Disabilities people: Investigation with use of the stereotype ordinal regression, variables and models selection for Brazil and São Paulo, Distrito Federal and Roraima states.

Paulo Oliveira*
IME-USP, São Paulo, Brazil – poliver@usp.br

Abstract

In his work, was applied crossings between pairs of variables, homogeneity test; stereotype ordinal regression, variables selection by the Wald Statistics, calculate the risk probability, and, by finally; models selection by the criteria AIC (Akaike Information Criterion), BIC (Bayesian Information Criterion) and DIC (Deviation Information criterion) second sample each of the following deficiencies: see, listen, move and mental from dataset obtained from the 2010 Population Census data sample (respondents Complete the Questionnaire) formed by 20,635,472 people interviewed all over the country with the objective of studying relationship between different variables such as disability, level of education, gender, income in minimum wages among others, and; comparative studies among the following states: São Paulo, Distrito Federal and Roraima.

Keywords: Keywords: stereotype ordinal regression, variables section, models selection, homogeneous groups.

1. Introduction

It is currently regarded as a fact that has always existed throughout history disabilities people (Silva, 1986; Carvalho, 2001). Gradually, societies perceive that beyond the charity and assistance, such persons should be included in programs and policies that could enhance their productive potential (Silva, 1986; Domingos, 2006; Figueira, 2008). In fact, the very disabilities people were showing signs that they could and wanted to study, work and be fully included in society (Gaspar, 2010).

According to the World Health Organization (WHO), it is estimated that more than a billion people live with some form of disability, about 15% of the world population (based on 2010 estimates). This is lower than the estimates coming from IBGE, which also date back to 2010 and suggest that approximately 23.9% of Brazil's population, represented by 45.6 million, are people with at least one disability 6.9% being for serious cases that represent 13.1 million approximately.

Deficiency: still considered to be a universal challenge with social and economic costs for individuals, families, communities and nations; varies according to a complex combination of factors including age, sex, exposure to environmental hazards, economic status members, culture and available resources; are associated with chronic health problems; global aging; and finally; disabilities people and households with a member with disabilities face the worst economic and social realities, comparing to people who does not have a disability.

Disability is characterized as a complex multidimensional experience, impose many challenges of measurement. Approaches to measuring disability vary between different countries and influence the results. The operational measures of disability vary according to the purpose and application of the data, the design deficiency, aspects of disability that examines: impairments, limitations to perform certain activities, restrictions to participate in activities, related health problems, factors environmental - definitions, types of issues raised, information sources, data collection methods and operating expectations.

In statistical terms, shows that there are few studies in formal terms, among which we highlight the data obtained from the census, which enables questions: How people with disabilities are distributed throughout the country? How to evaluate their access in terms of the various services mentioned above? How is the development of disabled people by comparing them with those without disabilities? Different disabilities are homogeneous? What are the variables that contribute most to the cases of disabilities? There is a national registry of disabilities persons? Response to these and other questions in statistical

terms may possibly contribute to better support these people in order to be better assisted and resources are better managed and optimized by the actions of public policies in this area.
Already, according to WHO, in statistical terms, we must improve national statistics on disability, improve the comparability of data at national and international level, and finally; develop appropriate tools and fill gaps between the different surveys.
In this work, we applied the homogeneity test for checking the severity degree of disabilities types of the visual importance and stereotype ordinal logistic regression (Oliveira, 2014a).
Selections of the variables for to choose a subset of the variables that retains the most important predictor variables and models that "best fit" the data of a certain experiment according to a given criterion adopted (Oliveira, 2008; Oliveira et al., 2014b).
Epidemiology is the science that studies patterns of occurrence of a particular disease or disability in human populations (Liliensfeld, 1980) and the application of these studies in the control of health problems and disabilities.
Among the main objectives of epidemiology, we can mention: to identify the cause of illness or disability and relevant risk factors; determine the extent of illness or disability in the community; define the natural history of disability or illness quantitatively; evaluating preventive and therapeutic measures, and, finally; provide basis for the development of public policies related to environmental problems, genetic and other nature with regard to prevention and health promotion and reduction of disability-related issues. (Gordis, 2009)
Epidemiological risk can be defined as the probability of occurrence of an event related to health or any person becomes disabled person.
In this paper, we will define terms like risk, epidemiological risk and epidemiology, and will use the stereotype ordinal logistic regression model (variable response that has three or more categories), variable selection using test forward likelihood ratio and models using criteria AIC, BIC and DIC (Hosmer and Lemeshow, 1989; Oliveira, 2013).
The main objective in this work is to show possible heterogeneity among Brazil and states Roraima, São Paulo and Distrito Federal using the techniques homogeneity testing and stereotype ordinal logistic regression.

2. Materials and Methods

2.1. Motivation

To be able to include people with disabilities, it is necessary, first of all, more accurately estimate what would be the amount of people who find themselves in these conditions for each of the different disabilities, how they live and where they live, and an alternative in this case, was to consider the database obtained from census 2010 for the Sample Questionnaire, and, according to this same census estimates, it is believed that there are 45,606,048 people in Brazil with at least one permanent disability, representing approximately 23 9% of all the population.

2.2. Epidemiology

According to the IEA (International Epidemiology Association) defines epidemiology as the study of the factors that determine the frequency and distribution of diseases in human communities.
According Suser (1987), the epidemiology is essentially a population science, which is based in the social sciences for understanding the structure and social dynamics, mathematical statistics to notions of probability, inference and estimation and biological sciences to the knowledge of the substrate organic where demonstrations observed find individual expression.
Driven by the growing complexity and considering the scope of its current practice, a single definition is not in need of epidemiology as a scientific field. In simple terms, we can conceptualize it as:
Science that studies the health-disease in society, analyzing population distribution and determinants of risk factors, diseases, injuries and events linked to health, proposing specific measures to prevent, control or eradication of disease, injury or health problems and protection, promotion or recovery of individual and collective health, producing information and knowledge to support decision making in planning, management and evaluation systems, programs, services and health care (Almeida Filho and Ronquayrol, 2012).

Epidemiology is a basic discipline of public health aimed to understand the health-disease process within populations, aspect that differentiates the clinic, which aims to study this same process, but in individual terms.
As a science, epidemiology is based on causal reasoning; already as a discipline of public health, is concerned with the development of strategies for actions for the protection and promotion of community health.
Epidemiology is also tool for policy development in the health sector. Its application in this case must take into account the available knowledge, adapting it to local realities.
Among the main uses of epidemiology, we can mention: identify profiles and risk factors; carry out epidemiological assessment services; understand the causality of health problems; identify risk factors for a disease and groups of individuals at greatest risk of being struck by specific illness; establish the methods and control strategies of health hazards; establish preventive measures; assist the planning and development of health services, and finally; establish criteria for health surveillance.
To the question of disability, we are considering in their epidemiological studies visions in the social, under aspects of accessibility, assistive technology among others, and; doctors, from the perspective of prevention, treatment and control.

2.3. Epidemiological risk.
In health, some studies on risk concentrate the focus in epidemiology. In summary, epidemiological risk can be defined as the probability of occurrence of an event related to health, estimated from the event that occurred in the recent past. Thus, it is estimated the risk quantifying the number of times the event occurred divided by the number of potential events that could have happened. Therefore, the risk becomes disabled person in a population or group of people, the number of disabled people that have occurred in the preceding period by the number of persons at that time, since anyone or all could potentially become -If disabled person.
The constitution of the epidemiological risk concept and method incorporated by medical research ultimately define lifestyles, producing meanings that guide behavior; articulates thus a way of monitoring the powdered form of the individual, internalized and less visible in self translated (Luiz and Cohn, 2006).
In this work, we are considering the risk of a particular person becomes disabled person, comprising a set of factors related to health and social.

2.4. Ordinal logistic regression
Many of the variables of study in the humanities and social sciences are ordinal. Often, the dependent variable takes discrete values, or sortable categories but whose distance between them is not known, nor constant. For example, in epidemiological and severity degree of disability studies to see, hear or move as established in the sample questionnaire in Census 2010 IBGE which can be classified into *¨can´t somehow¨*, *¨can, but with greater difficulty¨*, *¨can, but with some difficulty¨*, and, finally, "*presents no problem*" to hear, see or move. In the case of intellectual disability is divided into *¨have¨* or *¨haven´t¨*.
Stereotype model proposed by Anderson (1984) that is used in situations where the response variable is an ordinal variable it isn´t a discrete version of a continuous variable.
For this work, we have as the response variable: disabilities, visual, hearing, intellectual and move that these are ordinal variables that aren´t continuous variables version, in view of this, we adopt in this work the stereotype ordinal logistic regression model.

2.5. Risk disabilities
According to the WHO:
- The prevalence of disabilities people is high;
- The number of disabilities people increases due to the aging population and due to the overall improvement of the chronic health conditions associated with disability such as diabetes, cardiovascular disease and mental illness;

- Several experiments in which the deficiency resulting from the interaction between health conditions, personal and environmental factors ranging widely, and, finally;
- Vulnerable populations whose prevalence varies with the conditions of each country, purchasing power, working conditions and training level. Factors such as these are considered as risks for people to be disabled, which in turn can aggravate the situations mentioned above.

In this scenario, has emerged reasons justifying the need to assess the well-being or life quality of disabled people, we propose the creation of the *index risk disabilities person* made up by weighting the responses of different variables obtained from micro data of the Census IBGE and selected as significant after applying the backward stepwise methodology in setting the stereotype ordinal logistic type regression for each studied disabilities.

3. Results and discussions

For this study, for each one of the states Distrito Federal, Roraima and São Paulo and all Brazil, we used:

Test for independence (Contingency Table) for bivariate multinomial population and homogenecity test between disabilities variable and other variable related with other problem as education, health and others;

Stereotype ordinal logistic regression analysis for each of the following response variables logistic regression:

- Deficiencies, which represents the number of disabilities that each person possesses and can take a value among 0-4 deficiencies;
- Deficiencies to see, hear and move considering the categories: 0, *¨for those who can´t somehow¨* 1, *¨for those who can, but with greater difficulty¨* 2, *¨for those who can, but with some difficulty¨*, and 3, for whom *¨presents no problem*", and finally;
- Intellectual Disability considering the categories *¨have¨* or *¨haven't¨*.

For each of the following sections: identification, education, family and work; the model consisting of all significant variables and for each block in adjusted models were applied:

a) Methods of backward stepwise for variable selection and the variables that shape not considered significant by the Wald test in each step were excluded;

b) Repeat the analysis until no more variables to be excluded;

c) For each of these adjustments models was calculated selection criteria AIC, BIC and DIC, and finally;

d) Selection of the best model among the different final models for each of the different number of shortcomings and deficiencies for each of the following criteria: AIC, BIC and DIC.

The use of data from Brazil, together with data from the states of Roraima, São Paulo and the Federal District were motivated by their weak economic power; great economic and population poderiol; and, finally; because of their political power respectively.

The Figure 1 show the distribution in absolute values and % of the instruction level in function of the disability for see, hear, walk, intellectual and number of the disabilities for Brazil, Roraima, São Paulo and Distritom Federal, with each casela containing the number of people in the selected sample and the proportion of disability and level of education.

Note the Table 1 that the higher the education level, the lower the amount and people with disabilities in all the different severity levels (levels I, II and III) consebgue reach it

On the other hand, in the comparative study of the proportions, the level I usually have better educational level than the level II, except in the state of Roraima to the visual and walk disabilities.

In all deficiencies, the state that holds more educated is the Federal District (situation better than Brazil as a whole, while the worst situation is that of the Roraima state with worst results than the Brazilian situation studied.

This heterogeneus situation reflects the gap between investment and resources offered by different regbiões the country, and consequently greater difference between the treatments offered so you can encourage people with disabilities to study more.

Table 1. Distribution in absolute values and (%) of instruction level for to see, to hear, to walk, intellectual and number of disabilities.

		BRAZIL					RORAIMA					SÃO PAULO					DISTRITO FEDERAL				
		INSTRUCTION LEVEL					INSTRUCTION LEVEL					INSTRUCTION LEVEL					INSTRUCTION LEVEL				
		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
SEE	I	35282	5185	5975	2414	223	121	14	23	4	1	6691	1575	1856	920	90	142	41	66	44	2
		71,9%	10,6%	12,2%	4,9%	,5%	74,2%	8,6%	14,1%	2,5%	,6%	60,1%	14,1%	16,7%	8,3%	,8%	48,1%	13,9%	22,4%	14,9%	,7%
	II	525029	67107	67038	19317	1464	1360	202	313	83	5	64931	12009	12991	4492	372	1764	481	585	268	19
		77,2%	9,9%	9,9%	2,8%	,2%	69,3%	10,3%	15,9%	4,2%	,3%	68,5%	12,7%	13,7%	4,7%	,4%	56,6%	15,4%	18,8%	8,6%	,6%
	III	2071475	396152	469894	168618	10703	5234	1183	1869	561	53	291826	79608	99531	44402	2788	7553	2673	4629	2683	126
		66,5%	12,7%	15,1%	5,4%	,3%	58,8%	13,3%	21,0%	6,3%	,6%	56,3%	15,4%	19,2%	8,6%	,5%	42,8%	15,1%	26,2%	15,2%	,7%
	IV	10252623	2454723	3061225	936452	79123	34849	6287	9101	2094	407	1542841	496423	700532	265962	18864	42891	13500	24453	14013	480
		61,1%	14,6%	18,2%	5,6%	,5%	66,1%	11,9%	17,3%	4,0%	,8%	51,0%	16,4%	23,2%	8,8%	,6%	45,0%	14,2%	25,6%	14,7%	,5%
HEAR	I	27192	3419	3627	1247	168	58	11	11	2	1	4629	970	1135	518	69	124	40	69	23	7
		76,3%	9,6%	10,2%	3,5%	,5%	69,9%	13,3%	13,3%	2,4%	1,2%	63,2%	13,2%	15,5%	7,1%	,9%	47,1%	15,2%	26,2%	8,7%	2,7%
	II	171280	16139	15256	4506	266	385	40	39	9	2	23753	3325	3408	1237	70	469	102	125	74	2
		82,6%	7,8%	7,4%	2,2%	,1%	81,1%	8,4%	8,2%	1,9%	,4%	74,7%	10,5%	10,7%	3,9%	,2%	60,8%	13,2%	16,2%	9,6%	,3%
	III	632673	84428	89136	29011	1467	1590	234	301	66	8	87374	16515	18081	7335	358	2083	507	733	438	10
		75,6%	10,1%	10,7%	3,5%	,2%	72,3%	10,6%	13,7%	3,0%	,4%	67,4%	12,7%	13,9%	5,7%	,3%	55,2%	13,4%	19,4%	11,6%	,3%
	IV	12054038	2819585	3496556	1092102	89629	39531	7401	10956	2665	455	1790783	568946	792438	306709	21626	49677	16049	28808	16472	608
		61,7%	14,4%	17,9%	5,6%	,5%	64,8%	12,1%	18,0%	4,4%	,7%	51,5%	16,3%	22,8%	8,8%	,6%	44,5%	14,4%	25,8%	14,8%	,5%
WALK	I	66711	5005	5522	2006	124	642	66	85	16	0	11614	1282	1475	646	46	244	31	64	37	1
		84,1%	6,3%	7,0%	2,5%	,2%	79,4%	8,2%	10,5%	2,0%	0,0%	77,1%	8,5%	9,8%	4,3%	,3%	64,7%	8,2%	17,0%	9,8%	,3%
	II	351851	30299	25785	7468	304	1697	242	254	62	4	51981	5984	5294	1930	77	1044	198	232	90	9
		84,6%	7,3%	6,2%	1,8%	,1%	75,1%	10,7%	11,2%	2,7%	,2%	79,6%	9,2%	8,1%	3,0%	,1%	66,4%	12,6%	14,7%	5,7%	,6%
	III	772323	88327	84609	27048	1132	39092	7365	10957	2662	460	112441	17394	16846	6482	298	2383	527	729	393	12
		79,3%	9,1%	8,7%	2,8%	,1%	64,6%	12,2%	18,1%	4,4%	,8%	73,3%	11,3%	11,0%	4,2%	,2%	58,9%	13,0%	18,0%	9,7%	,3%
	IV	11694145	2799880	3488581	1090335	89966	41564	7686	11307	2742	466	1730470	565074	791423	306741	21701	48682	15941	28710	16485	605
		61,0%	14,6%	18,2%	5,7%	,5%	65,2%	12,1%	17,7%	4,3%	,7%	50,7%	16,5%	23,2%	9,0%	,6%	44,1%	14,4%	26,0%	14,9%	,5%
INTELLECTUAL	A	254623	19310	15893	3790	462	574	45	47	6	2	36895	4163	3805	1088	113	960	125	157	59	6
		86,6%	6,6%	5,4%	1,3%	,2%	85,2%	6,7%	7,0%	,9%	,3%	80,1%	9,0%	8,3%	2,4%	,2%	73,5%	9,6%	12,0%	4,5%	,5%
	B	12630669	2904293	3588735	1123082	91068	40990	7641	11260	2736	464	1869701	585602	811278	314714	22010	51394	16573	29579	16949	621
		62,1%	14,3%	17,6%	5,5%	,4%	65,0%	12,1%	17,8%	4,3%	,7%	51,9%	16,3%	22,5%	8,7%	,6%	44,6%	14,4%	25,7%	14,7%	,5%
NUMBER OF DISABILITIES	0	9448281	2339296	2937581	897293	77005	33121	6016	8731	2005	396	1421099	473007	673850	255653	18318	40221	12816	23426	13400	462
		60,2%	14,9%	18,7%	5,7%	,5%	65,9%	12,0%	17,4%	4,0%	,8%	50,0%	16,6%	23,7%	9,0%	,6%	44,5%	14,2%	25,9%	14,8%	,5%
	1	2298081	475122	569052	199296	12998	5846	1349	2245	673	63	327464	95362	121803	52707	3406	8595	3173	5406	3181	142
		64,7%	13,4%	16,0%	5,6%	,4%	57,4%	13,3%	22,1%	6,6%	,6%	54,5%	15,9%	20,3%	8,8%	,6%	41,9%	15,5%	26,4%	15,5%	,7%
	2	838836	89049	81664	25139	1290	1880	266	289	55	6	117687	17381	16123	6111	328	2639	584	740	359	17
		81,0%	8,6%	7,9%	2,4%	,1%	75,3%	10,7%	11,6%	2,2%	,2%	74,7%	11,0%	10,2%	3,9%	,2%	60,8%	13,5%	17,1%	8,3%	,4%
	3	280898	18981	15305	4781	213	680	51	38	8	1	38587	3843	3103	1219	65	843	116	153	62	6
		87,7%	5,9%	4,8%	1,5%	,1%	87,4%	6,6%	4,9%	1,0%	,1%	82,4%	8,2%	6,6%	2,6%	,1%	71,4%	9,8%	13,0%	5,3%	,5%
	4	22498	1302	1110	377	24	37	4	4	1	0	3384	293	266	116	6	91	9	11	6	0
		88,9%	5,1%	4,4%	1,5%	,1%	80,4%	8,7%	8,7%	2,2%	0,0%	83,2%	7,2%	6,5%	2,9%	,1%	77,8%	7,7%	9,4%	5,1%	0,0%

Legend - Instruction level

1- Fundamental level incomplete

2- Between fundamental level complete and incomplete secondary level

3 - Secondary level complete and college degree incomplete

4 - College degrees complete or more

5 - Not determineted

Legend - Disability severity degree, except intellectual

I - Can´t any way

II - can with great difficulty

III - can with some dificilty

IV - Don´t exhibit any deficiency

Legend - Intellectual disability

A - yes

B - no

Among the different deficiencies studied, visual impairment is to have the most amount of people and that usually get better levels of education.

In order to evaluate the different degrees of severity yeah, can not in any way but with much difficulty, homogeneity tests were performed for these severity levels of the variables see, move and hear that in all cases were obtained level significance of 0.000 for this test and concluded that there is no homogeneity between these levels tested.

Table 2 shows the results distribution ordinal logistic regression stereotype considering different disabilities to Brazil and the states of Roraima, São Paulo and the Federal District, Wald statistic for variable selection and criteria AIC, BIC and DIC for models selection.

The variable selection shows the best fit models and their respective number of parameters for each of the different disabilities and number of deficiencies to Brazil, Roraima, São Paulo and the Federal District.

It is also noticed that the values represented in bold represents the models selected using the selection criteria AIC, BIC and DIC, and we can see serious divergence between the different criteria.

4. Conclusions

The state that represent major situation is Distrito Federal while that the worst situate is Roraima.

Lack of homogeneity for different disabilities by level of education.

Divergence between the results obtained by different criteria.

For future work, I intend to consider more improved technologies for variable selection, model selection and risk calculation considering other sets of variables and other banks of Brazil and foreign data.

Table 2. Results obtained after the application of stereotype logistic regression for different disabilities to Brazil, Roraima, São Paulo and the Federal District.

Country/state	disability	begin	end	LR	npar	size	AIC	BIC	DIC
Brazil	see	4453,438	4028,280	425,158	47	20800804	-106,105	-7176,231	34,895
	hear	131441,369	123623,043	7818,326	52	20800804	-121,928	-131760,648	**34,072**
	move	277026,174	247664,443	29361,731	64	20800804	-148,575	**-494780,488**	43,425
	intellectual	16515,679	15489,513	1026,166	169	20800804	**-351,867**	-17305,280	155,133
	number of disabilities	122239,961	115566,107	6673,854	65	20800804	-147,612	-112475,403	47,388
Roraima	see	267,074	269,691	-2,617	6	64166	-13,924	27,044	4,076
	hear	73,670	40,851	32,819	4	64166	-14,982	-370,263	-2,982
	move	935,910	1393,199	-457,289	16	64166	**-44,251**	5049,586	3,749
	intellectual	83,038	28,166	54,872	4	64166	-16,010	-615,401	-4,010
	number of disabilities	4208,805	1554,478	2654,327	10	64166	-35,768	**-29397,121**	**-5,768**
São Paulo	see	27264,872	26006,925	1257,947	13	3681111	-40,274	-19032,829	**-1,274**
	hear	26190,557	24468,109	1722,448	31	3681111	-76,903	-26056,121	16,097
	move	60388,517	52820,488	7568,029	38	3681111	**-93,863**	-114436,814	20,137
	intellectual	346,343	201,293	145,050	9	3681111	-27,954	-2202,925	-0,954
	number of disabilities	86250,385	73004,530	13245,855	36	3681111	-90,983	**-200279,424**	17,017
Distrito Federal	see	4892,453	4639,013	253,440	14	117333	-39,070	-2969,417	2,930
	hear	2289,378	1823,606	465,772	21	117333	-54,287	-5449,137	8,713
	move	3955,039	621,670	3333,369	6	117333	-28,223	**-38925,878**	**-10,223**
	intellectual	366,254	239,792	126,462	10	117333	-29,680	-1485,842	0,320
	number of disabilities	8835,920	7363,838	1472,082	23	117333	**-60,589**	-17197,865	8,411

References

ANDERSON, T. W. (1984). *An Introduction to Multivariate Statistical Analysis*, (2nd ed.) N.Y.: Wiley

CARVALHO, J.O.F. (2001). *Soluções tecnológicas para viabilizar o acesso do deficiente visual à Educação à Distância no Ensino Superior*. School of Electrical and Computer Engineering, UNICAMP, Campinas-SP, Brazil.

DOMINGOS, M.A. (2006). *Sentidos e significados produzidos por alunos e professores no cotidiano numa escola do sistema regular de ensino a partir da inclusão de alunos portadores de necessidades educacionais especiais*. MSc Thesis, School of Education, PUC-MG, Belo Horizonte-MG, Brazil.

FILHO, N.A.; BARRETO, M.L. (2012) Epidemiologia & saúde. Guanaba Koogan, Rio de Janeiro, Brazil.

FIGUEIRA, E. (2008). *Caminhando em Silêncio*. Giz Editorial e Livraria Ltda., São Paulo – SP, Brazil

GASPAR, V.G. (2010). *Pessoas com deficiência e o mercado de trabalho – histórico*. Doctoral Thesis, Institute of Economics - UNICAMP, Campinas – SP, Brazil.

GORDIS, L. (2009). *Epidemiology*. Fourth edition, Elsevier Inc., USA.

HOSMER, D.; LEMESHOW, S.(1989) Applied Logistic Regression. Jonh Wiley & Son, New York, USA

LILIENFELD, D. (1980). The Epidemiologic Approach to Disease. London, Oxford University Press, 1980, 3–22.

NETER, J.; WASERMAN, W.; WHITMORE, G.A. (1993). *Applied Statistics*. Allyn and Bacon, Bonton, USA.

NEWBOLD, P. (1995). *Statistics for business & economics*. Prentice Hall of the United Stated

OLIVEIRA, P.T.M.S. (2008). Aplicação do algoritmo genético no mapeamento de genes epistáticos em cruzamentos controlados. Doctoral Thesis, IME-USP, São Paulo, Brazil.

OLIVEIRA, P.T.M.S. (2013). Pessoas com deficiência: análise dos resultados do Censo 2010 e sua evolução. Sigmae, 3(2):1—23.

OLIVEIRA, P.T.M.S. (2014a). People with disabilities: Some analyzes of the results of the 2010 Population Census and new challenges. Journal of Mathematics and Sys. 4:231-243.tem Sciences

OLIVEIRA, P.T.M.S. (2014b). Ser pessoa com deficiência – questão de risco. Revista Brasileira de Estatística UFOP, 1(2):228—253

OLIVEIRA, P.T.M.S.; ANDRADE, M.; KRIEGER, J.E.; SOLER, J.M.P.. (2014). Genetic algorithm for mapping epistasis in controlled crosses. Revista Brasileira de Biometria, 32(1):143—157.

ROTHMAN, K.J.; GREELAND, S.; LASH, T.L. (2011). Epidemiologia Moderna. Terceira edição, Artmed, Porto Alegre-RS.

SILVA, O.M. (1986). *A Epopéia Ignorada*. CEDAS, São Paulo-SP, Brazil.