

Households and residences in registers

Definition of a household

Household and family statistics are an important part of a population census. Traditionally, a household is defined as a housekeeping unit: a household is made up of people who share a place of residence and housekeeping expenses. A household can also consist of one person.

In a register-based census, it is impossible to determine the housekeeping arrangements of people sharing a dwelling and therefore a dwelling-based definition is used: a household is made up of persons living in the same dwelling. As sometimes more than one household live at one address, there are slightly fewer dwelling-based households than traditional ones. Analysis of the 2011 census revealed that the number of dwelling-based households was 7% smaller than that of traditional households¹.

The definition of family in the census is narrow and only includes nuclear families. A nuclear family is one of the following: a married or cohabiting couple without children, a married or cohabiting couple with one or more children living with them, or a lone parent and his or her child(ren) living with him or her. If a child living with his or her parent(s) has a partner or children, he or she is not counted as a member of the parents' family². A household may contain one, several or no families.

During the first pilot census in 2016, it became clear that the statistics on households and families based on the residence data in the Population Register (PR) were very different from those of the census. For example, in the 2011 census, 24% of nuclear families were lone-parent families and 76% were families of married or cohabiting couples. In the pilot census conducted four years later, the share of lone-parent families was 41% and 59% were families of couples³.

The reason for the discrepancy lies in the quality of dwellings data in the PR. It has been established that roughly 80% of people have registered the correct place of residence in the PR⁴. According to PR data, members of the same family often live in different dwellings. If, for example, in a two-child, two-parent family, the mother is registered at the same address with one child and the father is registered at a different address with the other child, the Population Register will show two lone-parent families.

To ensure that the statistics are not biased, it is important to identify families even if they do not share a dwelling according to the PR. In nuclear families, there are two types of relationships between individuals: between children and parents, and between partners. Children's relationships with parents and marriages are very well covered in the PR. Identifying cohabiting partners is much more complex, but it can usually be done with the help of registers.

Partnership index

In 2017–2018, Statistics Estonia developed a partnership index methodology, the aim of which was to identify partners who live in separate dwellings according to the Population Register, using various administrative sources. It is analogous to the residency index that allows to quite precisely identify who lives permanently in Estonia and who does not, using the so-called signs of life found in various registers (e.g. going to work, visiting a doctor, buying a car). Instead of signs of life, the search is on for so-called signs of partnership that connect two potential partners (i.e. two opposite-sex adults who are not related). Partnership signs include, for instance, marriage, having children together, a shared home loan, registration at the same address, using the same car. Signs that indicate that cohabitation is unlikely, such as divorce or a maintenance dispute, are also informative.

The partnership index is a score that describes the likelihood of two people being partners. The index is essentially a weighted sum of the partnership signs, which also takes into account the time when the signs were created and the age differences of the individuals. Weighing is important as signs are not equal: for example, married people are usually partners but users of the same car can simply be colleagues. Weights of signs are estimated on the basis of two major annual household surveys: the Estonian Social Survey and Estonian Labour Force Survey. Once the weights are known, the partnership index can be calculated for any couple in the population. As in the residency index, the presence or absence of any particular partnership sign is not decisive; it is the total weight of all the signs that counts. ^{5,6}

In the Comparative Survey of Household and Place of Residence conducted in 2018, the partnership index was able to correctly identify 84% of the actual couples and the accuracy of family statistics increased dramatically. According to the survey, 22% of families were lone-parent families. A similar result – 24% – was achieved using registers and the partnership index. Based on the place of residence registered in the PR, lone-parent families would have accounted for 40%.⁷

Placing partners who are separated according to PR data in the same household leaves open the question of the household's place of residence. Do they live in the registered dwelling of the man or woman? Or in the apartment with an electricity contract in the man's name? Or in the house owned by the woman?

Location index

The location index is designed to answer two questions: where and with whom does a person live. In other words, the distribution of people into households and their places of residence are determined simultaneously. Compared to the partnership index, this is a more general approach.

The workflow of the location index is as follows. Different datasets are used to collect signs that could indicate whether two people live in the same household (Table 1). Such signs include signs of partnership but, unlike in the partnership index, there are no restrictions on gender, age, or blood relationship of the persons. Therefore, parenthood or the payment of child allowance to an adult caring for a child are also suitable linking signs.

Signs that connect a person with various locations (Table 2) are also important, whether they are possible places of residence (e.g. address in the PR, property, dwelling connected into the electricity grid) or simply indications to the area in which the person lives (e.g. GP, workplace, school, pharmacy where electronically prescribed medication was purchased).

Table 1. Signs linking individuals

Database	Link between persons
E-File, information system for the expedited payment order procedure	Persons are <i>on the same side</i> in a maintenance dispute (e.g. the recipient and the child for whom maintenance is paid)
	Persons are <i>opposing parties</i> in a maintenance dispute (e.g. the recipient and the payer)
Health Insurance Information System	One person has cared for another person in the year preceding the census
Traffic Register	Persons are linked to the same vehicle (e.g. owner and user of the car)
Register of Taxable Persons	Persons have jointly taken out a housing loan (information provided by the bank for the interest refund)
	A person has declared the training expenses of another person on their income tax return
	A person received income tax exemption for two or more children. The link is between the child and the declarant
	One spouse has transferred tax-free income to the other spouse

Database	Link between persons
Estonian Medical Prescription Centre	One person has purchased electronically prescribed medication on behalf of another person
Population Register	Persons are married
	Persons are divorced
	One person is the mother of the other
	One person is the father of the other
	An adult serves as the guardian of another adult
	Child is separated from parent
	A person has partial or limited right of custody over child's property and/or child
	A person has full right of custody over child's property and child
	A person receives family allowance for a child
	A person receives parental benefit for a child
Social Services and Benefits Registry	Persons in the same household have received subsistence benefit

Table 2. Signs linking persons and locations

Database	Link between person and location	Location accuracy
Elering	Person has an electricity contract at a particular address	Possible place of residence
Register of persons registered as unemployed or job-seekers, and of provision of labour market services	Person's place of residence	Possible place of residence
	Person's postal address	Possible place of residence
Prison Register	Place of residence of the person in criminal custody	Possible place of residence
Land Register	Real estate belonging to person	Possible place of residence
Population Register	Person's registered place of residence	Possible place of residence
	Persons additional address	Possible place of residence
	Person's previous places of residence	Possible place of residence
	Person's place of stay (e.g. dormitory)	Possible place of residence
Population and housing census of 2011	Addresses of the person and his or her mother	Possible place of residence
Social Services and Benefits Registry	Person's place of residence	Possible place of residence
Register of Taxable Persons	Real estate purchased with a person's housing loan	Possible place of residence

Database	Link between person and location	Location accuracy
Estonian Education Information System	Kindergarten of child	Municipality
	School of vocational or higher education student	Municipality
	School of pupil in general education	Municipality
	Teacher's place of work	Municipality
Health Insurance Information System	Dental care institution visited by the person	Municipality
	Medical institution visited by the person	Municipality
	Person's GP	Municipality
Identity Documents Database	Place of receipt of an identity document	Municipality
Mandatory Funded Pension Register	Address of person who has joined the second pension pillar	Municipality
Estonian Medical Prescription Centre	Pharmacy in which the person has purchased electronically described medication	Municipality
Employment Register	Person's place of work	Municipality

Next, the likelihood that the persons linked by a sign actually do live together is assessed. Similar to the partnership index, information on actual cohabitation is available from large household surveys: the Estonian Social Survey and the Estonian Labour Force Survey. Based on survey data, the model parameters are estimated and then the probabilities are calculated for all pairs of individuals found in the registers.

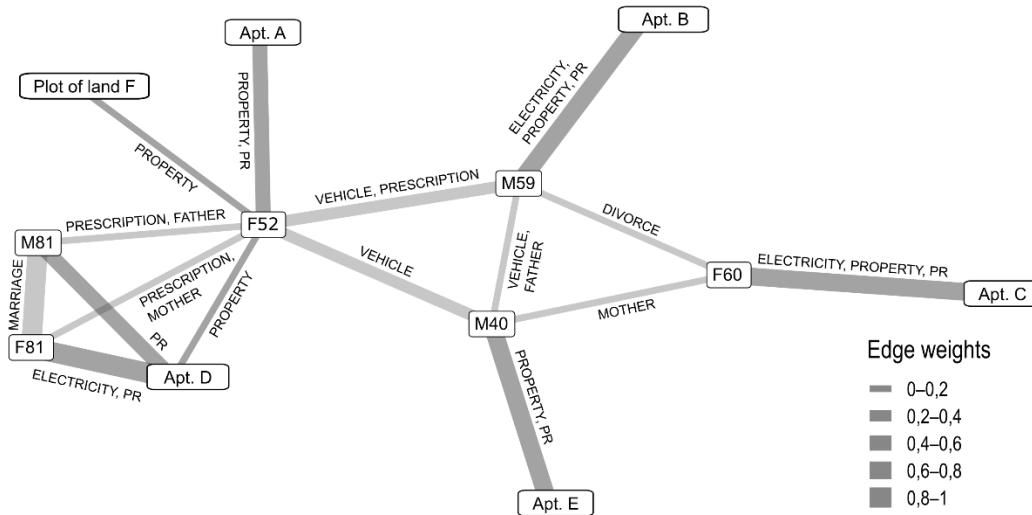
The probabilities of a person living at a particular location are calculated in a similar manner. The existence of various links with a specific address and municipality as well as the person's distance from his or her workplace, school or kindergarten are taken into account.

Persons, places, and the links between them can be described mathematically as a *graph*. Graphs consist of vertices and edges connecting them. For example, social networks can be viewed as a graph: vertices are people, and edges are friendships. Sometimes weights are assigned to the edges. For instance, in transportation, the weight of a road (edge) connecting two geographical points (vertices) may be the length of the road. In this case, vertices are people and places, and edges are the links between them. Weights are the statistically estimated probabilities of two persons living together or of a person dwelling in the particular place (Figure 1).

In the analysis of social networks, *community detection* plays an important role. In mathematical terms, the search is for a set of vertices that are closely related to each other and weakly related to other vertices. The household with its place of residence can also be seen as such a sub-graph. The core of the location index is the subdivision of the graph of people and places into sub-graphs containing one or more persons and at least one possible place of residence, using a community detection algorithm. Persons in the same sub-graph form a household and their place of residence is also in this sub-graph.

If more than one residence is associated with a household, the most likely of these is selected. This is done by taking into account the household's weights for each place, electricity consumption, size of dwelling and amenities (central heating, bathroom, toilet, water). Electricity consumption data are obtained from Elering, and size and amenity data from the Building Register. Although the location index includes a wide range of registers in the sample, in most cases individuals have the strongest association with the PR residence. For instance, in 2022, the location index left 74% of the individuals in their PR place of residence.

Figure 1. Fragment of a graph of persons and locations. The vertices indicating persons show the person's sex and age. The width of lines indicates the likelihood of persons living together (light lines) or of a person dwelling in the particular place (dark lines). The labels on the edges indicate the nature of the link: PRESCRIPTION – one person has bought electronically prescribed medication on behalf of another person, PR_RESID – place of residence according to the Population Register, VEHICLE – persons are linked to the same vehicle, e.g. users of the same car. The figure has been previously published in the journal Akadeemia ⁸.



The algorithm described above is applied to people belonging to private households. Persons known to be homeless or living in an institution, i.e. belonging to an institutional household, are identified separately. Data on the homeless population are obtained from municipalities, data on nursing homes and special care homes from the Social Protection Information System, data on substitute homes from the Social Services and Benefits Data Register, and data on prisoners from the Prison Register. Monastery residents are identified by their PR residential address. In addition, information on places of residence found in the PR is used – under the new Population Register Act, which entered into force in 2019, a number of institutions, including social welfare institutions, are obliged to register their residents in the PR.

Results

No model or survey reveals the absolute truth about a population. Errors are inevitable in census taking but care must be taken to minimise them. For an accurate picture of the quality of the location index, a comparison with the census survey is needed. This analysis is still pending at the time of writing (May 2022). Preliminary knowledge is encouraging, as the breakdown in the year before – 01.01.2021 location index for households and families – was quite realistic. For instance, lone-parent families accounted for 19%, which is close to the figures in recent years.

If we switch from residences registered in the PR to the location index, the total population of Estonia remains the same, but populations of municipalities change (Table 3). The table shows the populations published on 01.01.2021 and the populations that were determined using the location index on 01.01.2021 and 01.01.2022. Thus, the effects of the methodology can be distinguished from changes occurring over time. For example, the decrease in the population of small islands is primarily due to the impact of the location index.

Table 3. Population of municipalities in 2021 (Population Register and location index) and 2022 (location index).

County	Municipality	2021 (old, PR)	2021 (new, index)	2022 (new, index)
Harju county	Anija rural municipality	6,253	6,288	6,263
	Harku rural municipality	15,650	16,044	16,379
	Jõelähtme rural municipality	6,692	6,797	6,969
	Keila city	10,078	10,457	10,499
	Kiili rural municipality	5,891	5,969	6,165
	Kose rural municipality	7,211	7,376	7,451
	Kuusalu rural municipality	6,421	6,285	6,242
	Loksa city	2,467	2,636	2,615
	Lääne-Harju rural municipality	12,661	12,951	12,997
	Maardu city	15,284	16,154	16,171
	Raasiku rural municipality	5,138	5,070	5,114
	Rae rural municipality	21,765	21,901	22,901
	Saku rural municipality	10,722	10,821	11,002
	Saue rural municipality	23,790	23,519	24,110
	Tallinn city	438,341	435,223	437,811
Viimsi rural municipality	21,151	21,266	21,872	
Hiiu county	Hiiumaa rural municipality	9,381	8,597	8,497
Ida-Viru county	Alutaguse rural municipality	4,682	4,304	4,167
	Jõhvi rural municipality	11,699	11,973	11,947
	Kohtla-Järve city	32,577	33,934	33,498
	Lüganuse rural municipality	8,219	8,435	8,223
	Narva city	53,424	54,792	53,953
	Narva-Jõesuu city	4,479	4,226	4,175
	Sillamäe city	12,230	12,666	12,438
	Toila rural municipality	4,603	4,414	4,335
Jõgeva county	Jõgeva rural municipality	13,262	13,222	13,185
	Mustvee rural municipality	5,204	5,099	4,982
	Põltsamaa rural municipality	9,616	9,778	9,690
Järva county	Järva rural municipality	8,837	8,743	8,632
	Paide city	10,285	10,512	10,438
	Türi rural municipality	10,695	10,727	10,623
Lääne county	Haapsalu city	12,883	13,166	13,132
	Lääne-Nigula rural municipality	7,005	6,861	6,794
	Vormsi rural municipality	397	307	301
Lääne-Viru county	Haljala rural municipality	4,297	4,170	4,089
	Kadrina rural municipality	4,791	4,832	4,838

County	Municipality	2021 (old, PR)	2021 (new, index)	2022 (new, index)
	Rakvere city	14,984	15,199	15,141
	Rakvere rural municipality	5,619	5,780	5,745
	Tapa rural municipality	10,611	10,966	10,902
	Vinni rural municipality	6,788	6,727	6,683
	Viru-Nigula rural municipality	5,575	5,759	5,647
	Väike-Maarja rural municipality	5,737	5,771	5,664
Põlva county	Kanepi rural municipality	4,685	4,507	4,480
	Põlva rural municipality	13,609	13,569	13,394
	Räpina rural municipality	6,179	6,214	6,115
Pärnu county	Häädemeeste rural municipality	4,794	4,674	4,616
	Kihnu rural municipality	690	556	551
	Lääneranna rural municipality	5,190	5,103	5,074
	Põhja-Pärnumaa rural municipality	8,046	8,154	8,046
	Pärnu city	50,639	51,132	51,209
	Saarde rural municipality	4,455	4,468	4,349
	Tori rural municipality	11,946	11,942	11,860
Rapla county	Kehtna rural municipality	5,416	5,468	5,407
	Kohila rural municipality	7,322	7,526	7,525
	Märjamaa rural municipality	7,374	7,481	7,368
	Rapla rural municipality	13,004	13,149	13,229
Saare county	Muhu rural municipality	1,919	1,659	1,646
	Ruhnu rural municipality	140	99	89
	Saaremaa rural municipality	30,973	29,806	29,557
Tartu county	Elva rural municipality	14,597	14,755	14,706
	Kambja rural municipality	12,089	12,405	12,858
	Kastre rural municipality	5,430	5,286	5,401
	Luunja rural municipality	5,182	5,250	5,378
	Nõo rural municipality	4,314	4,266	4,266
	Peipsiääre rural municipality	5,331	5,215	5,108
	Tartu city	95,430	97,711	98,312
	Tartu rural municipality	11,539	11,467	11,729
Valga county	Otepää rural municipality	6,412	6,272	6,238
	Tõrva rural municipality	6,064	5,925	5,872
	Valga rural municipality	15,486	15,731	15,540
Viljandi county	Mulgi rural municipality	7,372	7,172	7,026

County	Municipality	2021 (old, PR)	2021 (new, index)	2022 (new, index)
	Põhja-Sakala rural municipality	7,872	7,794	7,734
	Viljandi city	16,875	17,254	17,244
	Viljandi rural municipality	13,758	13,464	13,407
Võru county	Antsla rural municipality	4,372	4,296	4,222
	Rõuge rural municipality	5,180	4,978	4,877
	Setomaa rural municipality	3,114	2,951	2,849
	Võru city	11,533	11,974	11,867
	Võru rural municipality	10,699	10,506	10,367
County unknown		3,643	172	0

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