

MULTI-STAGE MAXIMUM VARIATION SAMPLING IN HEALTH PROMOTION PROGRAMS' EVALUATION

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Abstract. Aim. The current paper presents an effective sampling method accessible to health promotion programs' evaluation fitted to get rich information about issues of central importance to the purpose of the assessment. **Method.** The data collection procedure is rooted in a maximum variation sampling. The sample design is based on the principle of maximum diversity, which is an extension of the statistical principle of *regression towards the mean* based on which instead of seeking representativeness through equal probability, it is sought by including a broad range of extremes. **Results.** The desirable sample size for our evaluation is 264 respondents. Based on this value we established the key dimensions of diversity which enable us to set up the entire sampling procedure. **Conclusions.** Maximum variation sampling allows that against scarcity of data to achieve considerable results which can be more representative than those gained through a random sample.

Key words: health promotion, evaluation program, sampling design, sample size, maximum variation principle

Rezumat. Scop. Articolul prezintă o metodă eficientă de eșantionare accesibilă în evaluarea programelor de promovarea sănătății în scopul obținerii unor informații exhaustive asupra problemelor centrale ale acestora. **Metodă.** Procedura de culegere a datelor are la bază principiul variației maxime, care este o generalizare a regresiei către medie pe baza căreia reprezentativitatea nu este căutată prin atribuirea de probabilități egale de selecție ci prin escaladarea diversității. **Rezultate.** Volumul eșantionului stabilit pentru programul de evaluare prezentat cuprinde 264 respondenți. Pe baza acestei valori am stabilit cele opt dimensiuni cheie care ne-au permis aplicarea tehnicii de eșantionare propusă. **Concluzii.** Eșantionarea pe baza principiului variației maxime permite ca în anumite condiții (lipsa unor informații centralizate) să se ajungă la rezultate care să caracterizeze mai bine populația evaluată.

Cuvinte cheie: promovarea sănătății, program de evaluare, tehnici de eșantionare, volumul eșantionului, principiul variației maxime

INTRODUCTION

Health promotion is "the process of enabling people to increase control over, and to improve, their health" (1). In this framework, prevention programs often use both universal and targeted approaches for all persons potentially at risk, and empower them

to manage their health. The aim of the prevention programs is to change the attitude, behavior and practices of large number of people such as children, their parents and teachers to avoid health damages and losses due to climate changes or epidemics. It is well known that health promotion is a

process of development its dynamics “vary as a function of the cultural, community and social settings within which health related issues are embedded” (2).

Prevention programs use multiple strategies such as providing and improving access to information, operate from individual to family levels including families and through a variety of community sectors such as schools, ethnic communities or companies. They aim to make small but widespread changes in health by transforming the environment in which health-related behavior occurs. These prevention programs need evaluation to encounter progress. Program evaluation is “the systematic gathering, analysis and reporting of data about program to assist in decision making” (Ontario Ministry of Health, Public Health Branch, 1996).

Types of Evaluation Programs. According to a classification provided by experts from University of Toronto, programs evaluation can be grouped into the following three main categories based on **the moment they are conducted** and **the type of information collected** (2):

(1) **formative evaluation** is used in the planning stages, is focused on programs that are under development and includes: *needs assessment, analysis to determine if the programs intended outcomes are able to be evaluated, program logic models, pre-testing program materials, audience analysis*

(2) **process evaluation** seeks to answer the question “*what services are being delivered and to whom?*”,

examines the procedures, is focused on programs that are already in progress, and tasks involved in providing a program; it includes: *tracking quantity and description of people who are reached by the program, tracking quantity and types of services provided, description of how services are provided, descriptions of what actually occurs while providing services, quality of services provided, implementation evaluation.*

(3) **summative evaluation** is focused on programs that are already in progress or completed, investigates the effects of the program and depending on the questions they answer at they can be classified in one of the following two categories:

- *impact evaluation* – case in which it answers at the question “*did the program make a difference?*” and
- *outcome evaluation* - case in which it answers at the question “*did the program meet its stated goals and objectives?*”.

Outcome evaluations can assess both **short term outcomes**, such as immediate changes in participants (*participation rates, awareness, knowledge, attitude, behavior or/and practice*) and **long terms outcomes** (sometimes referred to as impact evaluation) which look at the larger impacts of a program on a community, it can also analyze the results in relation to the costs of the program. Summative evaluation includes: *changes in attitudes, knowledge, behavior or practice, changes on morbidity or mortality rates, number of people participating, cost-benefit*

MULTI-STAGE MAXIMUM VARIATION SAMPLING IN HEALTH

analysis, cost-effectiveness analysis, changes in policies, impact assessments.

Note. Implementation evaluation can fall under both formative and process evaluations because it assesses how well a program is implemented and determines ways to improve program delivery and is carried out after the initial implementation of a program.

The key steps in an evaluation of a health promotion program are (2,3): 1. clarify the population of interest, the outcome objectives, activities and outputs and indicators of success; 2. clarify staff, time, money and other needed resources; 3. design the evaluation (select the best type of evaluation for the program); 4. determine the appropriate methods of measurement and procedures (determine how and when data will be collected, develop the evaluation data collection tools, choose a sample size and a sample design); 5. collect data; 6. prepare data and develop the analysis methodology; 7. interpret the results; 8. disseminate the information obtained; 9. make changes to improve the program based on the evaluation outcomes.

In this article we will refer to the fourth step mentioned above and present an effective sampling method, which can be applied in health promotion programs' evaluation when we have few structured information about the target population. We explain the reason for which the method proposed is appropriate and how can it be applied.

In light of these, to simplify the explanation, we consider the following hypothetical scenario: we have to

evaluate in a very short time, a training program on prevention of harmful health effects of infectious diseases for children enrolled in primary school. The training program was implemented by an NGO with activities in health promotion, in some Romanian schools, during 2005-2007. The training program was developed and spread based on local needs, was focused mainly on teaching duties and there are no structured centralized statistics about it. What we actually know is: the number of participants by county, the number of schools implicated by area and county and the information about knowledge, attitudes, behavior and practices developed by children involved in the training program before the course attendance. The program evaluation was requested by high level decision factors from public health community with the aim of setting up a national action plan in the field.

MATERIAL AND METHODS

Select the Sampling Design.

Sampling is used to cut costs while still obtaining important information from a representative sample of the target population. It is essential that the number of individuals providing information for the evaluation be large enough to produce outcomes that are reliable and valid and truly represent the target population.

The sampling design and methodology must be determined for each specific data collection method employed. The design depends on the data collection method and the purpose of collecting data.

The main questions in selecting the sampling design are: *What is the size of the target population? How will the people be selected? What can the budget allow? How confident do we need to be with the results? Do we need to look at any subgroups?* Regardless the methods of measurements the desirability of a sampling procedure depends on both *its vulnerability to error* and *its costs* which usually are focused on *time, money* and *human resources* (3). Deciding on the sample size is primarily driven by the budget and the size of subgroups we wish to analyze. We have to be sure that we have sampled enough people to get an adequate number of respondents in our subgroups to accurately draw conclusions about the group. If the target population is relatively small we have to do an audit and include everyone. If the target population is very large we will not improve the accuracy of our results by interviewing more and more people. Once we get up to a thousand interviews the improvement in accuracy is minimal and the cost is very high.

In this context the selection of the sampling strategy and the appropriateness of qualitative or quantitative methodology should be focused on the following issues:

Quiz A. Does it fit the purpose of the evaluation program?

Quiz B. Which are the available resources?

Quiz C. Are the questions being asked and the constraints being faced?

Keeping in mind the fact that *quantitative methods* seek causal determination,

prediction and generalization of findings while, *qualitative methods* seeks illumination, understanding and extrapolation to similar situations we'll briefly try to answer to the three quizzes with the aim to provide the best sampling strategy for an outcome evaluation program in a given framework (4, 5, 6).

Consider that we have to evaluate a training program developed by an NGO at national level both on urban and rural area.

Quiz A. Choosing one of the above methods should consider the fact that the core element of data analysis in quantitative methods is “testing the null hypothesis” and sometimes it ignores effects that may be extremely important but are not statistical significant (7).

In contrast, in qualitative inquiry the dominant strategy is purposive sampling. The scientists identified around 16 types of purposive sampling which includes *maximum variation sampling (or maximum diversity sample)* (8, 9). A purposive sample is not representative but a *maximum variation sample aims to be in certain situations more representative than a random sample*.

The principle of the maximum diversity - is an extension of the statistical principle *of regression towards the mean* based on which instead of seeking representativeness through equal probability, it is sought by including a wide range of extremes: **“if a group of people is (on average) extreme in some way, it will contain some people who themselves are average”**.

MULTI-STAGE MAXIMUM VARIATION SAMPLING IN HEALTH

This means that looking for a "minimum variation" sample by only trying to cover the types of people who we thought are average, we have chance to miss out a number of different groups which could be quite a high proportion of the population. Seeking maximum variation, average people are automatically included.

Conclusion: *The principle says that if we deliberately try to interview a very different selection of people, their aggregate answers will be close to the average. (7)*

Possible outcomes:

- The logic of maximum variation sampling is to get “information-rich cases...from which one can learn a great deal about issues of central importance to the purpose of the evaluation” as opposed to “gathering little information from a large, statistical significant sample” (9).
- Stratified purposeful sampling illustrates characteristics of particular subgroups of interest and facilitates comparisons between the different groups.
- Mixed purposeful sampling combines various sampling strategies to achieve the desired sample. This helps in triangulation, allows for flexibility, and meets multiple interests and needs.

The outcome evaluation of the health promotion programs involves looking at training process and unstructured linkages and also the exploration of variables which are not yet identified. The outcomes should include identification of important common patterns that cut across variations and the implications of the training

program to child health and welfare. In this context representativeness is not as important as ensuring that we have specific individuals selected into our survey.

Quiz B. In quantitative inquiry, the dominant sampling strategy is probability sampling, which depends on the selection of a random and representative sample from the larger population. This strategy needs an adequate/valid sampling frame.

In the training project subject to our evaluation we face the paucity of data – the information regarding the study population is not completely gathered and structured, we know the size of the population but we don’t have information about its’ characteristics. There is no possibility of creating an accurate and reliable sample frame for a probabilistic sampling and the reasons are complex and very well justified by the framework in which the training program developed: it grew up like a snowball as an answer to the local needs and was focused only on the quality of the teaching duties, actually it developed like an action-orientated program.

Quiz C. The questionnaire should be a standardized measurement device. If such an instrument is not available and we have to construct it by ourselves we have to analyze it’s reliability and validity to see if the instrument we’ve built measure what it is intended to measure.

Decision: The best suited sampling strategy for our outcome evaluation study employs purposeful sampling, using *multi-stage maximum variation method*.

RESULTS AND DISCUSSIONS

Multi-stage maximum variation sampling design includes the following stages (10):

The first stage is to decide which parts of the population area will be surveyed.

The survey is to represent the children included in the preventive education program in during 2005-2007 and it's not feasible to survey every individual, so we have to decide which parts of the country will be included. We consider that these parts are called counties and we will need to select some of them.

Constraints:

1. *Has the training program been implemented in all Romanian counties?*

In our case the answer is affirmative; this means that all counties will be included in the selection procedure

2. *Are similar educational programs developed in Romania? If so, in which counties?*

A screening to identify similar programs will be done at local level (in the selected localities). The schools where similar programs developed before or during the same time period will be excluded from the study.

What we have to do now is to think of all ways in which the above mentioned counties differ from each other and the country as a whole.

Note: Bucharest and Ilfov will be treated separately because they cover an area with specific social, cultural and economic characteristics.

The method according to we can establish the ways in which the counties can differ is presented in Box 1.

Box. 1

The method for identifying the dimensions of diversity:

- Think of about 10 factors/dimensions (or less) which are relevant to the survey.
- For each factor make a list of counties which have *a high level of the factors* and counties which have *a low level of factors*.
- Include in the survey those counties, which are most often mentioned in the list of extremes.
- Mark these counties on a map
- Has any well-populated county with different features from the others has been omitted?

If Yes, add another county which is as far as possible from all the other mentioned.

If No, go to the second stage.

MULTI-STAGE MAXIMUM VARIATION SAMPLING IN HEALTH

Number of the dimensions of diversity. There is no fixed rules sample size calculation. The size of the sample depends on the costs and on what we try to find out and from what perspectives. In our evaluation program the desirable sample size is 264 children. The number of dimensions of diversity recommended for our outcome evaluation study is 8. The reason is that the closest integer number to 264, multiple of 2 is $2^8 = 256$.

Selection criteria for dimensions: (1) relevance for the training project; (2) interpretability beyond national context; (3) availability - official source provision.

Sometimes to identify the dimensions of diversity, a preliminary brainstorming session is useful. In this context the suggestions from the team involved in the evaluation project, experts, and stakeholders are very welcome. In the same time documentation from official sources is recommended: UNICEF, UNDP and National Institute of Statistics studies and reports as well as Eurostat, ILO and WHO databases.

Having in view that the measurements in the project will be done for children, the dimensions of diversity and their correspondent indicators included in the sampling methodology try to cover a broad area able to describe the environment where the children grow up and develop. Detailed information about these dimensions is provided by Table 1.

For each dimension I made a list of the counties which has the best 10% and the worst 10% of the level of the indicator/dimension. The counties

which are most often mentioned in the list are: Bistrita Nasaud, Calarasi, Cluj, Covasna, Mehedinti, Prahova, Teleorman, Timis, and Vaslui. We mark the selected counties on a map (Map.1) and check if any other well-populated area, which differs from the other provinces, is omitted from our selection. In our case we can notice that South-east region is not represented. In light of this we decide to include in the sample Tulcea because it has the highest number of trained children and has different socio-cultural and economic features from all the other counties.

In the sample, the interviews with children who attended the training course are proportionally distribution by county while the interviews with the children who never attended courses are allocated based on a quota rule, such as in both subgroups the no. of interviews is even (132 interviews per sub-group).

The second stage - a number of urban and rural localities where the training has been developed should be selected based on the maximum variation principle. For example, if the county was chosen for a specific dimension choose a locality for which that factor/dimension is representative – if the county was chosen for high rate of unemployment (ex. Vaslui) choose the localities with the highest number of unemployed persons.

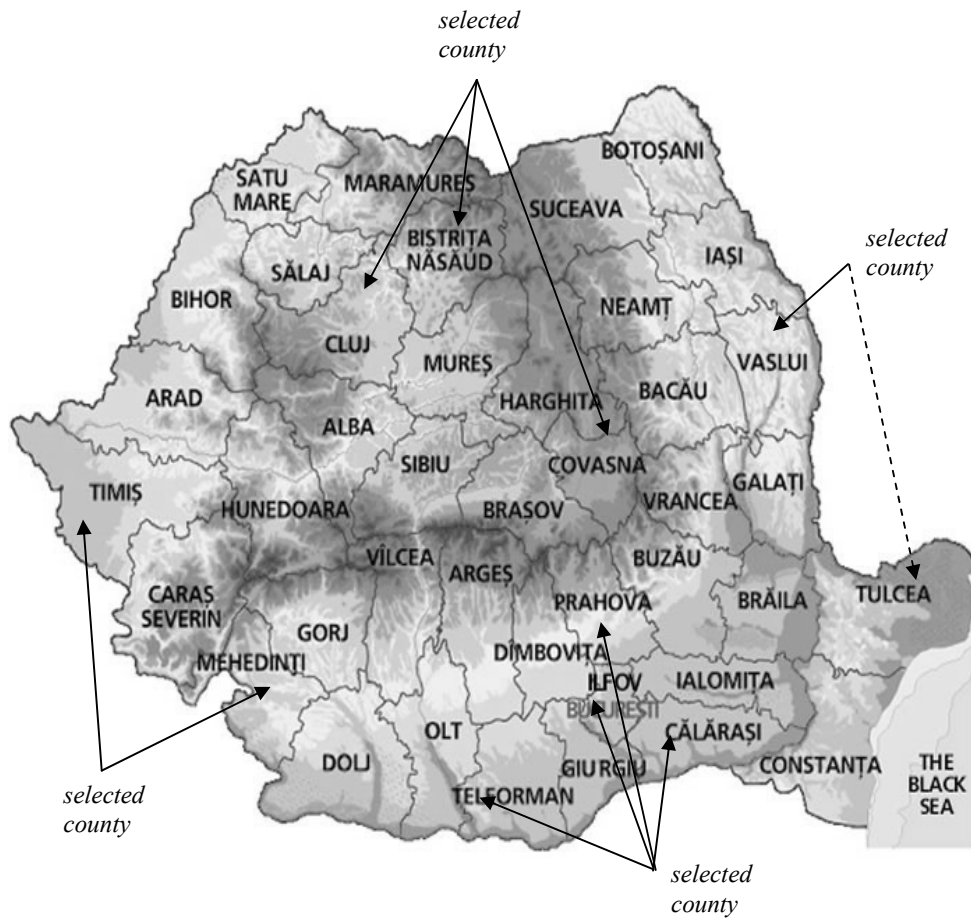
At local level is recommended that when is possible to select *minimum two towns* (a big one and a small one) and *two or three rural localities* (a big one and one or two small ones).

Table 1. Dimensions of diversity

County Where the training program has been implemented	<i>D1:</i> Program attendance	<i>D2:</i> Demographic situation	<i>D3:</i> Family stability	<i>D4:</i> Education		<i>D5:</i> Labor market	<i>D6:</i> Welfare	<i>D7:</i> Justice
	Indicator: No. of trained parents in the program* 2005	Indicator: Birth rate (per 1000 inhabitants)** 2005	Indicator: Live births outside matrimony (per 100 live births)*** 2005	Indicator: Education index 2005***	Indicator: Ratio of children enrolled in primary education to no of teaching staff** 2005	Indicator: Unemployment rate** 2005	Indicator: Average net nominal monthly earnings** (RON/employee) 2005	Indicator: Criminality rate** 2005
Alba	2688	9.9	24.8	0.876	8.64	8.3	645	282
Arad	316	9.7	28.9	0.903	10.96	3.6	666	264
Arges	419	9.4	24.6	0.905	14.93	5.2	756	183
Bacau	1820	10.9	27.4	0.855	19.80	6.3	718	362
Bihor	2628	11.4	29.1	0.91	14.73	2.7	629	575
Bistrita Nasaud	5396	11	19.5	0.846	8.36	4.3	653	281
Botosani	620	11.4	19.1	0.842	13.07	6.2	618	434
Braila	607	9.2	25.7	0.854	7.75	6.8	622	364
Brasov	1474	10	33.2	0.916	12.24	8.7	681	171
Buzau	1407	9.5	29.1	0.846	11.43	7.4	639	286
Calarasi	4189	11	47.7	0.819	8.15	9	577	410
Caras Severin	3715	9.3	33.7	0.863	7.64	7.9	635	243
Cluj	708	9.5	24.2	0.969	13.28	4.4	750	278
Constanta	1427	10.5	30.1	0.911	16.54	5.6	780	245
Covasna	353	12.3	34.2	0.843	5.66	8.8	579	236
Dambovita	902	9.7	36.1	0.858	13.45	7.4	714	341
Dolj	596	9.1	39.2	0.903	16.32	6.3	720	309
Galati	1175	9.7	25.9	0.878	15.28	8.3	735	341
Giurgiu	1650	9	51.1	0.795	7.43	5.6	629	138
Gorj	2042	9.4	22	0.885	10.02	9.3	871	404
Harghita	247	11.6	29.8	0.862	8.11	8.5	617	407
Hunedoara	2900	8.7	28.7	0.887	10.66	9.4	761	376
Ialomita	531	10.6	45.4	0.838	7.60	12.1	635	321
Iasi	781	12.6	23.1	0.938	22.82	7.2	703	332
Maramures	1261	10.9	17.6	0.854	12.87	4.5	596	367
Mehedinti	727	8.8	32.4	0.865	6.92	9.5	740	488
Mures	1002	11.2	35.6	0.872	14.34	4.6	735	214
Neamt	1068	10.2	23.3	0.847	14.67	5.6	603	330
Olt	1017	8.5	34.3	0.84	11.53	7.1	707	402
Prahova	847	9.9	27	0.869	17.92	6.3	773	209
Salaj	835	10.7	23.5	0.848	6.14	6.1	689	250
Satu Mare	972	11.2	27.9	0.845	9.35	3.4	646	251
Sibiu	1052	10.9	29.7	0.922	10.25	6	694	215
Suceava	2024	12.4	16.3	0.869	20.85	6	639	360
Teleorman	407	7.9	42.1	0.821	9.37	8.9	669	251
Timis	1112	9.9	25.7	0.956	14.66	2.3	750	212
Tulcea	3054	9.5	31.4	0.826	5.75	6	652	325
Valcea	2147	9	25	0.863	9.52	6.6	639	289
Vaslui	1573	12.1	31.3	0.843	13.39	10.1	608	421
Vrancea	4221	10.6	34.8	0.828	9.25	4	632	389
Bucharest	1653	9.7	25.6	1.095	30.85	2.4	988	245
Ilfov	315	10.7	37.7	0.812	6.96	2.0	866	213

Source: * simulated data, ** Romanian Statistical Yearbook 2006, *** National Human Development Report – Romania 2007

MULTI-STAGE MAXIMUM VARIATION SAMPLING IN HEALTH



Map 1. The distribution of the selected counties

Note. When we have chosen the towns and rural localities we can continue using the maximum variation principle or we can use another method, such as quota sampling.

The third stage - we already have selected the localities, what we need next are the selection points. The selection point in our case can be the school. Inside the localities the schools should be selected based on the

maximum variation principle. In the sample, the number of schools where the training courses were conducted is proportional distributed while the number of schools where the training

courses were not conducted is based on a quota rule such as the number of selection points is even for both sub-groups. The distribution of the sampling points is presented in Table 2.

Table 2. The distribution of sampling points by county

County	Sampling points (Schools)		Total
	No. of schools where the training courses were conducted	No. of schools where the training courses were not conducted	
Bistrita Nasaud	4	3	7
Calarasi	3	3	6
Cluj	1	0	1
Covasna	0	1	1
Mehedinti	0	1	1
Prahova	1	1	2
Teleorman	1	0	1
Timis	1	1	2
Tulcea	2	2	4
Vaslui	1	1	2
Ilfov	0	1	1
Bucharest	1	1	2
Total	15	15	30

Constrain: *the number of selection points in the sample should be no less than 30.*

No of interviews: no more than 20 and 10 interviews should be conducted in a big urban locality and in one rural locality respectively. The distribution of the interviewees by county and sampling points is presented in Table 3.

The fourth stage. At the ground level the child selection procedure has in views the following two criteria or control variable: (1) the year of program attendance (table 4) and, (2)

the patterns defined by dimensions of diversity (Box 2). Regarding the second criteria it's important to notice that taking each of the eight dimensions in turn there are $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 256$ possible categories. The patterns defined by these criteria will be randomly assigned to the counties selected for the evaluation study according to the number of interviews calculated for each of them (table 3).

MULTI-STAGE MAXIMUM VARIATION SAMPLING IN HEALTH

Table 3. The distribution of respondents by county and sampling points

County	Selection points (schools)	No. of interviewees per sampling point	Total interviews
	N	N	N
Bistrita Nasaud	7	10	70
Calarasi	6	9	54
Cluj	1	9	9
Covasna	1	5	5
Mehedinti	1	9	9
Prahova	2	5-6	11
Teleorman	1	5	5
Timis	2	7-8	15
Tulcea	4	10	40
Vaslui	2	10	20
Ilfov	1	4	4
Bucharest	2	7-8	22
Total	30		264

Table 4. The distribution of respondents by the year of attendance the training program and county

County	Year 2005	Year 2006	Year 2007	Total
	N	N	N	N
Bistrita Nasaud	20	32	28	70
Calarasi	14	22	18	54
Cluj	0	0	9	9
Covasna	0	5	0	5
Mehedinti	9	0	0	9
Prahova	0	11	0	11
Teleorman	0	0	5	5
Timis	15	0	0	15
Tulcea	11	17	12	40
Vaslui	0	9	11	20
Ilfov	0	0	4	4
Bucharest	10	0	12	22
Total	79	96	99	264

Box. 2

Dimensions of diversity:

Dimension 1: Program attendance

A= child which attend/attended **only** the training program implemented by the NGO

B= child which not attend/attended **any** kind of similar training program

Note: gives the reason of the project

Dimension 2: Demographic situation

C= is the only child in the family

D= is coming from a family with 2 or more children

Note: gives an image of the family size

Dimension 3: Family stability

E= the child parents are married

F= the child is leaving with one parent or in a consensual environment

Note: gives an image of the concept of family and related issues

Dimension 4: Education - parents

G= the parent who cares more about the child has university degree or high school education

H= the parent who cares more about the child has primary education or no

Dimension 4: Education – gender approach

I= the child interviewed is girl

J= the child interviewed is boy

Note: gives an image about the family behavior regarding gender issues

Dimension 5: Labor market

K= the child has a parent which is working in-country or abroad

L= the child has a parent which is unemployed

Note: gives an image about family working environment

Dimension 6: Welfare

M= the child has a parent with a monthly earning “equal or more than 746 RON”

N= the child has a parent with a monthly earning “less than 746 RON”

Note: gives an image about the family financial situation

Dimension 7: Justice

O= the child is leaving in a central/ safe area

P= the child is leaving in a marginal / unsafe area

Note: gives a clue about a violent or non-

The number of respondents which received training is proportionally distributed by county while the number of respondents who didn't received training is established based on quota rule such as the number of respondents of both sub-groups is even. Consistent with these control variables the distribution of interviewee's for Cluj, for example, should meet the patterns envisaged in

the Table 5. According to the pattern and quota rules as well as on the maximum variation principle for localities selection the town included in our study is Cluj Napoca. A decrypted example from Table 5 is presented in Box 3. In the general framework, the patterns will be randomly assigned to the localities selected for each county according to the quota rules.

MULTI-STAGE MAXIMUM VARIATION SAMPLING IN HEALTH

Note. If we cannot find people who match some of these patterns we just have to make sure that people in the same category are very different in some other aspect that seems relevant for our evaluation program.

Table 5. The distribution of respondents' patterns for Cluj

No.crt.	Dimensions of diversity								Year of the course attendance	Area	Locality
1.	A	C	E	H	I	K	N	P	2007	Urban	Cluj Napoca
2.	B	C	E	G	J	L	M	O	2007	Urban	Cluj Napoca
3.	B	C	F	H	J	L	N	P	2007	Urban	Cluj Napoca
4.	A	D	E	H	J	K	N	O	2007	Urban	Cluj Napoca
5.	A	D	F	G	I	L	N	P	2007	Urban	Cluj Napoca
6.	B	D	E	G	J	L	M	P	2007	Urban	Cluj Napoca
7.	A	C	F	G	J	L	N	O	2007	Urban	Cluj Napoca
8.	B	D	F	G	I	L	M	P	2007	Urban	Cluj Napoca
9.	B	D	F	G	I	L	N	O	2007	Urban	Cluj Napoca

Box 3

Example

From Cluj Napoca which belongs to urban area we have to interview a child enrolled in primary school who meet the following criteria:

- | | |
|--|---|
| A = attended in 2007 <u>only</u> the training program implemented by the NGO | I = the child selected is a girl |
| C = belongs to a family with only 1 child | K = one parent is working in-country or abroad |
| E = the child parents are married | N = one parent has a monthly earning "less than 746 RON" |
| H = the parent who is taking care mostly of the child has primary education or no education | P = the child is leaving in a marginal / unsafe area |

CONCLUSIONS

Maximum variation sampling allows that against scarcity of data to achieve considerable results which can be more representative than those gained through a random sample.

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