

Mathematical Estimation of Mobility of Peasants in Vilnius Governorate in the 19th Century

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Abstract. The article deals with the problem of local mobility of peasants in Vilnius Governorate in the nineteenth century. To solve the problem, statistical-demographical data from the “Memory Books” permanently issued by the Tsarist Russian government was used. Pure demographic data brings little information, unless it is properly mathematically processed. Such processing leads to the discovering of new proportions concerning inhabitants, villages and farmsteads. Such proportions are related to the administrative territorial unit under investigation and show how many people reside in a farmstead and how many farmsteads are comprised in a village. In the course of time, numbers of villages and farmsteads change, and these numbers show the numbers of people taking part in local mobility of inhabitants. The higher are changes in villages and farmsteads, the higher is mobility of inhabitants.

Key words: migration, farmstead, village.

Introduction

In recent years, the historians’ attitude to the mobility of inhabitants in pre-industrial Europe has significantly changed. They start thinking that stable rural community and massive outburst of migration in the nineteenth and twentieth centuries is only a myth, that mobility of inhabitants is not an outcome of industrialisation and that in pre-industrial Germany it was a common phenomenon. Many mobility combinations and immobility in general can bring an identical result. Exactly research studies on migration, especially seasonal and temporary, carried out by French researches show high percentage of mobility in pre-industrial society. They emphasise the importance of a dynamic exchange between centre and periphery, town and village, region. In four parishes in Sweden, it was found out that between 1829 and 1866 there were only 30 percent of individuals older than 25 years who were born in the very parish, and some 48 percent were born in sites located at a distance of 15 kilometres (Oris, 2003).

In other study by M. Oris (Oris, 1996), migration in the heart of the industrial revolution is dealt with. A methodological approach to migration is presented in the work by A. Kalinitchev (Kalinitchev, 2011).

More on tendencies of contemporary history of migration can be found in scientific periodicals, such as “Annales de Demographie Historique” and “The History of Family”.

The situation in Tsarist Russia in the nineteenth century little differed from that in Western Europe, especially Curonian Governorate where peasants were emancipated earlier, in 1819, even though peasants had not gained their complete freedom yet. Despite the fact that officially peasants were emancipated in Russia in 1861, still throughout the nineteenth century frequent agrarian reforms carried out by the tsarist government meant a gradual move towards the emancipation of peasants and equalising of the peasants’ statuses in both legal and economic approaches. Wanting to adjust to these changes, peasants had to be smart and be externally highly mobile (Kanišauskas, 2015).

Research studies by A. Plakans and C. Wetherell (Plakans, 2001, 2005, 2006; Plakans & Wetherell, 2000, 2004; Wetherell & Plakans, 1998) provide information on the mobility of peasants in the nineteenth-century governorates of the Tsarist Russia’s Baltic Region. These research works focus on the economic side of peasants’ living, size of

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households, property relations inside a family. A. Plakans's research demonstrates that internal mobility of peasants among farmsteads inside a large landed estate was much higher than outside a large landed estate. Thus, majority of migrations were local, inside a landed estate or to a neighbouring landed estate.

Even though similar processes also took place in Vilnius Governorate, nevertheless they will be explored in a different way, without going deeper into the economic aspect of the peasant's life.

The aim of the article is to find mathematical transformations which turn appropriate statistical-demographical data into characteristics of people's mobility, with regard to various administrative territorial levels of distribution.

Materials and Methods

The Mathematical Model of Internal Migration

Demography-related mathematical methods are presented in the monograph (Keyfitz & Caswel, 2005). This study may lack some probability methods applied in demographics; therefore, a below-presented probability-based model of internal migration will be a regular supplement of the known methods.

Before dealing with mobility of inhabitants of a particular administrative unit, i.e. local mobility, it is worth exploring internal migration of inhabitants in a larger administrative unit. The mathematical model of internal migration suggested, applied in V. Kanišauskas's work (Kanišauskas, 2015) for the first time, fits this purpose.

Let us assume that we have a simple random sample $X^n = X_1, X_2, \dots, X_n$; here X_1, X_2, \dots, X_n are independent random elements symbolising inhabitants of a governorate or any other big territory. The common amount of inhabitants is marked by n . Let A_j symbolises a j county of Vilnius (or any other land), when $j = 1, \dots, k$; k is the number of counties. Let us mark the number of inhabitants Y_j who are attributed to the county A_j :

$$Y_j = \sum_{i=1}^n 1(X_i \in A_j), \quad j = 1, \dots, k.$$

Instead of the primary sample $X^n = (X_1, X_2, \dots, X_n)$ we obtain the sample $Y^k = (Y_1, Y_2, \dots, Y_k)$. A random vector $Y^k = (Y_1, Y_2, \dots, Y_k)$ has a polynomial distribution $Y^k \sim P = (p_1, p_2, \dots, p_k, n)$, i.e.

$$P(Y_1 = n_1, Y_2 = n_2, \dots, Y_k = n_k) = \frac{n!}{n_1! \dots n_k!} p_1^{n_1} \dots p_k^{n_k},$$

here $n_1 + \dots + n_k = n$ and $p_1 + p_2 + \dots + p_k = 1$, p_i , $i = 1, \dots, k$ are probabilities.

We check the statistical hypothesis $H_0 : p_i = p_{i0}$, $i = 1, \dots, k$, having the sample $Y^k = (Y_1, Y_2, \dots, Y_k)$.

We apply the Chi-square criterion. We draw Pearson's statistics:

$$\chi^2 = \sum_{i=1}^k \frac{(Y_i - n \cdot p_{i0})^2}{n \cdot p_{i0}} = \sum_{i=1}^k \frac{n}{p_{i0}} \cdot \left(\frac{Y_i}{n} - p_{i0} \right)^2,$$

which asymptotically has a distribution χ^2 with $k-1$ degrees of freedom, when the hypothesis is H_0 correct.

Therefore, having chosen the significance level α , we construct the following critical area in order to check the hypothesis H_0 :

$$W = \{Y^n : \chi^2 > \chi_{1-\alpha}^2(k-1)\},$$

here $\chi_{1-\alpha}^2(k-1)$ is a quantile of χ^2 distribution with $k-1$ degrees of freedom $1-\alpha$ row.

If realisation of the sample $y^k = (y_1, y_2, \dots, y_k)$ is that

$$\chi^2 = \chi^2(y^k) > \chi_{1-\alpha}^2(k-1)$$

then the hypothesis H_0 is rejected, and if

$$\chi^2 \leq \chi_{1-\alpha}^2(k-1)$$

the hypothesis is accepted.

Introduction of dependence on time t . Since inhabitants of Vilnius Governorate were monitored in various periods of time (revisory population censuses), our model will be inanimate if the number of inhabitants in parishes $Y^k = (Y_1, Y_2, \dots, Y_k)$ does not depend on t . We introduce t : $Y(t)^k = (Y(t)_1, Y(t)_2, \dots, Y(t)_k)$. Now $Y(t)_j$ indicates the number of inhabitants in a j county at a moment t , and $Y(t)^k \sim P(t) = (p(t)_1, p(t)_2, \dots, p(t)_k, n(t))$, i.e. has a polynomial distribution. Since we are focused on internal migration of inhabitants, i.e. changes in the numbers of residents in counties from a time moment t_1 to t_2 ($t_1 < t_2$), therefore we check a statistical hypothesis $H_0 : p_i = p_{i0}$, $i = 1, \dots, k$, when $p_{i0} = \frac{Y_i(t_1)}{n(t_1)}$, and $\hat{p}_i = \frac{Y_i(t_2)}{n(t_2)}$, $n = n(t_2)$. Having chosen the level of significance α , at a wanted exactness we will find out if the numbers of residents increased in certain counties of the governorate after a certain period of time (at least one year) has passed. If the hypothesis H_0 is accepted (with the probability $1-\alpha$), then from the time moment t_1 to t_2 the numbers of inhabitants in the governorate increased or decreased equally in all counties, and it may be claimed, grounding on high probability, that internal migration did not take place inside the governorate. If we reject H_0 , we can claim that internal migration proceeded inside

Table 1

Changes in the Numbers of Peasants and Landlords

By year	1879	1880	1881	1882	1883	1884	1885	1886	1887
Number of peasants	819 500	825 364	829 969	820 907	814 031	819 651	827 638	845 202	859 951
Number of landlords	58 447	58 274	58 173	58 886	54 939	52 580	58 101	58 666	54 806

Table 2

Dynamics of the Correlation between Peasants and Landlords

By year	1868	1872	1874	1875	1876	1877	1879
Number of landlords per 100 peasants	6.48	6.36	6.51	6.73	6.82	7.02	7.13
Number of peasants per 1 landlord	15.43	15.72	15.36	14.86	14.66	14.25	14.03
By year	1880	1881	1882	1883	1884	1885	1886
Number of landlords per 100 peasants	7.06	7.01	7.17	6.75	6.42	7.02	6.94
Number of peasants per 1 landlord	14.16	14.27	13.95	14.81	15.58	14.25	14.41

the governorate. The biggest change $\Delta = p_{i_o} - \hat{p}_i$ with a positive mark indicates where inhabitants arrived. Analogically, the biggest change with a minus mark indicates the departure of inhabitants. Tracing such changes in all counties, we can observe how the flows of residents moved inside the governorate as the years passed. The method was applied for Vilnius Governorate in the second half of the nineteenth century by V. Kanišauskas in his research work (Kanišauskas, 2015).

The Method of Transformation of Statistical-Demographical Data

Simple statistical-demographical data is usually insufficiently informative, until it is properly mathematically transformed. The method of such transformation is difficult to describe by using a single formula because primary demographical data may reflect different phenomena. Nevertheless, one suitable example can demonstrate the essence of such transformation. For instance, numbers of peasants and landlords will be taken into consideration (Table 1) in different periods of the nineteenth century in Vilnius Governorate (Kanišauskas, 2015). These numbers only suggest that there were approximately 820 thousand peasants and approximately 58 thousand landlords.

Further, we transform the data in a way to find out how many peasants are allocated for one landlord and how many landlords are per 100 peasants (Table 2) (Kanišauskas, 2015). Transformed primary data is quite stable and demonstrates direct interdependence between peasants and landlords. One landlord is allocated 15 peasants and this may have a certain economic meaning. 7 landlords are steadily in proportion to one hundred peasants; this is also more informative data in comparison to the primary one. The essence of the data transformation method lies in finding new unknown more informative proportions between primary data.

Results and Discussion

Statistical-demographical data used in various research studies is usually insufficiently informative. Information on the life of governorates in tsarist Russia was collected in “Memory Books” (Памятные книжки Виленской губернии). The data from these sources has been processed and presented in the V. Kanišauskas study (Kanišauskas, 2015). The study includes a table (Table 3) (all the data is presented in “Memory Books”, the years of publishing are two years later than indicated in the table); it presents general data on the life of peasants, its development.

Table 3

General Data on Peasants in Small Rural Districts, Their Development

	Number of small rural districts			Number of villages		
Counties	In 1868	In 1872	In 1874	In 1868	In 1872	In 1874
Vilnius	19	19	19	2 068	2 629	2 454
Trakai	17	17	17	1 114	1 167	1 207
Lida	24	24	24	1 085	1 108	1 092
Švenčionys	24	23	23	1 664	1 631	1 653
Ašmena	23	23	23	1 280	1 383	1 420
Vileika	30	29	28	1 197	1 212	1 222
Disna	24	22	22	1 477	1 522	1 537
In total	161	157	156	9 885	10 652	1 537
	Number of farmsteads			Number of inhabitants		
Counties	In 1868	In 1872	In 1874	In 1868	In 1872	In 1874
Vilnius	9 065	9 649	9 433	94 257	97 022	101 620
Trakai	8 584	8 713	7 947	78 060	79 358	85 568
Lida	9 207	9 316	9 246	87 526	90 521	89 949
Švenčionys	9 957	9 789	9 943	89 748	88 474	95 632
Ašmena	12 814	13 812	13 214	104 223	105 605	112 317
Vileika	10 305	10 178	10 161	94 957	94 273	87 972
Disna	10 029	9 392	9 814	95 085	89 216	94 449
In total	69 961	70 849	69 758	643 856	639 469	667 579

Table 4

Farmsteads, Villages and Inhabitants in the Counties

By year	Vilnius County						
	1868	1872	1874	1875	1876	1877	1879
Number of inhabitants	94 257	97 022	101 635	101 644	104 579	109 844	111 117
Number of farmsteads	9 065	9 649	9 433	8 834	10 248	10 218	10 240
Number of villages	2 068	2 629	2 454	2 352	2 375	2 379	2 379
Number of farmsteads in a village	4.38	3.67	3.84	3.76	4.31	4.3	4.3
Number of inhabitants in a farmstead	10.4	10.06	10.77	11.51	10.2	10.75	10.85
Number of inhabitants in a village	45.58	36.9	41.42	43.22	44.03	46.17	46.71
Changes in the numbers of inhabitants		2 765	4 613	9	2 935	5 265	1 273
Changes in the numbers of farmsteads		584	-216	-599	1 414	-30	22
Changes in the numbers of villages		561	-175	-102	23	4	0

Table 5

Farmsteads, Villages and Inhabitants in the Counties

By year	Švenčionys County						
	1868	1872	1874	1875	1876	1877	1879
Number of inhabitants	89 748	88 474	95 632	99 276	99 475	102 669	103 761
Number of farmsteads	9 957	9 789	9 943	10 518	10 861	10 687	10 218
Number of villages	1 664	1 631	1 653	1 676	1 703	1 722	1 638
Number of farmsteads in a village	5.98	6	6.02	6.28	6.38	6.21	6.24
Number of inhabitants in a farmstead	9.01	9.04	9.62	9.44	9.16	9.61	10.15
Number of inhabitants in a village	53.94	54.25	57.85	59.23	58.41	59.62	63.35
Changes in the numbers of inhabitants		-1 274	7 158	3 644	199	3 194	1 092
Changes in the numbers of farmsteads		-168	154	575	343	-174	-469
Changes in the numbers of villages		-33	22	23	27	19	-84

According to the data under discussion, the number of small rural districts remains quite stable, the number of peasants increases, as in parallel the numbers of villages and farmsteads change, too. However, this information does not tell much because it lacks some logic.

The logic appears after a slight transformation of the data (Table 4). The table displays three quite stable numbers: number of inhabitants in a farmstead – 10 people; number of farmsteads in a village – 4 units; number of inhabitants in a village – 45 people. Thus, a certain order was maintained in the people's lives.

Slight changes in the numbers of inhabitants, villages and farmsteads (Table 4) show vast mobility of peasants in villages and farmsteads throughout the

county. Big changes in the numbers of farmsteads mean the formation of new farmsteads of peasants and the neglect of the old ones – people would migrate in parallel, too.

To explore if the situation in another county of Vilnius significantly differs from the previous one, Švenčionys County is presented here.

The situation in Švenčionys District is slightly different from that in Vilnius County, though similar. In Švenčionys County, there are more farmsteads per village, i.e. 6 farmsteads, whereas in Vilnius County – 4. However, in one farmstead of Švenčionys County live less people – 9 individuals, whereas in Vilnius County – 10 individuals. In a village in Švenčionys County more people live together – 58 individuals, whereas in Vilnius – 44 individuals. These are

Table 6

Data on Small Rural Districts

Small rural districts	Number of villages				Number of farmsteads				Number of inhabitants			
	In 1868	In 1872	In 1874	In 1876	In 1868	In 1872	In 1874	In 1876	In 1868	In 1872	In 1874	In 1876
Adutiškis	92	96	96	96	721	821	821	921	6 566	6 417	6 488	6 496
Kamajai	66	62	73	82	442	442	444	448	3 983	4 222	4 143	5 231
Svirkai	41	48	48	48	376	371	376	380	3 631	3 703	3 714	3 728
Melagėnai	36	39	39	39	262	280	280	412	3 281	2 880	2 878	3 002
Tverėčius	60	83	81	83	423	571	746	832	4 081	4 218	5 439	5 668
Lentupis	61	48	61	64	289	393	254	275	3 487	2 316	2 716	2 770

interesting differences which should be examined in a separate study. The most important aspect is that these minor differences reflect just individual characteristics of counties but make no impact on the applied mathematical method demonstrating the mobility of people. For instance, from 1868 to 1872, 168 farmsteads (including 9 people in each) and 33 villages (including 54 people in each) disappeared; and this means that approximately 1.5 thousand people lost their old houses. Naturally, over the next two years (from 1872 to 1874) 154 new houses appeared. Over the next year, the number of houses increased by 575 units, including more than 5 thousand inhabitants. All these people had to be highly mobile to survive.

The same situation is also observed at the level of small rural districts.

Table 6 demonstrates several small rural districts in Švenčionys County. They have not been chosen by accident. Their names signify well-known locations – small towns which remain to the present day. Being aware of the distances from Adutiškis to these towns, we can prognosticate a possibility of peasant mobility between them. There are 16 km from Adutiškis and Kamajai or Melagėnai, to Svirikai – 10 km, to Tverečius – 20 km, to Lentupis – 32 km. As seen from the number of villages, Svirikai and Adutiškis – small rural districts are the most stable. This evidences quite a long history of these locations and a sedentary life style (in a sense of its structure) of these people. The increase in the amount and changes of farmsteads reflects the process of the division of peasants' households. In Kamajai and Svirikai – small rural districts, numbers of farmsteads were astonishingly stable, what is not characteristic in terms of all small rural districts of the governorate. This is an object of another research. It is likely that stability of the amount of farmsteads is related to religious or national specificity of local community. As the numbers of men and women were not equal in these small rural districts, unmarried young individuals had to search for their second-halves either in neighbouring small rural districts or further. According to the data of 1872, Adutiškis rural district encompassed 3,185 men and 3,232 women, Melagėnai had 1,385 men and 1,495 women, Tverečius had 1,895 men and 2,325 women, Svirikai had 1,785 men and 1,918 women, Lentupis had 1,210 men and 1,106 women. Thus, quite significant variation has been obtained; this might have caused tension to young individuals and force the search for a second-half elsewhere (Kanišauskas, 2015).

The direction of further research. Peasants lived not only in farmsteads and villages but also in estates. The network of estates covered both tsarist

Russian and Lithuanian governorates. We cannot completely estimate the routes of peasants' mobility without investigating their life in estates. We could ground on research works by L. Truska (1985) and S. Pamerneckis (2004) as a starting point in this aspect of further research.

Conclusions

1. Simple demographic data gives little information; it should be transformed into a specific shape in order to see the numbers of small rural districts, farmsteads in counties of a governorate; the numbers of inhabitants in farmsteads and villages; numbers of farmsteads in villages.
2. High changes in the numbers of villages and farmsteads across time (every two years) show intensive mobility of groups of peasants moving from one place to other.
3. The mathematical model of internal migration grounding on the polynomial distribution better suits the investigation of internal migration.
4. Throughout the entire nineteenth century, in Vilnius Governorate there was a stable ratio of one landlord to 15 peasants. This may hide still unknown economical reasons.
5. Tsarist statistical reports on small rural districts suggest that in the nineteenth century Vilnius Governorate due to lack of women and men part of peasants were forced to travel to neighbouring small rural districts to search for a spouse.

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Acknowledgements

This research was supported by the Nordplus Higher Education 2016 project NPHE-2016/10342 Raising awareness about the role of math skills in building specialists competence for the sustainable development of society.