Modeling the resilience in elderly workers

Rafaela Pereira*
State University of Maringa, Maringa, Brazil – rafaelapereira07@hotmail.com

Thais Cano Miranda de Nóbrega
State University of Maringa, Maringa, Brazil – miranda.tha@gmail.com

Rosangela Getirana Santana
State University of Maringa, Maringa, Brazil – rgsantana@uem.br

Isolde Previdelli
State University of Maringa, Maringa, Brazil – iprevidelli@uem.br

Abstract

The general linear model is a tool that quantifies the relation between the response variable and the covariates (quantitative or qualitative). This model is considered more restrict once it is assumed that the random component has normal distribution, constant variance (homoscedastic) and is independent. This study aimed to model the senior workers' resilience through some observed measures, using a general linear model. For such it was held a cross-sectional study with employees with more than 60 years of age at Maringa's State University who answered questionnaires and were identified with their resilience's score, it is important to model the resilience in order to identify a possible pattern between elderly and as consequence of this comprehension, discussions may be held and early interventions that favor the health promotion may be promoted, as well as a healthy aging. The steps of modeling involved covariates selection through type 1 and 3 squares summing, evaluation and adequacy of the model and residual analysis. It was identified that the self-evaluation variable, that is and indicative of self-esteem, is the most significant covariate to resilience. Through the analysis it is perceived that the residual follow the model's suppositions. However, the model presented low explanatory performance, not being recommendable as a predictive model.

Keywords: General linear model, residual analysis.

1. Introduction

Statistical and analytical models are often used as tools to sum and interpret data. In particular, these models can facilitate the evaluation of the form and interest associations' intensity. In this study the general linear model methodology with factors (categorical) and covariates (quantitative), will be used to quantify the relation between the independent variables (factors and covariates) and the response variable. In this case, it is intended to comprehend how the resilience between the senior is related to some measurements, such as: sex, age, mental health, etc. The general linear model has as assumptions the normality, homoscedasticity, and the independence of the residual. And can be described as:

$$Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots \beta_{p-1} X_{p-1} + \varepsilon_i \; ; \quad i = 1, \ldots, n,$$

being $\beta_0, \beta_1, \ldots, \beta_{p-1}$ the parameters and $X_{i1,\ldots,} X_{i(p-1)}$ the factors or known covariables, ε_i, are random independent errors with distribution $N(0, \sigma^2)$ and n is the size of the sample (KUTNER et al., 2004). The categorical variables are incorporated to the model through indicative variables (*dummy*).

As resilience is an interactive and multifactorial process, the aim of this work is to identify covariates associated to resilience.

According to Fortes et al. (2009), "Resilience is defined as the capacity of an individual or family to confront adversity, being transformed by them and manage to overcome them". A resilient

person is capable of searching alternative ways to overcome conflicts, not becoming passive in the face of difficulties.

"In the last 60 years, the absolute number of people with more than 60 years increased 9 times" (IPEA, 2004). With the increasing of age the resilience capacity becomes essential, because the possibility of stressful events such as diseases or malaise becomes bigger. The elderly present peculiar problems; their treatment requires an increase of previously predicted cares that is exempt in other age groups, as well as strategies to be used for characteristic questions of this phase's evaluation (FORTES et al., 2009).

Therefore, it is important to model the resilience in order to identify a possible pattern between elderly and as consequence of this comprehension, discussions may be held and early interventions that favor the health promotion may be promoted, as well as a healthy aging.

2. Method

It is a cross-sectional study carried out in Maringa-PR, with Maringa's State University's over 60 year old workers. Usually the university has 309 senior employees and among these, a random sample of 175 elders was observed.

The factors and covariates of this study were: sex (1=male, 2=female), age, ethnicity (1=white, 2=black or brown, 3=yellow), studying years, marital state (1=single, 2=married, 3=widowed, 4=divorced), familiar income (1=until 4 minimum salary, 2=from 5 to 10 minimum salary, 3= more than 10 minimum salary), self-evaluation, position held (1=elementary school's auxiliary, 2=high school's auxiliary, 3=higher education's auxiliary, 4=professor), working time, desire of retirement (1= no, 2=yes), parallel work (1=no, 2=yes), work satisfaction, functional capacity, limitation by physical aspects, pain, general state of health, vitality, social aspects, limitation by emotional aspects, mental health, gds (1=no, 2=yes), chronical diseases (0=do not have chronical disease, 1=one chronical disease, 2=two or more chronical diseases), overweightness (1=no, 2=yes), smoking (1=no, 2=yes), physical activities (1=no, 2=yes), frequent drinker (1=no, 2=yes).

Resilience was measured through a questionnaire validated with 25 Likert type questions, varying between 7 points since (1) completely disagree and (7) completely agree. The scale's scores varied from 25 to 175 points, with high values indicating high resilience. This scale was validated in 2005 for usage in Brazil (PESCE et al., 2005).

The steps involved in the analysis of this study are the following: exploratory analysis of data, general linear model's adjustment, covariates' selection, evaluation and adequacy of the model and the residual analysis.

The initial model with all covariates is given by:

$$Y_{ij\ldots qrs} = \beta_0 + \alpha_i + \beta_1 X_{1s} + \gamma_j + \beta_2 X_{2s} + \cdots + \mu_q + \tau_r + \varepsilon_{ij\ldots qrs}$$

In which $y_{ij\ldots qrs}$ is the resilience of the individual s from i sex of j ethnicity, etc. s=1,...,175, i=1,2; j=1,...,3. β_0 is the intercept, and in the same that were described the covariables above, α_i is the effect due to i sex, β_1 is effect due to age, γ_j is the effect due to j ethnicity, β_2 is the effect due to the years of study, and so successively and $\varepsilon_{ij\ldots qrs}$ is the specific error for each individual, and that follows the assumptions of the model with $\varepsilon_{ij\ldots qrs} \sim N(0, \sigma^2)$ and of independence.

To covariates' selection, the statistical significance was observed in the square sums of type I and type III. Likelihood ratio tests were also used to compare the embedded models and observe if resilience was explained by a more parsimonious as the complete model.

Parameters' estimation was done by the minimum square method, with its respective p-values. SAS applicative – version 9.3 – was used, available in the statistics department / UEM for all analysis.

3. Results

The average resilience was of approximately 146.3 with standard deviation of 14.11 indicating a high resilience. From the 175 elders, 64 are women and 111 are men. It was identified in the Box-plot that the resilience's behavior at each factor's level did not present major changes in variability, in relation to average only "position held" showed a distinct average. To the covariates the scatter

diagram pointed a linear tendency more accentuated to the self-evaluation, vitality and mental health variables. The correlation coefficient of Pearson was also obtained and presented a moderated positive correlation between resilience and the variables self-evaluation and vitality.

The variables' selection was based in the square sum of type I and type III, providing a model (reduced) with the five covariates described below, the likelihood ratio test did not point any significant difference between the complete and the reduced model. In addition to that, the adjusted R^2 for the complete model was of 0.209451 and R^2 for the reduced model was of 0.1713596, having a performance reduction of 0.038, although as the likelihood ratio test did not point any difference, the parsimonious model was chosen.

In the chosen model the covariates adopted were the following: self-evaluation, vitality, chronical diseases1, chronical diseases2 and frequent drinker. The chronical diseases variable was transformed into an indicator variable to the general linear model's adjustment.

The parameters' estimates are given in table 1 below:

Table 1: Model's estimates of parameters

Variable	**Estimate**	**Standard deviation**	**P-value**
Intercept	107.44804	7.10781	$< 2.10^{-16}$
Self-evaluation	2.71647	0.83969	0.00146
Vitality	0.22887	0.06920	0.00115
Chronical diseases1	0.01107	2.50883	0.99648
Chronical diseases2	3.79226	2.51798	0.1339
Frequent drinker	-5.31056	2.02174	0.00941

It is perceived by table 1 that self-evaluation, which is an indicative of self-esteem, is one of the variables that majorly influence in a positive way the answer variable, thus indicating, that people with high self-evaluation tend to have high resilience, like in the studies of Santos et al. (2009) and Ferreira et al. (2012). The negative symbol of the frequent drinker variable indicates that for frequent drinker its resilience diminishes

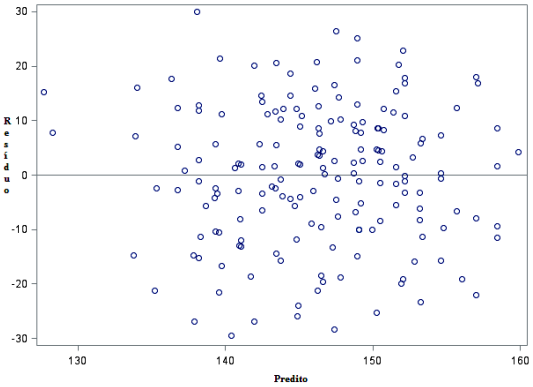
A possible resilience model is described by:

$\widehat{\text{Resilience}}$ = 107.448+2.716 (self-evaluation) +0.228 (vitality) +0.01107 (Chronical diseases1) + 3.79226 (Chronical diseases 2) – 5.31056 (Frequent drinker).

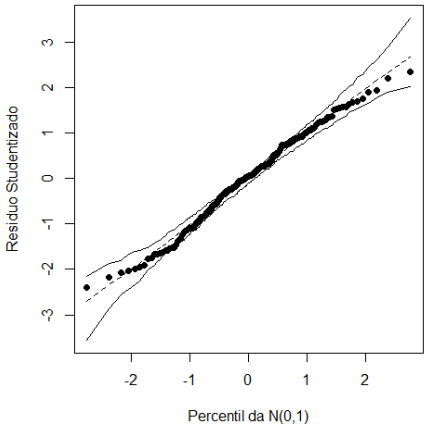
To verify the models' hypothesis, namely, of normality, homoscedasticity and independence, a residual analysis was held.

It is observed that the graphic 1 confirms the homoscedasticity supposition for the errors and the graphic 2 confirms the normality assumption. The envelope's graphic allows a better comparison between the residual and the standard normal distribution's percentages (PAULA, 2010). Verifying the residuals' homoscedasticity through White's test, with$\alpha = 0.05$, it was obtained a value of p = 0.5979, i.e., we do not have any evidence to reject the homoscedasticity hypothesis.

Graphic 1: Residuals *vs* predicted value



Graphic 2: Envelope's graphic



4. Conclusions

One of the limitations of this model is that it somewhat explains the total variability of the data, in other words, it presents a low explanatory power, not being recommendable as a predictive model. Through the results it is perceived that self-evaluation is the most significant covariate in the explanation to resilience.

References

FORTES, T. F. R. et al. (2009). A resiliência em idosos e sua relação com variáveis sociodemográficas e funções cognitivas. Estudos de Psicologia. Campinas, São Paulo.

FERREIRA,C. L. et al. (2012). Resiliência em idosos assistidos na rede de atenção básica de saúde em município do nordeste brasileiro. Escola de enfermagem. São Paulo.

KUTNER, Michael H. et al. (2004). Applied linear statistical models**.** New York, Mcgraw-hillf.

IPEA. (2004). Os novos idosos: muito além dos 60?. Rio de Janeiro.

PAULA, G. A. (2010). Modelos de regressão: com apoio computacional. São Paulo, USP.

PAULA, G. A. (2014). Texto Modelos de Regressão. Available in: <http://www.ime.usp.br/~giapaula/textoregressao.htm>.

SANTOS, L. M. O. et al. (2009). Resiliência e auto-estima em idosos assistidos na rede de atenção básica de saúde em Natal/RN. XVII Semana de Humanidades. Natal, UFRN.

PESCE R. P. et al. (2005). Adaptação transcultural, confiabilidade e validade da escala de resiliência. Cad Saúde Pública. Rio de Janeiro.