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THE AHP QUANTIFICATION OF STUDENT POPULATION ATTITUDES IN WINE PURCHASING

SUMMARY

This paper aims to apply the methodology of the Analytical Hierarchy Process (AHP) to prioritize factors and their weighting influence on the attitudes of respondents in wine purchasing decision making. The research was conducted online using the Google forms platform. Primary data were collected from 150 students at the University of Banja Luka during a COVID-19 lock-down in the Republic of Srpska and Bosnia and Herzegovina in April 2020. Based on the collected responses in Microsoft Excel, the significant rates of the measured purchase factor were calculated. The obtained rates were used as an input variable for the Expert Choice program in which the process of determining the weight influence of attitudes on buying wine was applied. The reasoning process in this paper is based on the fuzzy method in the MATLAB R2016a program which gives a precise answer to the question of how important a given factor is when buying wine. Based on the fuzzy output, it can be concluded that wine quality factors influence the purchase decision by more than 90%. Market factors have a weighting influence on the purchase decision of less than 10%. In terms of wine quality, the most important factor is the taste of the wine, and in terms of market factors, the price.

Keywords: wine, student population, attitudes, AHP method, Fuzzy logic

INTRODUCTION

Wine production in B&H has a long tradition. As Sudarić et al. (2020) state for the example of Croatia, also in B&H viticulture and winemaking has a long tradition, a high level of production knowledge and producers experience which, in addition to favorable natural conditions and a developed market of demand, give stimulating conditions for sustainable production development. On average, about 3.500 ha are planted under vines annually, about 25.000.000 kg of grapes are harvested, from which 16.000.000 liters of wine are obtained (Ivanković et al., 2018). According to the FAO (2021), slightly less than 6 litres of wine is consumed per capita. Compared to consumption in the more developed countries

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of the world, this quantity is low and this research analyzes and identifies important factors in the consumption and purchasing of wine. Consumer behavior arises as a result of the interaction of external and internal factors, ie. various factors that act on them from the environment in which they live (Golijan, 2016). The level of understanding consumers' motives when buying wine, greatly facilitates producers and importers in the on-time and adequate organization of all activities (Vlahović et al., 2012). Nacka et al. (2016) confirmed, based on the North Macedonian National Strategy for

Viticulture and Wine production, that the wine market in the country has two consumer groups: middle-aged who have lower purchasing power and consume larger quantities of cheaper wine and younger to middle-aged with higher purchasing power who prefer smaller quantities of high-quality wine. Čavor (2015) research about consumer behavior in Montenegro research emphasized that the age of consumer play a significant role in wine purchasing - younger consumers take into consideration more attributes than older. Research in the consumer behavior in terms of attitudes and requirements in the consumption and purchasing of wine in Bosnia and Herzegovina and the city of Banja Luka has not been sufficiently researched, especially in the field of student population and Y generation (Fountain and Lamb, 2011). Because of that, the research was conducted among students of Banja Luka University. Youth people certainly do not represent the segment that has the highest consumption of wine, but it is important to explore the attitudes, opinions and preferences at the end of their adolescence (Kristić, 2012).

The decision-making process is very complex and often contains a large number of interconnected and interdependent factors whose influences are not simply precisely recognized and linked into a single decision (Srđević, 2005). The Fuzzy AHP method was applied, using the Expert Choice and MatLab R2016a programs, to determine which are the most important factors that initiate the purchase and consumption of wine by the student population at the University of Banja Luka. AHP is based on the concept of balance and is used to obtain the overall relative importance of a set of criteria/alternatives. It is applied to the analyzed decision problem involving multiple criteria at multiple hierarchical levels by assigning relative weights to the criteria and then normalizing weights using the Expert Choice program (Hadelan, 2010). The subject of this paper is the research of the application of Fuzzy AHP methods in determining the importance of quality factors and market factors based on which respondents decide to buy wine. The term wine in this paper means wine in general, red, white, imported, or domestic, so wine in the broadest sense. Recently, certain multi-criteria methods based on fuzzy logic have been used to cover a complex of problems related to group decision-making, human subjectivity, expert knowledge, and the tendency to use verbal instead of numerical grades (Srđević, 2003). Thanks to fuzzy sets and fuzzy logic, it is possible to model values that not only have to belong or do not belong but can have a certain degree of belonging to a certain set, language variable or attribute (Bašić, 2017). The values of the factors that influence the

attitudes of the respondents about wines are presented by the fuzzy way of reasoning, because, as Bašić (2017) states, they describe in a more precise way the affiliation to a certain fuzzy number than the classical Boolean way of inference. Quality as the first factor in purchasing according to Zeithaml (1988) represents the overall result of experience and various influences that affect the customer, who on this basis assesses the competitiveness of product/brand quality. Jovanović et al. (2017) stated that of all the factors analyzed in relation to consumers' behavior and preference, the dominant factors identified are demographic factors-age, region, family size and place of living, social factors-education and income, and behavioral factors-price importance, place of purchase and product characteristics. The study by Radman et al. (2004) included as the most important factors of wine the name of the producer or brand, the shape of the bottle or label, the method of production, price, age, and the importance of internal (intrinsic) characteristics: color, taste and aroma. In this paper "wine quality" means color, smell, taste, alcohol content and year of harvest. The second set of factors that influence the purchase of wine and consumer attitudes when buying this product is called "market characteristics" and includes price, availability, familiarity and packaging.

MATERIAL AND METHODS

The research was conducted through the collection of primary data by a structured survey. Considering the way of data collection for this research, the method belongs to the so-called field research. The questionnaire was created by the authors and the survey was conducted on a sample of 150 students from the University of Banja Luka. Out of the total number of respondents, 5 respondents gave a negative answer to the question of whether they drink wine and therefore were not subject to further processing. The answers were collected in April 2020, online using Google forms. This method was the only one possible because of restrictions on movement caused by the COVID-19 virus.

The evaluation of the relevant weights of the obtained answers was performed based on Saaty's nine-point scale. The mentioned scale is insensitive to small changes in the expression of preferences by decision-makers, which indirectly enables good compensation of uncertainty that is often present in the process of assessing importance in pairs (Milovanović and Stojanović, 2016). Primary data collected by the structured questionnaire were sorted originally in Microsoft Office Excel. Also, in the same program, the frequencies of responses were weighted and the rates were obtained, which became inputs for the next phase of data processing using the AHP method, applied to prioritize the factors of buying wine. The weights of the response frequencies were performed to evaluate the responses as precisely as possible. Table 1 shows that the strongest weight of 0.5 was assigned to answers 1 and 9 that are furthest from the middle of the scale, a weight of 0.4 was assigned to answers 2 and 8; 0.3 answers 3 and 7; 0.2 answers 4 and 6; and answer 5 denoting the equal importance of the terms was assigned a weight of 0.1. The sum of all weighted quantities is marked as Σ_A^I.

L denotes the rate of weighted responses on the left which implies greater importance of the term on the left, answers 1, 2, 3, 4 and half of the answer 5. R denotes the rate of weighted responses on the right which implies greater importance of the term on the right, answers 6, 7, 8, 9 and a half answers 5 (Table 1).

The example of one question:

COLOUR *1 2 3 4* 5 *6 7 8 9* SMELL

L R

Table 1. Modified (weighted) Saaty scale

A) **a***0.5	An extremely important factor on the left (1-EIL)	F) **i***0.5	An extremely important factor on the right (9-EIR)
B) **b***0.4	A much more important factor on the left (2-MMIL)	G) **h***0.4	A much more important factor on the right (8-MMIR)
C) **c***0.3	A more important factor on the left (3-MIL)	H) **g***0.3	A more important factor on the right (7-MIR)
D) **d***0.2	A little more important factor on the left (4-LMIL)	I) **f***0.2	A little more important factor on the right (6-UVR)
E) **e***0.1	Neutral (5-N)	E) **e***0.1	Neutral (5-N)
LEFT SIDE OD SCALE (L)		**RIGHT SIDE OD SCALE (R)**	
1 2 3 4 5 6 7 8 9			

The frequencies of answers 1, 2, 3, 4, 5, 6, 7, 8, 9 to the question from the questionnaire represent the values (a, b, c, d, e, f, g, h, i). Values 0.5; 0.4; 0.3; 0.2; 0.1 are weights determined by the authors based on an assessment of the importance of individual responses. For example, the response frequency from surveys (a = 3; b = 2; c = 6) follows A = 3 * 0.5; B = 2 * 0.4; C = 6 * 0.3 and so on. The coefficients (Left side and Right side values) required to enter the value of each individual survey question in the Expert Choice program were obtained as follows:

$$\boldsymbol{Ls} = \frac{A + B + C + D + E/2}{\Sigma_A^I}$$

$$\boldsymbol{Rs} = \frac{F + G + H + I + E/2}{\Sigma_A^I}$$

"A, B, C, D, E, F, G, H, I" represents the Fuzzy number (FN) determined by multiplying the calculated weighted response rate on the right by the number 9:

$$FN = Rs*9$$

The Fuzzy Logic Toolbox of the MATLAB platform (R2016a) was used for the conclusion. The Fuzzy number was created on the Satty scale from the survey.

RESULTS AND DISCUSSION

The two main groups of criteria in this research are wine quality and market characteristics. As sub-criteria of quality of wine are singled out the color, smell, taste, alcohol content and year of harvest. The sub-criteria of market

characteristics of the wine are price, availability, popularity and packaging. The criteria are compared according to the degree of their influence. In AHP, pairings are based on a standardized nine-level comparison scale (Saaty, 1990). Each question was set up in such a way that the respondents chose one of the answers on a nine-point scale (1 to 9).

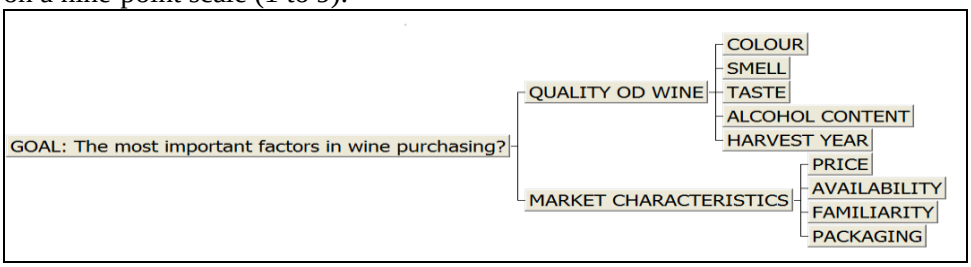

Figure 2. Hierarchy of goals, criteria and sub-criteria (Expert Choice program)

Figure 2 shows a scheme of criteria and sub-criteria that were used to examine or determine the significance of making a decision when buying wine. It is noticeable that the quality of wine and market characteristics are the two main factors, and to the right they are divided into sub-criteria. Five criteria have been determined for wine quality and four criteria for market characteristics. Presentation of the respondent's answers to the asked questions follows.

Quality as a factor when buying wine

Expert choice offers several ways to display results. The option "Synthese" is selected from the menu, (Figure 3). The sum of values corresponding to the name of the sub-criteria is 1. The highest values imply a higher influence on the quality factor. To confirm the validity of the model, the calculated inconsistency factor must be less than 0.1, which practically means that there are no logical contradictions (Ishizaka and Labib, 2009). In the case of the valuation quality factor, the inconsistency is 0.06, which means that the validity condition is met and that the comparison is valid.

Figure 3. Calculated values of the Quality sub-criteria

As Pinto et al. (2016) stated, even though the wines are very close in quality, it is possible to obtain a more precise ranking, despite the subjectivity and complexity. Based on the obtained answers of the respondents and the output of the AHP process (Figure 3), it is realized that the least important wine quality factor is its color. It affects less than 2% on wine quality. This is followed by factors of alcohol content whose significance is 5.7% and the year of harvest with

a significance of 6.7%. The smell of wine is important somewhere around 10 percent for the student population. The most important factor that convincingly dominates in the attitudes of wine quality is taste, with an impact of 75.8%.

Market characteristics as a factor when buying wine

Figure 4 shows the sub-criteria of wine market characteristics and their influence on the criteria of "market characteristics". Price, availability, familiarity and packaging collectively affect 100 percent of these criteria. The factor of the inconsistency of market characteristics is 0.01 and therefore there are no logical contradictions, and the comparison is valid.

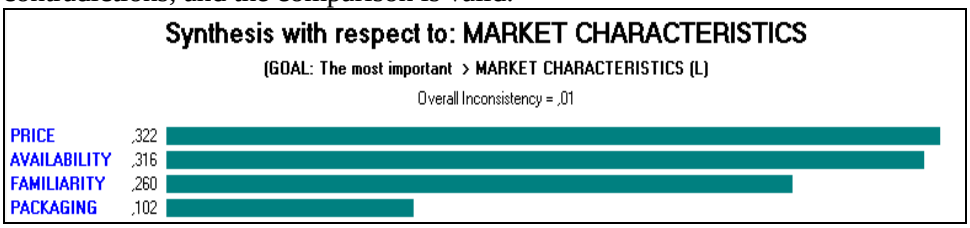

Figure 4. Calculated values of the market characteristics sub-criteria

Figure 4 shows that the least important factor in the market characteristics of wine is its packaging with a significant rate of 10%. The most important factor in this group of sub-criteria is the price of the wine with a significance of 32%. Ostojić et al. (2018) stated, comparing the changes in consumer attitudes regarding the factors that influence the decision to buy wine during the two observed periods, that price is one of the basic elements for deciding to buy wine and that 75% of respondents believe that wine prices on the domestic market are high.

Based on the weighted rates of respondents' answers, the relations between the criteria and the sub-criteria were established. This was influenced by the design of a survey questionnaire that aimed at the comparison of each of these relationships. The number of combinations (Nc) between factors, i.e. the number of questions in the questionnaire, was determined using the formula in which k represents the number of criteria (Stojanović and Regodić, 2016):

$$\mathrm{Nc} = \frac{k(k-1)}{2}$$

As an example, we wilL show the interpretation of the interconnection between responses assigned to color and smell (L = 0.16; R = 0.84) and to taste and year of harvest (L = 0.89; R = 0.11). These rates show that color affects 16% compared to smell which is 84% important. Taste is 89% important compared to 11% of the year of harvest. These relations cannot be seen directly from Figure 5 because all rates and all sub-criteria relationships (color, smell, taste, alcohol content and year of harvest) are taken into account. Sublimation of all these relations gives a percentage share of the importance of these factors. The calculated rates in the Expert Choice program serve as inputs for the Matlab Fuzzy logic toolbox or fuzzy decision-making process.

1	COLOUR	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	SMELL
2	COLOUR	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TASTE
3	COLOUR	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ALCOHOL CONTENT
4	COLOUR	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	HARVEST YEAR
5	SMELL	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	TASTE
6	SMELL	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ALCOHOL CONTENT
7	SMELL	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	HARVEST YEAR
8	TASTE	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	ALCOHOL CONTENT
9	TASTE	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	HARVEST YEAR
10	ALCOHOL CONTENT	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	HARVEST YEAR
1	PRICE	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	AVAILABILITY
2	PRICE	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	FAMILIARITY
3	PRICE	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PACKAGING
4	AVAILABILITY	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	FAMILIARITY
5	AVAILABILITY	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PACKAGING
6	FAMILIARITY	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	PACKAGING

Figure 5. Results of crossing criteria based on the processed survey responses

Figure 5 shows the average response rates of respondents to the given comparisons. As stated in the methodology, the respondents chose between the factor on the left and the factor on the right side. The first ten comparisons refer to the quality of the wine and the criteria color, smell, taste, alcohol content and harvest year. The last six comparisons include a comparison of factors within market characteristics, price, availability, familiarity and packaging. The membership function, which can take values from the entire closed unit interval, shows how many values belong to a specific fuzzy number (Bašić, 2017). The problem of wine sensory evaluation contains many quality attributes which can not or be difficult to be depicted by crisp numbers. Linguistic terms are suitable to deal with this situation and in the real decision process, they are often transformed into triangular fuzzy numbers (Xie, 2016). Based on this and similar claims, the universal triangular fuzzy - membership functions was selected and used by which the process of defuzzification is performed, i.e. determining the degree of belonging to a certain epithet:

$$f(x;a,b,c)=\begin{Bmatrix}0 & x\le a\wedge c\le x\\ \dfrac{x-a}{b-a} & a\le x\le b\\ \dfrac{c-x}{c-b} & b\le x\le c\end{Bmatrix}$$

And by which the fuzzy functions are determined for this particular case:

$$\mu EIL=\begin{Bmatrix}0 & x\ge 0.125\\ \dfrac{0.125-x}{0.125} & 0\le x\le 0.125\end{Bmatrix}\quad \mu MMIL=\begin{Bmatrix}0 & x\le 0\wedge 0.25\le x\\ \dfrac{x}{0.125} & 0\le x\le 0.125\\ \dfrac{0.25-x}{0.125} & 0.125\le x\le 0.25\end{Bmatrix}$$

$$\mu MIL=\begin{Bmatrix}0 & x\le 0.125\wedge 0.375\le x\\ \dfrac{x-0.125}{0.125} & 0.125\le x\le 0.25\\ \dfrac{0.375-x}{0.125} & 0.25\le x\le 0.375\end{Bmatrix}\quad \mu LMIL=\begin{Bmatrix}0 & x\le 0.25\wedge 0.5\le x\\ \dfrac{x-0.25}{0.125} & 0.25\le x\le 0.375\\ \dfrac{0.5-x}{0.125} & 0.375\le x\le 0.5\end{Bmatrix}$$

$$\mu N = \begin{Bmatrix} 0 & x \le 0.375 \wedge 0.625 \le x \\ \dfrac{x-0.375}{0.125} & 0.25 \le x \le 0.375 \\ \dfrac{0.625-x}{0.125} & 0.375 \le x \le 0.5 \end{Bmatrix} \quad \mu LMIR = \begin{Bmatrix} 0 & x \le 0.5 \wedge 0.75 \le x \\ \dfrac{x-0.25}{0.125} & 0.5 \le x \le 0.625 \\ \dfrac{0.75-x}{0.125} & 0.625 \le x \le 0.75 \end{Bmatrix}$$

$$\mu MIR = \begin{Bmatrix} 0 & x \le 0.625 \wedge 0.875 \le x \\ \dfrac{x-0.625}{0.125} & 0.625 \le x \le 0.75 \\ \dfrac{0.875-x}{0.125} & 0.75 \le x \le 0.875 \end{Bmatrix} \quad \mu MMIR = \begin{Bmatrix} 0 & x \le 0.75 \wedge 1 \le x \\ \dfrac{x-0.75}{0.125} & 0.75 \le x \le 0.875 \\ \dfrac{1-x}{0.125} & 0.875 \le x \le 1 \end{Bmatrix}$$

$$\mu \mathrm{EIR} = \begin{Bmatrix} 0 & x \le 0{,}875 \\ \dfrac{x-0{,}875}{0{,}125} & 0{,}875 \le x \le 1 \end{Bmatrix}$$

EIL means extremely important on left, MMIL-much more important on left, MIL-more important on left, LMIL-little more important left, N-neutral, LMIR-little more important right, MIR-more important right, MMIR-much more important right, EIR-extremely important on the right side.

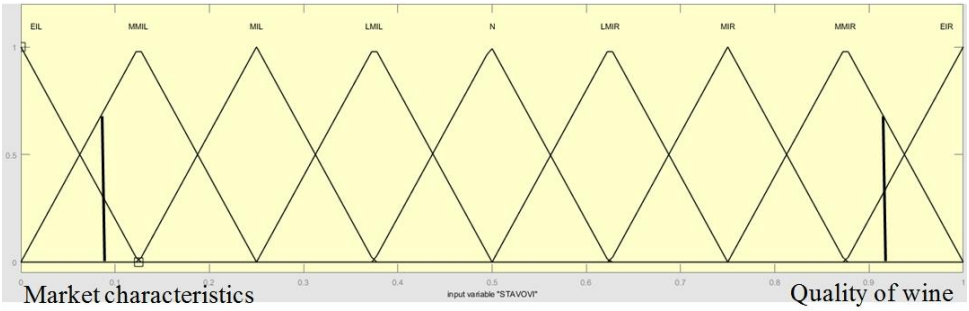

Figure 6. Determining the fuzzy value

Figure 6 shows the degree of belonging to the epithets of the variables, Quality (Q) and Market Characteristics (MC) that were compared. The values of these epithets were obtained based on the Expert Choice methodology and then used as inputs in the fuzzy process. Calculated values are 0.916 for quality and 0.084 for market characteristics. Based on the set of fuzzy functions of belonging to epithets, the degrees of belonging to each epithet are determined, and therefore the quality belongs to the interval from 0.875 to 1. For this interval, two functions of fuzzy belonging to the epithet quality are determined, the first Qmmir= $\frac{1-x}{0{,}125}$, and second Qeir=$\frac{x-0{,}875}{0{,}125}$. The calculation gives the values: Quality is 67.2% much more important (MMI) and 32.8% extremely important (EI) than the criterion with which it is compared. Belonging to certain epithets is determined in the same way for another criterion, market characteristics. With a value of 0.084, it is in the range of 0 to 0.125. Fuzzy functions are defined for this interval MCmmil=$\frac{x}{0{,}125}$ i MCeil=$\frac{0{,}125-x}{0{,}125}$.

The calculation determined that market characteristics are extremely unimportant than quality 32.8% and much more unimportant than quality 67.2%.

Consumers could be viewed from different aspects, as an individual, member of some social group or class, or as a representative of a certain nation, race, or religion, or also a person who buys a certain product to satisfy personal needs, existential safeness and social acceptance, and even to show the prestige over other members of the social community (Vlahović et al., 2012). In this case, consumers were considered as a person who buys some product for the exact reasons.

The ratio of Quality (Q) of wine and Market Characteristics (Q) was (L = 0.916; R = 0.084), which means that for the respondents the Wine Quality factor is important 91.6% in relation to the Market Characteristics, which are important only 8.4%. So, the factors color, smell, taste, alcohol content and year of harvest have a weight impact of 0.916 on buying wine, while the factors of price, availability, familiarity and packaging have a weight impact of 0.084. This attitude stems from the fact that the students population does not earn their income, so the money is worthless. Based on that, price and market factors have a smaller influence on the decision to wine purchase.

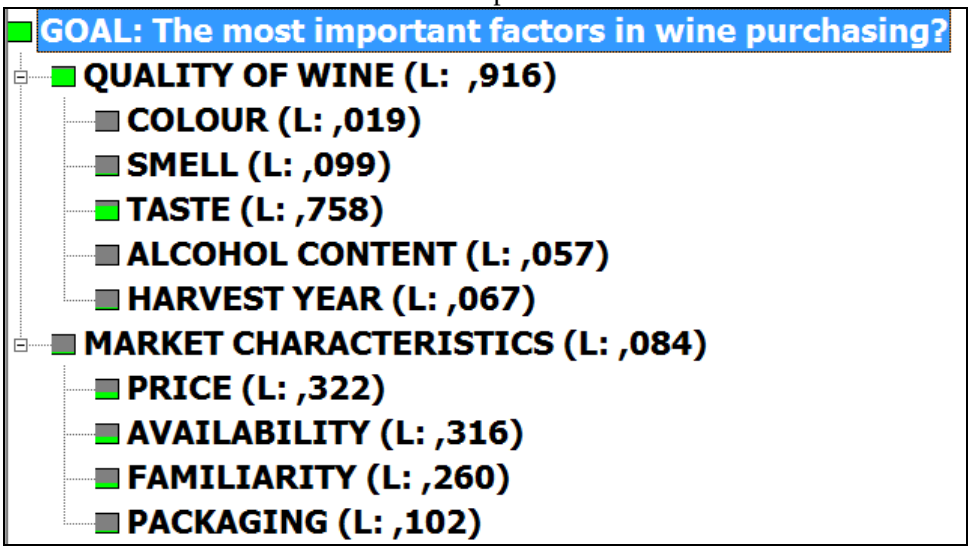

Figure 7. Calculated values of criteria and sub-criteria (Expert Choice program)

The conducted research highlights the limitations and possibilities for further research. That is, above all, a question why the price is not as important as expected in the purchase preferences of the student population. For the following research, we recommend that the compared factors be in the same plane, i.e. that there are no more levels of criteria and sub-criteria. In this way, all factors would be directly compared with each other and the influence of potential ignorance that the sub-criteria make up certain criteria would be removed.

In addition to these, the following research could expand and increase the sample of respondents as well as the method of data collection, preferring a face-to-face survey instead of an online survey.

CONCLUSIONS

The aim of the research was to show the factors that are important for student populations in Banja Luka when buying wine. Likewise, the goal was to try to merge the Analytical Hierarchical Process and the Fuzzy process. Based on the Expert Choice program, the influence of individual sub-criteria on the main criteria was determined, and then the influence of the two main criteria on the final purchase decision. By weighing the main criteria, the influence of the sub-criteria on the final purchase decision was determined. The quality of the wine for the student population is a much more important factor than the market characteristics and assigned about 91% of the influence on the purchase. As the least important factors, students evaluate colour and packaging. The following less important factor is the familiarity of wines with a small impact on wine purchasing. Price and availability equally impact on purchase, less than 3%. The alcohol content participates with 5.2%, harvest year with 6.1% on the purchase of a particular wine. The smell is 9.1% important and the absolute most dominant criteria for buying wine is a taste of wine with an impact of more than 60%.

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