

Predicting the Demand for Frequently Purchased Items

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Two ways of administering the standard Juster scale were used to predict the rate at which consumers would buy frequently purchased items. Respondents were asked to estimate their households' purchases of seven frequently purchased items over a four week period. Half of the respondents were asked for separate Juster probabilities for each level of purchase; half were asked to allocate tokens over the levels of purchase in proportion to their Juster probabilities. Respondents were reinterviewed four weeks later to determine actual purchases of each item. The method using tokens was superior in all measures of predictive accuracy. For all items, this method slightly overestimated purchases while the other produced considerable underestimates.

Keywords: Juster Scale, predicting demand, purchase probabilities, constant sum, multiple question

Introduction

The Juster scale is a purchase probability scale which has been used to predict consumer purchase rates of a range of items including durables, services, and fast moving consumer goods, over time periods from three months to a year (Day, Gan, Gendall & Esslemont 1991). In all these cases the Juster scale has proved a better predictor than purchase intention scales.

However, for frequently purchased items, it is usually more important to estimate the number of items purchased in a given period, rather than the proportion of households which will buy at least one unit of the items concerned. The purpose of this study was to determine whether the Juster scale could be used to make such estimates, and to compare the predictive accuracy of two ways of administering the Juster procedure.

Method

Two methods of applying the Juster Scale were employed:

(a) The Multiple Question Method

The first method required respondents to state the probability that their household would purchase one unit of a given item, then two units, and so on, until a number was reached for which the purchase probability was zero. This method is referred to as the Multiple Question Method.

Respondents were shown the Juster Scale and asked to give a number, between 0 and 10, that best represented the likelihood of their household buying the specified number of items within the specified period of time. The Juster Scale is shown in Figure 1.

Figure 1. The Juster Scale

10 Certain, Practically Certain	(99 in 100 chance)
9 Almost Sure	(9 in 10 chance)
8 Very Probable	(8 in 10 chance)
7 Probable	(7 in 10 chance)
6 Good Possibility	(6 in 10 chance)
5 Fairly Good Possibility	(5 in 10 chance)
4 Fair Possibility	(4 in 10 chance)
3 Some Possibility	(3 in 10 chance)
2 Slight Possibility	(2 in 10 chance)
1 Very Slight Possibility	(1 in 10 chance)
0 No chance, Almost no chance	(1 in 100 chance)

(b) The Constant Sum Method

The second method required respondents to indicate the probabilities of purchasing various quantities of items, in such a way that the sum of the probabilities equalled one. To do this, respondents were provided with a rectangular board and 10 counters, as shown in Figure 2. The board was divided into 13 squares, one per item, representing from zero to 12 purchases of each item. Each counter represented a purchase probability of 0.1.

For each item in turn, the respondents were asked to place all ten counters on the board and distribute them in the manner they believed most accurately represented their household's likely purchase behaviour over the next four-week period. For example, if respondents felt there was a 50-50 chance the household would purchase either two or three tubes of toothpaste over the four week period, they would assign five tokens to each of the squares representing two and three tubes of toothpaste. All 10 counters, and only 10, had to be used.

As this method forced the total purchase probabilities to add to one, it is referred to as the Constant Sum Method.

Figure 2. Constant Sum instrument

PREDICTED PURCHASES WITHIN THE NEXT FOUR WEEKS	
	0 1 2 3 4 5 6 7 8 9 10 11 12
Toothpaste	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Margarine	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Butter	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Eggs	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Spaghetti	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Ice Cream	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
Cheese	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>

Procedure

A cluster sample was drawn from eight geodemographic meshblocks developed for Palmerston North (Corlett 1988). The size of the samples taken from each meshblock was proportional to the size of the meshblocks within the population. A starting point was randomly selected for each cluster, and an interview was attempted at every second household. Up to two callbacks were made before abandoning a particular household. The two methods of using the Juster Scale were alternated across interviews to minimize the demographic differences between the two samples.

In each household, the main household grocery shopper was selected, and asked to predict the household's purchases of seven frequently purchased items over the ensuing four weeks. The seven items used in the study were toothpaste, margarine, butter, eggs, spaghetti, ice cream and cheese. These products are among the fifteen most frequently purchased grocery items in New Zealand (Department of Statistics 1988). Respondents were given no indication that another interview would occur, but a follow-up interview was attempted with the same respondents twenty-eight days after the initial interview to measure actual purchase behaviour. Respondents not contacted within 31 days were treated as non-contacts.

A total of 70 first interviews and 66 follow-up interviews were obtained; 34 for the Multiple Question Method and 32 for the Constant Sum Method. This represents a response rate of 60% for first interviews, and 57% overall. The average time taken to complete interviews using the Multiple Question Method was 15 minutes, compared with 13 minutes using the Constant Sum Method. The follow-up interview took approximately 5 minutes to administer.

Results

The predictive errors of the two methods are shown in Figure 3. They are expressed as the percentage difference between predicted quantity and actual quantity. This was calculated using the following formula:

$$(\text{Predicted quantity} - \text{Actual quantity}) / \text{Actual quantity} \times 100$$

Figure 3: Predictive error for the two methods

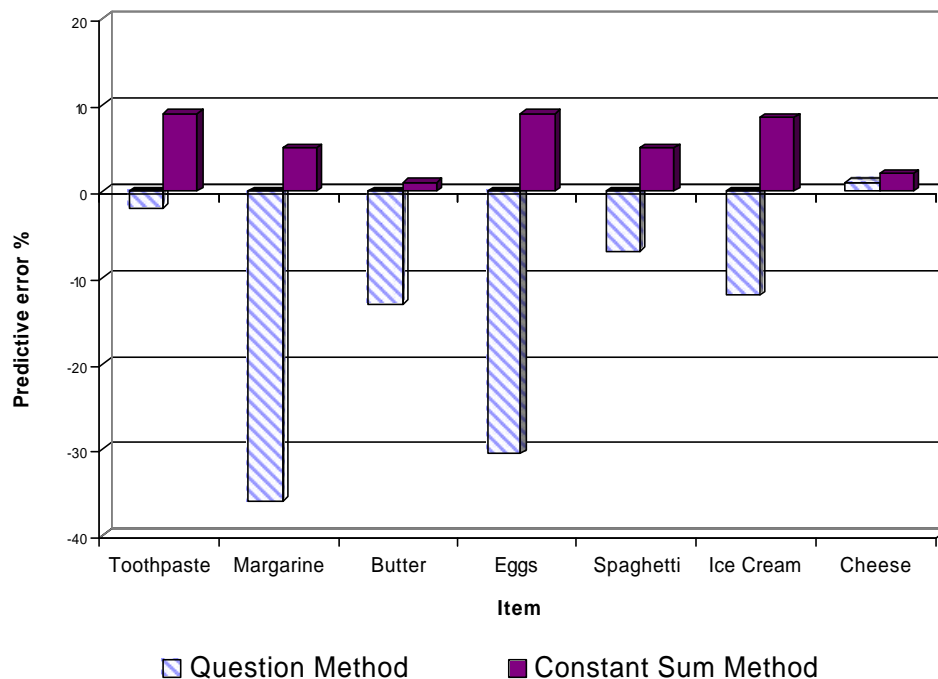


Figure 3 shows that purchases of all items were under-estimated by the Multiple Question Method and over-estimated by the Constant Sum Method. It can also be seen that the Multiple Question Method had the greatest range of predictive error.

The most accurate purchase prediction made by the Multiple Question Method was an under-estimation of 1% for cheese, and the least accurate prediction was an under-estimation of 36% for margarine. The most accurate forecast by the Constant Sum Method was an over-estimate of 1% for butter and the least accurate was an over-prediction of 9% for eggs and toothpaste.

The mean predictive error of each method is derived by summing the absolute error for each item and dividing this figure by the number of items. The mean predictive error was 15% for the Multiple Question Method, compared with 6% for the Constant Sum Method. Moreover, the Constant Sum Method predicted consumers' purchases more accurately than the Multiple Question Method for five of the seven items. These differences in mean predictive error between the two methods were not significant. However, this is probably due to the small sample size used in this study rather than a lack of differentiation between the two methods.

Discussion

This study demonstrates that modifications to the normal procedure for using the Juster Scale can successfully be used to predict purchases of frequently purchased items. The results suggest that more accurate estimates of quantities purchased may be made by asking consumers to distribute tokens across a continuum of possibilities, than by asking them for separate purchase probabilities for different purchase quantities.

An advantage of using movable objects with the Constant Sum Method was that respondents readily altered the initial distribution if they felt it was not a correct representation of their purchase probabilities. Furthermore, this participation tended to maintain their interest. On the other hand, the high level of repetitiveness with the Multiple Question Method meant that some respondents tended to lose their initial enthusiasm.

The Multiple Question Method consistently under-estimated purchases while the Constant Sum Method consistently over-estimated purchases. A possible reason for the under-estimation produced by the Multiple Question Method may be the repetitive and potentially boring nature of the task, possibly tempting respondents to report smaller purchases in order to complete the task quickly.

There was, however, no evidence that this was occurring. There is no obvious explanation of why the Constant Sum Method over-estimated purchases, but this result is consistent with those of other published studies (Clawson 1971). However, it should be noted that there are three key differences between previous studies and this study, and these need to be taken into account when comparing results.

First, previous studies predicted household purchase rates of frequently purchased items, not the number of purchases as in this study. Second, the frequently purchased items used in previous studies were largely non-grocery products, and therefore more durable and purchased less frequently than the items used in this study. Finally, the predictive period in previous studies was 12 weeks, considerably longer than the four week period used in this study.

The low rate of predictive error with the Constant Sum Method lends some support to the findings of Axelrod (1968), who found the constant sum scale (which is similar in principle to the constant sum method tested in this study) yielded the most accurate purchase predictions of the ten predictive scales he examined. Axelrod claims that the scale could also be used to accurately predict consumer purchases of particular brands. It would clearly be in the interests of marketing managers to test whether this is the case, and this question is currently being addressed by the Marketing Department at Massey University.

This study also found considerable variability in the level of predictive error between the products for both methods. While both methods accurately predicted the rate of purchase for some items, they had large predictive errors for others. Although the Constant Sum Method tended to be more accurate overall, the Multiple Question Method was more accurate for two of the items. Thus, the accuracy of the scales tested appears to be somewhat related to the nature of the predicted item. Further research should study different products to develop levels of predictive accuracy for each method within various product categories. The length of the predictive period should also be altered to test whether predictive periods of different lengths have a significant influence on the predictive accuracy of the two methods.

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