



A multinomial multilevel model for measuring continuity and regularity of the Italian museums opening

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Museums are widely spread all over the Italian territory and represent the major repositories of the national cultural heritage, whose preservation, enhancement and promotion are continuously supported and guaranteed. In the literature, various studies was proposed in order to investigate the visitors profile or to evaluate the managerial performance and economic efficiency of the museums, by considering different approaches and methods. Differently from these studies, the aim of this paper is to implement a multilevel multinomial model suitable to predict the probability of the museums schedule, which can be classified with respect to their opening times, namely all over the year, seasonally or occasionally. This model takes into account contextual factors and relevant determinants which can influence their regular opening. The ISTAT microdata regarding the Italian survey on the museums and cultural institutions, will be used. The obtained empirical evidence will provide useful hints for adopting optimal management strategies, which could be useful to promote and consolidate the image of the museums and to improve their performance and attractiveness.

Keywords: cultural heritage, museums, odds ratios, multilevel multinomial model, opening times.

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Abstract

Museums are widely spread all over the Italian territory and represent the major repositories of the national cultural heritage, whose preservation, enhancement and promotion are continuously supported and guaranteed. In the literature, various studies were proposed in order to investigate the visitors profile or to evaluate the managerial performance and economic efficiency of the museums, by considering different approaches and methods. Differently from these studies, the aim of this paper is to implement a multilevel multinomial model suitable to predict the probability of the museums schedule, which can be classified with respect to their opening times, namely all over the year, seasonally or occasionally. This model takes into account contextual factors and relevant determinants which can influence their regular opening. The ISTAT microdata regarding the Italian survey on the museums and cultural institutions, will be used. The obtained empirical evidence will provide useful hints for adopting optimal management strategies, which could be useful to promote and consolidate the image of the museums and to improve their performance and attractiveness.

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1 Introduction

The Italian cultural heritage is characterized by an extensive range of museums, which differ for institutional features, types of collection, geographical location, exhibition space, number of visitors and other important factors. The management and enhancement of museums and their cultural heritage have been receiving growing attention in recent years from the policy makers [5, 12, 1] and logistic approach has a key role [7], since it may support public and private museums in the strategic choices, in order to ensure effectiveness, efficiency and efficacy of functioning. In this context, the opening times and related costs represent a trade-off that the manager has to evaluate.

The focus of most of the works available in the literature was concentrated on empirical evidences of the specific dynamics related to museum visitors or to assess the managerial performance and economic efficiency of the museums [6]. Nevertheless, none of them put their attention on the specific factors regarding the museum management and in particular the factors that might influence the opening times.

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For this reason, the aim of this paper is to implement a multilevel multinomial model suitable to predict the probability of defining continuous, seasonal or occasional museums opening. Various contextual factors and relevant determinants which can influence their regular opening are considered. The impact of the type of institutions (public or private) and the existence of a network of museums on their opening choices are studied. The ISTAT microdata regarding the Italian survey on the museums and cultural institutions, are used. The obtained empirical evidence provide useful hints for supporting optimal management strategies, which could be adopted to promote and consolidate the image of the museums and to improve their performance and attractiveness.

After a brief review on multilevel modeling (Sect. 2), a description of the survey results regarding the opening times of the Italian museums is proposed and different multinomial multilevel logit models of the probability of respecting the decision to open all over the year, seasonally or occasionally are implemented and interpreted (Sect. 3).

2 Brief theoretical background on multinomial logistic regression model

The multilevel approach is a statistical methodology for the analysis of hierarchical data structure with complex patterns of variability [4, 11]. This structure classifies the cases into known groups, with their own set of explanatory variables at each group level. In the last few decades, various researchers have been demonstrating interest in the development of multilevel regression models, as shown by a variety of monographs [4, 11], together with their applications on a wide range of fields [2, 3, 9, 10]. In the following, a brief review of multinomial logistic regression model used in this paper, is proposed.

Multinomial logistic regression is a technique that basically fits multiple logistic regressions on a multi-category unordered response variable that has been dummy coded.

Let Y_{ij} be a multinomial response variable which takes values $s = 1, 2, \dots, S$ (response categories) and let x_{ij} be an explanatory variable for the i -th unit at level one and the j -th unit at level two.

The two-level multinomial logit model is given as follows [11]:

$$\log it(\pi_{ij}^{(s)}) = \eta_{ij}^{(s)} = \alpha^{(s)} + \beta^{(s)'} x_{ij} + \varepsilon_j^{(s)} + \delta_{ij}^{(s)}, \quad (1)$$

where

$$\pi_{ij}^{(s)} = P(Y_{ij} = s | x_{ij}, \varepsilon_j, \delta_{ij}) = \frac{\exp\{\eta_{ij}^{(s)}\}}{1 + \sum_{r=2}^S \exp\{\eta_{ij}^{(r)}\}}$$

corresponds to the response probabilities for each category s , whilst ε_j and δ_{ij} are vectors of random errors representing unobserved heterogeneity at the j -th unit at level two and the i -th unit at level one, respectively.

Note that the model (1), structured in two levels, can be easily extended to three or more levels.

The response variable Y_{ij} has a multinomial distribution, taking values in the set of categories $\{1, 2, \dots, S\}$, where $s = 1$ is the reference category for which all the parameters and the random errors are set to

zero and the conditional probability of $Y_{ij} = 1$ is $1/(1 + \sum_{r=2}^S \exp\{\eta_{ij}^{(r)}\})$. The model (1) consists of

$S - 1$ contrasts or sub-equations, one for each category apart from the reference one. In the model (1), each sub-equation has specific parameters $\alpha^{(s)}$ and $\beta^{(s)}$; moreover, $\varepsilon_j^{(s)}$ and $\delta_{ij}^{(s)}$ are vectors of random errors with the following distributional assumptions: a) the errors at different levels are independent; b) $\varepsilon_j' = (\varepsilon_j^{(2)}, \dots, \varepsilon_j^{(S)})' \sim N(\mathbf{0}, \mathbf{\Omega}_\varepsilon)$; c) $\delta_{ij}' = (\delta_{ij}^{(2)}, \dots, \delta_{ij}^{(S)})' \sim N(\mathbf{0}, \mathbf{\Omega}_\delta)$.

3 Data and methods

In this paper the microdata used in the analysis were collected from the ISTAT (Italian National Institute of Statistics) during a survey conducted in 2018 on the public and private museums located in Italy. In particular, the characteristics of each museum, classified with respect to different categories, such as management section, access and visits, type and stock of items, staff, financial resources, section of structures, support of fruition, activities and services, section of relationship with the territory, were recorded. The sample size is equal to 4,908 units (museums and similar institutions), of which 3,882 museums, galleries or collections (on which the study is concerned), 327 archaeological areas and parks and 630 monuments and monumental complexes as well as 69 ecomuseums. After excluding missing values, the data set used for the analysis includes 3,217 museums, galleries or collection (2,043 public and 1,174 private). Museum supply is widespread all over the country with one municipality out of three having at least a museum [8]. In particular, 48% of the total is located in the Northern regions, 28% in the Central regions and the remaining 24% in the Southern regions.

In this context, a multilevel approach has been applied by considering different variants of multinomial multilevel logit models in order to determine the probability of respecting the decision of the museums to open the whole year or seasonally or occasionally and taking into account contextual factors and relevant determinants which can influence their regular opening. These variants have been implemented in order to highlight the potential impact of the type of museum (public or private), the existence of a network of museums (concerning integrated management with other museums/institutions through formal acts based on the sharing of human, technological or financial resources) and the relationship with the territory on their opening choices.

In particular, three hierarchical levels have been introduced: *the first level*, that is the museums (3,217 museums); *the second level* corresponding to the Italian provinces where the museums are located (108 Italian provinces), *the third level*, referred to the Italian regions where the museums are placed (20 Italian regions). The choice of three hierarchical levels is justified from the natural hierarchical structure of the geographical distribution, where the regions are considered as the highest level, in which the cultural heritage can offer different opportunities; on the other hand, the museums represent the lowest level of nesting. A thorough descriptive analysis on ISTAT microdata has been performed on the museums schedules, as well as on their characteristics in terms of management, access, visits, staff, financial resources, structures, support of fruition, activities and services, relationship with the territory. The interest in the dynamics related to the decision of the opening times has led to estimate a three-level multinomial logistic model for the probability of fixing opening times which guarantee continuity, or alternatively which include other flexible schedule forms, namely seasonal or occasional opening. The multinomial structure of the model enables the discernment of the different effects that both museums and regional characteristics might cause on the three abovementioned alternatives of opening times. On the basis of this exploratory data analysis, the following covariates have been selected and recoded for computational purposes: access absolutely free or with admission fee; discounted rates (reduced tickets) for the following categories of museum visitors: children (up to 12 years), teenagers (13-17 years), young people (18-25 years), seniors (over 65 years), families, school pupils; availability of exhibition spaces (in square meters); dedicated rooms/laboratories for teaching, study, research and/or conference activities; total number of visitors; percentage of Italians and Foreigners, as well as percentage of young people between 18 and 25 and seniors over 65 who have visited the museum, systematic or occasional satisfaction campaigns in the last five years, presence of specific professional figures for educational services, for public relations, promotion, marketing, fundraising, for IT services (digitalization, web, etc.), private loans (sponsorships, contributions from former banking foundations, donations, etc.) or income deriving from additional services to the public (concessions, royalties, etc.) and a derived variable recoded in order to evaluate the level of digitization of Italian museums, based on the presence of a digital inventory, a digital catalogue, video and audio-guides, applications dedicated for smartphones and tablets, interactive installations and/or virtual reconstructions (touch screen tables, videos), QR Code and/or proximity devices (Bluetooth, Wi-Fi, etc.), tablets available for the visitors,

immersion video/multimedia rooms, free Wi-Fi connection, dedicated website, online ticketing service, digital catalogue accessible online, virtual tours online, social media accounts (Facebook, Twitter, Instagram; Pinterest; Foursquare, etc.), link to digital maps and/or geographic coordinates for the location of the museum.

On the basis of the modeling results, it was underlined that the predicted probabilities associated to the museums schedule is higher for those museums included in a network, as well as for the museums which have built relationship or partnership with other public or private cultural institutions over the territory. The variability in the probability of defining continuous, seasonal or occasional museums opening depends more on differences between the region-level rather than the province-level. The prominent factors which might stimulate the continuity and regularity of the Italian museums opening depend on the nature of access, the reduced tickets, as well as the presence of relationship over the territory. The obtained empirical findings will be useful for adopting optimal management strategies, in order to promote and consolidate the image of the museums and to improve their performance and attractiveness.

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