Factors of life quality material dimension

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ABSTRACT

This paper will be focused on Multinomial Logistic Regression models to examine the social and demographic factors that may influence the components of life quality material dimension in terms of income and durable goods. As statistical source for the regression model will be use the Household Budget Survey. Within the predictors of the model could be mentioned: gender, age, marital status, education level, residential area. Statistical software used for the analysis is R Project along with specific package for multinomial logistic regression.

This research will contribute to know the determinants of life quality material dimension in Romania.

Key words: *Material Dimension, Quality of Life, Multinomial Regression, Household Budget Survey, R, Packages*
JEL Classification: *J31, C50, C87*

INTRODUCTION

Quality of life is a multidimensional concept that captures the evolution of a group of people or an individual, their identity, the nature of life, their own experiences, lifestyles and perceptions about themselves. This is a concept of evaluation, reporting of living conditions and activities that make up life, needs, values, human aspirations. It refers both to the global assessment of life and to the evaluation of different conditions or spheres of life. The most important dimension of life quality is that which refers to material aspects. Material dimension represents all the economic conditions of people's material existence, as well as the satisfied needs, absolutely and relatively balanced in relation to human aspirations. It is reflected most clearly through economic aspects, in particular on income. Closely associated with material well-being are different aspects of the quality of living environment, quality housing, the endowment with durable goods and the quality of neighborhood.

In this paper the Multinomial Logistic Regression (MLR) was applied to examine how the social and demographic factors may influence the components of life quality material dimension in terms of income and durable goods.

STATISTICAL METHOD USED FOR DATA ANALYSIS

In this study, the statistical methods are multinomial logistic regression models. It was applied two types of models at individual level and household level. Thus, the explained variables (individual/household) are considered as categorical variables with *n* groups that are mutually replaceable but are not in the natural order. In multinomial logistic regression models one category of the outcome variable would be taken as reference category.

Multinomial logistic regression is used to model nominal outcome variables, in which the log odds of the outputs are modelled as a linear combination of the covariates. The model based on multinomial logistic regression explains the relationship between the covariates and the outcome variable. Actually, the model attempts to explain the relative effect of differing covariates on the outcome.

We will assume that we have a series of *n* observations. Let *Y* be the outcome variable having *J* responses.

$$Y_i = \begin{cases} \text{category} - 1 \\ \text{category} - 2 \\ \text{category} - 3 \\ \ldots \\ \text{category} - J \end{cases}$$

For the observation *i*, the probability is:

$$p_i = \begin{cases} p_{i1} \\ p_{i2} \\ p_{i3} \\ \ldots \\ p_{ij} \\ \ldots \\ p_{iJ} \end{cases} \qquad \text{where: } j = 1,2,\ldots,J$$

A category of the outcome variable is chosen as reference category. The odds ratios are determined separately for all covariates for each category of the dependent variable, except the reference category, which is omitted from the analysis.

In the model described above, *J* is the reference category. A simple way to reach the multinomial Logit model is to imagine, for *J* possible outcomes, that we run *J-1* multinomial logistic regression models, in which one outcome is chosen as reference and the other *J-1* outcomes are separately regressed against the pivot outcome.

The equation of the model is the following:

$$\ln\left(\frac{p_{ij}}{1 - p_{iJ}}\right) = \beta_{j0} + \beta_{j1}x_{i1} + \beta_{j2}x_{i2} + \ldots + \beta_{jk}x_{ik} = \beta_j^{'}x_i \qquad (1)$$

The odds will be computed following the algorithm:

$$\Omega = \frac{p_{ij}}{1-p_{iJ}} = e^{\beta_{j0}+\beta_{j1}x_{i1}+\beta_{j2}x_{i2}+...+\beta_{jk}x_{ik}} = e^{\beta_j^{'}x_i} \quad (2)$$

The success probability (where $j < J$) for the observation *i*, is computed by:

$$p_{ij} = \frac{e^{\beta_j^{'}x_i}}{1+\sum_{j=1}^{J-1} e^{\beta_j^{'}x_i}}; \text{ for } j < J; \quad (3)$$

The failure probability (where $j = J$) for the observation *i* , is computed by:

$$p_{iJ} = \frac{1}{1+\sum_{j=1}^{J-1} e^{\beta_j^{'}x_i}}; \text{ for } j = J; \quad (4)$$

For interpreting the results of the multinomial logistic regression model, the odds ratio is calculated:

$$OR = \frac{\Omega_{(x_{ik}+1)}}{\Omega_{(x_{ik})}} = \frac{e^{\beta_{j0}+\beta_{j1}x_{i1}+\beta_{j2}x_{i2}+...+\beta_{jk}(x_{ik}+1)}}{e^{\beta_{j0}+\beta_{j1}x_{i1}+\beta_{j2}x_{i2}+...+\beta_{jk}x_{ik}}} = e^{\beta_{jk}} \quad (5)$$

Odds ratio compares the relative odds of the occurrence of the outcome (e.g. poverty level), characterized by different values of the covariate (x_{ik} and $x_{ik}+1$), all other covariates being constant.

In the formula above, β_{jk} represents the change in the odds of the dependent variable being in a particular category versus the odds to be in the reference category, associated with a single unit change of the corresponding independent variable x_{ik}.

The significations odds ratios could be as follows:

- OR =1, The exposure does not influence the odds of outcome
- OR<1, The exposure implies higher odds of outcome
- OR>1, The exposure implies lower odds of outcome

Variable selection for multinomial logistic regression is similar to those used for standard multiple regressions. The intercepts give the estimated log-odds for the reference categories. The results consist in logistic coefficient for each predictor for all categories of the outcome variable, except the reference category. The logistic coefficient represents the expected amount of change in the Logit for each one unit change in the predictor. The closer a logistic coefficient is to zero, the less influence the predictor has in predicting the Logit.

DATA AND SOFTWARE USED

Data source used for the multinomial analysis is the Household Budget Survey (HBS) conducted in the year 2013. The survey realised each year by the National Institute of Statistics collect data on a sample of 37440 households from urban and rural, randomly selected from all the counties of the country and from

Bucharest Municipality. HBS is organized as a quarterly continuous survey lasting three successive month period, on a sample of 9360 permanent dwellings, broken down in monthly independent subsamples of 3120 permanent dwellings each.

For computing the multinomial logistic regression model, the ***multinom*** function from the ***nnet*** package in R was used. This package does not include p-value calculation for the regression coefficients; therefore, it was obtained p-values by Wald tests. The model summary output has a block of coefficients and a block of standard errors. Each of these blocks has one row of values corresponding to a model equation.

VARIABLES OF THE MODEL

In this study were applied two types of models at individual level and household level.

A) Household level

Dependent Variables for the household level are the following:

- *Facing the current expenditure with the monthly income* is a dummy variable for the status of the possibility of the head of household to meet the household needs by using the monthly income [SATIS (1= can face the current expenditure using the monthly income, 2= cannot face the current expenditure by using the monthly income)].
- *Item deprivation status - car* is a dummy variable for car deprivation status [MASINA (1=does have a car, 0=does not have a car)].
- *Item deprivation status – mobile phone* is a dummy variable for telephone deprivation status [TEL (1=does have a mobile phone, 0=does not have a mobile phone)].

Independent Variables for the household level are the following:

- *Household income* is a categorical variable with 5 ordered groups for household net income by quintiles [QUINT (1=Q1, 2=Q2, 3=Q3, 4=Q4, 5=Q5)].
- *Number of children* is a categorical variable showing the number of children in the household [NRCOP (0=no children, 1=one child, 2=two children, 3=three children, 4=four or more children)].
- *Gender* is a dummy variable showing the gender of the head of household [SEXCAP (1=Male, 2=Female)].
- *Age Groups* is a categorical variable with different age groups of the head of the household [GRVCAP (1=15 to 24, 2=25 to 34, 3=35 to 44, 4=45 to 54, 5=55 to 64, 6=65 years or more)].
- *Education* is a categorical variable of education level of the head of household with 6 categories [GR_NIVECAP (1=no formal education, 2=primary and lower secondary education, 3=upper secondary education, 4=post-secondary, non-tertiary education, 5=apprenticeships, technical or vocational education, 6=tertiary education)].
- *Marital status* is a categorical variable of the marital status of the head of household [STACIVCAP (1=married, 2=consensual union, 3=divorced, 4=widowed, 5=single, 6=separated)].

- *Residence area* is a dummy variable for residence area where the household is located [MEDIU (1=Urban, 3=Rural)].
- *Regions* is a categorical variable; according to Romanian administrative territorial structure, there are 8 Regions [REG (1=North-West, 2=Centre, 3= North-East, 4=South-East, 5=South, 6=Bucharest-Ilfov, 7=South-West, 8=West)].

B) Individual level

Dependent Variables for the individual level is the following:

Individual income is a categorical variable with 5 ordered groups for individual net income by quintiles [QUINT (1=Q1, 2=Q2, 3=Q3, 4=Q4, 5=Q5)].

Independent Variables for the individual level are the following:

- *Gender* is a dummy variable showing the gender of the person [SEX (1=Male, 2=Female)].
- *Age Groups* is a categorical variable with different age groups of the person [GR_VARSTA (1=15 to 24, 2=25 to 34, 3=35 to 44, 4=45 to 54, 5=55 to 64, 6=65 years or more)].
- *Education* is a categorical variable of education level of the person with 6 categories [GR_NIVE (1=no formal education, 2=primary and lower secondary education, 3=upper secondary education, 4=post-secondary, non-tertiary education, 5=apprenticeships, technical or vocational education, 6=tertiary education)].
- *Marital status* is a categorical variable of the marital status of the person [STACIV (1=married, 2=consensual union, 3=divorced, 4=widow, 5=unmarried, 6=separated)].
- *Residence area* is a dummy variable for residence area [MEDIU (1=Urban,3=Rural)].
- *Regions* is a categorical variable; according to Romanian administrative territorial structure, there are 8 Regions [REG (1=North-West, 2=Centre, 3=North-East, 4=South-East, 5=South, 6=Bucharest-Ilfov, 7=South-West, 8=West)].

LIFE QUALITY MATERIAL DIMENSION BY MULTINOMIAL LOGISTIC REGRESSION

A) Household level

At household level, three types of multinomial logistic regression are performed, in accordance with the outcome variables described in the section above.

Stepwise regression model was used for the selection of the variables. The candidate for dropping is the variable having poor correlation with the dependent variable (in the R package the `step` function uses the AIC criterion for weighting the choices, which takes proper account of the number of parameters fit; at each step an add or drop will be performed that minimizes the AIC score). The Akaike Information Criterion (AIC) is a measure of the relative quality of a statistical model for a given dataset. AIC estimates the quality of each model of the data, relative to the other models. Hence, AIC provides a means for model selection. There will almost always be information lost due to using a candidate model to represent the "true" model. We wish to select, from among the candidate models, the model that minimizes the information loss. We cannot choose a model with certainty, but we can minimize the estimated information loss.

First model will predict whether a head of household has the possibility to face the current expenditure by using the monthly income. The output of multinomial logistic regression is presented in the Annex 1.

The equation of the model can be written as follows:

$$
\begin{aligned}
&\ln\left(\frac{P(SATIS=1)}{P(SATIS=2)}\right) = \beta_{SATIS=1} + \\
&+\beta_{SATIS=1,female} \times (SEXCAP=2) + \beta_{SATIS=1,consensualunion} \times (STACIVCAP=2) + \\
&+\beta_{SATIS=1,divorced} \times (STACIVCAP=3) + \beta_{SATIS=1,widowed} \times (STACIVCAP=4) + \\
&+\beta_{SATIS=1,\sin gle} \times (STACIVCAP=5) + \beta_{SATIS=1,separated} \times (STACIVCAP=6) + \\
&+\beta_{SATIS=1,noEd} \times (GR\_NIVECAP=1) + \beta_{SATIS=1,lowerEd} \times (GR\_NIVECAP=2) + \\
&+\beta_{SATIS=1,post\sec Ed} \times (GR\_VNIVECAP=4) + \beta_{SATIS=1,aprEd} \times (GR\_NIVECAP=5) + \\
&+\beta_{SATIS=1,tertiaryEd} \times (GR\_NIVECAP=6) + \\
&+\beta_{SATIS=1,15-24} \times (GRVCAP=1) + \beta_{SATIS=1,25-34} \times (GRVCAP=2) + \beta_{SATIS=1,45-54} \times (GRVCAP=4) + \\
&+\beta_{SATIS=1,55-64} \times (GRVCAP=5) + \beta_{SATIS=1,65+} \times (GRVCAP=6) + \\
&+\beta_{SATIS=1,NW} \times (REG=1) + \beta_{SATIS=1,C} \times (REG=2) + \beta_{SATIS=1,NE} \times (REG=3) + \\
&+\beta_{SATIS=1,SE} \times (REG=4) + \beta_{SATIS=1,BI} \times (REG=5) + \beta_{SATIS=1,SW} \times (REG=7) + \beta_{SATIS=1,W} \times (REG=8) + \\
&+\beta_{SATIS=1,rural} \times (MEDIU=3) + \\
&+\beta_{SATIS=1,1cop} \times (NRCOP=1) + \beta_{SATIS=1,2cop} \times (NRCOP=2) + \\
&+\beta_{SATIS=1,3cop} \times (NRCOP=3) + \beta_{SATIS=1,4cop} \times (NRCOP=4) + \\
&+\beta_{SATIS=1,Q1} \times (QUINT=1) + \beta_{SATIS=1,Q2} \times (QUINT=2) + \beta_{SATIS=1,Q4} \times (QUINT=4) + \beta_{SATIS=1,Q5} \\
&\times (QUINT=5)
\end{aligned}
$$

Further models were fitted similarly with the one presented above.

The second model conducted for household level refers to car deprivation status - to have or to not have a car. Its output is presented in the Annex 2.

The third model studies the phone deprivation status - to have or not to have a telephone. Annex 3 is describing its output.

The intercepts give the estimated log-odds for the reference sex = men, age group = 35 – 44 years, education = upper secondary, marital status = married, number of children in the households = without children; income quintile = 3, region = Bucharest-Ilfov and the residence area=urban. All socio-demographic variables are referring to household head characteristics.

Dependent variables are considered the following: can face the current expenditure with monthly net income; have a car; have mobile phone.

The effect of selected socio-demographic variables on durable goods endowment and a qualitative variable

Table 1

Variables related with the household head		Durable goods and qualitative variable exp(coefficients) Can face expenditure with net income	Car	Mobile Phone
Gender	Men - reference			
	Women	0,8131714	0,541085	1,0938586
Age groups	15 - 24	0,4740683	0,6991851	2,6625448
	25 - 34	0,9472601	1,0742278	1,538973
	35 - 44 - reference			
	45 - 54	0,9114371	1,0651751	0,8804435
	55 - 64	1,0149316	0,9022194	0,4837727
	65+	1,6012844	0,3603736	0,1554396
Education	no education	0,4625419	0,5378845	0,1988461
	primary & lower secondary	0,6133303	0,3826076	0,4931707
	upper secondary - reference			
	post-secondary, non-tertiary	1,1402645	1,3452667	1,06037
	apprenticeships	0,7182761	0,6609168	0,8185456
	tertiary	1,7490174	1,8592157	1,052182
Marital status	married - reference			
	consensual union	0,8648016	0,7209701	0,7066685
	divorced	1,2114561	0,6631192	1,0726926
	widow	1,2935344	0,9200509	0,9991354
	unmarried	1,2280106	0,6259042	0,7829797
	separated	0,9605652	0,6506255	1,3628512
Number of children	Without - reference			
	1 child	0,5897186	1,1952333	1,9041575
	2 children	0,4409407	1,166374	1,5113035
	3 children	0,2847433	0,6211409	0,6339015
	4 children and more	0,1674953	0,3673152	0,3970709
Income quintile	Q1	0,3664005	0,2197819	0,2446361
	Q2	0,6315330	0,4532944	0,5217255
	Q3 - reference			
	Q4	1,7588380	2,4249688	1,6222701
	Q5	4,2512645	6,2270085	4,5728252
Region	North-West	0,1693859	0,5015297	2,0096183
	Centre	0,1174473	0,7004345	1,6383847
	North-East	0,1829420	0,8932945	1,9529487
	South-East	0,2819697	0,681604	1,6982869
	South	0,4040877	0,7811367	1,2657508
	Bucharest-Ilfov - reference			
	South-West	0,3465742	0,8429348	1,4962907
	West	0,3055667	0,4207856	1,2076841
Residence area	Urban - reference			
	Rural	1,3437150	0,935646	0,704242

Analysing the exponential coefficients in Table 1 could be underlined once again, aspects that are evident in reality. Three profiles of household categories were outlined in the following, taking into account the case where the reference variables are constant.

Which category of household could face the current expenditure?

As compared with the household headed by men, aged 35 – 44 years old, with upper secondary education, married, having a child, income in the third quintile, living in Bucharest-Ilfov region, urban area

The households which can face the current expenditure with the monthly income are those headed by a men (women have lower probability than men – reference variable) aged 55 years old, have tertiary education, is single (widow, divorced, unmarried), have the net income in the fifth quintile. As regard the regions in which persons have the higher probability to face the expenditure with the monthly income, because the richer region (Bucharest) was choose as reference variable, for the other regions the probability to face the expenditure is very low. Also, when comparing the two residence area, in rural the expenditures are lower than in urban (reference variable), that why the probability to face the expenditure with the monthly income are higher.

Which category of household has car?

As compared with the household headed by men, aged 35 – 44 years old, with upper secondary education, married, having a child, income in the third quintile, living in Bucharest-Ilfov region, urban area

The households which have the highest probability to have a car are households headed by a men (women have lower probability than men – reference variable) aged 25 – 34 years, with tertiary education, more probably widow, with one child, having the income in the fifth quintile, being in the urban area.

Which category of household has mobile phones?

As compared with the household headed by men, aged 35 – 44 years old, with upper secondary education, married, having a child, income in the third quintile, living in Bucharest-Ilfov region, urban area

The households which have the highest probability to have mobile phones are those conducted by women aged 15 – 24 years old, having post-secondary or tertiary education, being separated, with one child, having net income in the fifth quintile, living in the North-West region and in urban area (rural have lower probability than urban – reference variable)

B) Individual level

It was performed a multinomial logistic regression model at individual level, to predict whether a person is situated in one of the five income quintiles. Using **`relevel`** function, it was choose 3rd quintile as reference group of the QUINT variable.

As income is one of the most important indicators for material dimension of life quality, it was choose for multinomial regression model as dependent variable. At individual level, net income by quintile was used and the third quintile as reference variable.

To analyse the multinomial Logit coefficients presented in the table below, it should be taken into consideration that the intercepts give the estimated log-odds for the reference sex = men, age group = 35 – 44 years, education = upper secondary, marital status = married, region= Bucharest-Ilfov and the residence area=urban.

It was calculated odds ratio, which compares chances of that a person to have net income in category j in this case income quintile 1, 2, 4 or 5 for dependent variable to record a success, relative to the reference category J (Quintile 3).

The effect of selected socio-demographic variables on individual net income

Table 2

Variables		Net Income Quintile exp(coefficients) - Q3 reference			
		Q1	Q2	Q4	Q5
Gender	Men - reference				
	Women	3,4113745	2,408037	0,6573858	0,3140086
Age groups	15 - 24	5,2137937	1,6817575	0,8888125	0,6144249
	25 - 34 - reference				
	35 - 44	0,8962782	1,137747	1,1292493	1,4930147
	45 - 54	0,7260835	1,1799398	0,960583	1,2111116
	55 - 64	0,2423391	0,6922068	0,798004	0,7524551
	65+	0,06566901	0,60755257	0,95844856	0,82322564
Education	no education	6,967642	7,4178324	0,3082435	0,2201482
	primary & lower secondary	2,1243617	3,610019	0,4145695	0,1996554
	upper secondary - reference				
	post-secondary, non-tertiary	0,7749566	0,5473388	1,6708362	3,5229437
	apprenticeships	0,9276095	1,3787129	0,7663841	0,5085882
	tertiary	0,9250876	0,580584	1,783445	9,999351
Marital status	married - reference				
	consensual union	0,8346935	1,3729112	0,7723872	0,7074635
	divorced	0,3070993	1,0136863	0,9278393	0,9123909
	widow	0,08109994	0,67180314	0,85702276	0,85702276
	unmarried	1,5392457	2,8458415	0,8060146	0,5835731
	separated	0,4050195	1,6250467	0,8263345	0,6563935
Region	North-West	1,5351554	1,9795005	0,7773671	0,8535536
	Centre	1,8142565	2,0929267	0,8619868	0,8603593
	North-East	1,3195318	1,5013457	0,8244285	0,8272109
	South-East	1,7628538	2,1011578	0,8206067	0,6848922
	South	1,3128543	0,833085	0,9343135	1,2920533
	Bucharest-Ilfov - reference				
	South-West	1,124026	1,062477	1,145807	1,190972
	West	1,2280465	0,7452681	1,017822	1,3750946
Residence area	Urban - reference				
	Rural	1,7757403	2,5682294	0,598463	0,5193421

When looking at the coefficients in Table 2 and take into consideration the reference independent variable, the following remarks could be stated:

- women relative probability to have an income in first quintiles is higher than for men;
- the poorest persons are aged 15 – 24 years old and the "richest" are those persons aged 35 – 44 years old;

- people with no education or lower education have higher probability to be in the first two quintile of net income in opposition with those who have higher education;
- unmarried persons as compared with reference “married” has higher probability to be in the first two income quintile;
- the poorest region are Centre and South-East;
- rural area have higher probability to be poorer than the persons from urban.

CONCLUSIONS

The aim of this paper was to reveal the main social and demographic factors that may influence the components of life quality material dimension in terms of income and durable goods. The factors influence was investigated using multinomial logistic regression models. Components of material dimensions of life quality were modelled as function of socio-demographic characteristics and territorial profile. The multinomial logistic regression was applied on Household Budget Survey 2013 data.

Analysis made on exponential coefficients revealed the fact that material dimension of life quality is affected in different proportion by the factors considered in this study.

The main conclusions raised from the multifactor analysis are the following:

- At individual level: Factors as education and gender have an important impact on income the most important indicator of material life quality dimension. The higher education one has, the higher probability is to have income in the fifth quintile. The risk to be poor as relative compared with median quintile (Q3) appears more probable for women.
- At household level: Analysis made on household’s head socio-demographic characteristics reveal that the important factors that influence the possession of a durable goods (in this case: car and mobile phone) are almost all variables selected for this study: gender, age, education and marital status. The probability to have a car or mobile phone is higher for households with only one child, as relative compared with a household without children. Also, income has an important impact on the durable goods possession.

This paper focused on few variables of life quality material dimension a lot of other aspects could be analysed. Thus, a continuously work for future research could be done, in order to investigate the factors that influence dimensions of life quality.

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Annex 1

Output of the model 1 for household level (Dependent variable SATIS)

```
         Df      AIC
<none>                33 33676.46
- abf_gosp$SEXCAP     32 33701.73
- abf_gosp$STACIVCAP  28 33708.86
- abf_gosp$MEDIU      32 33765.46
- abf_gosp$GRVCAP     28 33904.55
- abf_gosp$NRCOP      29 33973.52
- abf_gosp$GR_NIVECAP 28 33998.78
- abf_gosp$REG        26 35760.03
- abf_gosp$QUINT      29 35893.20

> summary(step_regression_multinom)
Call:
multinom(formula = abf_gosp$SATIS ~ abf_gosp$SEXCAP + abf_gosp$STACIVCAP +
    abf_gosp$GR_NIVECAP + abf_gosp$GRVCAP + abf_gosp$REG + abf_gosp$MEDIU +
    abf_gosp$NRCOP + abf_gosp$QUINT, data = abf_gosp)

Coefficients:
                          Values  Std. Err.
(Intercept)           1.58023093 0.07223083
abf_gosp$SEXCAP2     -0.20681342 0.03961195
abf_gosp$STACIVCAP2  -0.14525520 0.08187357
abf_gosp$STACIVCAP3   0.19182301 0.05827950
abf_gosp$STACIVCAP4   0.25737828 0.04782429
abf_gosp$STACIVCAP5   0.20539545 0.06557572
abf_gosp$STACIVCAP6  -0.04023346 0.12646863
abf_gosp$GR_NIVECAP1 -0.77101811 0.18009208
abf_gosp$GR_NIVECAP2 -0.48885170 0.04424139
abf_gosp$GR_NIVECAP4  0.13126025 0.07204140
abf_gosp$GR_NIVECAP5 -0.33090120 0.04097420
abf_gosp$GR_NIVECAP6  0.55905417 0.06063778
abf_gosp$GRVCAP1     -0.74640378 0.13028951
abf_gosp$GRVCAP2     -0.05418157 0.07065370
abf_gosp$GRVCAP4     -0.09273267 0.05292254
abf_gosp$GRVCAP5      0.01482120 0.05354572
abf_gosp$GRVCAP6      0.47080603 0.05630422
abf_gosp$REG1        -1.77557555 0.05428848
abf_gosp$REG2        -2.14176556 0.05793381
abf_gosp$REG3        -1.69858600 0.05432995
abf_gosp$REG4        -1.26595572 0.05802948
abf_gosp$REG5        -0.90612328 0.05970050
abf_gosp$REG7        -1.05965838 0.05593517
abf_gosp$REG8        -1.18558732 0.06581691
abf_gosp$MEDIU3       0.29543816 0.03111943
abf_gosp$NRCOP1      -0.52810973 0.04940399
abf_gosp$NRCOP2      -0.81884477 0.06572445
abf_gosp$NRCOP3      -1.25616707 0.14785803
abf_gosp$NRCOP4      -1.78680013 0.21221513
abf_gosp$QUINT1      -1.00402820 0.04492745
abf_gosp$QUINT2      -0.45960507 0.04064998
abf_gosp$QUINT4       0.56465338 0.04153740
abf_gosp$QUINT5       1.44721647 0.04943066

Residual Deviance: 33610.46
AIC: 33676.46
```

Table of exponentiation coefficients (odds ratios) from the model

```
> exp(coef(step_regression_multinom))
        (Intercept)     abf_gosp$SEXCAP2  abf_gosp$STACIVCAP2  abf_gosp$STACIVCAP3
          4.8560771            0.8131714            0.8648016            1.2114561
 abf_gosp$STACIVCAP4  abf_gosp$STACIVCAP5  abf_gosp$STACIVCAP6 abf_gosp$GR_NIVECAP1
          1.2935344            1.2280106            0.9605652            0.4625419
abf_gosp$GR_NIVECAP2 abf_gosp$GR_NIVECAP4 abf_gosp$GR_NIVECAP5 abf_gosp$GR_NIVECAP6
          0.6133303            1.1402645            0.7182761            1.7490174
    abf_gosp$GRVCAP1     abf_gosp$GRVCAP2     abf_gosp$GRVCAP4     abf_gosp$GRVCAP5
          0.4740683            0.9472601            0.9114371            1.0149316
    abf_gosp$GRVCAP6        abf_gosp$REG1        abf_gosp$REG2        abf_gosp$REG3
          1.6012844            0.1693859            0.1174473            0.1829420
       abf_gosp$REG4        abf_gosp$REG5        abf_gosp$REG7        abf_gosp$REG8
          0.2819697            0.4040877            0.3465742            0.3055667
     abf_gosp$MEDIU3      abf_gosp$NRCOP1      abf_gosp$NRCOP2      abf_gosp$NRCOP3
          1.3437150            0.5897186            0.4409407            0.2847433
     abf_gosp$NRCOP4      abf_gosp$QUINT1      abf_gosp$QUINT2      abf_gosp$QUINT4
          0.1674953            0.3664005            0.6315330            1.7588380
     abf_gosp$QUINT5
          4.2512645
```

Annex 2

Output of the model 2 for household level (Dependent variable MASINA)

```
                     Df      AIC
<none>               33 19926.03
- abf_gosp$MEDIU     32 19926.55
- abf_gosp$NRCOP     29 19959.20
- abf_gosp$STACIVCAP 28 19966.25
- abf_gosp$SEXCAP    32 20019.24
- abf_gosp$REG       26 20137.55
- abf_gosp$GRVCAP    28 20353.22
- abf_gosp$GR_NIVECAP 28 20493.51
- abf_gosp$QUINT     29 22378.12

> summary(step_regression_multinom)
Call:
multinom(formula = abf_gosp$MASINA ~ abf_gosp$SEXCAP + abf_gosp$STACIVCAP +
    abf_gosp$GR_NIVECAP + abf_gosp$GRVCAP + abf_gosp$REG + abf_gosp$MEDIU +
    abf_gosp$NRCOP + abf_gosp$QUINT, data = abf_gosp)

Coefficients:
                          Values  Std. Err.
(Intercept)          -0.93546985 0.08403738
abf_gosp$SEXCAP2     -0.61417894 0.06325495
abf_gosp$STACIVCAP2  -0.32715759 0.10211758
abf_gosp$STACIVCAP3  -0.41080045 0.08745829
abf_gosp$STACIVCAP4  -0.08332629 0.07524390
abf_gosp$STACIVCAP5  -0.46855792 0.09105147
abf_gosp$STACIVCAP6  -0.42982109 0.20160620
abf_gosp$GR_NIVECAP1 -0.62011148 0.47813394
abf_gosp$GR_NIVECAP2 -0.96074544 0.06403365
abf_gosp$GR_NIVECAP4  0.29659226 0.07222710
abf_gosp$GR_NIVECAP5 -0.41412725 0.04833350
abf_gosp$GR_NIVECAP6  0.62015472 0.05639371
```

```
abf_gosp$GRVCAP1     -0.35783976 0.18553693
abf_gosp$GRVCAP2      0.07160206 0.07826798
abf_gosp$GRVCAP4      0.06313917 0.05887551
abf_gosp$GRVCAP5     -0.10289759 0.06157055
abf_gosp$GRVCAP6     -1.02061408 0.06857967
abf_gosp$REG1        -0.69009239 0.07088944
abf_gosp$REG2        -0.35605440 0.07181252
abf_gosp$REG3        -0.11283891 0.06471865
abf_gosp$REG4        -0.38330644 0.07316232
abf_gosp$REG5        -0.24700514 0.07112856
abf_gosp$REG7        -0.17086571 0.06444357
abf_gosp$REG8        -0.86563194 0.07426904
abf_gosp$MEDIU3      -0.06651813 0.04190819
abf_gosp$NRCOP1       0.17834141 0.05396224
abf_gosp$NRCOP2       0.15389983 0.07180982
abf_gosp$NRCOP3      -0.47619727 0.17964758
abf_gosp$NRCOP4      -1.00153500 0.27569857
abf_gosp$QUINT1      -1.51511940 0.12363767
abf_gosp$QUINT2      -0.79121353 0.08119131
abf_gosp$QUINT4       0.88581866 0.05405806
abf_gosp$QUINT5       1.82889604 0.05438890

Residual Deviance: 19860.03
AIC: 19926.03
```

Table of exponentiation coefficients (odds ratios) from the model

```
> exp(coef(step_regression_multinom))
         (Intercept)     abf_gosp$SEXCAP2  abf_gosp$STACIVCAP2  abf_gosp$STACIVCAP3
           0.3924015            0.5410850            0.7209701            0.6631192
 abf_gosp$STACIVCAP4  abf_gosp$STACIVCAP5  abf_gosp$STACIVCAP6 abf_gosp$GR_NIVECAP1
           0.9200509            0.6259042            0.6506255            0.5378845
abf_gosp$GR_NIVECAP2 abf_gosp$GR_NIVECAP4 abf_gosp$GR_NIVECAP5 abf_gosp$GR_NIVECAP6
           0.3826076            1.3452667            0.6609168            1.8592157
    abf_gosp$GRVCAP1     abf_gosp$GRVCAP2     abf_gosp$GRVCAP4     abf_gosp$GRVCAP5
           0.6991851            1.0742278            1.0651751            0.9022194
    abf_gosp$GRVCAP6       abf_gosp$REG1        abf_gosp$REG2        abf_gosp$REG3
           0.3603736            0.5015297            0.7004345            0.8932945
       abf_gosp$REG4       abf_gosp$REG5        abf_gosp$REG7        abf_gosp$REG8
           0.6816040            0.7811367            0.8429348            0.4207856
     abf_gosp$MEDIU3     abf_gosp$NRCOP1      abf_gosp$NRCOP2      abf_gosp$NRCOP3
           0.9356460            1.1952333            1.1663740            0.6211409
     abf_gosp$NRCOP4     abf_gosp$QUINT1      abf_gosp$QUINT2      abf_gosp$QUINT4
           0.3673152            0.2197819            0.4532944            2.4249688
     abf_gosp$QUINT5
           6.2270085
```

Annex 3

Output of the model 3 for household level (Dependent variable TEL)

```
                     Df      AIC
<none>               33 22837.84
- abf_gosp$SEXCAP     32 22839.38
- abf_gosp$STACIVCAP  28 22850.89
- abf_gosp$NRCOP      29 22912.30
- abf_gosp$MEDIU      32 22918.11
- abf_gosp$REG        26 23018.82
- abf_gosp$GR_NIVECAP 28 23095.23
- abf_gosp$GRVCAP     28 24101.87
- abf_gosp$QUINT      29 24561.8

> summary(step_regression_multinom)
Call:
multinom(formula = abf_gosp$TEL ~ abf_gosp$SEXCAP + abf_gosp$STACIVCAP +
    abf_gosp$GR_NIVECAP + abf_gosp$GRVCAP + abf_gosp$REG + abf_gosp$MEDIU +
    abf_gosp$NRCOP + abf_gosp$QUINT, data = abf_gosp)

Coefficients:
                           Values  Std. Err.
(Intercept)           2.8080203780 0.10813497
abf_gosp$SEXCAP2      0.0897114555 0.04771670
abf_gosp$STACIVCAP2  -0.3471935468 0.10769608
abf_gosp$STACIVCAP3   0.0701719635 0.07698783
abf_gosp$STACIVCAP4  -0.0008650024 0.05481922
abf_gosp$STACIVCAP5  -0.2446484520 0.08965740
abf_gosp$STACIVCAP6   0.3095789938 0.17894375
abf_gosp$GR_NIVECAP1 -1.6152238921 0.18731835
abf_gosp$GR_NIVECAP2 -0.7068999932 0.06078897
abf_gosp$GR_NIVECAP4  0.0586179480 0.11180999
abf_gosp$GR_NIVECAP5 -0.2002261876 0.06386660
abf_gosp$GR_NIVECAP6  0.0508661292 0.10659668
abf_gosp$GRVCAP1      0.9792823682 0.29401243
abf_gosp$GRVCAP2      0.4311153366 0.14403233
abf_gosp$GRVCAP4     -0.1273295262 0.09816301
abf_gosp$GRVCAP5     -0.7261401961 0.09131491
abf_gosp$GRVCAP6     -1.8614983017 0.09114274
abf_gosp$REG1         0.6979447798 0.06053801
abf_gosp$REG2         0.4937108136 0.06441719
abf_gosp$REG3         0.6693403633 0.06112251
abf_gosp$REG4         0.5296200092 0.06612922
abf_gosp$REG5         0.2356655033 0.06741749
abf_gosp$REG7         0.4029892037 0.06306530
abf_gosp$REG8         0.1887045875 0.08115970
abf_gosp$MEDIU3      -0.3506331872 0.03871095
abf_gosp$NRCOP1       0.6440396582 0.09819295
abf_gosp$NRCOP2       0.4129725086 0.12589494
abf_gosp$NRCOP3      -0.4558616765 0.20431471
abf_gosp$NRCOP4      -0.9236404290 0.23043768
abf_gosp$QUINT1      -1.4079832828 0.05249590
abf_gosp$QUINT2      -0.6506136906 0.04954237
abf_gosp$QUINT4       0.4838264802 0.05864566
abf_gosp$QUINT5       1.5201312122 0.08936787

Residual Deviance: 22771.84
AIC: 22837.84
```

Table of exponentiation coefficients (odds ratios) from the model

```
> exp(coef(step_regression_multinom))
        (Intercept)     abf_gosp$SEXCAP2  abf_gosp$STACIVCAP2  abf_gosp$STACIVCAP3
         16.5770694            1.0938586            0.7066685            1.0726926
  abf_gosp$STACIVCAP4  abf_gosp$STACIVCAP5  abf_gosp$STACIVCAP6 abf_gosp$GR_NIVECAP1
          0.9991354            0.7829797            1.3628512            0.1988461
 abf_gosp$GR_NIVECAP2 abf_gosp$GR_NIVECAP4 abf_gosp$GR_NIVECAP5 abf_gosp$GR_NIVECAP6
          0.4931707            1.0603700            0.8185456            1.0521820
    abf_gosp$GRVCAP1     abf_gosp$GRVCAP2     abf_gosp$GRVCAP4     abf_gosp$GRVCAP5
          2.6625448            1.5389730            0.8804435            0.4837727
    abf_gosp$GRVCAP6        abf_gosp$REG1        abf_gosp$REG2        abf_gosp$REG3
          0.1554396            2.0096183            1.6383847            1.9529487
       abf_gosp$REG4        abf_gosp$REG5        abf_gosp$REG7        abf_gosp$REG8
          1.6982869            1.2657508            1.4962907            1.2076841
      abf_gosp$MEDIU3      abf_gosp$NRCOP1      abf_gosp$NRCOP2      abf_gosp$NRCOP3
          0.7042420            1.9041575            1.5113035            0.6339015
      abf_gosp$NRCOP4      abf_gosp$QUINT1      abf_gosp$QUINT2      abf_gosp$QUINT4
          0.3970709            0.2446361            0.5217255            1.6222701
      abf_gosp$QUINT5
          4.5728252
```

Annex 4

Output of the model for individual level (Dependent variable QUINT)

```
                     Df      AIC
<none>              104 151213.3
- abf_pers$REG       76 152535.9
- abf_pers$STACIV    84 153321.3
- abf_pers$MEDIU    100 153731.5
- abf_pers$SEX      100 156571.8
- abf_pers$GR_VARSTA  80 158557.8
- abf_pers$GR_NIVE   84 162629.6

> summary(step_regression_multinom)
Call:
multinom(formula = abf_pers$QUINT ~ abf_pers$SEX + abf_pers$STACIV +
    abf_pers$GR_NIVE + abf_pers$GR_VARSTA + abf_pers$REG + abf_pers$MEDIU,
    data = abf_pers)

Coefficients:
  (Intercept) abf_pers$SEX2 abf_pers$STACIV2 abf_pers$STACIV3 abf_pers$STACIV4
1   -1.034891     1.2271153       -0.1806907      -1.18058416       -2.5120731
2   -2.673815     0.8788119        0.3169334       0.01359347       -0.3977899
4    1.053938    -0.4194842       -0.2582693      -0.07489669       -0.1542908
5    1.212881    -1.1583349       -0.3460693      -0.09168672       -0.1647979
  abf_pers$STACIV5 abf_pers$STACIV6 abf_pers$GR_NIVE1 abf_pers$GR_NIVE2 abf_pers$GR_NIVE4
1        0.4312925       -0.9038202          1.941277         0.7534714        -0.2549482
2        1.0458588        0.4855366          2.003887         1.2837130        -0.6026872
4       -0.2156534       -0.1907556         -1.176865        -0.8805146         0.5133242
5       -0.5385855       -0.4209948         -1.513454        -1.6111625         1.2592969
  abf_pers$GR_NIVE5 abf_pers$GR_NIVE6 abf_pers$GR_VARSTA0 abf_pers$GR_VARSTA1
1       -0.07514439        -0.0778669           2.594147           1.6513077
2        0.32115037        -0.5437207           3.854243           0.5198394
4       -0.26607177         0.5785469          -1.607902          -0.1178689
5       -0.67611661         2.3025202          -8.897685          -0.4870686
```

```
  abf_pers$GR_VARSTA3 abf_pers$GR_VARSTA4 abf_pers$GR_VARSTA5 abf_pers$GR_VARSTA6
1          -0.1095044         -0.32009025          -1.4174175         -2.72312822
2           0.1290500          0.16546345          -0.3678706         -0.49831657
4           0.1215531         -0.04021492          -0.2256417         -0.04243938
5           0.4007974          0.19153862          -0.2844139         -0.19452494
  abf_pers$REG1 abf_pers$REG2 abf_pers$REG3 abf_pers$REG4 abf_pers$REG5 abf_pers$REG7
1     0.4286316     0.5956758     0.2772769     0.5669340    0.27220363    0.11691683
2     0.6828445     0.7385634     0.4063618     0.7424885   -0.18261956    0.06060296
4    -0.2518426    -0.1485153    -0.1930649    -0.1977113   -0.06794327    0.13610906
5    -0.1583469    -0.1504052    -0.1896957    -0.3784939    0.25623270    0.17476986
  abf_pers$REG8 abf_pers$MEDIU3
1    0.20542467       0.5742174
2   -0.29401129       0.9432167
4    0.01766507      -0.5133906
5    0.31852252      -0.6551925

Std. Errors:
  (Intercept) abf_pers$SEX2 abf_pers$STACIV2 abf_pers$STACIV3 abf_pers$STACIV4
1  0.07443932    0.03254942       0.07709313       0.08950190       0.09322305
2  0.08748744    0.03208735       0.08001272       0.07555816       0.03989532
4  0.06660758    0.02806361       0.07482244       0.05780047       0.03672373
5  0.07070151    0.03186731       0.08133777       0.06216106       0.04625227
  abf_pers$STACIV5 abf_pers$STACIV6 abf_pers$GR_NIVE1 abf_pers$GR_NIVE2 abf_pers$GR_NIVE4
1       0.05821409        0.2051493         0.1441524        0.04206262        0.12535354
2       0.06507564        0.1659965         0.1421847        0.04943802        0.19685979
4       0.05842570        0.1452877         0.2307680        0.03932681        0.08016781
5       0.06084457        0.1599044         0.3170324        0.04753708        0.07741664
  abf_pers$GR_NIVE5 abf_pers$GR_NIVE6 abf_pers$GR_VARSTA0 abf_pers$GR_VARSTA1
1        0.04554278        0.08540633           0.2145149          0.07668978
2        0.05452126        0.14297048           0.2153524          0.09082663
4        0.03691431        0.07172420           0.5871094          0.08931944
5        0.04005439        0.06648987          30.0129131          0.09867129
  abf_pers$GR_VARSTA3 abf_pers$GR_VARSTA4 abf_pers$GR_VARSTA5 abf_pers$GR_VARSTA6
1          0.06028901          0.06112801          0.06215228          0.07231204
2          0.07391797          0.07382655          0.07111452          0.07135280
4          0.06086073          0.06084148          0.05829726          0.05993452
5          0.06251882          0.06291116          0.06175158          0.06457913
  abf_pers$REG1 abf_pers$REG2 abf_pers$REG3 abf_pers$REG4 abf_pers$REG5 abf_pers$REG7
1    0.05426852    0.05727880    0.05323656    0.05928892    0.06372957    0.05771315
2    0.05249845    0.05608749    0.05240590    0.05722337    0.06752371    0.05867266
4    0.04838199    0.05098897    0.04615355    0.05258998    0.05263776    0.04723726
5    0.05502459    0.05800932    0.05279461    0.06047178    0.05788187    0.05357398
  abf_pers$REG8 abf_pers$MEDIU3
1    0.07061916      0.03231256
2    0.08100515      0.03379887
4    0.05708842      0.02828815
5    0.06105895      0.03218020

Residual Deviance: 151005.3
AIC: 151213.3
```

Table of exponentiation coefficients (odds ratios) from the model

```
> exp(coef(step_regression_multinom))
(Intercept) abf_pers$SEX2 abf_pers$STACIV2 abf_pers$STACIV3 abf_pers$STACIV4
1  0.35526496     3.4113745        0.8346935        0.3070993       0.08109994
2  0.06898851     2.4080370        1.3729112        1.0136863       0.67180314
4  2.86892596     0.6573858        0.7723872        0.9278393       0.85702276
5  3.36315929     0.3140086        0.7074635        0.9123909       0.84806511
  abf_pers$STACIV5 abf_pers$STACIV6 abf_pers$GR_NIVE1 abf_pers$GR_NIVE2 abf_pers$GR_NIVE4
1        1.5392457        0.4050195         6.9676420         2.1243617         0.7749566
2        2.8458415        1.6250467         7.4178324         3.6100190         0.5473388
4        0.8060146        0.8263345         0.3082435         0.4145695         1.6708362
5        0.5835731        0.6563935         0.2201482         0.1996554         3.5229437
  abf_pers$GR_NIVE5 abf_pers$GR_NIVE6 abf_pers$GR_VARSTA0 abf_pers$GR_VARSTA1
1         0.9276095         0.9250876        13.385161485           5.2137937
2         1.3787129         0.5805840        47.192864500           1.6817575
4         0.7663841         1.7834450         0.200307429           0.8888125
5         0.5085882         9.9993510         0.000136705           0.6144249
  abf_pers$GR_VARSTA3 abf_pers$GR_VARSTA4 abf_pers$GR_VARSTA5 abf_pers$GR_VARSTA6
1           0.8962782           0.7260835           0.2423391          0.06566901
2           1.1377470           1.1799398           0.6922068          0.60755257
4           1.1292493           0.9605830           0.7980040          0.95844856
5           1.4930147           1.2111116           0.7524551          0.82322564
  abf_pers$REG1 abf_pers$REG2 abf_pers$REG3 abf_pers$REG4 abf_pers$REG5 abf_pers$REG7
1     1.5351554     1.8142565     1.3195318     1.7628538     1.3128543      1.124026
2     1.9795005     2.0929267     1.5013457     2.1011578     0.8330850      1.062477
4     0.7773671     0.8619868     0.8244285     0.8206067     0.9343135      1.145807
5     0.8535536     0.8603593     0.8272109     0.6848922     1.2920533      1.190972
  abf_pers$REG8 abf_pers$MEDIU3
1     1.2280465       1.7757403
2     0.7452681       2.5682294
4     1.0178220       0.5984630
5     1.3750946       0.5193421
```