Material deprivation in Europe: Which expenditures are curtailed first?

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1) Introduction

- Since 2009, the European Union portfolio of commonly agreed <u>social indicators includes measures of material deprivation</u>, where the latter was originally conceived as an enforced lack of a combination of nine items depicting material living conditions:

1) coping with unexpected expenses;
2) one week's annual holiday away from home;
3) avoiding arrears (in mortgage or rent, utility bills or hire purchase instalments);
4) a meal with meat, chicken, fish or vegetarian equivalent every second day;
5) keeping the home adequately warm;
6) a washing machine;
7) a colour TV;
8) a telephone;
9) a personal car.

- The idea of defining such a list is that it would be a nice <u>complement to income poverty</u> figures but also better reflect differences in actual standards of living across the European Union, especially since the last enlargement.

- It was however suggested that this list of European Union material deprivation indicators should be revised because it is based on a <u>small number of items</u>.

- Such a revision became feasible after 2007, following a <u>Eurobarometer survey</u> in which respondents were asked "how necessary are a large list of items to have a decent life in each country".

- On the basis of the results of this survey, a collection of additional "necessary" material deprivation items were added to the 2009 thematic EU-SILC module on material deprivation so that there is now a list of 13 material deprivation items covering some key aspects of living conditions which appear to be customary in the whole EU and from which some people are excluded due to a lack of resources.

- Such a concept of material deprivation is consistent with Townsend's (1979) theory of relative deprivation.

- The focus of this "deprivation approach" is on "enforced lacks", i.e. lack due to insufficient resources and not lack due to choices (for more details on this distinction, see, Mack and Lansley, 1985).

- The main goal of this paper is to rank the 13 material deprivation items and compare the priority patterns across the EU by using two different methods based respectively on the so-called *Item Response Theory* and on the concept of an "*order of acquisition of durable goods*".

- More precisely we wish

     - to explore which <u>items people have to go without as their resources decrease/deprivation increases</u>

     - to know whether the <u>deprivation patterns differ between EU Member states</u>

     - and whether the <u>two methodologies</u> highlight a <u>similar deprivation pattern,</u> which would then be independent of the methodological choices made to determine the rankings.

2. The Methodology

2.1. On the Concept of Deprivation Sequence

- Forty to fifty years ago Paroush (1963, 1965 and 1973) suggested using information available on the order of acquisition of durable goods to estimate the standard of living of households.

- Paroush's ideas drew on Guttman's work (Guttman, 1950) and have later on be combined with ordered logit regression to estimate multidimensional poverty (see, for example, Deutsch and Silber, 2008, and B renger, Deutsch and Silber, 2013).

- Rather than discovering the order of acquisition of durable goods as individuals/households become richer, as originally proposed, it is also possible to find out what is the **order of curtailment of expenditures** when individuals/households start facing economic difficulties and become deprived.

- Deutsch et al. (2013) have thus analysed the sequence of expenditures cutbacks, in particular health expenditures, implemented by individuals facing poverty.

- Let us assume, for simplicity, that we collect information on the non-ownership of three durable goods A, B and C.

- In this example a household can own one, two, three or none of these goods, so there are $2^3 = 8$ possible profiles of non-ownership of durable goods. The number 1 indicates that the household cannot afford the corresponding durable good, a zero that it can.

Table 1: The eight deprivation profiles when there are three items

Deprivation profile	The household can't afford item A	The household can't afford item B	The household can't afford item C
1	0	0	0
2	1	0	0
3	0	1	0
4	0	0	1
5	1	1	0
6	0	1	1
7	1	0	1
8	1	1	1

- Suppose we know that the least deprived households cannot afford good A, the second least deprived cannot afford goods A and B and that the most deprived ones cannot afford any of the goods while a household which has all three goods is not deprived at all. There would then be no household with the profiles 3, 4, 6 and 7 in Table 1.

- However, even if we assume that A, B C is generally the "deprivation sequence" in the population, we cannot assume that every household will follow exactly this sequence. Some will certainly deviate from this most common ranking.

- To measure the extent of such deviations Paroush (1963, 1965 and 1973) suggested computing the number of changes in numbers (from 0 to 1 or from 1 to 0) necessary to bring a deviating household back to one of the profiles corresponding to a given deprivation sequence.

- Thus if A, B, C is the most common deprivation sequence in the population, the "distance" for an individual with profile 4 in Table 1 will be expressed as

$$|0 - 1| + |0 - 1| + |1 - 1| = 2$$

- Clearly K is the maximal value of the distance for an individual, assuming there are K durable goods. Such a distance is, for example, observed for an individual with profile 1 in Table 1.

- We can compute such a distance for each individual and then deduct the average distance of individuals from this Deprivation sequence A, B, C.

- We want however to discover what the most common "deprivation sequence" in the population is. This implies that we should compute such an average distance for every possible Deprivation Sequence.

- We know that there are $K!$ possible sequences. The most commonly selected deprivation sequence in the population will then be the one for which the average distance is minimal.

- Discovering this most common deprivation sequence requires a very high number of computations. Thus in the empirical illustration of Section 3 we have 13 items. Assume, for simplicity, that there are 10,000 individuals in the sample. As explained previously, 140,000 comparisons will then be needed, to determine the average distance for a given "deprivation sequence". The procedure has however to be repeated 13!=6227020800 times, which is the total number of possible "deprivation sequences" resulting from 13 items. We will then end up with a total number of iterations equal to =140,000 × 6227020800 = 8.72
A big number, but we managed to do it…

2.2. Item Response Theory (IRT)

- IRT has been originally used to analyze the results of psychometric tests.

- IRT models the response of each examinee of a given ability to each item in the test. IRT is based on the idea that the probability of a correct response to an item is a mathematical function of person and item parameters. The person parameter is assumed to be a single latent trait or dimension, like the intelligence of the individual.

- Parameters on which items are characterized include their difficulty (known as "location" for their location on the difficulty range), discrimination (slope) representing how steeply the rate of success of individuals varies with their ability, and a third parameter which we will ignore for the sake of simplicity.

Item Response Curves

$$P(X_{ij} = 1 \mid \theta_i, \beta_j, \alpha_j) = \frac{\exp(\alpha_j(\theta_i - \beta_j))}{1 + \exp(\alpha_j(\theta_i - \beta_j))}$$

θ=Deprivation
α=Discrimination
β=Severity
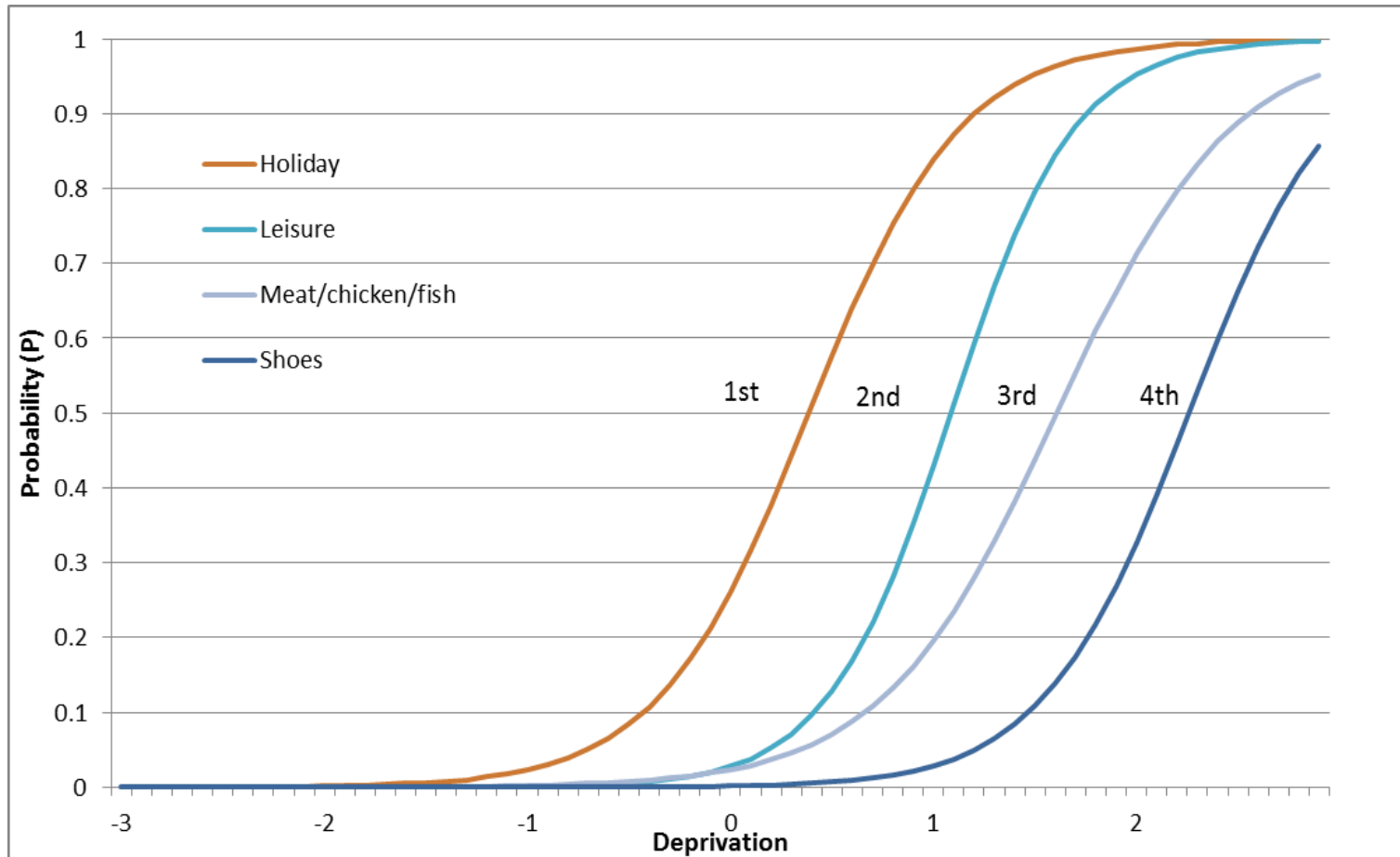
- All these parameters are estimated by Maximum Likelihood.

- Item Response Theory (IRT) models have been later used in the measurement of deprivation because poverty is after all also a latent variable difficult to measure (see, for example the works of Dickes (1983, 1989), Gailly and Hausman (1984), Pérez-Mayo (2004 and 2005), Cappellari and Jenkins (2006), Ayala and Navarro (2007 and 2008), Dickes and Fusco (2008), Guio, Gordon and Marlier (2012) and Szeles and Fusco (2013).

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- This implies that the level of deprivation endured by someone who cannot afford shoes is much stronger (2 standard deviations from the sample mean deprivation) than the one endured by someone who cannot afford holidays but can afford all other items.

- The severity (difficulty) is therefore the location of the S-shaped curve along the x-axis, more specifically the position on the x-axis reached when there is a probability of 0.5 on the y-axis.

- Because the curves (known as Item Response Curves, ICCs) are monotonic, the model also predicts that the vast majority of those who cannot afford shoes will not be able to afford holidays. Each item can therefore be ranked according to its position on the latent deprivation scale, giving a deprivation sequence highly comparable to the DS method.

- The second parameter shapes the steepness of the ICC, and shows how well each item discriminates between the deprived and non-deprived respondents.

Material Deprivation in the European Union: Which Expenditures are Curtailed First?

List of Deprivation Items

A. <u>'Adult items', i.e. items collected at individual adult level</u> (people aged 16+, living in private households).

- To replace worn-out clothes by some new (not second-hand) ones
- Two pairs of properly fitting shoes, including a pair of all-weather shoes
- To spend a small amount of money each week on oneself without having to consult anyone (hereafter referred to as "pocket money")
- To get together with friends/family for a drink/meal at least monthly
- To have regular leisure activities

B. 'Household items', i.e. items collected at household level. We assigned the household deprivation information to all household members when the household cannot afford:

- To replace worn-out furniture (but would like to have)
- A meal with meat, chicken, fish or vegetarian equivalent every second day
- To face unexpected expenses
- To keep home adequately warm
- One week annual holiday away from home
- To avoid arrears (mortgage or rent, utility bills or hire purchase instalments)
- A car/van for private use (but would like to have)
- A computer and an internet connection (but would like to have)

Results – EU order

IRT
1. Holidays
2. Unexpected expenses
3. Furniture
4. Leisure
5. Pocket money
6. Drink/meal out
7. Clothes
8. Meat/chicken/fish
9. Home warm
10. Car
11. Arrears
12. Computer/Internet
13. Shoes

Most common deprivation pattern
1. Holidays
2. Unexpected expenses
3. Furniture
4. Pocket Money
5. Leisure
6. Drink/meal out
7. Clothes
8. Meat/chicken/fish
9. Home warm
10. Arrears
11. Car
12. Computer/Internet
13. Shoes

We now show two tables, presented as heat-maps.

The first one gives results derived from *Item Response Theory* and conveys the high degree of similarity between the curtailment sequences in the different countries, red colors referring to the first items that are given up and green to the last ones.

Table 2 is similar and gives results based on the *"deprivation sequence"* approach.

Order of curtailment, results based on Item Response Theory

|	EU-27	AT	BE	BG	CY	CZ	DE	DK	EE	EL	ES	FI	FR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Holidays	1	1	1	3	2	2	3	2	1	1	1	2	3	2	2	1	4	3	3	1	3	1	1	1	2	3	1	2
Unexp. expenses	2	2	2	4	3	3	1	1	3	3	3	1	2	1	1	2	1	1	1	4	2	2	7	6	1	1	3	1
Fur-niture	3	5	3	1	1	1	5	3	2	2	2	3	1	3	3	11	2	2	2	2	1	3	2	2	3	2	2	5
Leisure	4	3	4	7	6	5	4	6	9	4	4	6	5	6	7	3	3	6	4	5	4	4	5	3	4	4	7	4
Pocket money	5	4	5	6	8	4	6	5	4	7	5	7	4	5	6	4	5	4	6	7	5	5	3	5	5	6	5	3
Drink/ meal out	6	7	6	8	9	10	2	11	5	10	6	11	8	4	5	5	6	5	7	3	7	7	6	4	12	9	9	6
Clothes	7	8	7	5	7	8	8	4	6	8	7	5	6	7	9	6	7	7	5	6	6	6	8	8	7	5	8	7
Meat/ chicken/ fish	8	6	10	9	10	6	7	8	8	9	13	9	9	8	12	9	8	11	8	8	12	8	12	9	9	9	4	8
Home warm	9	12	11	2	4	11	9	12	13	6	9	13	11	12	8	7	9	13	10	9	11	9	4	11	11	11	10	12	9
Car	10	9	9	11	13	7	12	10	7	12	12	8	13	10	10	13	10	10	9	13	9	10	10	7	10	13	6	10
Arrears	11	10	8	10	5	12	11	7	10	5	8	4	7	9	4	8	12	8	12	10	8	11	13	10	6	7	13	12
Com-puter/ Internet	12	11	12	12	12	9	13	13	11	11	11	10	12	11	13	10	11	12	13	11	13	12	11	12	13	11	10	13
Shoes	13	13	13	13	11	13	10	9	12	13	10	12	10	13	11	12	13	9	11	12	10	13	9	13	8	12	11	11

Source: EU-SILC 2009 cross-sectional data, Users' database - August 2011, authors' computation.

Order of curtailment, results based on the concept of "deprivation sequence"

	EU-27	AT	BE	BG	CY	CZ	DE	DK	EE	EL	ES	FI	FR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Holidays	1	2	1	3	2	2	2	2	1	2	1	2	3	2	2	1	2	2	2	1	3	1	1	1	2	3	1	2
Unexp. expenses	2	1	2	4	3	3	1	1	3	3	3	1	2	1	1	2	1	1	1	3	1	2	8	7	1	1	3	1
Furniture	3	5	3	1	1	1	6	3	2	1	2	3	1	3	3	11	3	3	3	2	2	3	2	2	6	2	2	6
Leisure	5	3	4	8	6	6	4	6	7	6	5	7	5	5	7	4	4	5	5	5	4	4	5	4	5	5	7	4
Pocket money	4	4	6	6	8	5	5	5	5	8	4	6	4	6	5	3	5	4	6	6	5	5	4	5	4	7	6	3
Drink/ meal out	6	6	5	7	9	10	3	7	8	9	6	8	8	4	6	5	6	6	7	4	6	6	6	3	8	9	8	5
Clothes	7	8	7	5	7	9	8	4	6	7	8	5	7	7	13	6	7	7	4	7	7	7	7	8	7	6	9	7
Meat/ chicken/ fish	8	7	10	9	10	4	7	10	9	10	13	9	9	8	11	8	8	10	8	8	12	8	12	9	11	8	4	9
Home warm	9	12	9	2	4	11	9	12	13	5	9	12	11	11	9	7	9	11	11	9	11	9	3	10	12	10	13	8
Car	11	10	11	11	12	7	12	11	4	12	12	10	12	10	8	13	10	12	9	11	9	11	10	6	9	12	5	12
Arrears	10	9	8	10	5	12	10	8	10	4	7	4	6	9	4	9	11	9	10	10	8	10	13	11	3	4	11	11
Computer Internet	12	11	12	12	13	8	13	13	11	11	10	11	13	12	10	10	12	13	12	12	13	12	11	12	13	11	10	13
Shoes	13	13	13	13	11	13	11	9	12	13	11	13	10	13	12	12	13	8	13	13	10	13	9	13	10	13	12	10
R	0.94	0.96	0.96	0.89	0.95	0.95	0.96	0.98	0.94	0.92	0.96	0.98	0.96	0.91	0.96	0.96	0.91	0.98	0.90	0.94	0.98	0.92	0.93	0.88	0.98	0.95	0.93	0.96

In Figure 2 we have plotted, for the European Union as a whole, the relationship between the sequence of curtailment and the percentage of individuals who give up a specific item. The negative correlation is very strong: the higher the rank of an item (i.e. the earlier it is curtailed), the greater the percentage of individuals who cannot afford it in the general population. The only exception concerns the item "arrears" as may be observed in Figure 2.

Figure 2: The Dominant Deprivation Pattern in the European Union
(Results based on IRT)
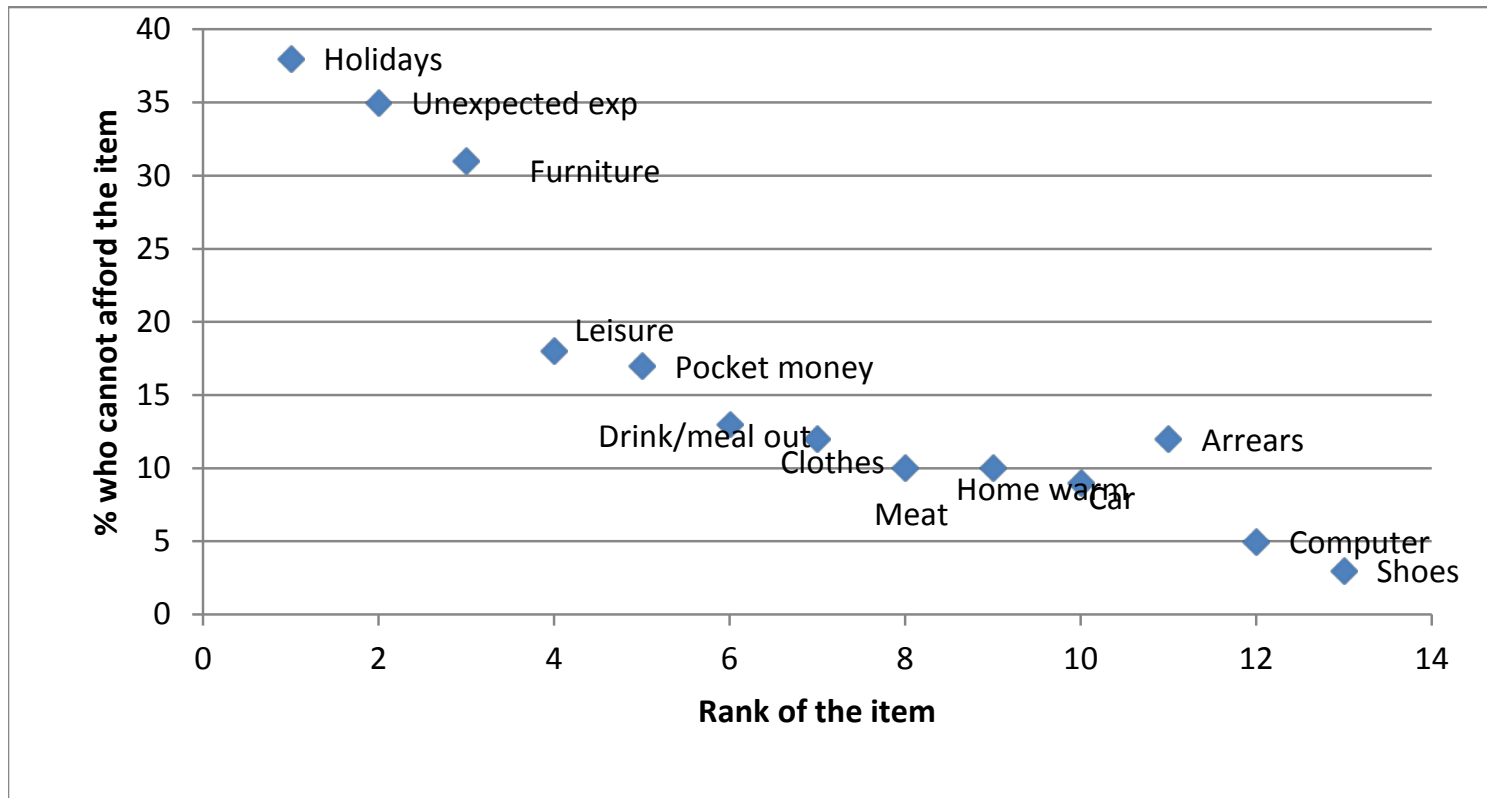
- We computed rank correlations between the Deprivation Sequences in the various EU countries.

- Many coefficients are higher than 0.9.

- We therefore conclude that the ranking is relatively homogeneous across all 27 EU countries.

Looking at specific population subgroups

- Here we check whether the results obtained previously, regarding the order in which individuals/households curtail their expenditures vary within a given country from one population subgroup to the other.

- We derived the Deprivation Sequence <u>for five population subgroups within each country:</u>

- <u>households with two adults or more with children</u>

- <u>households with two adults or more without children</u>

- <u>single households</u>

- <u>single households older than 65</u>

- <u>single households younger than 65</u>

The within-country rank correlation is above 0.6 for the vast majority of groups.

We can therefore conclude that the country Deprivation Sequence can be applied to the different population subgroups for the vast majority of subgroups.

Concluding Comments

- This paper aimed at taking a closer look at material deprivation in the various countries of the European Union, on the basis of a list of thirteen items which have recently been proposed to be used as indicators of material deprivation at the EU level.

- More precisely the goal of this study was to find out which expenditures households curtail first when facing economic difficulties.

- We used two methodologies: Item Response Theory and the Deprivation Sequence approach, a simple extension of an algorithm which originally aimed at detecting the order in which households acquire durable goods, as they get richer.

- Both methodologies show similar results when applied to EU-SILC data covering each of the Member States of the European Union.

- The deprivation pattern does not differ substantially *between* EU Member states.

- The rank correlation between countries and the heat maps show homogeneity between national rankings.

- Looking at *within* country variations, our analysis shows that the Deprivation Sequence of the country as a whole is very similar to that of the various population subgroups.

LONGITUDINAL DEPRIVATION SEQUENCE – BASIC IDEA

Two items, CS data – deprivation sequence: Holidays-Shoes

Holidays	Shoes
0	0
1	0
1	1

Two items, longitudinal data, two waves (Deprivation sequence: Holidays-Shoes)

WAVE 1		WAVE 2	
Holidays	Shoes	Holidays	Shoes
0	0	0	0
0	0	1	0
0	0	1	1
1	0	0	0
1	0	1	0
1	0	1	1
1	1	0	0
1	1	1	0
1	1	1	1

First results – 6 items available

	HOLIDAYS		EXPENSES		MEAL		WARM		ARREARS		CAR	
	CS	LONGI	CS	LONGI	CS	LONGI	CS	LONGI	CS	LONGI	CS	LONGI
EU	1	1	2	2	3	3	4	4	5	5	6	6
AT	2	2	1	1	3	3	6	6	4	4	5	5
BE	1	1	2	2	5	5	4	4	3	3	6	6
BG	2	2	3	3	4	4	1	1	5	5	6	6
CY	1	1	2	2	5	5	3	3	4	4	6	6
CZ	1	1	2	2	3	4	5	5	6	6	4	3
DK	2	2	1	1	4	4	6	5	3	3	5	6
EE	1	1	2	2	4	4	6	6	5	3	3	5
ES	1	1	2	2	6	5	4	4	3	3	5	6
FI	2	2	1	1	4	5	6	6	3	3	5	4
HU	2	2	1	1	3	3	6	6	4	4	5	5
IT	1	1	2	2	4	5	3	4	5	3	6	6
LT	2	2	1	1	3	4	4	3	6	6	5	5
LU	2	2	1	1	4	4	5	5	3	3	6	6
LV	2	2	1	1	3	3	6	6	5	5	4	4
MT	1	1	2	2	3	3	4	6	5	4	6	5
NL	2	2	1	1	6	5	5	4	3	3	4	6
PL	1	1	2	2	3	3	4	4	5	5	6	6
PT	1	1	3	3	5	6	2	2	6	5	4	4
RO	1	1	3	2	4	6	5	5	6	4	2	3
UK	2	2	1	1	4	5	3	4	5	3	6	6

Codes of the various countries in the European Union

Country	Code
Austria	AT
Belgium	BE
Bulgaria	BG
Croatia	HR
Cyprus	CY
Czech Republic	CZ
Denmark	DK
Estonia	EE
Finland	FI
France	FR
Germany	DE
Greece	EL
Hungary	HU
Ireland	IE
Italy	IT
Latvia	LV
Lithuania	LT
Luxembourg	LU
Malta	MT
Netherlands	NL
Poland	PL
Portugal	PT
Romania	RO
Slovenia	SI
Slovakia	SK
Spain	ES
Sweden	SE
United Kingdom	UK