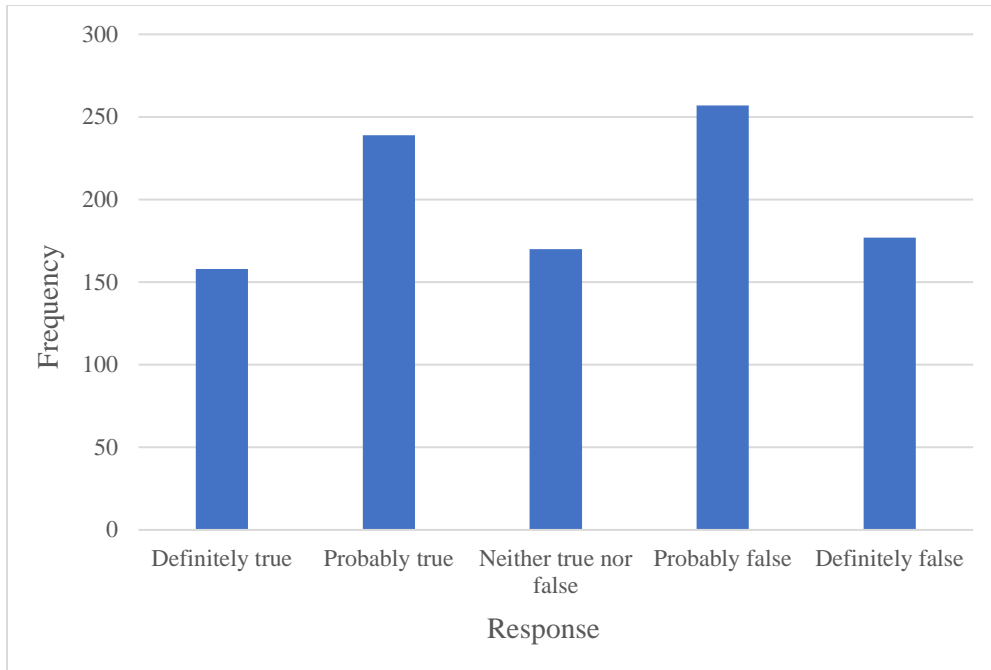


Figure 2. Participant Response to “Best if Used By” Label Indicating the Product “Should not be eaten after <date>”

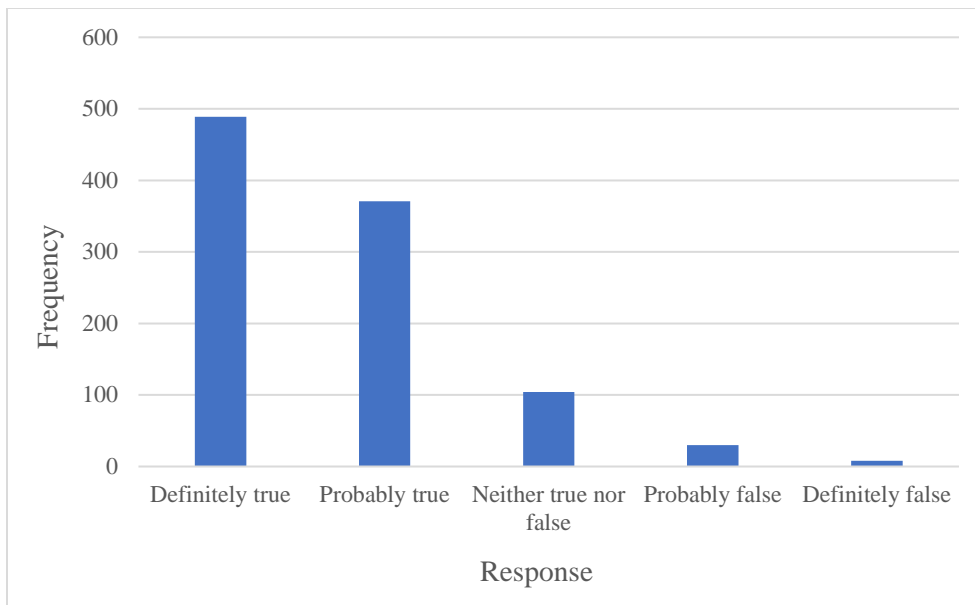


Figure 3. Participant Response to “Best if Used By” Label Indicating the Product “will be of best flavor or quality on or before <date>”

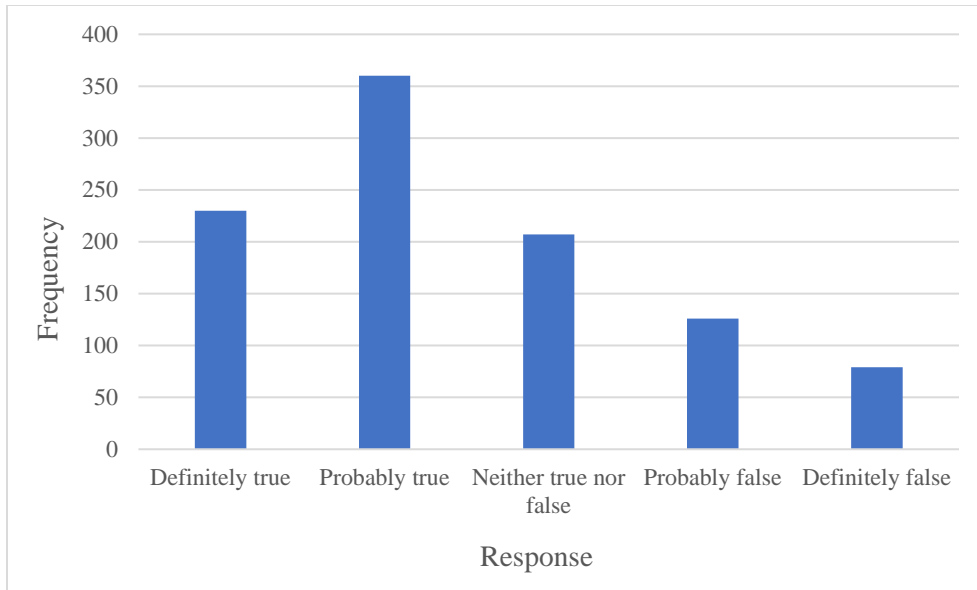


Figure 4. Participant Response to “*Best if Used By*” Label Indicating the Label Date is Not a Safety Date.

For the *Use By* label wording Must, Should Not, and Best Flavor/Quality questions, Definitely True and Probably True were the two main responses. For the *Use By* Not Safe question, the results were distributed fairly uniformly with Probably True garnering the top response. These results are summarized below in figures 5-8.

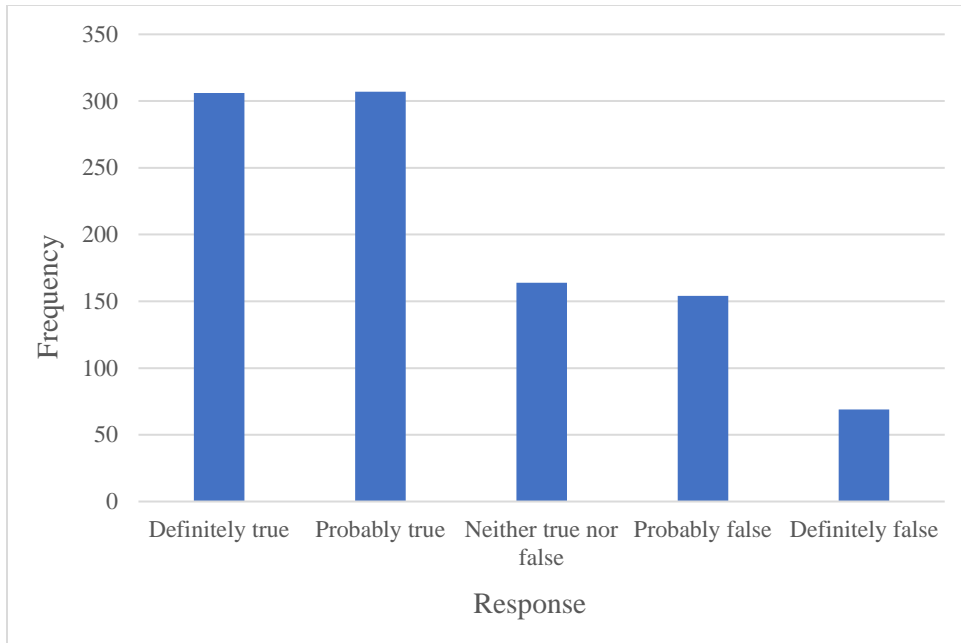


Figure 5. Participant Response to “Best By” Label Indicating the Product “Must be eaten on or before <date>”

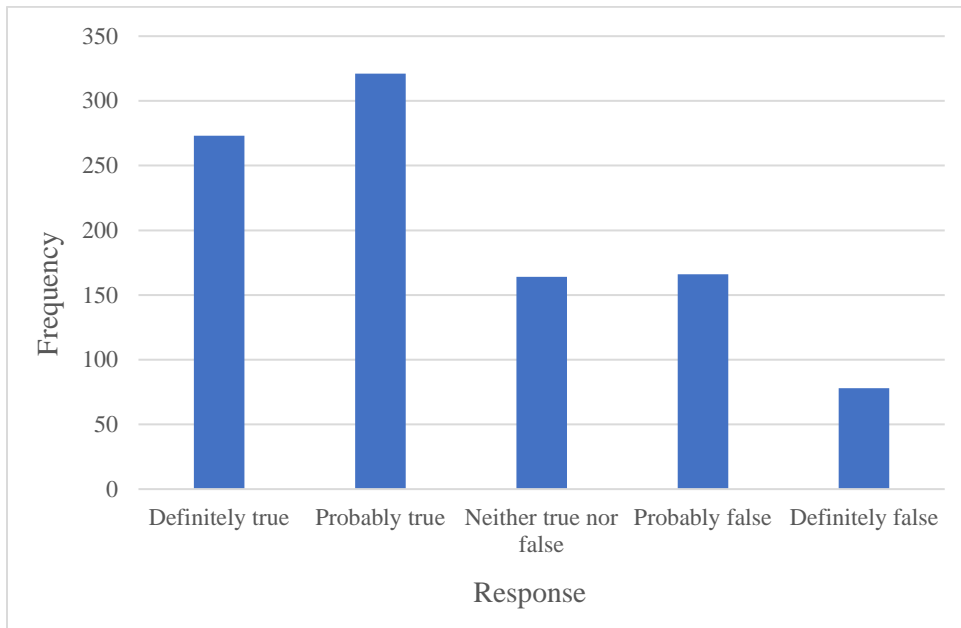


Figure 6. Participant Response to “Best By” Label Indicating the Product “Should not be eaten after <date>”

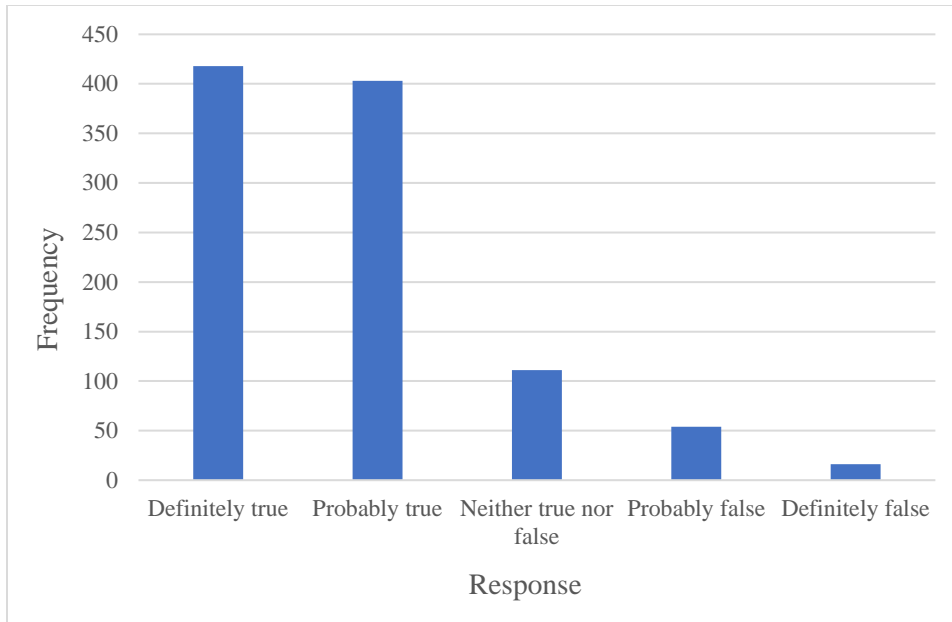


Figure 7. Participant Response to “*Best By*” Label Indicating the Product “*will be of best flavor or quality on or before <date>*”

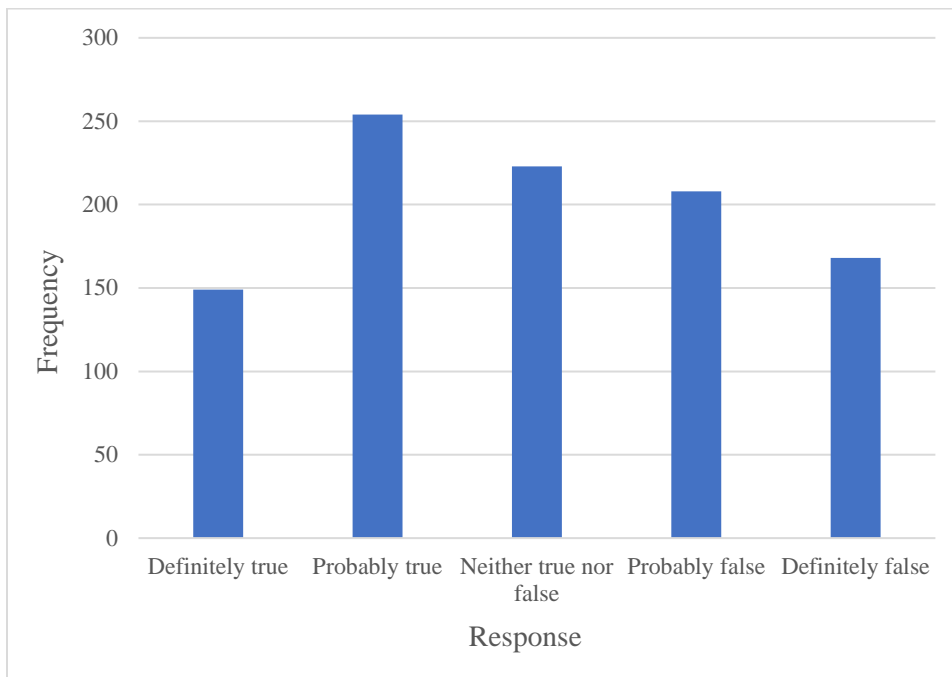


Figure 8. Participant Response to “*Best By*” Label Indicating the Label Date is Not a Safety Date.

The two main responses for the *Sell By* Must, Should Not, and Display questions were Definitely True and Probably True. Probably True was the top response for the *Sell By* Not Safe

question, while the remaining responses were distributed uniformly. These results are summarized below in figures 9-12.

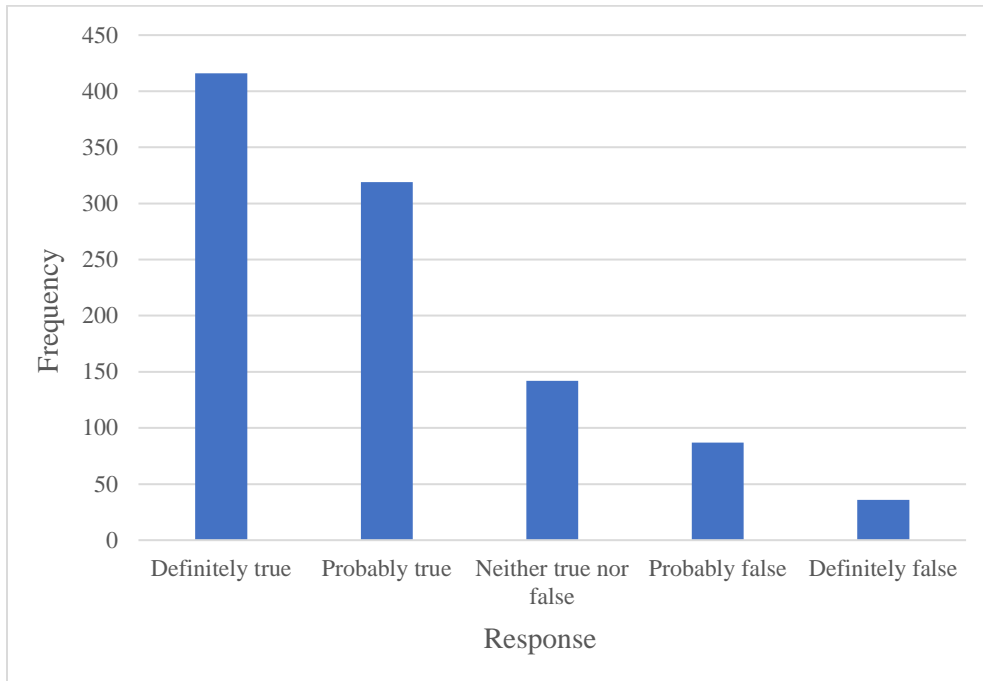


Figure 9. Participant Response to “*Sell By*” Label Indicating the Product “*Must be purchased on or before <date>*”

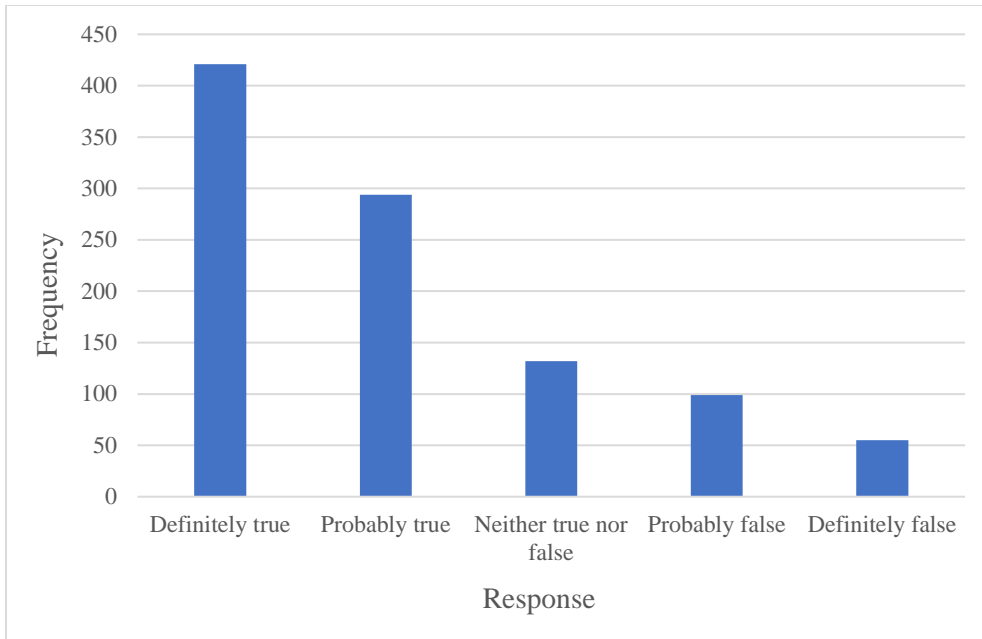


Figure 10. Participant Response to “*Sell By*” Label Indicating the Product “*Should not be purchased after <date>*”

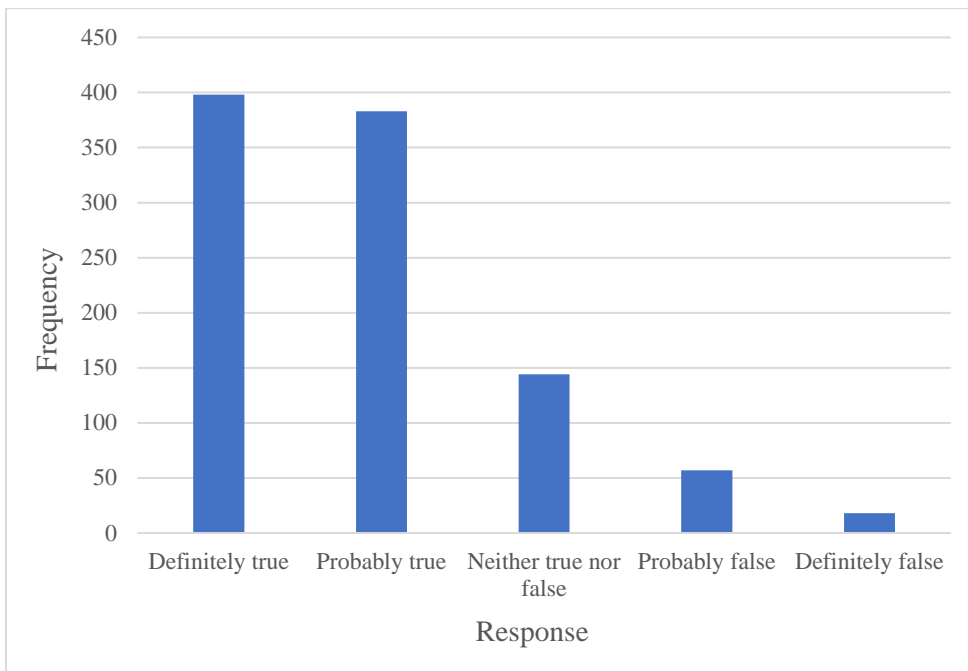


Figure 11. Participant Response to “*Sell By*” Label Indicating Display Length of the Product for “*Inventory Management*”

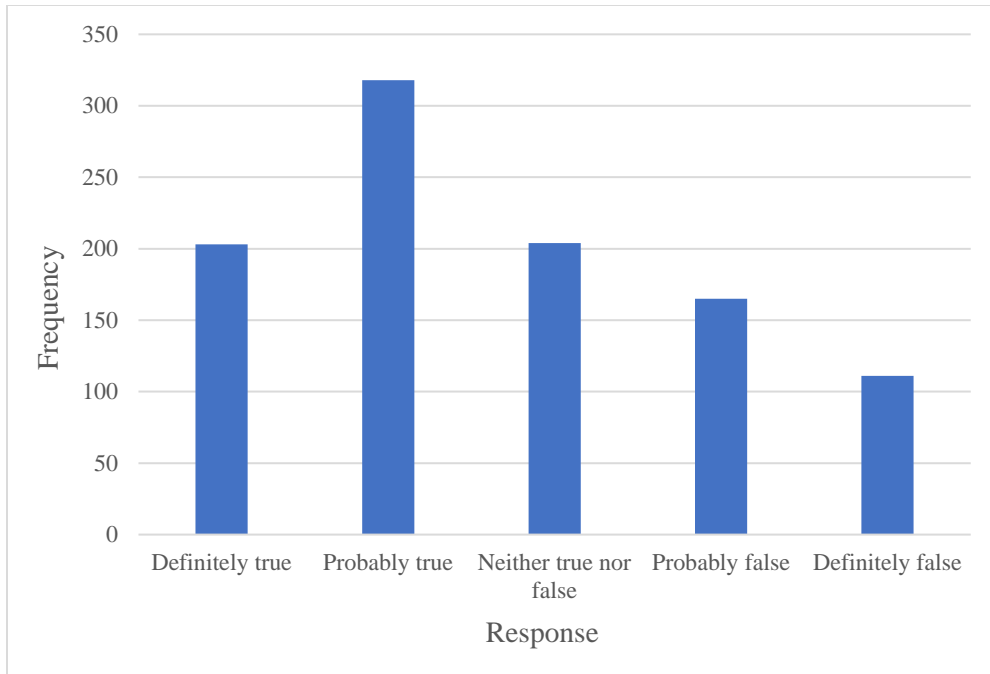


Figure 12. Participant Response to “*Sell By*” Label Indicating the Label Date is Not a Safety Date.

The second objective was to determine if the survey participant’s use of sight or smell versus the defined label date differed among the demographic variables. The question was posed on a zero to ten scale with zero indicating *only* sight or smell and ten indicating *only* label date was used to determine whether to discard the product. The scale was consolidated for the chi-squared test with 0 to 3 indicating sight or smell, 4 to 6 indicating neutral (indifferent between sight or smell and label date), and 7 to 10 indicating primarily label date when determining whether to discard a product. The results are summarized below in Table 5.

Table 5. Chi-Squared Test Outcome of Sight or Smell versus Label Date by Demographic

	Fruit	Vegetables	Salad	Liq. Dairy	Sol. Dairy	Meat	Bakery
Primary	Same	Different	Same	Same	Same	Different	Different
HH Inc.	Different	Same	Same	Same	Same	Same	Same
Gender	Same	Same	Same	Same	Same	Different	Same
Race	Same	Same	Same	Different	Different	Same	Different
Region	Same	Different	Same	Same	Same	Same	Same
Education	Different	Different	Different	Different	Same	Different	Different
Groc. Dec.	Different	Different	Different	Different	Different	Different	Different
Age	Different	Same	Same	Different	Different	Same	Different

Same: 30, Different: 26

Similar to tables 2-4, Same and Different were used to indicate if the use of sight/smell versus label date for the perishable items differed among the demographic variables. The results for Same/Different were equal across product categories, for the most part, with most of the results leaning toward being interpreted the same. Bakery items were mostly interpreted differently while salad and solid dairy items were mostly interpreted the same among the demographic variables.

The second objective was also to determine if the use of sight/smell versus label date varied among the different perishable items. The results for fruit, vegetables, and salad leaned more towards sight/smell usage. The liquid dairy results leaned more towards label date usage. Solid dairy and meat results were distributed evenly with label date usage as the top response. Lastly for bakery items, the results were distributed evenly, and the top response was a combination of sight/smell and label date usage. Therefore, results that were lower numerically mainly used sight/smell; results for the middle value used a combination of sight/smell and label date; and results that were higher numerically mainly used the label date. These results are summarized below in figures 13-19.

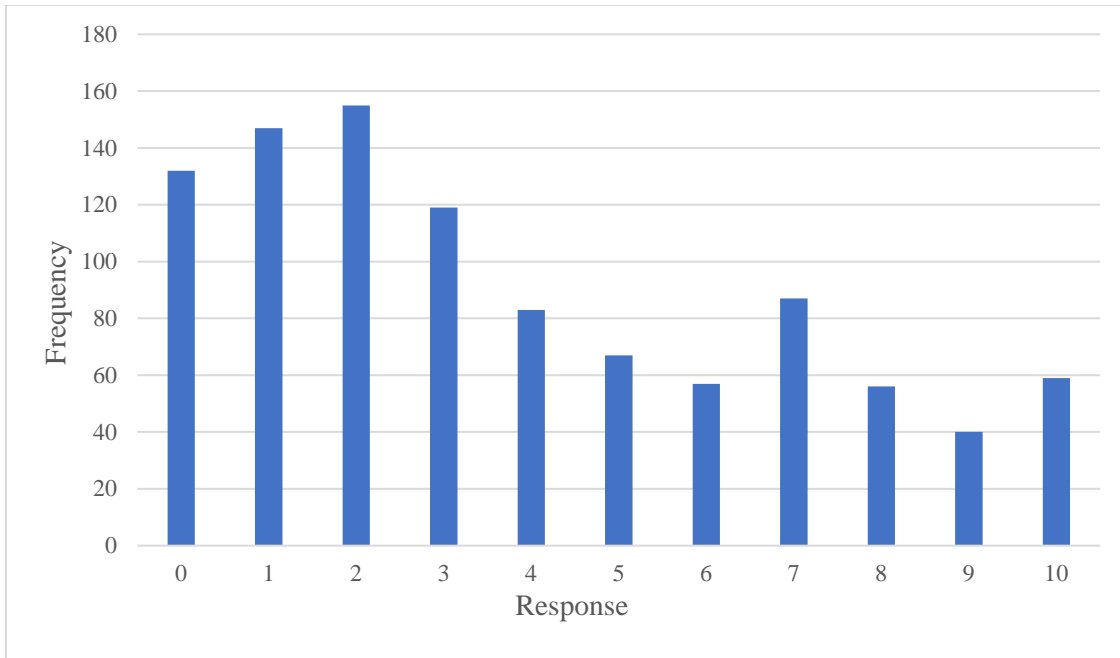


Figure 13. Participant Use of Sight or Smell versus Label Date When Considering Discarding Fruits (0 = Only Sight or Smell; 10 = Only Label Date).

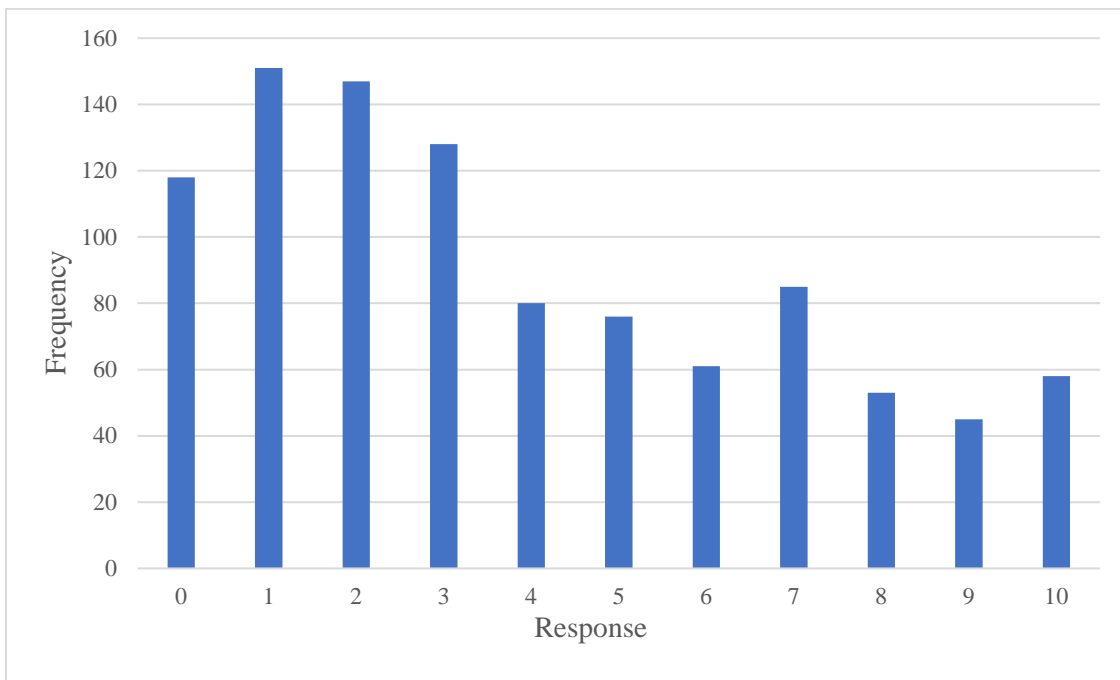


Figure 14. Participant Use of Sight or Smell versus Label Date When Considering Discarding Vegetables (0 = Only Sight or Smell; 10 = Only Label Date).

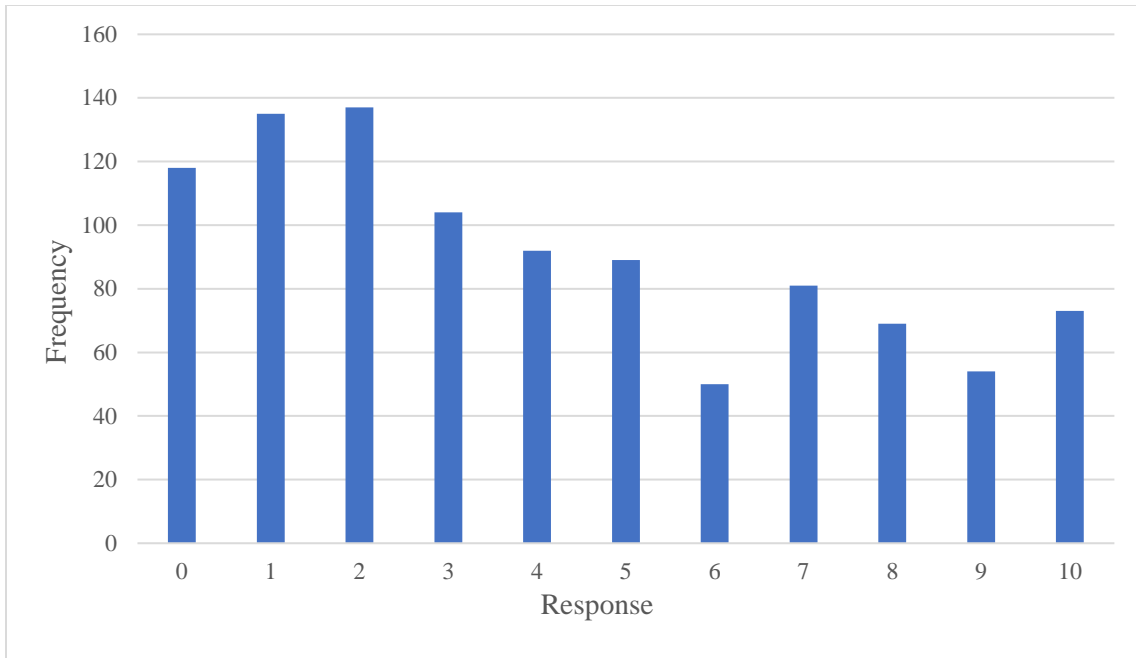


Figure 15. Participant Use of Sight or Smell versus Label Date When Considering Discarding Salad and Greens (0 = Only Sight or Smell; 10 = Only Label Date).

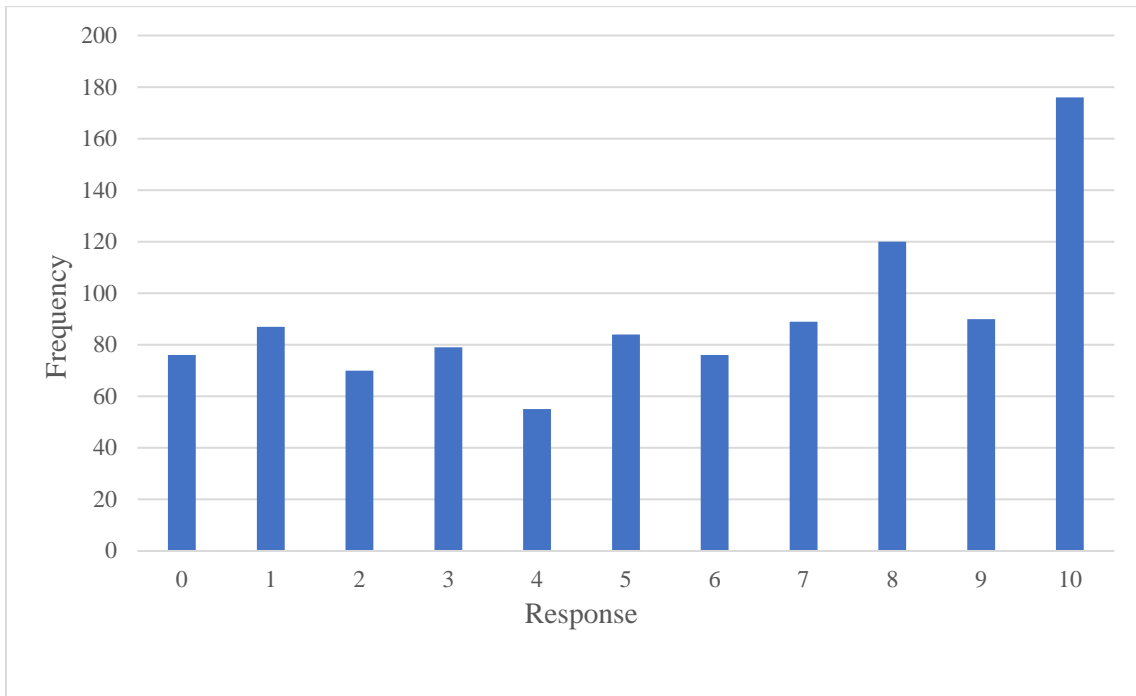


Figure 16. Participant Use of Sight or Smell versus Label Date When Considering Discarding Liquid Dairy (0 = Only Sight or Smell; 10 = Only Label Date).

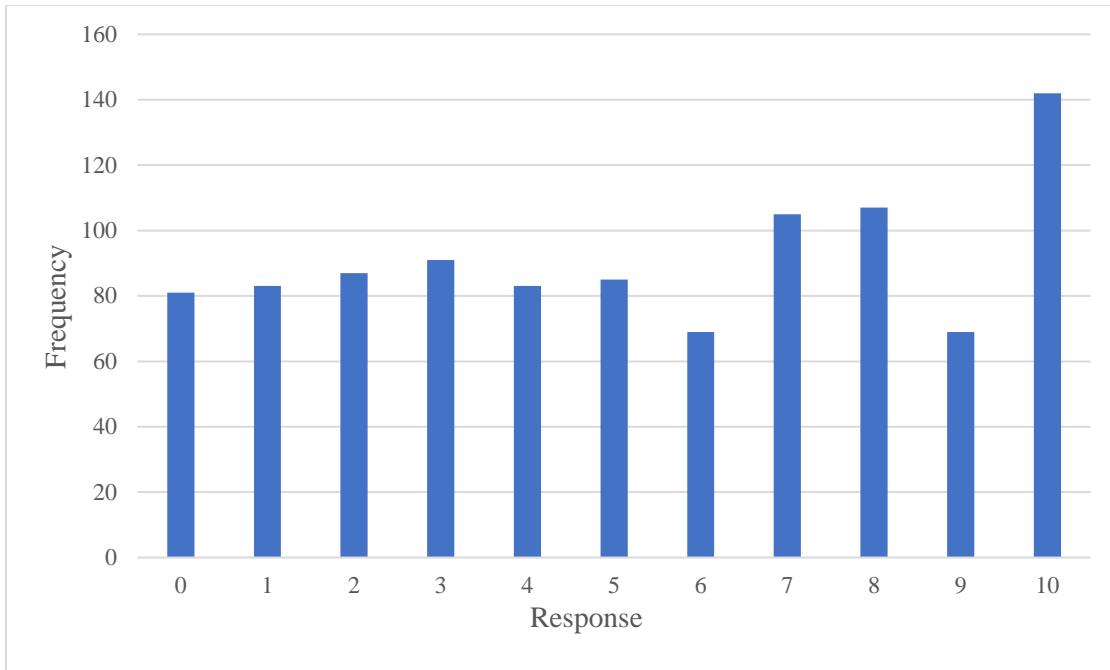


Figure 17. Participant Use of Sight or Smell versus Label Date When Considering Discarding Solid Dairy (0 = Only Sight or Smell; 10 = Only Label Date).

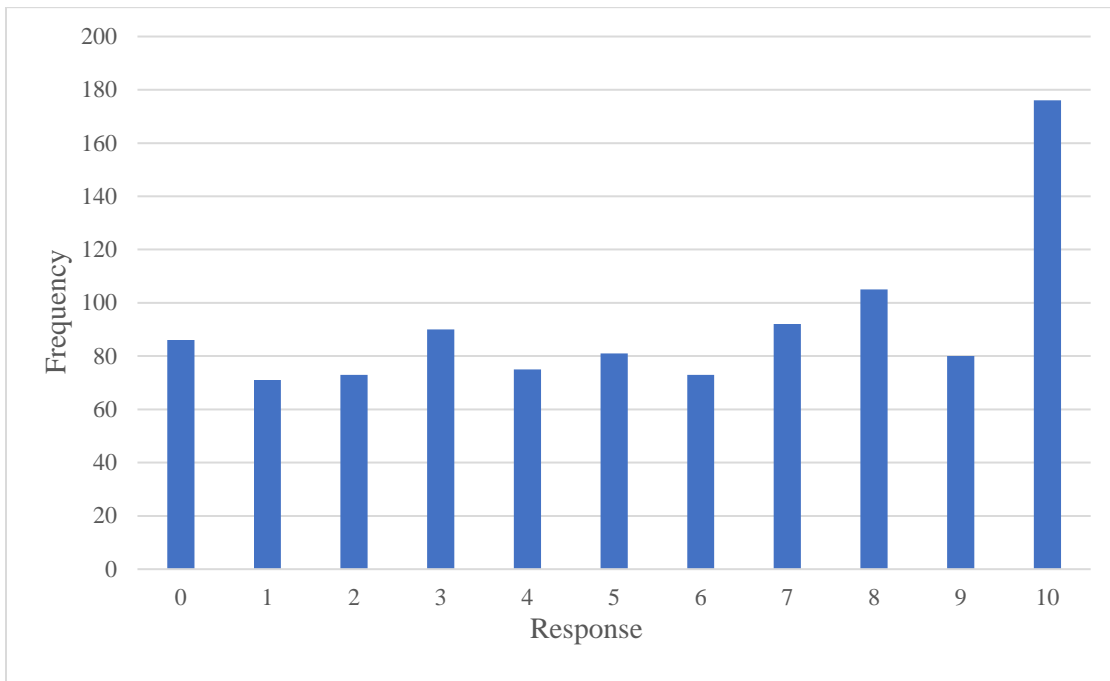


Figure 18. Participant Use of Sight or Smell versus Label Date When Considering Discarding Fresh Meat (0 = Only Sight or Smell; 10 = Only Label Date).

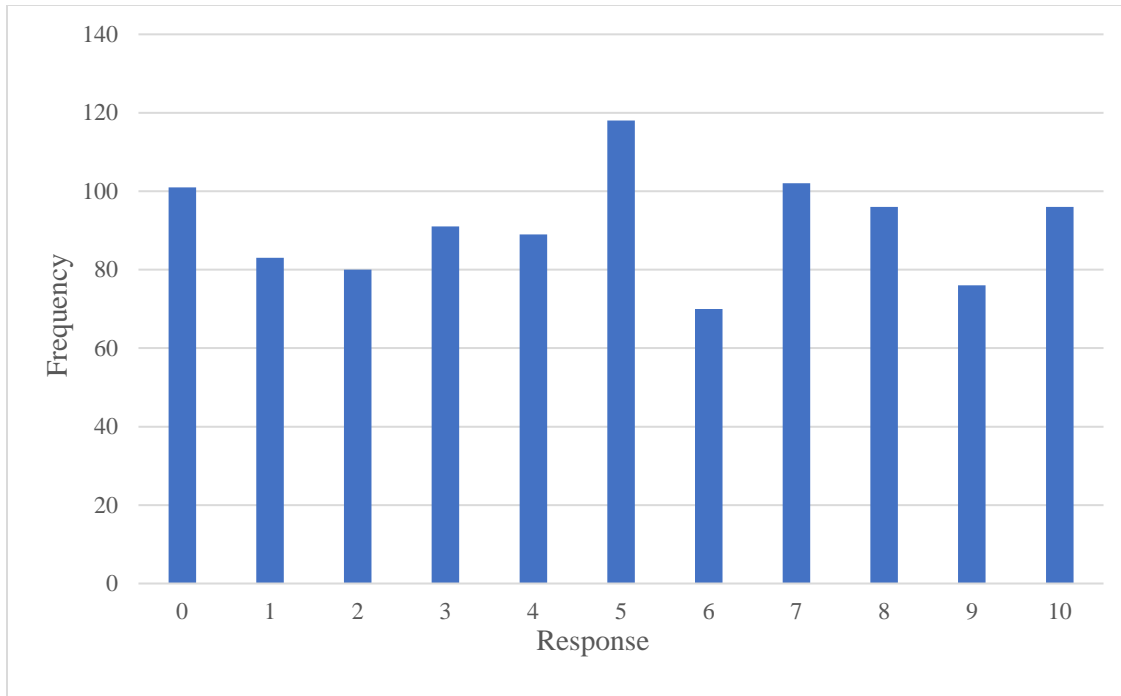


Figure 19. Participant Use of Sight or Smell versus Label Date When Considering Discarding Bakery Items (0 = Only Sight or Smell; 10 = Only Label Date).

The final objective was to determine if eating past the label date and issue of food waste differed among the demographic variables. These results are summarized below in Table 6.

Table 6. Chi-Squared Test Outcome of “Eat Past Date” and “Food Waste Interpretation” by Demographic

	Eat Past Date	Food Waste Important
Primary	Different	Same
HH Income	Different	Same
Gender	Different	Same
Race	Same	Same
Region	Same	Same
Education	Different	Same
Grocery Decisions	Different	Same
Age	Different	Different

Same: 9, Different: 7

Following the layout of the previous tables, Same and Different were used to distinguish the chi-square test outcomes. Eating past the label date was interpreted differently among the majority of the demographic categories. However, Age was the only demographic variable that resulted in the issue of food waste being viewed differently.

The provided responses for the eating past the label date question were Frequently, Often, Sometimes, Rarely, and Never with sometimes being the top response to the question. The provided responses for the issue of food waste were Strongly Agree, Agree, Somewhat Agree, Neither Agree nor Disagree, Somewhat Disagree, Disagree, and Strongly Disagree. Strongly Agree and Agree were the two main responses followed by Somewhat Agree and Neither Agree nor Disagree. These results are summarized below in figures 20 and 21.

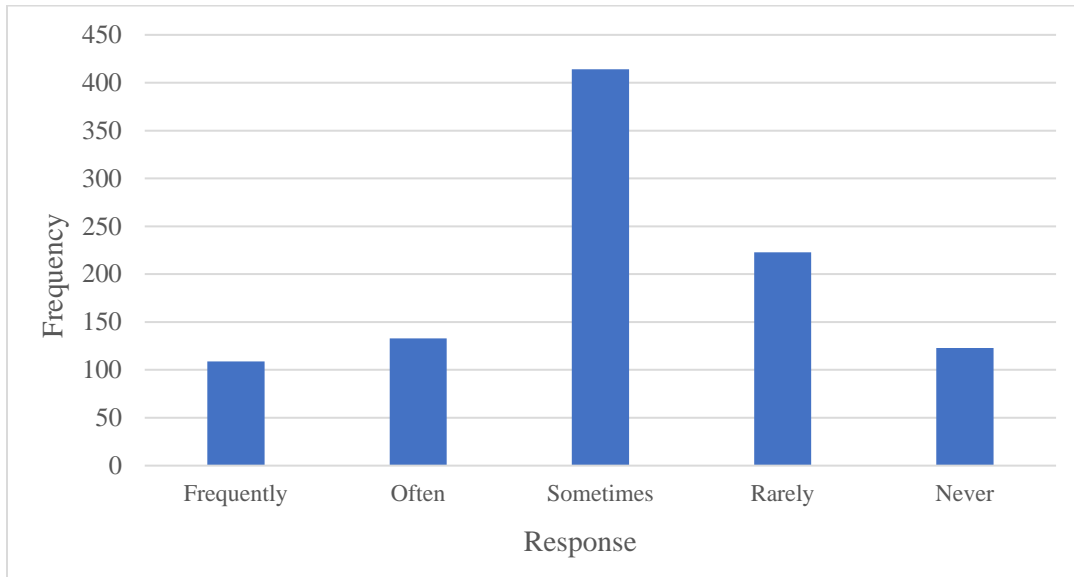


Figure 20. Participant Response for Eating Food Past the Defined Label Date.

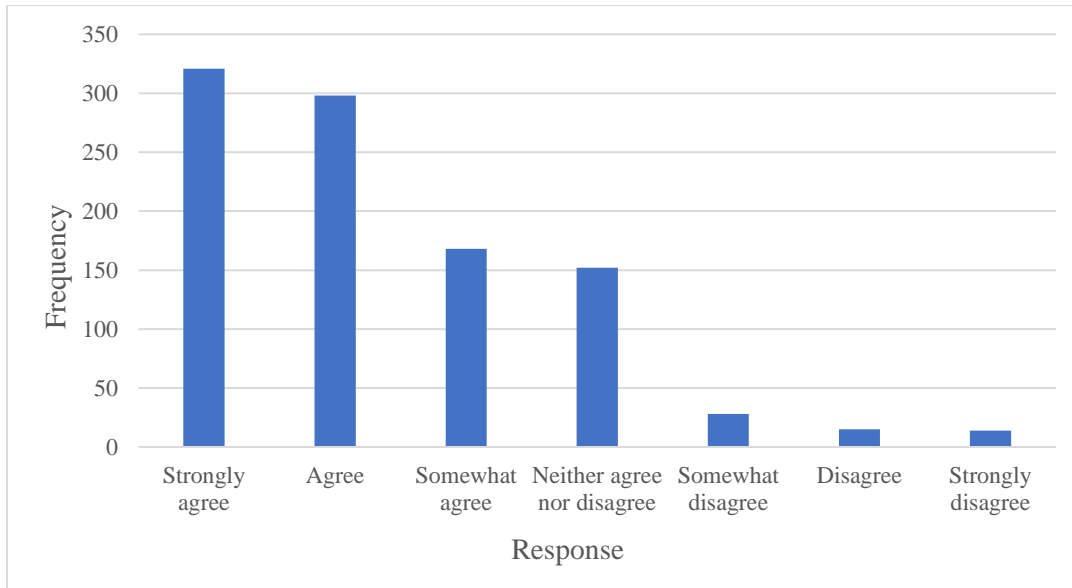


Figure 21. Participant Response to the “*Food Waste Is Important to You*” Survey Question

Conclusions

The objectives of this project were to determine if label interpretation, sight/smell versus label date usage, eating past the label date, and the issue of food waste differed among the demographic variables gender, age, race, region, education level, household income, primary grocery shopper, and the percentage of household income spent on groceries. A series of chi-square tests were performed to accomplish these objectives. The *Best if Used By* and *Use By* labels were interpreted differently across the demographic categories, thus could be perceived as a more ambiguous label, while the *Sell By* label was interpreted more consistently among the demographic variables. The sight/smell versus label date usage were interpreted almost evenly, with more of the results being interpreted the same. Bakery items were interpreted differently while salad and solid dairy items were interpreted the same among the demographic variables. The majority of the demographic variables interpreted eating past the label date differently while

age was the only demographic variable that interpreted the issue of food waste differently.

Lastly, some of the responses were uniformly distributed, but the majority of the questions had one or two dominant responses.

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