



Quality Score of Municipal Management in Environment

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Abstract

In this paper was used a model of the Item Response Theory (IRT) to estimate a quality score of municipal management environment. The database of the Survey of Basic Municipal Information of the year 2013 was used for the model fit, considering 19 items related to actions/planning in the environmental area. The score was estimated for the Brazilian municipalities that have implemented an initiative on sustainable consumption area. It was possible to identify what items that more contribute to improve environmental management in municipalities, with emphasis on the implementation in partnership of the following actions: *Collective educator, Green Room, Circuit Green Screen, Children and Youth Conference for the Environment and environmental sustainability of the institutions public, such as the Environmental Datebook in the Administration-A3P*. The three cities with better environmental management were: Quixeramobim-CE, Fortaleza-CE and Itaguaje-PR. The 19 municipalities that presented the lowest score in environmental management are distributed in the five Brazilian regions: Northeast, with 11 municipalities, South with 4 municipalities, Central West region with 2 municipalities and the North and Southeast with only one municipality.

Keywords: item response theory, quality score, environment.

1. Introduction

The database of the Survey of Basic Municipal Information (MUNIC) of the Brazilian Institute of Geography and Statistics (IBGE), collected from March to December 2013, has as main objective to get information on the structure, dynamics and the functioning of municipal public institutions in Brazil in several areas (CAVARARO, 2013). In this work, the relative information to the Brazilian municipal management in the environmental area was used.

Thus, with purpose to estimate a quality score in the management environment of Brazilian municipalities (EQGMAM), was used a model of Item Response Theory (IRT), suitable tool for estimating the scores associated with latent characteristics (ANDRADE et al., 2000). It is common in many areas of knowledge the need to assess performance, behavior, productivity, among others, through of building some indicator. Many of these aspects cannot be measured directly, requiring the use of factors (items) related to the same, and some way to extract the information contained in items on the indicator of interest. IRT models allow the estimation of indicators from the answers given to the items.

2. Methodology

Statistical models of IRT have been widely reported in the media because of their use in the educational assessment. Although this is best-known application, IRT models can be used in various areas of knowledge requiring the construction of latent measures (not observed directly), as satisfaction degree, performance indicators or management, pain intensity, quality score in product, among others. These models consider the responses given to items directly related to latent measure of interest, using a statistical model that relates the probability of a particular response to a certain item with parameters associated with this item and the latent measure.

In this study was used the Two Parameters Logistic Model (2LM), which is indicated in the presence of dichotomous items of type *Right/Wrong* or *Yes/No* or *agree/disagree*, among others. It was considered 21 items observed in MUNIC 2013 related to actions and planning of the municipalities in the environmental management. Available data contained information of 5,570 Brazilian municipalities, but were used in the estimation of EQGMAM only 2,286 municipalities that implemented some initiative on sustainable consumption area. The ML2 present the probability of a municipality j , answer positively to the item i as a function of their EQGMAM θ_j , the power of discrimination a_i and the degree of difficulty b_i of item i . This model is expressed by

$$P(U_{ij} = 1) = \frac{1}{1 + e^{-Da_i(\theta_j - b_i)}}, \quad i = 1, \dots, 21; \quad j = 1, \dots, 2.286. \quad (1)$$

The model estimation process above consists in estimate the parameters (a_i, b_i) for each item and scores θ_j for each municipality. In this study we used the R programming environment (Available at: <<http://www.R-project.org>> Access: December 2014).

3. Results

After initial adjustment of the model in (1), two items were excluded from the analysis because they presented a low correlation to score. Thus, 19 items were used. Table 1 presents the estimates of the parameters a_i and b_i associated with each item and the proportion of positive responses on the implementation of the actions/planning considered. The parameter a_i indicates discrimination or slope of item, that is, its power to discriminate between the municipalities of highest and lowest score in environmental management. The parameter b_i , estimated on the same scale of score, indicates the degree of difficulty of the item. That is, items more "difficult" are those in which municipalities of highest score in the management will be more likely to answer affirmatively. These estimates were initially obtained in the scale (0,1), that is, with mean zero and standard deviation one, but later were transformed linearly to the scale (250, 50), with purpose to avoid negative values for the score.

It is observed that the items with the highest parameter of difficulty were the items 20 (*Implement initiative using environmental criteria in purchasing or public competition*) and 17 (*Implement initiative for reducing the use of plastic bags*), indicating that the municipalities with the highest EQGMAM have more probability to offer this service. Now the item 6 (*part of river basin committee*) was the more "easy", indicating that the low and high municipalities score have high probability to answer it affirmatively.

Items 15 (*Party of any meeting of the Interagency Commission for Environmental Education (CIEA) or similar in the last 12 months*), 14 (*The municipality participates Interagency Environmental Education Commission (CIEA) of state or similar scope*), 10 (*Implement in Partnership: Circuit Green Screen*) and 13 (*Implement in partnership: Environmental sustainability of public institutions such as the Environmental Datebook in the Administration-A3P*) showed the highest values the a_i parameter, that is, these items have highest power of discrimination.

Table 2 presents the summary measures of the estimated score, already updated to the scale (250, 50). It was observed a mean score of approximately 250 with a standard error of 0.88, a

maximum value of 408.13 and minimum 160.82. Figure 1 shows the histogram of EQGMAM, suggesting the existence of groups of municipalities. After a categorization, five groups of municipalities were formed: Group 1 (EQGMAM <200) with 266 municipalities, Group 2 (200 ≤ EQGMAM <240) with 598 municipalities, Group 3 (240 ≤ EQGMAM <282) with 936 municipalities, Group 4 (282 ≤ EQGMAM <365) with 477 municipalities and Group 5 (EQGMAM ≥ 365) with 9 municipalities. To check if there is differences in mean scores between groups was performed an *Analysis of Variance (ANOVA)* using the Welch test, yielding p-value <0.001, therefore it is concluded that there are significant differences in the mean of groups. To verify that the groups differ between them, the Games Howell test was performed for multiple comparisons, resulting in the smallest p-values 0.001 in all comparisons, so all groups are different between them.

Table 1 - Percentage of affirmative responses from 2,286 municipalities to considered items, actions and planning in environmental management, with the parameter estimates of the items.

Items	Description of Items	Yes	a_i	b_i
1	Municipal Environmental Council - existence	74,72%	1,369	-1,055
2	Municipal Environmental Fund. - existence	49,34%	1,164	0,036
3	Began the process of preparing the Local Datebook 21	26,55%	1,128	1,126
4	Local Datebook 21 Forum held a meeting place in the last 12 months	7,39%	1,549	2,183
5	Specific legislation to deal with environmental issues	73,93%	1,372	-1,014
6	Take part in watershed committee	80,01%	0,567	-2,606
8	Implement in partnership: Collective educator	5,91%	1,286	2,654
9	Implement in partnership: Green Room	8,92%	1,337	2,208
10	Implement in partnership: Circuit Green Screen	2,54%	1,949	2,652
11	Implement in partnership: Children and Youth Conference for the Environment	12,47%	1,285	1,925
12	Implement in partnership: Environmental Education in Solid Waste Management Plan	33,46%	0,932	0,875
13	Implement in partnership: Environmental sustainability of public institutions such as the Environmental Datebook in the Administration-A3P	9,27%	1,939	1,778
14	The district participates in the Interagency Commission for Environmental Education (ICEE) of state or similar scope	11,99%	1,967	1,567
15	Participate in any meeting of the Interagency Commission for Environmental Education (ICEE) or similar in the last 12 months	9,36%	2,195	1,681
16	The district has Plan of Integrated Solid Waste Management in the terms established in the National Policy on Solid Waste	41,21%	0,754	0,535
17	Implements initiative to reduce the use of plastic bags	40,03%	0,134	3,031
18	Implements initiative for the environmental sustainability of public institutions such as the Environmental Datebook in the Administration-A3P	18,24%	0,851	2,008
19	Implements initiative to reduce water consumption or electricity	47,81%	0,123	0,716
20	Implements initiative using environmental criteria in purchasing or public competition	19,03%	0,306	4,824

Table 2 - Descriptive the Quality Score Municipal Management Environment

	N	Minimum	Maximum	Mean	EP of Mean	DP	Variance
EQGMAM	2286	160,82	408,13	250,00	0,88	42,32	1790,90

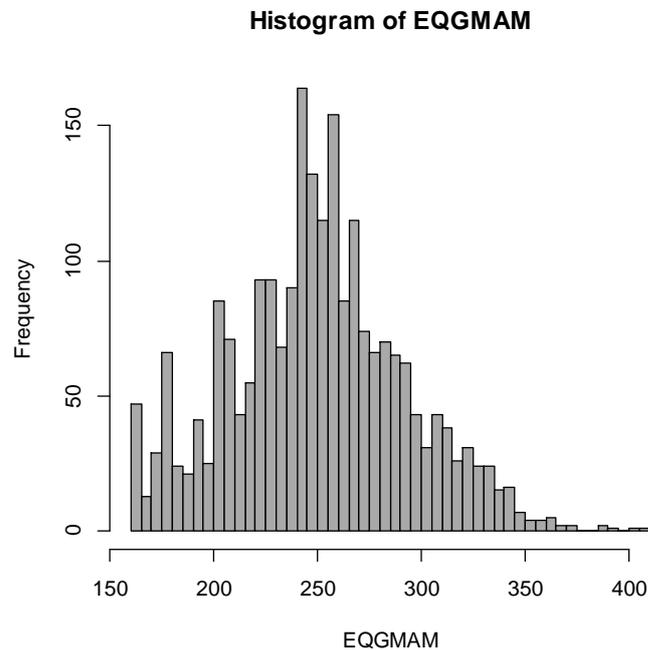


Figure 1 - Histogram EQGMAM: Quality Score Municipal Management Environment.

Group 5 was formed by 9 municipalities with the highest scores (better environmental management), and the municipalities of Quixeramobim-CE, Fortaleza-CE and Itaguaje-PR who presented the highest scores: 408.13, 403.32 and 394.42, respectively.

In group 1, formed by the 266 municipalities with the lowest score, the 19 municipalities that presented the lowest score in the management environment with common value of 160.82. These municipalities are distributed in the five Brazilian regions: Northeast with 11 municipalities, South 4 municipalities, Central West region with 2 municipalities and the North and Southeast with only one municipality.

Table 3 shows the percentage of positive responses of the municipalities of groups 1, 2, 3, 4 and 5 to 19 items considered in the study. With this, you can know what actions/planning should be implemented by municipalities of groups 1, 2, 3 and 4 to increase your EQGMAM and to enable their participation in group 5. In this sense highlighted the implementation in partnership of the following actions: *Collective educator, Green Room, Circuit Green Screen, Children and Youth Conference for the Environment and environmental sustainability of public institutions such as the Environmental Datebook in the Administration-A3P.*

4. Conclusions

With the adjusted model was possible to identify the actions that should be a priority for municipal managers, in order to obtain better quality in environmental management, as well to identify the behavior of each of the items considered in the model. These results may contribute to the development of public policies, giving direction for the proper use of environmental resources.

Table 3: Affirmative Response Percentage of Municipalities of Groups 1, 2, 3, 4 and 5 to 19 Items Considered in the Study.

Items	Group 1 (%)	Group 2 (%)	Group 3 (%)	Group 4 (%)	Group 5 (%)
Municipal Environmental Council - existence	4,51	63,88	92,31	92,45	100,00
Municipal Environmental Fund. - existence	1,13	17,22	68,91	77,36	88,89
Began the process of preparing the Local Datebook 21	6,02	9,03	24,89	62,05	88,89
Local Datebook 21 Forum held a meeting place in the last 12 months	0	0,50	4,06	25,58	66,67
Specific legislation to deal with environmental issues	6,02	61,20	91,35	93,08	100,00
Take part in watershed committee	46,99	76,09	87,82	87,63	100,00
Implement in partnership: Collective educator	0	1,00	4,06	17,40	88,89
Implement in partnership: Green Room	0,75	1,00	6,09	27,25	100,00
Implement in partnership: Circuit Green Screen	0	0	0,21	10,48	66,67
Implement in partnership: Children and Youth Conference for the Environment	0,38	3,34	8,65	36,48	100,00
Implement in partnership: Environmental Education in Solid Waste Management Plan	8,65	16,72	34,51	65,41	77,78
Implement in partnership: Environmental sustainability of public institutions such as the Environmental Datebook in the Administration-A3P	0	0,33	3,53	35,43	88,89
The district participates in the Interagency Commission for Environmental Education (ICEE) of state or similar scope	0	0,84	4,81	45,07	100,00
Participate in any meeting of the Interagency Commission for Environmental Education (ICEE) or similar in the last 12 months	0	0	2,67	37,74	100,00
The district has Plan of Integrated Solid Waste Management in the terms established in the National Policy on Solid Waste	11,28	26,42	45,83	66,46	88,89
Implements initiative to reduce the use of plastic bags	39,85	35,28	39,74	46,12	66,67
Implements initiative for the environmental sustainability of public institutions such as the Environmental Datebook in the Administration-A3P	6,77	7,69	16,24	40,46	88,89
Implements initiative to reduce water consumption or electricity	46,24	42,47	48,18	54,30	66,67
Implements initiative using environmental criteria in purchasing or public competition	12,41	15,38	19,34	26,00	55,56

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