

A MATHEMATICAL APPROACH FOR EVALUATION OF THE PURCHASED QUANTITIES OF SEVERAL TYPES OF MEAT AVERAGE PER HOUSEHOLD

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Abstract

The current paper presents a mathematical approach for evaluation of the purchased quantities of several types of meat average per household in Bulgaria. The investigated groups of data are stored in a relational database. They include the following eight considered elements - pork meat, lamb meat, minced meat, poultry meat, mutton and goat meat, edible offals and bacon. Certain set of variables have been calculated and analysed during the studied period (2010-2021). The pace of change of the indicated variables has also been discussed for the mentioned years. It significantly supports users in decision making and presenting the obtained conclusions about the examined objects. The share of average purchased quantities per household for poultry meat is higher in comparison with that for the other investigated types of meat for each one year of the period. The pace of change of the examined indicator for the pork meat is comparatively more intensive in 2019-2021. Only, the values of this indicator for edible offals decreased continuously for ten of the considered twelve years.

Key words: approach, database, evaluation, quantities, types of meat.

INTRODUCTION

Gathering data has become a main function for organizations not only in keeping the documentation but also in helping different tasks related to data analysis which are very important. However, it should be noted that a widespread and serious problem for almost every organization is the quality of the data. The presence of incorrect or contradictory data can greatly distort the results of the analysis [11]. The information must be correct, actual and presented in an appropriate form, regardless of whether it is obtained from a paper or electronic source [16]. This requirement shall be imposed in connection with the subsequent processing of the data.

Some data analysis methods require a certain way of presenting the data [8]. Very often the searched information is located in different files. There are cases where it needs to be structured and saved in one source. This would provide significantly faster access to the separate studied objects. In this regard, relational databases [6], [3], [4] are widely

used to store different information from the field of economics and agriculture.

The data on the purchased quantities of the relevant food types are presented into a built relational database in the current work. They are provided from the Bulgarian National Statistical Institute [14]. Subsequently, this information is found and extracted from the website of the mentioned organization. The obtained data are distributed in the built tables. The designed database contains the following relational schemes, as is shown in Fig.1:

- Objects (objects_id, characteristics, name_object,);
 - Foods (objects_id, name, id_f);
 - Types (id_t, name, id_f);
 - Quantities (Id_q, year, unit, quantity, id_t,);
 - Avg_Prices (Id_1, year, id_t, average_price).
- The Objects table is related to the Foods table. The Foods table is related to the Types table. The Types table is related to two others (Avg_Prices and Quantities). The indicated relationships between the considered tables are of one-to-many type.

The current work presents a mathematical approach for evaluation of the purchased quantities of several types of meat average per household in Bulgaria. Meat is one of the main foods (Grunert K. G., 2006) [9]. In an economic aspect, the competitiveness reflects the possibility of a certain product being sold at a lower or equal price compared to that of competitors and reveals the competitive market potential of the firm (Kostadinova N., 2010) [13]. Consumers place significant priority to improvements in animal husbandry and the animal welfare [13].

The study of Cosgrove M. and Kiely M., 2005 [2] notes that “Meat is a nutrient dense food

and meat and meat products are an important source of a wide range of nutrients. The protein content of meat is of high biological value with many essential amino acids” [2]. According to Henchion M., et al., 2014 “Meat consumption has increased and is likely to continue into the future. Growth is largely driven by white meats, with poultry in particular of increasing importance globally” [12]. The same authors also point out that “The influence of factors such as income and price is likely to decline over time so that other factors, such as quality, will become more important” [12].

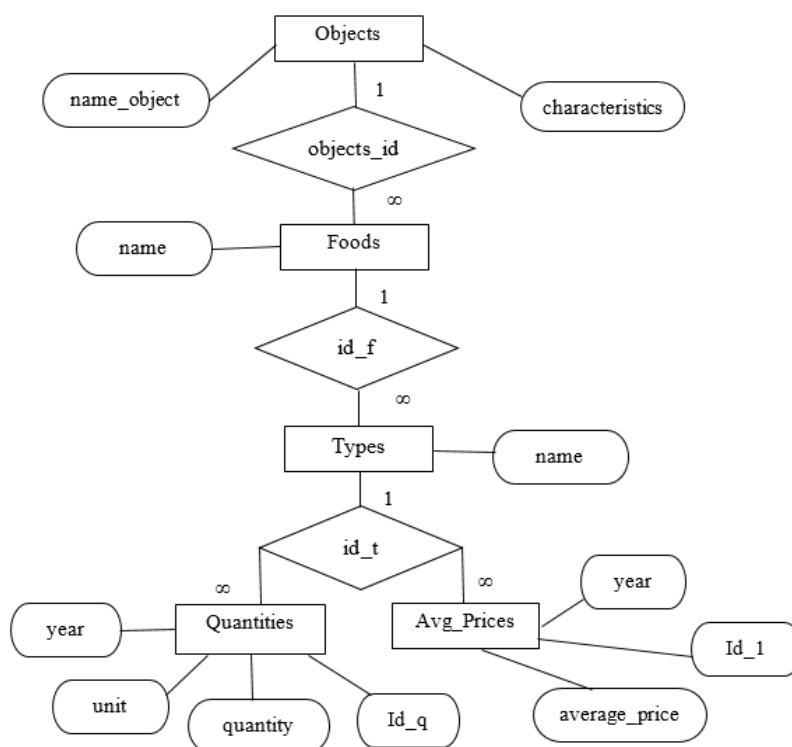


Fig. 1. Presentation of the built model
 Source: Own conception.

MATERIALS AND METHODS

The information concerning eighty-three food types in the interval 2010-2021 has been presented in the above-mentioned database. The object of consideration in this paper are several types of meat. They are the following:

- Pork;
- Lamb meat;
- Mutton and goat meat;

- Minced meat;
- Poultry meat;
- Edible offals;
- Bacon.

The values of the studied indicators related to these eight listed elements are searched and found from four tables of the indicated database. Users could visualize data only for selected objects, as well as for selected years of the time interval. It should also be noted

that they could integrate the information from several tables [5] and could create different reports or queries [15].

The present work estimates the average purchased quantities per household of the listed eight types of meat. In this regard, the following components should be calculated:

$$- A_p = \sum_{r=1}^q a_{pr} \dots\dots\dots(1)$$

where: a_{pr} - the average quantity of relevant type of meat for a certain year; $q=12$, $p \in \overline{1;7}$, A_p - total average quantities;

$$- B_r = \sum_{p=1}^w a_{pr} \dots\dots\dots(2)$$

where: $w=7$, $r \in \overline{1;12}$; B_r - total average quantities of the examined meat types during r^{th} year;

$$- G_{pr} = \frac{100 \cdot a_{pr}}{B_r} \dots\dots\dots(3)$$

where: $p \in \overline{1;7}$, $r \in \overline{1;12}$ and G_{pr} - the share of the respective average quantities of the meat type to the total average quantities of the meat types for the certain year;

$$- U_p = \frac{100 \cdot A_p}{B_1 + B_2 + \dots + B_{12}} \dots\dots\dots(4)$$

where: $p \in \overline{1;7}$, U_p - the share of the average quantities of relevant type of meat to the total average quantities of the listed meat types for the studied period;

- Difference – T_r

$$T_r = t_{\max r} - t_{\min r} \dots\dots\dots(5)$$

where: $r \in \overline{1;12}$, $t_{\max r}$ - the highest value of the purchased quantities average per household of the investigated type of meat during r^{th} year, $t_{\min r}$ - the lowest value of the purchased quantities average per household of the mentioned object for r^{th} year.

The current work discusses and analyses these above-indicated variables as well as their pace of change for the presented years from the considered period. It significantly supports users in decision making and presenting the obtained conclusions about the examined objects.

This information can also be stored and used in the future.

The data concerning the studied eight types of meat, average per household are processed by using MS Excel [1], [10] software product.

RESULTS AND DISCUSSIONS

The purchased quantities of the listed eight types of meat are studied in the interval from 2010 to 2021. Users have the ability to extract groups of data from the created database based on predefined and selected indicators. Usually, the necessary information is searched in several tables from the database. In this connection, the relational algebra operations [7] that need to be performed are selection, projection or joins [15].

The extracted and visualized groups of data include:

- the values of the investigated indicator for selected type of meat during this twelve years interval;
- chosen meat types and their characteristics;
- the examined indicator for these eight types of meat for a given year from the indicated period;
- the indicator values for certain meat types during chosen years.

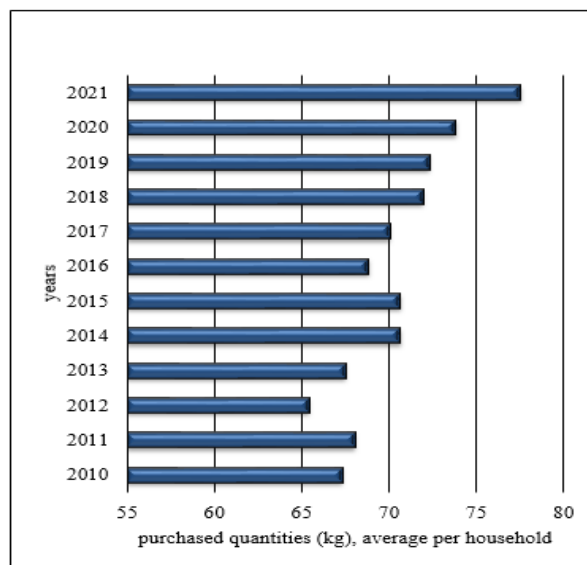


Fig. 2. Visualization of the obtained values of the component B_r

Source: Own calculations on the basis of data from [14].

The current paper evaluates these groups of data related to the average purchased quantities per household of the studied eight types of meat during the whole indicated period as well as for each individual year.

The analysis of the obtained values of the mentioned component B_r (Fig. 2) shows that they grow continuously for the last five years. Therefore, in this time segment, the investigated indicator for the considered types of meat increased by about 17 kg. Certain

reduction was established in 2012 and 2016 by 2.6 kg and 1.8 kg, respectively. A rather different situation occurred in 2014 as well as 2015. The calculated values of B_r are equal. This means that the total purchased quantities of these meat types, average per household for the listed two years are the same. The results of the data processing related to the next examined component G_{pr} are displayed in

Table 1. Calculated values of the component G_{pr} in the time segment 2010-2021

Year	Poultry meat	Minced meat	Pork meat	Edible offals	Lamb meat	Mutton and goat meat	Bacon
2010	34.47%	28.08%	22.44%	11.00%	3.12%	0.59%	0.30%
2011	34.12%	28.53%	23.68%	10.74%	2.21%	0.44%	0.29%
2012	33.49%	27.37%	25.38%	11.01%	1.99%	0.46%	0.31%
2013	32.89%	26.96%	26.37%	10.37%	2.52%	0.44%	0.44%
2014	33.57%	24.79%	28.05%	9.77%	2.97%	0.42%	0.42%
2015	33.99%	23.51%	30.31%	9.35%	2.27%	0.28%	0.28%
2016	32.99%	22.82%	30.96%	9.30%	3.20%	0.44%	0.29%
2017	33.43%	23.14%	30.14%	9.29%	3.14%	0.43%	0.43%
2018	33.38%	21.56%	31.99%	8.90%	3.48%	0.28%	0.42%
2019	34.72%	22.13%	30.71%	8.58%	3.04%	0.41%	0.41%
2020	33.74%	22.22%	31.71%	7.99%	3.39%	0.41%	0.54%
2021	33.16%	21.03%	34.19%	7.48%	3.48%	0.26%	0.39%

Source: Own calculations on the basis of data from [14].

Table 1. The share of poultry meat is higher compared to the shares of the other investigated types of meat for each one year of the considered period. Two things should be pointed out here. On the one hand, it seems that the consumption of white meat in households is higher. And on the other hand, it should be noted that the price of poultry meat is lower than that of some other types of meat such as pork, lamb, mutton and goat meat and minced meat. One more interesting fact should

be mentioned. The calculated values of G_{pr} are relatively lower for one of the examined elements (in this case, bacon) for nine of the indicated twelve years. This researched indicator for mutton and goat meat is the lowest only in 2018 as well as in the last two consecutive years 2020-2021. The pace of change of the examined indicator (purchased quantities) for the pork meat is comparatively

more intensive in the time segment 2019-2021. Here, the growth is about 4.3 kg. This process is relatively smoother for another studied element. In this case, major changes in the mentioned indicator for minced meat were not established in 2016-2020. A similar summary can be made for one of the examined objects - poultry meat during the last three years from the indicated period. Only, the values of the researched indicator for edible offals decreased continuously for ten of the considered twelve years (2011-2015 and 2017-2021). The pace of change of the average purchased quantities per household for lamb meat was quite dynamic. Four sub-periods were formed in which the indicator decreased and then increased gradually. The indicator values for mutton and goat meat remained the same in eight non-consecutive years.

An evaluation of the considered groups of data for the whole studied period was carried out. As can be seen from Fig. 3, the share of the average purchased quantities per household of poultry meat is 33.66%. This calculated value of the component U_p is about 4.7% and 9.1% higher than the obtained values for the second and the third element

(pork meat and minced meat), respectively. The shares of mutton and goat meat and bacon are much lower. In addition, low values of this variable U_p were also calculated for other two groups of data. In this case, these are edible offals and lamb meat.

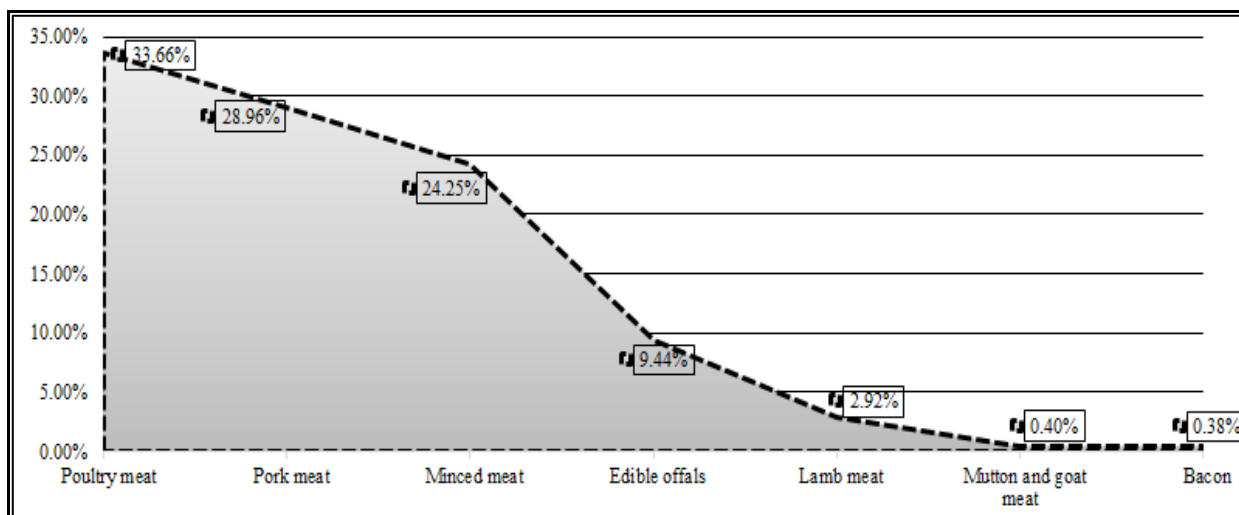


Fig. 3. The change of the component U_p for the studied eight elements
 Source: Own calculations on the basis of data from [14].

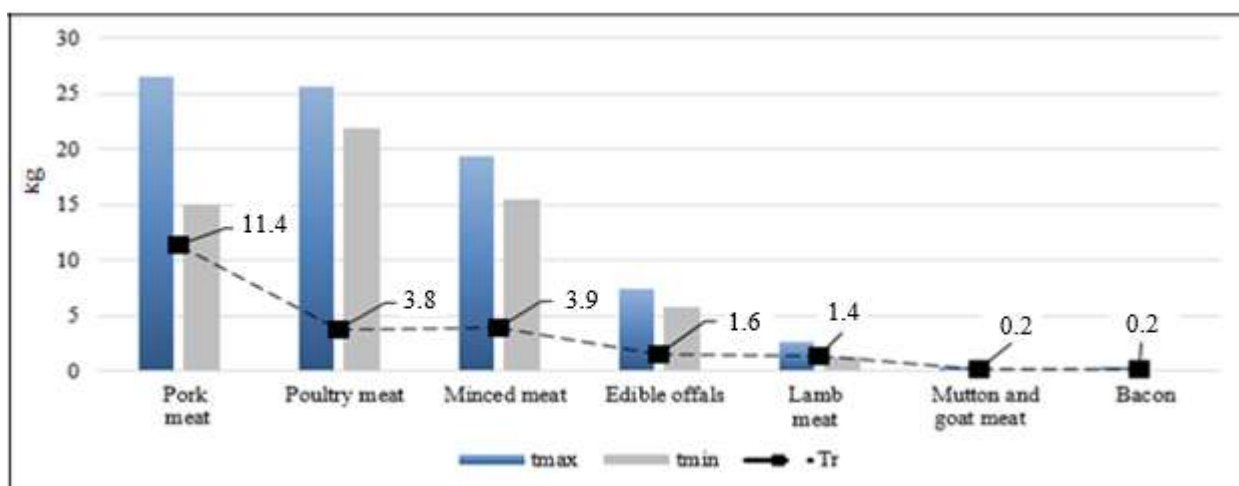


Fig. 4. Results for the difference T_r
 Source: Own calculations on the basis of data from [14].

The present paper also analyses the obtained values of the component T_r (Fig. 4). The difference between the highest and the lowest value of the examined indicator (average purchased quantities per household) for pork during the considered period is 11,400 kg. The studied values of T_r

for poultry meat and minced meat are about 3 times smaller than these ones for the mentioned element (pork). As can be expected, the variable T_r has the lowest values for bacon and mutton and goat meat. Figure 4 shows that this indicated variable has

low values for the following elements - lambmeat and edible offals.

CONCLUSIONS

The examined data related to different types of meat are presented in four tables of the indicated database. Users can extract groups of data from the database based on predefined and selected indicators. This obtained information can be studied.

A mathematical approach for evaluation of purchased quantities of several types of meat average per household in Bulgaria is presented in the paper. The considered period includes the years between 2010 and 2021. The mentioned types of meat are the following:

- Pork;
- Lambmeat;
- Mutton and goat meat;
- Minced meat;
- Poultry meat;
- Edible offals;
- Bacon.

The results of the performed evaluations in this paper show:

- The share of average purchased quantities per household for poultry meat is higher in comparison with that for the other examined types of meat for each one year of the considered period. The share of one of the examined elements (in this case, bacon) for nine of the indicated twelve years is relatively lower;
- The pace of change of the examined indicator for the pork meat is comparatively more intensive in the time segment from 2019 to 2021. The indicator values for mutton and goat meat remained the same in eight non-consecutive years;
- The values of the indicator (average purchased quantities per household) for edible offals decreased continuously for ten of the indicated twelve years.

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