



## Commitment of Brazilian municipalities with the Millennium Development Goals by a model of the Item Response Theory

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### ABSTRACT

In 2000 the UN (United Nations) signed with its member countries the agreement of the millennium declaration, consisting of universal commitments to solve the world's major problems. For this, the objectives were set for the millennium development to be achieved until 2015. This study aimed to get an appointment score of 2,148 Brazilian municipalities that joined this datebook appointment, using the basic information from search database municipals (MUNIC) conducted in 2013 by the Brazilian Institute of Geography and Statistics. Estimates of these scores were obtained by the Item Response Theory (IRT), an excellent tool for the estimation of scores associated with latent variables. The IRT is based on responses given to factors (items) related to this variable of interest, and a model to extract the information contained in items on it. The scores obtained was based on 12 items and categorized into 4 levels, leading to the formation of 4 groups of municipalities. The municipalities that have joined to datebook are distributed in 5 geographical regions: North Region (9.7%), Northeast Region (35.9%), Southeast Region (26.5%), South Region (19.9%) and Central West Region (7.9%). The highest score was observed in 337 municipalities, distributed for the regions: North Region (17.2%), Northeast Region (15.7%), Southeast Region (16.5%), South Region (12.1 %) and Central West Region (20.1%). The lowest score was observed in 4 municipalities: Santo Antônio-RN, Santa Bárbara-MG, Mercedes-PR and Nova Lacerda-MT. The 4 items that more contributed to the estimation of the score were: *Combat HIV/AIDS, Malaria and other diseases* (item 6), *reducing child mortality* (item 4), *improve maternal health* (item 5) and *promote Gender equality and Empowerment women* (item 3). For the characterization of the municipalities is possible to assess that policies should be prioritized by municipal managers, mainly for municipalities in Group 1 (those less commitment), so that they can improve their commitment score. In group 1, there are few municipalities committed to the *Combat HIV/AIDS, malaria and other diseases and the promotion of gender equality and the empowerment of women*.

Keywords: Millennium goals, commitment score

### 1. Introduction

In New York from 6 to 8 September 2000, heads of State and Government Gathered during the Millennium Summit organized by the United Nations (UN) listed the 8 Millennium Development Goals (MDGs), namely : *Eradicate poverty and hunger* (MDG1), *Quality basic education for all* (MDG2), *Gender equality and Empowerment women* (MDG3), *Reduce child mortality* (MDG4), *Improve maternal health* (MDG5), *Combat HIV/AIDS, Malaria and other diseases* (MDG6), *Environmental sustainability* (MDG7) and *Global partnership for development* (MDG8). This would require more effort and a strong global partnership for development to accelerate progress and achieve the goals by 2015 (In: <<http://www.un.org/en/ecosoc/about/mdg.shtml>>. Accessed on: February 02, 2015).

According to the survey of municipal basic information (MUNIC/2013) of the Brazilian Institute of Geography and Statistics (IBGE) held in 2013, only 56.5% of the managers of the 5,570 Brazilian municipalities reported having knowledge of the commitments agenda of the Millennium Goals, representing 3,149 municipalities. Of these, 2,148 municipalities (68.2%) have joined the agenda (In: <[ftp://ftp.ibge.gov.br/Perfil\\_Municipios/2013/munic2013.pdf](http://ftp.ibge.gov.br/Perfil_Municipios/2013/munic2013.pdf)>. Accessed on: February 02, 2015).

In this study will be used the database of MUNIC/2013 to estimate a score of commitment of 2,148 Brazilian municipalities that joined the agenda of the Millennium Goals, by the Two Parameters Logistic Model of the Item Response Theory (IRT) (ANDRADE, *et al.* 2000). Assigning scores to municipal managers who joined the commitments agenda allow the identification of the municipalities with higher and lower score of commitment to a new millennium, and contribute to the development of public policies for more and better municipal membership.

## 2. Materials and Methods

This study included 12 dichotomous items to adjusting the Two Parameters Logistic Model (2LM) of IRT, related to commitments made by municipal managers that joined the Millennium agenda. Affirmative/negative responses from managers were obtained from the database of MUNIC/2013. Four items that have more than two response categories were dichotomized to adjust the ML2. Was considered as latent variable the score of commitment of the managers the Millennium Development Goals (SCMDG). The 2LM is given by

$$P(U_{ij} = 1 | \theta_j) = \frac{1}{1 + e^{-D a_i (\theta_j - b_i)}} \quad (1)$$

and represents the probability of the municipality  $j$ , with commitment score  $\theta_j$ , answer affirmatively to the  $i$ -th item, where  $a_i$  is the discrimination parameter of the item  $i$ , and  $b_i$  is the parameter of difficulty of item  $i$ , measured on the same scale of the score  $\theta_j$ , and  $D$  is a constant scale factor and equal to 1. It uses the value of 1.7 when it is desired that the logistic function to provide results similar to the standard normal distribution. It is observed in (1) that the greater the commitment scores of municipal managers with the millennium development goals, the greater the probability of an affirmative answer to the item.

The estimation process of item parameters,  $(a_i, b_i)$ , to  $i = 1, 2, \dots, 12$ , and  $\theta_j$  scores for 2,148 Brazilian municipalities was implemented in R software (In: <<http://www.r-project.org/>>. Accessed on: January 27, 2015). These estimates were initially obtained in the scale (0,1), with mean score zero and standard deviation one. Later, they were standardized by a linear transformation to the scale (250, 50) in order to avoid negative values for the commitment score.

## 3. Results

Table 1 shows the percentage of affirmative responses from managers about their commitment to each of the 12 goals (items) considered in the study, the Biserial correlation ( $\rho_B$ ) between each item and the score, and the parameter estimates of the items on the scale (0, 1). Item 2, commitment to offering "Universal Primary Education", presented the highest percentage of positive responses among the 2,148 municipalities. Items 6, 4, 5 and 3, respectively, were more correlated with the commitment score, being them the most contributes for your estimation.

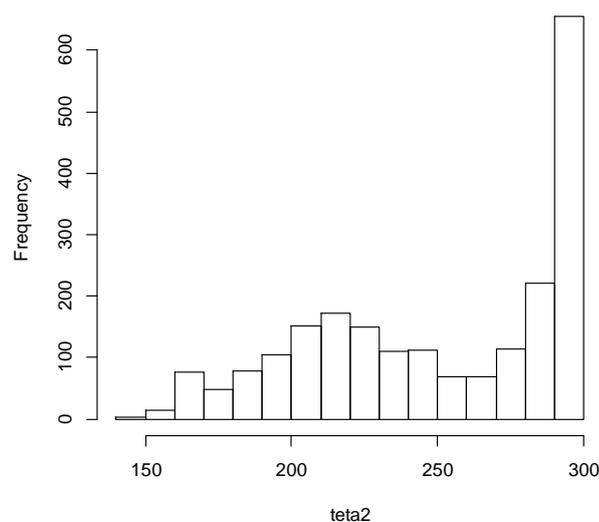
Item 12, commitment to present "*another form of monitoring and assessment related to the Millennium Development Goals*", was answered affirmatively by only 42.2% of the municipalities. This item also stands out for having presented the lowest power to discriminate ( $a_i$ ) between the municipalities of smaller and higher scores, and be the "more difficult" (higher value  $b_i$ ), that is, only the municipalities of highest score have high probability of answering it affirmatively.

Item 6, commitment to "Combat HIV/AIDS, Malaria and other diseases," presented the highest power to discriminate (higher value  $a_i$ ), and item 9, commitment to "allocate people and resources to the planned actions", was the "easier" (lower value of  $b_i$ ), that is, the municipalities of high and low scores have a high probability of answering it affirmatively.

The estimated commitment scores for the 2,148 municipalities are presented on the scale (250, 50) in the histogram in Figure 1. These scores were categorized into 4 levels, forming 4 groups of municipalities. Figure 2 presents a characterization of the municipalities in each group, according to the items considered in the study.

**Table 1:** Percentage of positive responses and parameter estimates for the twelve items related to the commitment of municipal managers with the millennium development goals.

	Items	Yes (%)	$\rho_B$	$a_i$	$b_i$
1	Erradicate poverty and hunger ;	78,1	0.599	1,854	-1,081
2	Universal Primary Education;	<b>91,9</b>	0.678	2,288	-1,758
3	Gender equality and Empowerment women ;	<b>62,8</b>	<b>0.737</b>	2,919	-0,423
4	Reduce child mortality ;	76,8	<b>0.762</b>	3,264	-0,871
5	Improve maternal health;	82,8	<b>0.745</b>	3,127	-1,111
6	Combat HIV/AIDS, Malaria and other diseases;	65,4	<b>0.776</b>	<b>3,690</b>	-0,488
7	Environmental sustainability;	83,5	0.631	1,808	-1,360
8	Global partnership for development;	71,1	0.518	1,288	-0,934
9	There is allocation of people and resources for the planned actions;	84,6	0.325	0,454	<b>-3,916</b>
10	There is social participation (participation of councils, committees, etc.) to monitoring the actions provided in the datebook;	79,5	0.342	0,401	-3,488
11	There is action plan to achieve (s) goal (s) used (s) in the datebook;	67,9	0.281	0,337	-2,287
12	There is another way of monitoring and evaluation related to the Millennium Development Goals;	<b>42,2</b>	0.188	<b>0,297</b>	<b>1,086</b>



**Figure 1:** Histogram the score of commitment of the municipalities with the Millennium Development Goals (SCMDG).

**Figure 2:** Characterization of the municipalities in each group according to the percentage of positive responses to the items.

Groups	% of municipal managers committed to the goal of:
<p style="text-align: center;">Group 1 SCMDG <math>\leq</math> 213.2 540 municipalities</p>	<ul style="list-style-type: none"> <li>• 44,3% - ending hunger and misery;</li> <li>• 73,1% - quality basic education for all;</li> <li>• <b>9,8%</b> - promote equality between sexes and empowerment women;</li> <li>• 24,1% - Reduce child mortality;</li> <li>• 39,4% - Improve pregnant health;</li> <li>• <b>6,1%</b> - Combat HIV/AIDS, malaria and other diseases;</li> <li>• 54,8% - promote quality of life and respect for the environment;</li> <li>• 43,1% - has everybody working for development;</li> <li>• 77,4% - allocate people and resources to the planned actions;</li> <li>• 72% - have social participation to monitor the actions provided for in the datebook;</li> <li>• 58,9% - there is an action plan to achieve targets set in the datebook;</li> <li>• 33,5% - have another form of monitoring and evaluation related to the Millennium Development Goals;</li> </ul>
<p style="text-align: center;">Group 2 213.2 &lt; SCMDG <math>\leq</math> 254.2 534 municipalities</p>	<ul style="list-style-type: none"> <li>• 72,1% - ending hunger and misery;</li> <li>• 94,9% - quality basic education for all;</li> <li>• 41,9% - promote equality between sexes and empowerment women;</li> <li>• 83,5% - Reduce child mortality;</li> <li>• 92,1% - Improve pregnant health;</li> <li>• 55,6% - Combat HIV/AIDS, malaria and other diseases;</li> <li>• 80,9% - promote quality of life and respect for the environment;</li> <li>• 53,6% - has everybody working for development;</li> <li>• 84,5% - allocate people and resources to the planned actions;</li> <li>• 79,4% - have social participation to monitor the actions provided for in the datebook;</li> <li>• 68,9% - there is an action plan to achieve targets set in the datebook;</li> <li>• 41,4% - have another form of monitoring and evaluation related to the Millennium Development Goals;</li> </ul>
<p style="text-align: center;">Group 3 254.2 &lt; SCMDG <math>\leq</math> 291.7 469 municipalities</p>	<ul style="list-style-type: none"> <li>• 95,7% - end hunger and misery;</li> <li>• 99,8 % - to ensure quality basic education for all;</li> <li>• 98,1 % - promote quality of life and respect for the environment;</li> <li>• 86,1% - have everyone working for development;</li> <li>• 73,3% - allocate people and resources to the planned actions;</li> <li>• 61,6% - have social participation for monitoring the actions set out in the datebook;</li> <li>• 35,8% - there is an action plan to achieve targets set in the datebook;</li> <li>• 35,6% - have another form of monitoring and evaluation related to the Millennium Development Goals;</li> <li>• 100% - commitment to all other goals.</li> </ul>
<p style="text-align: center;">Group 4 SCMDG &gt; 291.7 605 municipalities</p>	<ul style="list-style-type: none"> <li>• 55,7% - have another form of monitoring and evaluation related to the Millennium Development Goals;</li> <li>• 100% - commitment to all other goals.</li> </ul>



The 2,148 municipalities that have joined the datebook are distributed in 5 geographic regions: North (9.7%), Northeast (35.9%), Southeast (26.5%), South (19.9%) and Central West Region (7.9%). The highest score was 299.33, observed in 337 municipalities, distributed in regions: North Region (17.2%), Northeast (15.7%), Southeast (16.5%), South Region (12.1%) and Central-West (20.1%). The lowest score was 147.35, observed in 4 municipalities: Santo Antonio-RN, Santa Barbara-MG, Mercedes-PR and Nova Lacerda-MT.

#### 4. Conclusions

With the adjustment of the IRT model was possible to know the 4 items that more contributed to the estimation of the score: *Combat HIV/AIDS, Malaria and other diseases* (item 6), *reducing child mortality* (item 4), *improve maternal health* (item 5) and *promote Gender equality and Empowerment women* (item 3). For the characterization of the municipalities is possible assessing what policies should be prioritized by managers, mainly the municipalities of groups 1 and 2, so that they can improve their commitment score. In group 1 there are few municipalities committed with the *combat against HIV/AIDS, malaria and other diseases and the promotion of equality between sexes and the empowerment of women*.

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