

A prototype for the analysis of time use in Italy

Un prototipo di analisi sull'uso del tempo in Italia

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Abstract Our study focuses on a sub-sample of the Italian time use survey, where respondents are asked to evaluate to what extent each moment of the day is enjoyable. A mixture model framework is implemented to highlight the main components of the data generating process by which interviewees express their point subjective well-being (BESP) towards daily activities. A prototypical proposal is presented to understand interactions between individual evaluation of each activity and subjects' covariates.

Abstract *Lo studio approfondisce i risultati dell'Indagine sull'uso del tempo per un sottoinsieme di rispondenti individuando un modello mistura per la valutazione espressa dagli intervistati in merito al "Benessere Soggettivo Puntuale" (BESP). Il prototipo di analisi qui proposto consente di stimare l'effetto congiunto sulle risposte della natura dell'attività svolta e delle caratteristiche dei soggetti anche in termini di eterogeneità.*

Keywords: Time use survey, Point subjective well-being, Mixture models

1 Introduction

Our study aims to investigate people's moods and feelings towards daily activities, stemming from a sub-sample of the Italian time use survey, where respondents are asked to evaluate to what extent each moment of the day is enjoyable, the so-called *Point subjective well-being* (BESP). The following question is considered: "Is this

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a pleasant moment?”, taking into account the specific activity and the context. Preliminary results are provided exploiting a model to explicitly take into account both feeling and heterogeneity in response patterns and their relationships with activities and subjects’ characteristics.

The paper is organized as follows: in the next Section the survey design is briefly sketched; rationale for the prototype model-based approach are presented in Section 3; main results are interpreted in Section 4. Final considerations conclude the work.

2 Main survey features

Time use studies are an important section of current surveys in several contexts [4, 11, 10]. In Italy, time use survey is carried out five-yearly by Istat (the Italian National Institute of Statistics) as a part of an integrated system of social surveys, the Multipurpose Surveys on Households. Referred to the resident population in private households, it is a large sample survey (about 19,000 families and 45,000 individuals aged more than 11 years) whose core aim is to learn about the way each respondent allocates her/his time. Interviewees are asked to fill in a daily journal (24 hours, divided into 144 intervals, 10 minutes each), specifying their activities in detail [7]. The survey covers all daily life aspects which, in this study, have been clustered in 10 main activities: *personal care; job, education; houseworking; care-giving; social life; sport and leisure; games and hobbies; TV, radio and reading; travel*. In the following, reference is made to 2014 survey.

Exploratory results provide measures on the amount of time people use to spend in various daily activities on an average day of the year. In 2014 the average day of the population in Italy was as follows: 48.7% of 24 hours was dedicated to personal care (sleeping, eating, and so on), 8.8% to paid work, 3.6 % to study, 12.6% to houseworking, 21% to free time and 5.2% to travel (see [7] for more details).

For the first time, the 2014 survey measures the level of enjoyment associated with daily activities, rating the feeling on a scale from -3 to $+3$, with -3 meaning “not enjoyable at all” and $+3$ “very enjoyable”. Work and study turn out to be the least pleasant activities where leisure time is the most enjoyable one, although the rate is decreasing with age. Cultural activities, sports and outdoor leisure, social life, considered as a whole, made the day much more enjoyable.

In fact, individual, activity-related, and temporal dimensions should be jointly considered in a comprehensive model and this study explores such detailed information in order to propose a first probabilistic approach to examine survey results. Given the experimental nature of the proposal, a random sub-sample of 894 adult subjects is considered (aged over 20) and the activities are classified according to the above mentioned 10 groups. Then, individual characteristics as gender, age, education level, marital status, presence of children, number of household members and self-assessed economic condition, are registered. Finally, the day is considered as a working one or a public holiday.

3 Modelling framework for the affective component

A possible approach considers observed data on BESP as the realization of a process by which respondents choose ordinal ratings to denote perceived well-being when involved in each activity. These sequences of affective assessments are the results of a complex interaction of subjective, environmental and time-dependent circumstances. Then, as a first instance, it seems interesting to compute the probability of each rating as a function of the activity itself as well as of the individual characteristics by taking the ordinal structure of responses into account. As a matter of fact, for each i -th subject, a sub-sample of 12 responses –one per hour, out of 144 responses, picked in the time interval from 08 : 00 a.m. to 08 : 00 p.m. – has been selected. Thus, time effect and serial correlation are partially removed and (almost) conditional independence may be assumed.

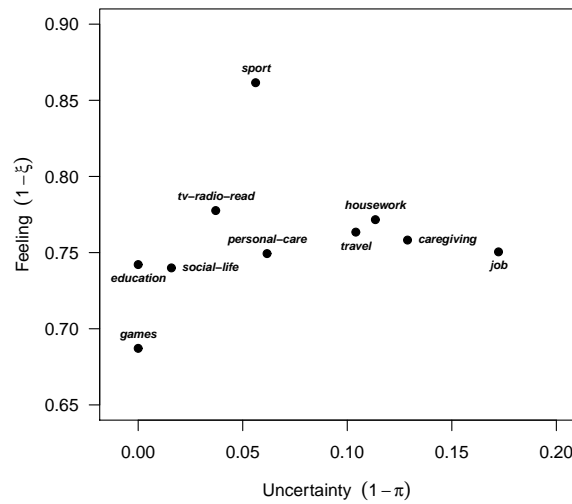


Fig. 1 Estimated models of the expressed enjoyment for different activities

A class of mixture models is applied to parameterize both *feeling* and *indecision/heterogeneity* components in the response pattern [8, 3, 9]; more extensive discussions of the approach –also in different contexts– are in [2, 1]. In particular, the parameters may be easily related to subjects' covariates and to the performed activity. By assuming conditional independence, all the observations may be considered as a whole. These models are estimated and checked by an R package available on the CRAN repository [6] and the visualization of the estimated distributions is an effective added value of the approach.

From a formal point of view, original response R_i^* are transformed into $R_i = R_i^* + 4$ in order to get the first $m = 7$ integers as support. Then, responses are linked to W_i subjects' covariates and A_k activities, for $i = 1, \dots, n$ and $k = 1, \dots, K$ by means of a logistic function.

Thanks to this structure, it is possible to visualize and compare the enjoyment declared by the sampled subjects in performing different activities in terms of both feeling and heterogeneity as in Figure 1. Sports and leisure are the most appreciated activities whereas games and hobbies get the lowest level of feeling. Other mandatory activities, such as those of caregiving and housework, travel and job (the latter with a comparatively higher level of heterogeneity) receive appreciation. In fact, heterogeneity in response patterns is very limited and feeling may be considered as the prominent component in this case study.

4 A more complex modelling structure

A more complex model implies that responses are considered as jointly conditional to the type of activity performed and subjects' characteristics. Thus, the basic model is:

$$Pr(R_i = r | W_i, A_{i,k}) = \pi b_r(\xi_{i,k}) + (1 - \pi) \frac{1}{m}, \quad r = 1, 2, \dots, m, \quad (1)$$

where $b_r(\xi_{i,k})$ is a shifted Binomial distribution, for $i = 1, 2, \dots, n$ and

$$\text{logit}(1 - \xi_{i,k}) = \gamma_0 + \sum_{j=1}^J \gamma_j w_{i,j} + \sum_{h=1}^H \delta_h A_{i,h},$$

Here, the dummy $A_{i,k} = 1$ if the i -th subject is performing the k -th activity in the selected sequences of responses. Then, the comparison between log-likelihoods of nested models (computed at maxima) solves in a likelihood ratio test (LRT) to infer on the significance of the covariates and/or the activities.

Table 1 Log-likelihoods and LRT of different models

Models	Log-likelihood	LRT	g
Benchmark	-17 196.91		
Activity dummies	-17 120.62	152.58	5
Subjects' covariates	-17 018.59	356.64	7
Omnibus	-16 959.35	475.12	11

Summarizing several intermediate steps, Table 1 reports such investigations and compares a benchmark model (a crude model of all the responses without covariates) with respect to: i) a model including only activities coded as dummies; ii) a model with only subjects' covariates and their possible interactions, if significant; iii) a comprehensive (*omnibus*) model where both subjective variables and activities

dummies are considered. LRTs are shown with their degrees of freedom (g) and all of them are highly significant.

From the model including only activities (here non reported for brevity), it turns out that :

- Activities gathered in the constant (that is: *personal care –mainly, meals–; job; education; caregiving; social life*) exert the prevailing effect on the responses;
- watching tv, listening to the radio and reading have positive effects on well-being;
- houseworking and sport activities positively affect response pattern;
- quite moderate is the role of mobility;
- playing games and hobbies have an adverse effect.

Although the consideration of activities significantly improves log-likelihood, the role of subjects' covariates is comparatively by far more relevant if considering LRT. Then, the joint specification of these explanatory components implies an *omnibus model* implemented with all the significant covariates, that is:

$$\left\{ \begin{array}{l} 1 - \hat{\pi} = 0.107 \\ \quad \quad \quad (0.006) \\ \text{logit}(1 - \hat{\xi}_i) = 0.838 + 0.080 \text{Act}1_i + 0.713 \text{Act}2_i - 0.350 \text{Act}3_i + 0.119 \text{Act}4_i \\ \quad \quad \quad (0.045) \quad (0.027) \quad (0.076) \quad (0.144) \quad (0.060) \\ \quad \quad \quad + 0.109 \text{Act}5_i + 0.191 \text{Gender}_i + 0.146 \text{Married}_i \\ \quad \quad \quad (0.029) \quad (0.035) \quad (0.035) \\ \quad \quad \quad + 0.272 \text{Holiday}_i - 0.013 \text{Education}_i + 0.070 \text{Components}_i \\ \quad \quad \quad (0.044) \quad (0.002) \quad (0.009) \\ \quad \quad \quad - 0.213 \text{Gender}_i \times \text{Married}_i, + 0.134 \text{Married}_i \times \text{Holiday}_i \\ \quad \quad \quad (0.045) \quad (0.057) \end{array} \right.$$

Here, significant activities are denoted as: Act1 (*houseworking*), Act2 (*sport and leisure*), Act3 (*games and hobbies*), Act4 (*Tv, radio and reading*), Act5 (*mobility*); as a consequence, the impact on the constant derives from all the other activities, Act0 (*personal care; job; education; caregiving; social life*). Thus, *ceteris paribus* with subjects' covariates, the impact on the enjoyment of the activities may be estimated as follows: Act0= 0.838; Act1= 0.919; Act2= 1.552; Act3= 0.489; Act4= 0.957; Act5= 0.947. It is confirmed that the largest and smallest contributions to enjoyment are given by *sport and leisure* and *games and hobbies*, respectively. Notice that holiday significantly impacts on the response with an additional +0.272 and a significant positive interaction with married people, estimated as 0.134.

The subjects' characterization influences the positive responses with respect to women, married people and household's components. Gender and marital status interact on the responses so that the final impact, *ceteris paribus*, is zero and 0.191 for unmarried men and women, respectively, and 0.146 and 0.124 for married men and women, respectively. Then, generally speaking, married women express lower enjoyment in their activities.

5 Concluding remarks

Time use survey is considered strategic for the knowledge of the population's life-time as it allows to detect everyday life organization in society and in families. Moreover, distributions of affective states, expressed through specific tasks and duties evaluation, provide valuable information on people's moods, in general and across different activities. When clustering population groups and specific activities, such an investigation may offer important complements to other measures of well-being.

According to these perspectives, to address and evaluate policy interventions, even in the fields of work-life balance and sustainability, the proposed modelling prototype is suitable to give useful insights to establish priority hierarchies at both individual and aggregated level. Thus, further research should be pursued to exploit the dynamic content of the expressed enjoyment during day as related to different activities. This objective might be achieved by generalizing the proposed models and including both longitudinal aspects and switching expressed modalities.

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