

## RANKING OF VOJVODINA MUNICIPALITIES ACCORDING TO MULTIDIMENSIONAL DENOMINATOR OF LIVESTOCK PRODUCTION COMMODITIES

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**Abstract:** Marketability of livestock production was analyzed based on the marketability of both pork, beef, sheep and poultry and eggs and cow's milk.

The sequential order of the Vojvodina municipalities according to the observed denominators is not identical. But, Spearman's coefficient of correlation points to a statistically very high degree of accordance between the rank-list of marketability of pork and the rank-lists of marketability of beef, poultry and milk as well as the rank-list of poultry and sequential classification of sheep meat and eggs, beef and milk. There was a statistically high correlation between the rank list of marketability of sheep meat and pork, beef and milk as well as poultry and milk.

Based on the value of Kendal coefficient of ranking, it can be concluded that there exists very high degree of accordance of all the rank lists being observed simultaneously. For determination of sequential classification according to the achieved marketability of all the analyzed livestock production commodities in the sense of synthetic denominator, Ivanovic distance was used in the present work.

**Key words:** ranking, I – distance, municipalities, marketability degree, livestock production.

### **I n t r o d u c t i o n**

The world has at its disposal natural resources and potentials, production conditions and technical-technological base for increasing food production, but

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still food production increase for the ever-rising population is of prime concern and the major issue of the world economy.

Along with the increase of national income and the standard of living of the population, the demand for food rises too. This trend brings about the change of structure of population's nutrition, tending to establish the balance between energetic value and nutrition value, the food of animal origin having all the greater significance. Therefore, in the structure of food demand in our country as well as throughout the world, livestock production commodities are becoming all the more significant.

A lot of attention should be given to livestock production also on account of the fact that the commercial market reacts very unrealistically to the lack of the majority of livestock production commodities, big financial resources being invested into production capacities and complexity of the reproduction.

Total output growth and marketability degree of livestock production commodities is also manifested as the factor of crop production growth - especially field crop production along with its marketability.

With regard to the above said, attention should be focused on increasing total livestock production and therefore also on increasing its marketability.

### **Materials and Methods**

Marketability of livestock production commodities in the Vojvodina<sup>1</sup> municipalities was analyzed based on the marketability of some major livestock production commodities: pork, beef, sheep and poultry, eggs and milk.

The research was based on the data for the year 1991 taken from Internal documentation of the Republic Institution for Statistics, Serbia.

Marketability indices were determined as the consumption and production quotient of each analyzed commodity in the municipality in order to be used in the application of the discrimination analysis. With regard to that, if the entire production was intended for the commercial market, the marketability index amounted to 0.00 and if the consumption and production were identical, the coefficient had the value of 1.00. For surplus products, the coefficients ranged from 0.00 up to 1.00 and that being reversible in proportion to the height of the surplus quantity, while for deficit products, the greater the deficit, the coefficients were over 1.00, which means in proportion with the deficit. Therefore, the height (strength) of marketability stands in reciprocal relation with the calculated coefficient.

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<sup>1</sup> On the territory of AP Vojvodina, in the year 1991, 45 municipalities had been constituted. The municipality Sremski Karlovci was not included into the work because it stands for the clean town municipality – it does not have agricultural capacities.

The accordance of the two classifications can be quantified in more than one ways. In this work, Spearman coefficient of rank correlation was used:

$$\rho = 1 - \frac{6 \sum_{i=1}^n d_i^2}{n^3 - n},$$

where  $d_i$  stands for the difference of certain individual pairs, and  $n$  - for the number of municipalities.

Statistical significance of Spearman coefficient is tested by t-statistics:

$$t = \sqrt{\frac{\rho^2(n-2)}{1-\rho^2}}.$$

The degree of accordance of all sequential classifications is determined by Kendal coefficient of manifold rank correlations:

$$W = \frac{12S}{k^2(n^3 - n) - kT},$$

and its significance was tested up by the statistics  $\chi^2 = k(n-1)W$  degrees of freedom. At that,  $S$  marks the sum of the squares of aberrations regarding the sums of the ranks of each municipality from the common average range,  $k$  is the number of denominators and  $T$  is correction on account of linked up ranks.

The nature of the issue investigated does not allow the construction of one general coefficient which would stand up to the degree of marketability of livestock production commodities in one municipality. But, using statistical measure of distance, it is possible to measure up the 'distance' between two municipalities in relation to marketability of livestock production commodities. Having in mind the characteristics of known/familiar statistical measures of the distance, for the purpose of solving the posed problem in the present work, total discrimination effect was used, shown by the I distance.

For each municipality out of the group  $O = \{O_1, \dots, O_{44}\}$  the vector  $x_i = \{x_{i1}, x_{i2}, x_{i3}, x_{i4}, x_{i5}, x_{i6}\}$  was established, giving information on marketability.

If, as a fictitious municipality, the municipality which has the highest degree of marketability should be chosen, regarding the method of ascertaining the denominator of marketability, its vector is determined by minimal values, i.e.

$$X = \{x_1^-, x_2^-, x_3^-, x_4^-, x_5^-, x_6^-\}.$$

I-distance between concrete and fictitious municipality is defined by the following analytical expression:

$$D_r^- = \sum_{i=1}^k \frac{X_{ir} - X_i^-}{\sigma_i} \prod_{j=1}^{i-1} (1 - r_{ji})$$

On account of heterogeneous data in the work, the Pearson coefficient of correlation has been replaced by Spearman coefficient of rank correlation, so explicit form I-distance for the 6 observed products is as follows:

$$\begin{aligned} D_r^- &= \frac{X_{1r} - X_1^-}{\sigma_1} + \frac{X_{2r} - X_2^-}{\sigma_2} (1 - \rho_{12}) + \frac{X_{3r} - X_3^-}{\sigma_3} (1 - \rho_{13})(1 - \rho_{23}) + \\ &+ \frac{X_{4r} - X_4^-}{\sigma_4} (1 - \rho_{14})(1 - \rho_{24})(1 - \rho_{34}) + \frac{X_{5r} - X_5^-}{\sigma_5} (1 - \rho_{15})(1 - \rho_{25})(1 - \rho_{35})(1 - \rho_{45}) + \\ &+ \frac{X_{6r} - X_6^-}{\sigma_6} (1 - \rho_{16})(1 - \rho_{26})(1 - \rho_{36})(1 - \rho_{46})(1 - \rho_{56}) \end{aligned}$$

The sequential order of including indicators into the form should respond to the real quantity in formations regarding marketability which the concrete indicator renders. Regarding the fact that iterative procedure is in the base of statistically objective method for determining sequential order of the indicators in practical work – the primary indicator is subjectively determined by the examiners, and further more the indicators are ranged up according to the strength of correlational link with the primary indicator.

In that way, the entire discrimination effect of the first indicator is taken into consideration i.e. the indicator which contains the greatest quantity of information. Then, all the smaller parts of the remaining indicators are added up by the inclusion of the coefficients of correlation, whose role is to eliminate the repetition of already included information.

As the discrimination effects are calculated as the distances from fictitious municipality being defined with maximum marketability as per all analyzed livestock production products, the sequential order of the municipalities is in reciprocal relation with the height of calculated I-instances.

## Results and Discussion

Average marketability observed as the relation of total demand and total production realized on the territory of AP Vojvodina, amounted to, 0.13 for pork, 0.008 for beef, 0.34 sheep, 0.37 poultry, 0.37 eggs and 0.29 milk, which means that the highest commercial surpluses have been achieved in the production of beef and the lowest in the production of poultry meat and eggs.

The high level of commodity production of beef meat in AP Vojvodina is the result of low consumption of beef meat in the nutrition of the population.

Traditionally, the population of Vojvodina consumes predominantly pork and poultry meat. On account of that, the production of poultry meat and eggs is traditionally natural. Auspicious conditions for the breeding of pigs, have, as the consequence, the range of production which despite outstanding per cent of pork meat in the nutrition of population, enables the production of pork meat to possess high level of marketability.

The production of pork and beef meat is present in all analyzed municipalities, while the production of sheep meat is present in a smaller number of municipalities, which have contributed to the low coefficient of marketability of this production being expressed by arithmetic mean value. Basic statistical indicators for analyzed municipal coefficients of marketability (Table 1) point to (given as arithmetic mean value) the highest average marketability (0.20) achieved in pork and beef meat production and the lowest in sheep meat production (1.66). The biggest variability was characteristic of sheep meat marketability (coefficient of variation  $c_v = 223.09\%$ ), while marketability of eggs varied the least ( $c_v = 45.83\%$ ). Low variability of egg marketability in the municipalities of Vojvodina was the result of the specific characteristic of the production of poultry meat and eggs. Namely, the story is about the high degree of industrialization of these productions which, in their lowest degree, depend upon natural conditions and available land areas under meadows and pastures. Intensive production of poultry is entirely based upon concentrate fodder.

With regard to the outstanding variability of the data, the better denominator of average marketability is medial value. The lowest medial values (0.18), therefore the highest average marketability in this case also have pork and beef meats. But, measured by medial value, the lowest marketability has been ascertained for poultry meat (0.47).

T a b. 1. - Basic statistical denominators/indicators

Product	Arithmetic mean value	Medial value	Minimum	Maximum	Standard deviation	Coefficient of the variation
Pork meat	0.203	0.178	0.018	0.758	0.153	75.17
Beef meat	0.203	0.184	0.030	0.624	0.128	62.75
Sheep meat	1.663	0.370	0.021	18.000	3.709	223.09
Poultry meat	0.532	0.471	0.043	2.005	0.370	69.45
Eggs	0.411	0.420	0.087	0.807	0.189	45.83
Milk	0.350	0.306	0.102	1.367	0.218	62.23

The sequential order of the municipalities ascertained according to marketability of individual analyzed livestock production products (Table 2) is not identical.

T a b. 2. - Rank list of municipalities of AP Vojvodina according to marketability of some major livestock production products

Municipality	Rank list					
	Pork meat	Beef meat	Sheep meat	Poultry meat	Milk	Eggs
Ada	2	1	1	2	2	4
Alibunar	10	33	19	7	32	18
Apatin	32	20	28.5	33	39	13
Bač	33	23	18	15	19	8
Bačka Palanka	18	15	23	40	18	40
Bačka Topola	8	8	25	6	21	11
Bački Petrovac	24	43	38	18	27	2
Bečej	4	13	24	8	4	30
Bela Crkva	41	31	5	34	28	39
Beočin	43	22	22	37	36	41
Čoka	6	34	4	24	37	22
Indija	23	38	35	32	29	38
Irig	31	12	16	22	12	23
Kanjiža	20	11	12	39	7	35
Kikinda	9	17	6	14	6	10
Kovačica	26	42	27	25	38	25
Kovin	21	7	21	27	23	28
Kula	25	18	31	44	14	9
Mali Idoš	44	25	44	16	16	7
Nova Crnja	19	29	14.5	17	41	14
Novi Bečej	29	4	3	9	5	31
Novi Kneževac	11	37	9	12	20	21
Novi Sad	42	40	41	42	42	42
Odžaci	30	19	33	38	9	37
Opovo	40	41	13	20	33	15
Pančevo	17	32	32	19	15	29
Pećinci	37	6	28.5	36	22	20
Plandište	39	39	36	3	43	34
Ruma	15	16	37	23	25	24
Sečanj	28	35	7	28	30	27
Senta	5	5	2	10	3	12
Šid	16	26	34	31	44	17
Sombor	14	14	30	13	17	32
Srbobran	3	3	8	5	8	5
Sremska Mitrovica	13	10	26	29	35	26
Stara Pazova	38	36	40	43	31	43
Subotica	12	9	17	11	13	16
Temerin	1	2	20	4	1	1
Titel	34	30	42	30	11	36
Vrbas	7	28	39	41	26	44
Vršac	35	27	14.5	26	24	19
Žabalj	36	44	43	35	40	3
Žitište	22	21	11	1	34	6
Zrenjanin	27	24	10	21	10	33

The coefficients of accordance of pairs of rank lists (Table 3), as it could be expected, show the highest correlation between rank list of marketability of meat and milk ( $\rho = 0.6654$ ) as well as of the rank of marketability of poultry meat and eggs ( $\rho = 0.5370$ ), while the rank lists of marketability of eggs and milk stand in the weakest link ( $\rho = 0.1336$ ).

T a b. 3. - Spearman coefficients of range correlations

Variables	Pork meat	Poultry meat	Beef meat	Sheep meat	Milk	Eggs
Pork meat	1.000	0.470**	0.463**	0.347*	0.400**	0.288 <sup>NZ</sup>
Poultry meat		1.000	0.289 <sup>NZ</sup>	0.429**	0.315*	0.537**
Beef meat			1.000	0.372*	0.665**	0.204 <sup>NZ</sup>
Sheep meat				1.000	0.340*	0.216 <sup>NZ</sup>
Milk					1.000	0.134 <sup>NZ</sup>
Eggs						1.000

The degree of accordance of all rank lists as measured by Kendal coefficient of the ranking amounts to 0.471 and is statistically very high.

Bearing in mind the structure of the production and consumption, as primary characteristic of marketability of livestock production, in this work, pork meat was taken. According to the procedure of the applied method, further sequential order of analyzed characteristics is: poultry meat, beef meat, sheep meat, milk and eggs. On account of the expressed variability of the data ( $c_v > 30\%$ ) in determining this sequence as well as in calculating total discrimination effects, the values of Spearman coefficient were used regarding the rank correlation. The sequence accepted on the basis of Spearman coefficient of rank correlation is also in accordance with the representation of individual meat categories in view of consumption and production. On the basis of the value of Pearson coefficient of correlation, the sequential order should be: pork, sheep meat, beef, poultry, eggs and milk, which, besides unfulfilled statistical condition, would not correspond the participation of meat categories in total production and consumption of meat either.

According to the previously quoted formula, total discrimination effects have been calculated and as per their values the sequential classification was formed (Table 4). The highest degree of marketability was achieved in the municipality of Temerin, followed by Ada, Srbobran etc., ending up with the municipality of Novi Sad.

T a b. 4. - Rank list of municipalities of AP Vojvodina according to the degree of marketability

Municipality	I-distance	Rank list	Municipality	I-distance	Rank list
Temerin	0.2023	1	Apatin	3.5753	23
Ada	0.2933	2	Kanjiža	3.5883	24
Srbobran	0.5949	3	Irig	3.6288	25
Bačka Topola	1.3013	4	Zrenjanin	3.7562	26
Senta	1.4082	5	Sečanj	3.9454	27
Kikinda	1.6146	6	Pećinci	3.9810	28
Žitište	1.8568	7	Vršac	4.0136	29
Bečej	2.0510	8	Bačka Palanka	4.0783	30
Subotica	2.1026	9	Kovačica	4.4162	31
Alibunar	2.3721	10	Odžaci	4.6329	32
Sremska Mitrovica	2.5075	11	Indija	4.6411	33
Sombor	2.6678	12	Kula	4.8130	34
Čoka	2.7050	13	Titel	4.8549	35
Novi Kneževac	2.7766	14	Vrbas	4.8894	36
Nova Crnja	2.7886	15	Opovo	5.1954	37
Ruma	2.8364	16	Plandište	5.39,3	38
Bač	3.0569	17	Žabalj	5.8300	39
Kovin	3.1514	18	Bela Crkva	5.8377	40
Pančevo	3.1941	19	Beočin	6.8453	41
Novi Bečej	3.2968	20	Mali Idoš	7.3702	42
Šid	3.3750	21	Stara Pazova	7.3705	43
Bački Petrovac	3.4040	22	Novi Sad	8.5433	44

## C o n c l u s i o n

Marketability of agricultural production therefore of livestock production too, is determined by the home market demand and export of agricultural commodities as well as by availability, structure and size of food industry capacities at disposal, which at the same time also effects them all and deserves to be paid special attention.

The level of marketability of individual livestock production commodities is the result and eating habits of the population.

Apart from the common analysis of marketability of individual livestock production commodities, the modified Ivanovic distance was used in the study to form the rank list of the municipalities according to the multidimensional denominator of livestock production marketability. The developed rank list indicates the current position of the analyzed municipalities but also points to the possible future trends in the production and price policy as well as to the changes in the structure of consumption and the sites of the processing capacities.



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RANGIRANJE OPŠTINA AP VOJVODINE PREMA  
VIŠEDIMENZIONALNOM POKAZATELJU  
ROBNOSTI STOČARSKE PROIZVODNJE

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R e z i m e

Robnost stočarske proizvodnje analizirana je preko robnosti svinjskog, goveđeg, ovčijeg i živinskog mesa, kao i robnosti jaja i kravljeg mleka.

Redosled opština u AP Vojvodini prema posmatranim pokazateljima nije identičan. Međutim, Spearman-ov koeficijent korelacije ukazuje na statistički vrlo visok stepen saglasnosti rang liste robnosti svinjskog mesa sa rang listama robnosti goveđeg mesa, živinskog mesa i mleka, kao i rang liste živinskog mesa i redosledne klasifikacije ovčijeg mesa i jaja, goveđeg mesa i mleka. Statistički jaka veza konstatovana je između rang liste robnosti ovčijeg mesa i svinjskog mesa, goveđeg mesa i mleka, kao i živinskog mesa i mleka.

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Na osnovu vrednosti Kendal-ovog koeficijenta ranga može se zaključiti da postoji vrlo visok stepen saglasnosti svih rang lista posmatranih istovremeno. Za određivanje redosledne klasifikacije prema ostvarenoj robnosti svih analiziranih stočarskih proizvoda kao sintetički pokazatelj, u radu je iskorišćeno Ivanović-evo odstojanje.

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