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Design of Experiments for Analysis Factors Influencing Consumer Behaviour

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Abstract

Fairtrade and organic consumption are examples of ethical consumption. Contrary to organic food products. Fairtrade concept is relatively recent in the Czech Republic. Current methodological appliance of DOE is represented by the set of scientific methods for identifying the significant and/or critical parameters associated with a process and thereby determining the optimal settings for those process variables which are able to enhance performance and capability of the response (e.g. selected character of a product quality).

This paper utilizes the powerful technique of “Design of Experiments” (DOE) to study the effect of several motivation factors on the response or characteristics of shopping behaviour of the Fairtrade products.

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1. Introduction

We presently live in a world of market economies where consumers (especially those from developed countries) enjoy a great selection of goods for a “reasonable price” produced on different continents. Unfortunately, this reasonable price is very often reached through production that does not respect the environment or the workers who

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are involved in it. Especially in developing countries, workers are exploited, so to say, for “unreasonable” wage. More and more consumers are aware of the true “unethical” price for their comfort and striking global differences (Yiridoe et al., 2005, Newholm and Shaw, 2007).

To protest against the customary practices of mass production, two radical movements have emerged that deal with the environmental and social problems – organic agriculture and Fairtrade (Codron et al., 2006).

They focus on basic human activities – agriculture and food production. On the other side of the market, there are consumers, who are not indifferent to environmental pollution and exploitation of people in developing countries and who want to contribute to change.

Consumption of organic and Fairtrade products, which is an example of a socially responsible, environmentally responsible and ethical behaviour it has been the centre of scientists’ attention for many years. Various models and variables have been designed to understand the motivations and decision-making process in this type of behaviour (Newholme and Shaw, 2007).

Although organic-product consumption and the consumption of Fairtrade products have usually been examined separately; organic agriculture and Fairtrade focus on ethical issues and they have much in common. The Fairtrade concept also includes environmentally friendly aspects in production processes and the organic-farming movement has included social aspect in its principles (FLO, IFOAM[†]). Likewise, consumers of organic-farming products and Fairtrade consumers have been regarded as two different groups of people. However, as suggested by some organizations engaged in organic and ethical trade in the UK, “the same kind of people are interested in both” (Browne et al., 2000).

In comparison with other European countries and the United States, the knowledge about ethical consumers in the Czech Republic is inadequate (Urban and Ščasný, 2007). A growing number of sales outlets selling organic food (food from organic agriculture) and Fairtrade products call for an examination in this area. Organic food already represents a significant niche in the market, 25 % of the population knows organic food and buy it irregularly (Václavík, 2007). Organic agriculture, as a production system, is supported by Czech and European legislation. Fair trade also represents a rapidly growing niche in the market – the total turnover has increased almost tenfold within three years (Václavík, 2008). However, the sales of Fairtrade are relatively new and very insignificant in comparison with the sales of organic-farming products.

The purpose of this article is to examine the factors that influence the shopping behaviour focused on Fairtrade products. The objective is, on that basis, to make a worthwhile shopping behaviour simulation concerning Fairtrade products, based on the so-called *mixed experiments*. This should allow to determine the percentage of Fairtrade products in the consumer basket of food of customers, at which there would be a significant strengthening of this to determine the optimum ratio is thus to contribute to further promoting and developing of Fairtrade-product sales in the Czech Republic.

Currently, the major retail chains in the Czech Republic offering Fairtrade products are the following ones: DM Drogerie, Globus, Interspar, Kaufland, Makro, Marks & Spencer and Tesco. Globally, commodities in Fairtrade include bananas, coffee and coffee beans, fresh and dried fruit, cotton, flowers and plants, fruit juices, sugar cane, quinoa, rice, nuts, tea, wine, etc. Cosmetic product have become popular, but also Fairtrade gold. The range of handmade products has also been constantly expanding; the offer also includes toys and sports equipment. The target group of customers of this type of retail seems to prefer the price of the goods and is not willing to invest in their shopping more money than is absolutely necessary. Another possible reason for the failure of the sales of Fairtrade products in retail chains may be insufficient or inappropriate way of promoting these products (Annual Report of the Association for Fairtrade, 2009).

The concept of Fairtrade in the Czech Republic does not have a long history, this idea became more widely known after 2000; the individual indicators have been fully monitored statistically since the second half of the last decade, specifically since 2007. The growth in retail sales of Fairtrade goods in the Czech Republic has shown a long-term sustained growth despite the unfavourable economic situation in recent years. The maximum increase of

[†] FLO = Fairtrade labelling organizations international, www.fairtrade.net

IFOAM = International federation of organic agriculture movements, www.ifoam.org

the studied value was recorded between 2009 and 2010 when the retail sales in this sphere rose by CZK 30 million. This fact may seem surprising given the global economic crisis. In the wider context, however, it can be explained by the fact that it was in 2010 when some retail chains started marketing Fairtrade products and thus increasing the volume of goods sold. These facts are clearly illustrated in the following graph.

In terms of product range it can be stated that coffee is clearly the best-selling product; its percentage in the overall structure of Fairtrade goods sold has been increasing, the highest annual increase – by 23 % – can be traced in 2010–2011. Other types of Fairtrade goods sold in the Czech Republic include cocoa, chocolate and sweets, and processed foods. A minor percentage share is also taken by sugar-cane sugar and sweeteners, beverages, cereals, rice, seeds and nuts. The decrease in the sales is evident in tea – there was a reduction in the percentage share by 8 %.

2. Methodology

The data used was collected during three weeks in January 2014. Three groups of consumers were addressed: Fairtrade-product consumers and organic-product consumers in specialized shops, and ordinary consumers in supermarkets as a sample of the general population. The design of this research is a quasi-experimental. The research was conducted mainly through online questionnaires. The total number of completed questionnaires was 246.

Three types of analysis were used to confirm or refute the hypotheses. To compare the groups, testing of means differences – t-test or ANOVA – was used. To test the hypotheses, five association tests, chi-squared test and Somers' D were used. These tests were conducted in the SPSS programme.

In addition, the simulation of a mixed experiment was conducted for three concentrates, expressing the relative share in the representation of the food basket of a typical customer. It is the determination in terms of response of an optimal proportional representation of food components among Fairtrade products (A), organic products (B) and commercial products (C). The methodology of *Three Component Mixture Design* was used for this purpose. The response was examined in terms of the expected benefits resulting from reaching a synergistic effect in satisfying the three needs. Product A (Fairtrade) defined the satisfaction of the need of altruism, product B (organic) defined the benefits of *healthy food* and product C (commercial food) defined the need to feed, i.e. to supply energy for the function of the organism. The aggregate quantity comprising of the three responses of consumer benefit then represented a response from a mixed proposal. The idea was to find such a concentration representation of A, B, C products to maximize the magnitude of the response. It all was based on the constraint that the sum of the three components of A, B, C products must be at 100 % (measured in either kg or KJ of food). To put it in financial terms, it is 100 % of the income that each consumer was willing to invest in food over the period of one week.

3. Results

3.1. Socio-demographic description of the group

3.1.1. Sex

The proportion of women in the whole group was higher than that of men – 75 % of women versus 25 % of men. There were no statistically significant differences between the groups ($F(2.235) = 2.65$, $p = 0.073$).

3.1.2. Age

The age of the respondents ranged between 15 and 71 years. The average age of the whole group was $M_{Tot} = 31.40$ ($SD_{Tot} = 11.95$)[‡], while separately for Fairtrade, organic-product and ordinary consumers, this was $M_{FT} = 27.80$ ($SD_{FT} = 8.73$), $M_{Bio} = 29.24$ ($SD_{Bio} = 8.97$) and $M_{B&Z} = 37.78$ ($SD_{B&Z} = 14.93$). Ordinary consumers were

[‡] M = mean, SD = standard deviation

significantly older than Fairtrade and organic-product consumers ($F(2.235) = 18.63$, $p < 0.001$; post hoc tests in Annex 2).

3.1.3. Education

In 2005, 20 % of the Czech population had primary education (or no education), 37 % of people were skilled, 32 % of people had secondary-school diplomas and 10 % of people had university education[§]. In Prague, the proportion of people with primary education was 13 %, there were 24 % of people with a vocational certificate, 41 % of people with secondary-school diplomas and 22 % of people with university degrees.

The group of ordinary consumers, which should represent the population, included 38 % of the respondents with university degrees. Therefore, this group is not a representative sample of either Prague or Czech population.

The group of Fairtrade-product consumers and the group of organic-product included even higher representation of university-educated people – 54 % and 45 % respectively (Annex 2). However, it cannot be estimated to what extent this sample represents all Fairtrade-product and organic-product consumers.

3.1.4. Occupation and number of children

The percentage of students in the groups is worth noting. The group of Fairtrade-product consumers contained most students – 52 %, the group of organic-product consumers contained 34 % of them and the group of ordinary consumers contained 17 % of them.

As for the number of children, 69 % of the respondents in the whole group were childless, 28 % of them had one or two children (Annex 2). These numbers correspond to the low age and to the number of students in the whole group.

H1: Fairtrade-product and organic-product consumers differ from ordinary consumers in their values, identities, beliefs and feelings associated with Fairtrade

Fairtrade-product and organic-product consumers were grouped into one group of “ethical consumers” and compared to ordinary consumers at the level of values, identities, beliefs and feelings associated with Fairtrade and at the level of education and age. The criterion of significance was reduced from 0.05 to 0.004 (Bonferroni correction).

On the basis of means, there were not any differences among the consumers in value orientation, the importance of health and enjoyment of life, the awareness of the consequences of food choices on health.

H2: Organic-product consumers buy Fairtrade products more often than ordinary consumers

23.5 % of people in the group of organic-product consumers did not buy Fair Trade products at all, 7.4 % of them bought such products less than once a year, 17.6 % at least once a year, 47.1 % monthly and 4.4 % each week.

89.5 % of people in the group of ordinary consumers did not buy Fair Trade products at all, 2.6 % of them bought such products less than once a year, 6.6 % at least once a year, 1.3 % monthly and nobody bought such products each week.

There is a significant relationship between the frequency of buying Fairtrade products and group membership (organic-product versus ordinary consumers), $\chi^2(4) = 68.246$, $p < 0.001$.

The testing confirmed that in average organic-product consumers buy Fairtrade products more frequently (at least once a year) than ordinary consumers (almost never), $MBio = 3.01$, $MBěž = 1.20$, $t(92.95) = 10.54$, $p < 0.001$ (for two-sided testing).

Hypothesis 2 was verified.

[§] Czech Statistical Office: [http://www.czso.cz/xa/ediciplan.nsf/t/920030D266/\\$File/Mezikrajské_srovnání_cel.xls](http://www.czso.cz/xa/ediciplan.nsf/t/920030D266/$File/Mezikrajské_srovnání_cel.xls)

H3: The knowledge of products is a prerequisite for ethical shopping

17.2 % of the respondents from the whole group answered that they did not know Fairtrade, 15.1 % had heard of it and 67.6 % knew it. None of those who did not know Fairtrade products also bought them and only 16.7 % of those who had heard of Fairtrade bought a product. Among those who knew Fairtrade 8.1 % of people did not buy these products. There is a significant relationship between the level of knowledge of Fairtrade and Fairtrade shopping behaviour, $\chi^2(2) = 163.78$, $p < 0.001$.

Thus the level of knowledge of Fairtrade can be understood as an explanatory variable of shopping behaviour and shopping behaviour as an explanatory variable of knowledge level.

In next phase the methodology of Design of Experiments, namely the three-component mixture, was used. This part of the paper briefly discusses mixture experiments in order to get an optimal ratio in consumer food cart. These are experiments in which the design factors are the components (or food ingredients of a mixture) and the response depends only on the proportions of the components that are present in the mixture. Because the mixture components are restricted to add to a constant (in our case 100% of the food mixture), the design region is constrained. Furthermore, special mixture polynomial were used to model the response. We have done these following designs.

The three-component mixture of food utility (it has these types of components: Organic vs Fair Trade vs Ordinary).

The results of the analysis are shown in Table 1. For significance test, it was decided to select significance levels of $\alpha = 5$ per cent (0.05). If the p-value is less than the significance level (0.05), the factor or interaction effect is then regarded to be statistically significant. For the present experiment, main effects organic food, fair-trade, and ordinary food are statistically significant. It is important to note that these effects have a significant impact on the consumers' shopping preference. The calculated effect factor in the response values (response factor to change from -1 to +1) is in the first column of Table 1. The second column is represented by the regression coefficient (that is a half effect of each factor). The statistical significance of each factor or interaction, expressed as a p-value, is noted in the fifth column. Blending components of a consumer food cart A and B; B and C; A and C; produces higher elongation values than would be expected just by averaging the utility of the pure blends. This is an example of "synergistic" blending effects.

In practice, this effect means that people in the situation with existence more kinds of food they spend more money than there would be only one kind of food. (eg, ordinary food). The coefficient of multiple determination $R^2(\text{adj}) = 49.99\%$ indicates that this equation is pretty suited to the acquired response data.

Table 1. Regression model for three-component mixture of food preferences

Estimated Regression Coefficients for Response (Numbers preferences) (component proportions)						
Term	Coef	SE	Coef	T	P	VIF
A - Organic	9,000	2,602	*	*	1,750	
B - Fair Trade	7,000	2,602	*	*	1,750	
C - Ordinary	19,500	2,602	*	*	1,750	
A - Organic*B - Fair Trade	18,667	11,240	1,66	0,131	1,750	
A - Organic*C - Ordinary	35,000	11,240	3,11	0,012	1,750	
B - Fair Trade*C - Ordinary	4,333	11,240	0,39	0,709	1,750	
S = 3,67927 PRESS = 285,5						
R-Sq = 78,66% R-Sq(pred) = 49,99% R-Sq(adj) = 66,81%						

From this contour plot (see Figure 1) of response, it is relatively easy to see that the optimum is very near $\{A,B,C\} = \{1/2,0,1/2\}$, and that the response is a maximum at this point. From watching the counter plot, it can be noted that the process may be slightly more sensitive to changes of ordinary prices time than to changes of organic and fair-trade prices.

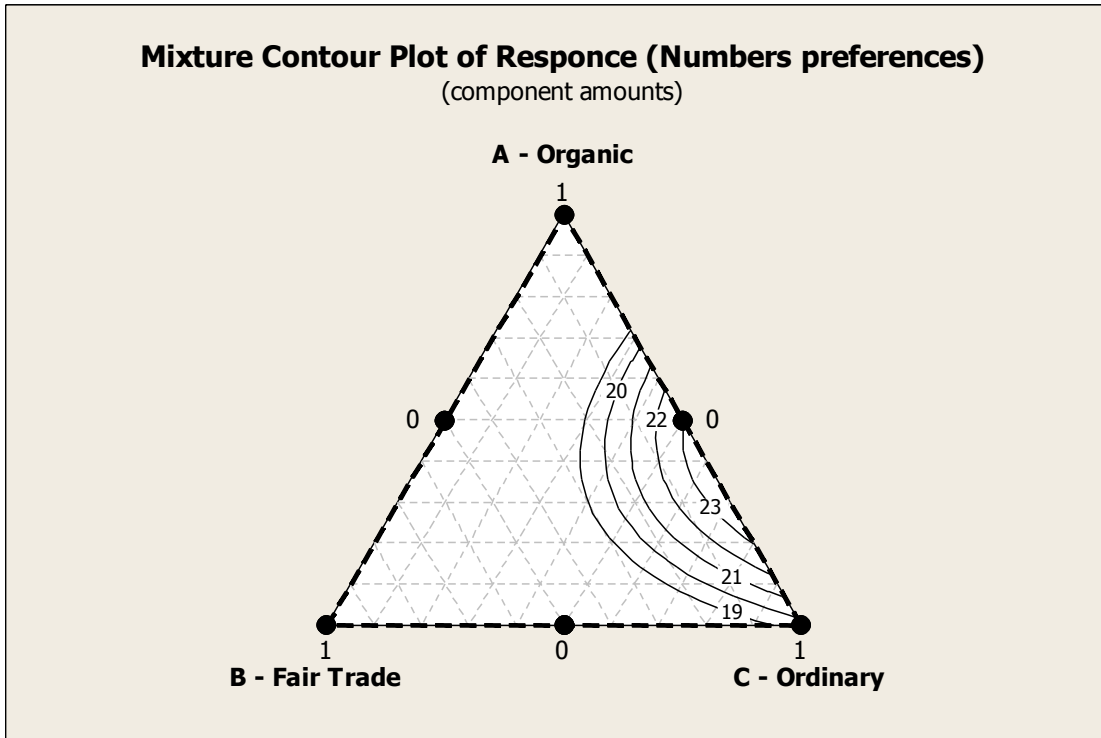


Fig. 1. The mixture contour plot of food utility represented by relative frequency of purchase

The next phase of the research is to perform more advanced methods such as Simplex lattice methodology adding center points and axial points to the current design (see Figure 2).

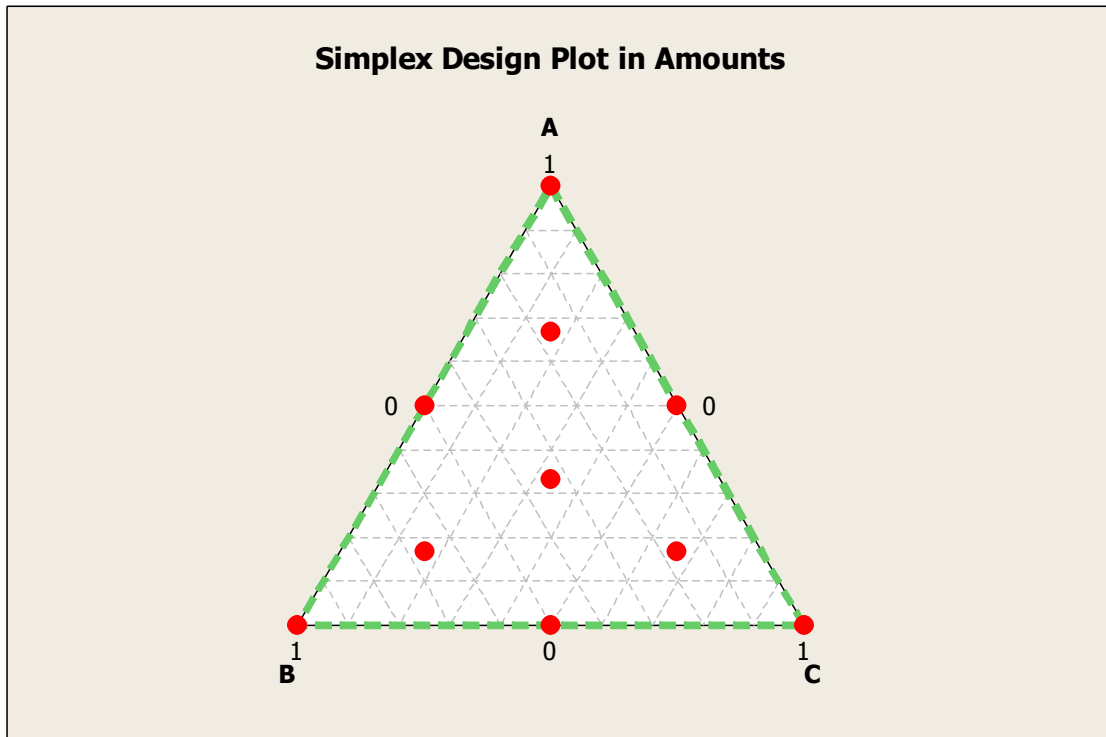


Fig. 2. The Simplex lattice design has 10 points, with four of these points on interior of the simplex

4. Conclusion

The business concept of Fairtrade is a relatively new phenomenon whose importance has been increasing in recent years. The principles of solidarity and social responsibility relate to every individual and every company these days. The volume of Fairtrade products has been increasing permanently, their structure as well as the way their sales are implemented has been changing dynamically. The action of market forces in the production of Fairtrade has been intensifying, its next form therefore poses many questions, however, the correctness of its principles cannot be denied.

The objective of the article was to identify the assumption through which commercial customers can be distinguished from those who buy organic products and Fairtrade products. Three hypotheses were tested statistically for this purpose. The subsequent task was to propose an optimal representation of organic products, Fairtrade products and commercial products in the shopping basket of a typical customer, which would optimize its aggregate benefit. To achieve this, the methodology of Design of Experiments, namely mixed proposals, was used.

The mixed experiment, as well as the answers to the questions related to the factors influencing “ethical shopping”, should provide insight into the motivations of current consumers of Fairtrade products in the Czech Republic. This is to help, subsequently, non-profit organizations and companies engaged in Fairtrade to develop information, communication or distribution strategies.

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