

Constructing Demand Curves from Purchase Probability Data: An Application of the Juster Scale

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Two studies examined the effect, on estimates of purchase rates and purchase level, of different procedures for obtaining Juster purchase probabilities ratings. The results of the two studies reported here indicate that, while it is certainly possible to obtain data for constructing demand curves using the Juster Scale, great care needs to be taken if this approach is used. The most important finding from the two studies reported was the strong effect associated with the order of presentation of the different price-points. Higher estimates were obtained for all price-points when the highest price-point was presented first. Since there is some evidence that all estimates are likely to be over-estimates, presenting the lowest price-point first would appear to be the better approach. However, this has yet to be confirmed. Unfortunately, it was not possible to determine just how accurate the estimates were, since the product was never put on the market. Also, there was some indication in the research reported of a possible context effect, since higher estimates were achieved when respondents had been required to answer preliminary questions related to the product in question.

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Introduction

The Juster Scale is an 11-point purchase probability scale used to estimate purchase rates, that is, to estimate the proportion of a population that will purchase a product or service. This scale, developed by Thomas Juster (Juster 1966), was found to provide reasonably accurate estimates of the purchases of some durables, particularly cars (see Day, Gan, Gendall and Esslemont 1991, for a review). Prompted by these promising early results, researchers in the Department of Marketing at Massey University have, over the past decade, examined the possibility of extending the use of the scale in a number of ways (see Day 1987; Day et al. 1991; Gendall, Esslemont & Day 1991; Hamilton-Gibbs, Esslemont & McGuinness 1992; Hoek, Esslemont & Youngs 1993; Hoek & Gendall 1993; Hosie, Hoek & Gendall 1993; Assendelft 1994; Brennan & Esslemont 1994; Brennan, Hini & Esslemont 1994; Holdershaw, Gendall & Garland 1994; Seymour, Brennan & Esslemont 1994; Brennan, Esslemont & Hini 1995a,b; Brennan, Esslemont & U 1995).

Juster showed that the scale could be used to estimate the proportion of households that would purchase major items within a given future period. Since such items are bought at relatively long intervals, estimating the proportion of households buying (the penetration) is equivalent to estimating the number of items to be bought, the economists' "quantity demanded". For products bought more frequently, such as FMCGs, it is not enough to know the penetration; what is required is the mean number of items bought. Hamilton-Gibbs, Esslemont, and McGuinness (1992) developed a method of using the scale to estimate this. In their method, respondents are asked to state their probabilities of buying different numbers of items during a given period. Different ways of eliciting this information have been tested (Seymour, Brennan & Esslemont 1994; Brennan, Esslemont & Hini 1995a; Brennan, Esslemont & U 1995).

The possibility of using the scale to estimate a demand curve was suggested by Day (1987) and tested by Brennan, Esslemont and U (1995). They attempted to estimate simple demand curves for two branded products: canned Coca Cola, and Campbell's Red & White Label soup. The method of Hamilton-Gibbs et al. was used to ask respondents the hypothetical question of how many cans they would buy, during the following four weeks, at two different market prices. In each case the high price was about 40% above the current retail price, and the low price about 30% below it. By this means estimates were obtained of the mean number of cans that would be bought (the "quantity demanded") at each price.

Straight-line interpolation between these two points on the demand curve was used to estimate the quantity demanded at the current price, and the actual quantity bought was ascertained in a telephone follow-up four weeks after the initial interview.

The results were mixed. The actual purchases of Coca Cola were almost exactly those predicted from the demand curve (within 12% of actual). But the estimated purchases of Red & White Label soup were several times higher than actual purchases. The same pattern occurred in estimates of penetration: quite accurate for Coca Cola (within 5% of actual), much too high for Red & White Label soup (over-estimated by 158%).

It may be that the explanation for these differences lies in the extent to which the brands are perceived as differentiated from other similar products. Subsequent research (Brennan & Esslemont 1994) indicates that it is possible to obtain accurate data for poorly differentiated brands using a two-stage questioning process.

In spite of the results for Campbell's Soup, the encouraging results for the Coca Cola suggest that it is possible to obtain reasonably accurate estimates of purchase rates and purchase levels, at least for some products, even when only two price-points are used. Obviously it would be desirable to obtain information for a greater number of price-points, as this should improve the precision of the demand curve. The question is, what is the most appropriate way of obtaining these data? For example, the most cost-effective procedure would be to simply ask respondents in a survey for Juster purchase probabilities at a variety of different price-points. However, this approach inevitably involves the possibility of item (price-point) order effects. This note reports the findings of two studies that examined this issue.

Method

The two sets of data were gathered in the Department of Marketing's annual Palmerston North Household Omnibus Survey, in 1994 and 1995. This survey is carried out by approximately 65 third year marketing students, as part of their course work. The students receive three hours instruction on interviewing procedures, and are required to conduct several practice interviews before beginning their interviewing. This level of training compares favourably with current commercial practice in New Zealand. Each student has to complete interviews with four people, two male and two female, over the age of 15. Using a starting address randomly selected from the telephone directory, an interview is attempted at the house to the right of the starting address, then at every third house to the right, until the quota is filled. The selected respondent is the person in the household whose birthday is due next. Up to two callbacks are made before replacement.

The response rates for the survey were 44% in 1994 and 50% in 1995, based on samples of 231 and 235 respondents, respectively.

Procedure

Purchase probabilities were gathered for the chances of hiring a laser disk player. This product is relatively new, and only two or three respondents currently owned a laser disk player at the time of the surveys. Only people who had personally ever rented a video tape, either on their own or with others, completed this part of the survey.

In both surveys, respondents were read the following statement:

Most new video releases are now also available on laser disks, which are much like CDs. Laser disks give a very high quality sound and picture, but require a special laser disk player to play them. Laser disk players are hooked up to your TV set in the same way as a video player.

It will soon be possible to hire laser disks and laser disk players. The laser disks will be the same price to hire as new video releases.

Respondents were then asked the following questions:

Taking everything into account, and using this scale (SHOW JUSTER SCALE), what would you say the chances were of you renting a laser disc, rather than a video tape...

... if you could hire a laser disk player for \$10 a day?

What if the price of the laser disk player was \$18 a day?

What if it was \$25 a day?

For half of the sample, the order of the prices was reversed (i.e., \$25, then \$18, then \$10).

Calculation of Purchase Rate

Each answer obtained from a respondent was a purchase probability, ranging from 0 (no chance, almost no chance: 1 in 100) to 10 (certain, practically certain: 99 in 100). These numbers correspond to estimates of the probability of purchase (ranging from 0 to 1). The mean of the respondents' individual purchase probabilities (i.e., the mean Juster Scale response x 10) is the estimated proportion of the sample who would buy, given the stated conditions.

Results and Discussion

The mean purchase probabilities for each price-point, and the associated demand curves for each order of presentation, are shown in Figure 1 for 1994 and in Figure 2 for 1995.

Figure 1. Demand curve for video disc players (1994)

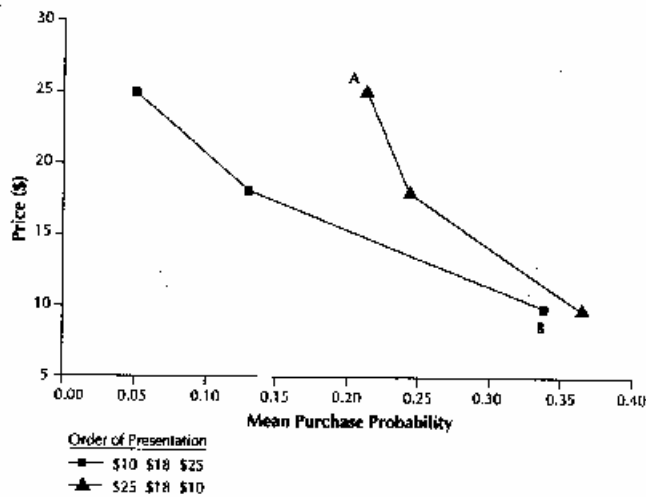
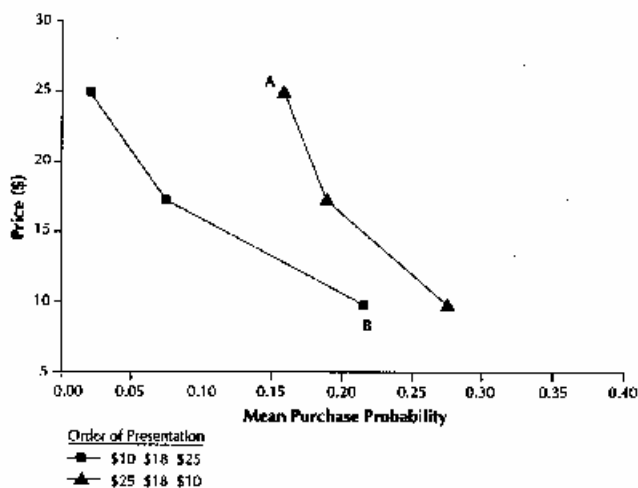


Figure 2. Demand curve for video disc players (1995)



As one might expect, demand for laser disk player hire declines as the hire price increases, and the estimated demand curves are indeed curved rather than straight line. However, the most notable feature of the curves is the marked order-of-presentation effect, apparent in both Figure 1 and Figure 2. In both cases, when the highest price is presented first, the purchase probability estimates are higher for each price-point than when the lowest price is presented first. In other words, higher estimates were obtained when the price-points were presented in descending order.

Since the laser disk hire scheme was never implemented, it is not possible to determine which of the demand curves gives the best estimate of actual demand. However, previous experience (Brennan & Esslemont 1994) would suggest that even the lowest estimates are likely to be inflated. And looking at the present figures, it is a little difficult to believe that

20% (1995) to 35% (1994) of video users would in fact hire a laser disk player, even at \$10, although there is no evidence to support this opinion.

A second point to note is that, in both Figures 1 and 2, the slopes of the two curves differ. The higher the price, the greater the effect of the order of presentation of the price-points. While the estimated purchase probabilities are quite similar at the lowest price-point in both 1994 and 1995, this is not the case for the mid and high price-points.

This effect might in part be due to the procedure used to obtain the estimates; the purchase probability estimates for each price-point were obtained from the same respondents. Thus the responses are not actually independent, since respondents' answers for the first price-point is very likely to have affected their answers to the remaining price-points. This may, in turn, have affected both the slope and shape of the estimated demand curves. This effect has been noted by others, such as Ehrenberg and Mills (1990, cited by Blamires 1992) and Schuman and Presser (1981).

An alternative approach would be to obtain the required data for each price-point from separate samples of respondents. While the responses would be independent, this procedure would introduce sampling variation for each price that would need to be taken into account. But it may also result in rather flatter demand curves, as can be seen by comparing, in both Figures 1 and 2, the mean purchase probabilities obtained for \$10 asked first (point A) and for \$25 asked first (point B). Whether or not this would produce more accurate estimates than using the procedure employed in this study remains to be seen.

Another approach would be to employ the Gabor/Granger technique, where respondents are presented with a quasi-randomised series of prices (Blamires, 1981). However, the results presented in Figures 1 and 2 suggest caution is also required when this technique is used, since the magnitude of the price-order effect varies for different price-points, and the randomisation might simply be disguising rather than eliminating this effect.

A further observation is that all of the 1994 purchase probability estimates are higher than the corresponding 1995 figures. The higher estimates obtained in the 1994 study are curious, since one might expect demand for a new technology to increase with time. However, the result may reflect differences in the way the two surveys were conducted. Some of the differences may be due to sampling error, as different respondents, and different interviewers, were involved in the two studies. But a more likely explanation is that the results were affected by the context of the questions. In 1994, the laser disk questions followed quite intensive questions about video use and video stores, whereas there was only a single preceding question about videos (whether the respondent had ever rented a video tape, on their own or with others) in 1995. Thus respondents in 1994 were highly focused on video use, and this may have influenced their answers. Context effects such as this are well documented, and can have dramatic effects (see, for example, Bishop, Oldendick & Tuchfarber 1982; Schuman & Presser 1981).

Conclusions

The results of the two studies reported here indicate that, while it is certainly possible to obtain data for constructing demand curves using the Juster Scale, great care needs to be taken if this approach is used.

The most important finding from the two studies reported was the strong effect associated with the order of presentation of the different price-points. Higher estimates were obtained for all price-points when the highest price-point was presented first. Since there is some evidence that all estimates are likely to be over-estimates, presenting the lowest price-point first would appear to be the better approach. However, this has yet to be confirmed. Unfortunately, it was not possible to determine just how accurate the estimates were, since the product was never put on the market.

From a pragmatic point of view, a procedure for obtaining purchase probabilities for a range of different price-points from each respondent would be preferable to a procedure that required a randomised presentation of price-points to each respondent. The next step in the development of the application of the Juster Scale discussed here is to determine the accuracy of results obtained in this way, and the challenge for future research is to develop the procedure further to minimise bias.

Finally, there was some indication in the research reported of a possible context effect, since higher estimates were achieved when respondents had been required to answer preliminary questions related to the product in question. Of course, this is not a function of using the Juster Scale, but the observation serves to highlight that care has to be taken when conducting survey research, particularly when the objective is to compare results from different surveys.

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