An Application of Fuzzy Pairwise Comparison to Farmer Attitude toward Advertisement Techniques Used for Farm Tractors in Turkey

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Abstract: It is the purpose of this study to elicit the priorities of advertisement methods in which the farmers takes into account while buying farm tractor. The data was gathered through a survey that is covering randomly chosen farmers in Aydın. Fuzzy pairwise comparison was used as the analysis technique. Mostly benefited advertisement methods such as field demonstrations, media commercials, fairs, brochures and factory trips were assumed to impact the farmers during their tractor buying process. The study showed that the most important advertisement method that stimulates the farmers to buy tractor is field demonstrations with a weight of 0.87. The subsequent methods are factory trips (0.50), exhibitions at fairs (0.41 and media commercials (0.15).

Introduction

The decision making mechanism of the farmers for buying has been the aim of many studies so far. A great amount of theories in regard with farmer attitudes were forwarded and discussed up to now. The most attractive theory which is also quite simple and applicable is the one suggested by Kurt Lewin, a psychologist (Figure 1) (Cankurt, 2008). This theory argues that attitudes are the function of personal and environmental factors which leads to developing a model so-called "black box" or "stimulation-response" (Odabaşı ve Barış, 2003).

FigPicture1: The Black Box (Consumer Mind) Model (Odabaşı ve Barış, 2003).

It is presumed that a customer reacts to the events under the effect of a number of individual and surrounding factors. For the ease of analysing the mechanism, grouping of the effective factors on farmer behaviour was the widespread approach in the presumed models. The grouped factors are assumed to influence the decision making process of farmers and give rise to a final behaviour, either buying or non-buying (Çabuk ve Yağcı, 2003). The factories are as follows (Odabaşı and Barış, 2003):

- Psychological factors,
- Socio-cultural factors,
- Demographic factors,
- Conditional factors,
- Marketing factors

This study aims at eliciting the influences of advertisement methods on the tractor buying behaviour of farmers.

As in many areas, marketing studies mostly compare alternative ways that may lead to the ranking of them with their weights or priorities. It has been an important goal for researchers to rank the objectives, products or information sources properly.

There have been some techniques that the researchers used in determining the priorities or rankings of elements in question. One technique that was first used by the researchers is simple ranking in which respondents are simply asked to give rank numbers to the elements while 1 represents the most preferred element and n the least preferred one. Ranking or rating scales are used in areas such as preference list and consumer satisfaction. They typically let individuals rank a product or performance via a numerical scale. While ranking scales can make it easy to assemble and tabulate the results, there are some inherent disadvantages in the gathering of the information. Ranking scales allow for consistency in the tabulation of responses. Each subject is rated using the same standards, so there is fairness in the evaluation process. The results are measurable, which makes for easy comparison. Since ranking scales are numerical, the results obtained are completely objective. Those who examine the results are not swayed by subjective comments or opinions, and there is no way for personal prejudices to factor in. Several different methods can be employed to gather information through ranking scales. In product evaluation, surveys can be done over the phone, in person or by postal mail. In-person surveys can also be conducted at a location where a product is purchased by giving out free samples. In the age of the Internet, information from ranking scales can even be gather via email or online survey. A possible weakness of ranking systems is that the evaluator may rank based on perception. Although those who interpret the results use objective methods, the actual evaluators may rate the subject based on their opinions or prejudices without basing them on fact. The evaluators may also interpret the rating scales differently. For example, with a rating scale that assigns a number based on criteria such as "good," "average" or "occasionally" room is left for interpretation as to what those terms actually mean, which can result in inaccurate ratings. An individual using a ranking scale may be influenced by how a survey is conducted. If a survey is conducted in person, the responder be swayed by the survey taker's personal appearance or tone of voice. They survey taker may also have a personal agenda which influences how they ask the questions..

In fact, studies indicated that more than five information sources can not be efficiently compared by non-preeducated minds (Baran, 2002). Another technique without such disadvantages that can be used in ranking is simple pairwise comparison. *Simple pairwise comparison* is a sort of divide-and-conquer problem-solving method. It allows one to determine the relative order (ranking) of a group of items (products). This is often used as part of a process of assigning weights to criteria in question. Pairwise comparison generally refers to any process of comparing entities in pairs to judge which of each pair is preferred, or has a greater amount of some quantitative property. The method of pairwise comparison is used in the scientific study of preferences, attitudes, voting systems, social choice and public choice. In psychology literature, it is often referred to as paired comparison.

This study deals with eliciting how much farmers pay attention to each of the advertisement techniques while making decision on buying a farm tractor. The results from the study is expected to serve as a tool for using most effective advertisement techniques to get the best selling levels of farm tractors.

Material And Method

The data was gathered through a survey that is covering randomly chosen farmers in Aydın. The province of Aydın has 17 counties, including itself as Central County. There is a poli-cultural production structure in Aydın. Total sample size was computed as 121 by estimating the population proportion with 90% confidence level and 7.5% error (Newbold, 1995). Three of the 17 counties of Aydın were selected to represent Aydın and total sample size was distributed to these counties according to their respective shares.

The data was analyzed by the FPC in which the farmers made pairwise comparisons of the five advertisement techniques. FPC presented weighted scores for each of the advertisement methods that enabled us to rank them. In the FPC, a farmer was asked to compare two advertisement techniques. The comparison includes not only a preference of one technique over the other technique but also drawing out the level or power of the preference.

Fuzzy Pair-Wise Comparison

Fuzzy theory began with a paper on "fuzzy sets" by Zadeh in 1965. Fuzzy set theory is an extension of crisp set theory (Tanaka, 1997). Fuzzy sets are sets with boundaries that are not precise. Thus, fuzzy sets describe ranges of vague and soft boundaries by degree of membership (Lai and Hwang, 1994). The membership in a fuzzy set is a matter of a degree (Klir and Yuan, 1995). Fuzzy set is characterized by a membership function, which is allowed to choose an arbitrary real value between zero and one.

FPC was first used by Van Kooten, Schoney and Hayward (1986) to study farmers' goal hierarchies for use in multiple-objective decision making. The first step of FPC approach in this study is data collection by using a unit line segment as illustrated in Figure 2. Two advertisement methods, D (field demonstration) and T (factory trips), are located at opposite ends of the unit line. Farmers are asked to place a mark on the line to indicate the degree of their affected advertisement method. A measure of the degree of preference for advertisement method D over T, r_{DT}, is obtained by measuring the distance from the farmer's mark to the D endpoint. The total distance from D to T equals 1. If $r_{DT}<0.5$, advertisement method D is preferred to D; if $r_{DT}=0.5$, the farmer is indifferent between D and T and if $r_{DT}>0.5$, then advertisement method D is preferred to T. $R_{DT}=1$ or $r_{DT}=0$ indicates absolute preference for advertisement method D or T. For example, if $r_{DT}=1$, then advertisement method D is absolutely preferred to T (Van Kooten et al, 1986).

Neutral
D ——————————————————————|——————————T————————

Figure 2. Fuzzy method for making pair-wise comparison between advertisement methods (D)Demonstration and (T)Trip.

The present study employs five advertisements used tractor advertisement. The number of pair-wise comparisons, λ, can be calculated as follows:

$$\lambda = n*(n-1)/2 \tag{1}$$

where n = the number of advertisement methods. Thus, a farmer made ten pair-wise comparisons in a personal interview.

In the second step of FPC, for each paired comparison (i,j), r_{ij} ($i \neq j$) is obtained. r_{ij}'s values is collected directly from farmer. Also r_{ij} ($i \neq j$) is a measure of the degree by which the farmer prefers advertisement method i to advertisement method j and $r_{ji}=1- r_{ij}$ represents the degree by which j is preferred to i. Following Van Kooten at al (1986), the farmer's fuzzy preference matrix R with elements can be constructed as follows:

$$R_{ij} = \begin{cases} 0 & if \ i = j \ \forall i, j = 1,...,n \\ r_{ij} & if \ i \neq j \ \forall i, j = 1,...,n \end{cases} \tag{2}$$

Finally, a measure of preference, μ, can be calculated for each advertisement method by using farmer's preference matrix R. The intensity of each preference is measured separately by the following equation:

$$\mu_j = 1 - \left(\sum_{i=1}^{n} R_{ij}^2 /(n-1) \right)^{1/2} \tag{3}$$

μ_j has a range in the closed interval [0,1]. The larger value of μ_j indicates a greater intensity of preference for advertisement method j. As a result, farmer's advertisement methods are ranked from most to least preferable by evaluating the μ values.

To analyze advertisement methods derived from FPC, nonparametric statistical tests are used (Başarır and Gillespie, 2003). Friedman test is employed to establish whether the advertisement methods are equally important within a block which is a farmer's advertisement method rankings according to his/her preferences. Since five advertisement methods are presented to farmers, each row includes five values which are the degree of the preferences for the advertisement methods exposed from a farmer. The null hypothesis is that there is no difference in preferences over

the advertisement methods among farmers. Alternatively, at least one advertisement method is preferred over the others. Another nonparametric test was Kendall's W which is a normalization of the Friedman test. Kendall's W is a test for agreement among more than two set of rankings (Bowen and Starr, 1982) . Kendall's W is the coefficient of concordance, and ranges between 0 (no agreement) and 1 (complete agreement).

Findings

In the fuzzy pairwise analysis, five of the advertisement techniques mostly used in Farm Tractor commercials in Turkey were taken into account:

- **Field demonstrations:** Tractors are introduced under field conditions
- **Media commercials:** Tractors are introduces via adds in televisions, radios, newspaper and magazines
- **Fairs and exhibitions:** Tractors are introduced at fairs and exhibition centres for visitors
- **Brochures and pamphlets:** Technical information about tractors is given with some supplementary pictures.
- **Factory trips:** Farmers are picked up and taken to the factories where tractors are produced.

Descriptive statistics related with the values of each advertisement techniques obtained from FPC analysis is presented in Table 1.

Advertisement techniques	Mean	Standard deviation	Minimum	Maximum
Field demonstrations	0.87	0.14	0.34	1.00
Media commercials	0.50	0.11	0.26	0.95
Fairs and exhibitions	0.41	0.13	0.07	0.83
Brochures and pamphlets	0.23	0.13	0.00	0.68
Factory trips	0.15	0.10	0.00	0.68

Friedman Test Chi-square: 378.46; (p<0.00)
Kendall's W= 0.78

Table 1: Effect of Advertisement Techniques on Tractor Buying

The Friedman test concludes that the advertisement techniques have statistically different effects on the farmers during their decision making for buying a tractor (Friedman: 378.46). The Kendall's W coefficient (0.78) implies that the farmers are in a strong agreement on the ranking of the techniques. The most effective technique was found as field demonstration with a score of 0.87 which was followed by factory trips (0.50), fairs and exhibitions (0.41), brochures (0.23) and media commercials (0.15).

Conclusion

As part of the factors affecting tractor demand, advertisement techniques that can be employed for farm tractors were dealt with in this study. Five of the techniques were analyzed by fuzzy pairwise comparison. The analysis indicated that the most effective advertisement technique during the decision making process for tractor buying of farmers was field demonstration. The subsequent techniques were factory trips, fairs and exhibitions, brochures and pamphlets and media commercials. According to the nonparametric tests, the farmers mostly agreed upon the advertisement techniques that they were affected. This denotes that the farmers would like to see tractors working on the real conditions in their fields. A combination of field demonstration and brochures-pamphlets distributed during fairs and exhibitions could be recommended for increasing tractor demand.

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