Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 9, Issue, 03, pp.47378-47382, March, 2017

INTERNATIONAL JOURNAL
OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

THE ROR'S METHODOLOGY AN IT'S POSSIBILITY TO FIND INFORMATION IN A WHITE NOISE

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ARTICLE INFO

Article History:
Received 24th December, 2016
Received in revised form
04th January, 2017
Accepted 15th February, 2017
Published online 31st March, 2017

Key words:
Cuba, Methodology ROR, Prognosis, Regression, White noise.

ABSTRACT

The objective of this paper is to determine how methodology ROR can give information when having a series, whose auto correlograms are a white noise. Deceased by car accidents variable was used for Cuba in the period 2006- 2011. The future projection of the data series can be obtained by using modeling ROR, which provides a new and important way, promising for the series that behave as a white noise, because this gives new information for the series and its behavior. Deceased tendency is to diminish at about 29 persons a year; deceased persons depend on quantity of deceased two years backwards. As the model is perfect and errors with zero value are obtained, Cristosols Numbers are introduced, which could create new statistics and prediction models. This study was done using the statistical package of Social Sciences (SPSS) Version 13.

Citation: Ricardo Oses Rodríguez, Jaime Wilfrido Aldaz Cárdenas, Rigoberto Fimia Duarte, *et al*. 2017. "The ROR'S methodology an it's possibility to find information in a white noise", *International Journal of Current Research*, 9, (03), 47378-47382.

INTRODUCTION

The information in a data series is important when projecting the future, but what happens when the modeling series is a white noise? and there is no information in previous steps allowable to model for the future. In this article methodology ROR is treated and how important information is obtained by using it to project the future behavior of the series. Methodology ROR (Regressive methodology) is carried out in several steps, which are explained in this article; however it is necessary to detail in this work since mathematic point of view (Osés and Grau, 2011). In this methodology a curve adjustment is made using the square minimum method, which is explained below. It is frequently necessary to represent by a functional relation, data given as a group of points X -Y. For example, an experiment has been carried out and the points have been obtained X–Y represented in a graphic of Y against X. As these points are going to be used for computer calculus, several problems are confronted.

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1. There are experimental errors in the values of Y. Variations due to experimental errors must be softened somehow.
2. The value of Y is desirable to know, corresponding to some value of X, which is found between two experimental values of X.
3. It would be desirable – in fact it can be the main purpose of the calculus – extra polar, that is to determine Y value, corresponding to X value outside the rank of experimental values of this variable.

All these considerations lead to the necessity of a functional relation between X and Y in equation form and this must be simple. The question is to determine a curve to approximate data with adequate precision. The first question presented is this: How is it going to be decided if a given curve is a good "adjustment" to data?. This discussion will be simpler if a new term is defined. The deviation in a given point is the difference between Y experimental value and Y calculated value from a functional relation. The question to adjust a curve to data can be formulated: What condition can be put to the deviations to achieve an adequate curve?.

An attractive possibility is to ask for the sum of deviations as small as possible. If a prima is used to identify Y values calculated beginning from a searched functional relation, this means to ask for be a minimum, in which N is the number of data points but the attractive of this possibility disappears when considering the case simply to adjust a line at two points. This difficulty could be avoided when specifying absolute values, that is to require minimizing.

$$\sum_{i=1}^{N} (Y_i - Y_i')$$

$$\sum_{i=1}^{N} I\, Y_i - Y_i'\, I$$

To find a minimum value, it cannot be derived because the absolute value function does not have a derivate in its minimum. It could be asked for the maximum error to be a minimum, which is Chebyshev approximation, but this leads to a complicated iterative process to determine the functional relation.

Thus, the square minimums criteria arrives, in which it is asked for a minimum value of

$$\sum_{i=1}^{N} (Y_i - Y_i')^2$$

As it can be seen, this expression can be differentiated to determine its minimum. It leads to lineal equations, which in many cases are of practical interest, and from the beginning are easy to solve. Finally, there are statistical considerations that suggest the square minimums criteria is a good criterion, besides the computer facilities.

Thus, the function of approximation for methodology ROR is written as follows

$$Y_i' = c_1 * \delta_1(xi) + c_2 * \delta_2(xi) + c_3 * \mathbf{NoC}(xi).$$

Where:

$$\delta_1(xi) = \begin{cases} 0 \text{ if } Xi = 2n \\ \quad n = 0,1 \ldots N \\ 1 \text{ if } Xi = 2n+1. \end{cases}$$

$$\delta_2(xi) = \begin{cases} 1 \text{ if } Xi = 2n \\ \quad n = 0,1 \ldots N \\ 0 \text{ if } Xi = 2n+1. \end{cases}$$

$\mathbf{NoC}(xi) = xi$, $xi = 0,1,\ldots, N$.

The objective is to determine C1, C2 and C3, to minimize:

$$S = \sum_{i=1}^{N} (Y_i - Y_i')^2$$

$$S = \sum_{i=1}^{N} (Y_i - c_1 * \delta_1(xi) - c_2 * \delta_2(xi) - c_3 * \mathbf{NoC}(xi)^2$$

As it is known when minimizing S considered as function of C1, the partial derivate of S is equal to zero with respect to C1, the result is:

$$(\partial S/\partial c_1) = (-2)\sum_{i=1}^{N} (Y_i - c_1 * \delta_1(xi) - c_2 * \delta_2(xi) - c_3 * \mathbf{NoC}(xi) = 0.$$

Making equal to zero and readequating, it is obtained

$$c_1 * (\sum_{i=1}^{N} \delta_1(xi)) + c_2 * (\sum_{i=1}^{N} \delta_2(xi)) + c_3 * (\sum_{i=1}^{N} \mathbf{NoC}(xi)) = \sum_{i=1}^{N} Yi.$$

$$c_1 * (\ {}^{0}_{N}\ ) + c_2 * (\ {}^{N}_{0}\ ) + c_3 * (\sum_{i=1}^{N} (xi)) = \sum_{i=1}^{N} Yi.$$

Deriving S with respect to C2 and then with respect to C3 and making each of the results equal to zero, two more equations are obtained in the unknown C1, C2, C3, the three simultaneous equations in these three incognitos are named normal equations to adjust an equation to the set of data, then:

$$c_1 * (\ {}^{0}_{N}\ ) + c_2 * (\ {}^{N}_{0}\ ) + c_3 * (\sum_{i=1}^{N} (xi)) = \sum_{i=1}^{N} Yi.$$

$$c_1 * (\ {}^{0}_{N}\ ) + c_2 * (\ {}^{N}_{0}\ ) + c_3 * (\sum_{i=1}^{N} (xi)) = \sum_{i=1}^{N} Yi.$$

$$c_1 * (\ {}^{0}_{N}\ ) + c_2 * (\ {}^{N}_{0}\ ) + c_3 * (\sum_{i=1}^{N} (xi)) = \sum_{i=1}^{N} Yi.$$

To find a "better" function for data; it is only necessary to carry out the sums needed and solve the three equations system, this combination explains a great quantity of variance Yi, then it is obtained:

$$Y_i' = c_1 * \delta_1(xi) + c_2 * \delta_2(xi) + c_3 * \mathbf{NoC}(xi).$$

The errors left are $e_i = (Y_i - Y_i')$ then the cross correlation is calculated of e_i with $Y_{i-n}(xi)$ in the following formula:

$$Corr(ei, Y_{i-n}(xi)) = \frac{Cov(ei, Y_{i-n}(xi))}{[Var(ei) * Var(Y_{i-n}(xi))]^{1/2}}$$

and the maximum value of that function is selected.

Function that is the corresponding peak named t, then variable Y_t is calculated and the system is resolved this time with variable Yt,

$(\partial_{ei}/\partial c_i) = (\partial S_2/\partial c_i) = 0$ this time with the function:

$S_2 = (Yi - c_1 * \delta_1(xi) - c_2 * \delta_2(xi) - c_3 * \mathbf{NoC}(xi) - c_4 * Yt(xi))^2$, Then an error e_2 is left, which is cross correlated with $g_{i-k}(xi)$ as hexogen variable similar to e_i obtaining a new peak in t for variable $g_{i-k}(xi)$, and the system is resolved again (t can be of different order to the one calculated for the function $Y_{i-n}(xi)$.

This time $(\partial_{ei}/\partial c_i) = (\partial S_3/\partial c_i) = 0$ in such way that

$S_3 = (Yi - c_1 * \delta_1 (xi) - c_2 * \delta_2 (xi) - c_3 * NoC (xi) - c_4 * Yt (xi) - c_5 * g_t (xi))^2$,

An error e_4 is finally obtained, which must have media zero and variance 1 and the process is stopped obtaining the highest quantity of variance as possible, in this approximation data of the same function Y_{i-n} (xi) and hexogen data of the function g_{i-k} (xi).

This methodology has been used in the model for angiostrongilosis variable, where it was obtained the following model of function:

Coefficients[a,b]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	DI	-981.340	308.741	-1.381	-3.179	.003
	DS	-795.908	304.288	-1.120	-2.616	.013
	NoC	7.166	3.007	.374	2.383	.023
	Lag3angiostot	.880	.190	.719	4.630	.000
	Lag3XY1	33.632	12.277	1.626	2.739	.010

a. Dependent Variable: Angiostotal

b. Linear Regression through the Origin

Where DS= δ_1 (xi) and DI = δ_2 (xi) NoC= **NoC** (xi), is the tendency and Lag3angiostot = $Y_{i-n}(xi)$ is the regressive angiostrongilosis in three bimonthly periods (t=3) and lag3XY1 is the hexogen variable Mean Temperature in Yabú station ($g_{i-k}(xi)$ regressive in three bimonthly periods where t is equal to 3, the same as for angiostrongilosis. The objective of this paper is to determine how methodology ROR can give information when having a series, whose auto correlograms are a white noise.

MATERIALS AND METHODS

For this work the quantity of death by car accident was used, in Cuba from 2006 to 2011, besides the ROR methodology was used as (Osés and Grau, 2011), the methodology of Box *et al.* (1994), was not used since this has limitations as (Osés and Grau, 2011). We used SPSS Version 13 and FORTRAN Programation (McCracken and Dorn, 1971). The Regressive method was used for the analysis. This methodology is also used in the forecast of great intensity earthquakes in Cuba (Osés *et al*., 2012b), besides it was implemented in mosquitoes control (Fimia *et al*., 2012a) and these results were used in the study of climatic change applied to animal health in Villa Clara, Cuba (Osés *et al*., 2012c). The mathematical modeling was applied to Malaria (Fimia *et al*., 2012b). The ROR methodology is widespread to meteorology, for example in the modeling of cold front and the impact of sun spots as in (Osés *et al*., 2012d). The ROR methodology is also applied to long term prediction of larvarial density of anopheles mosquitoes in (Osés *et al*., 2012e), besides in (Osés *et al*., 2014), was done a long term-prognostic (1 year in advance) to obtain daily forecast of meteorological variables in Sancti Spiritus, Cuba. The Regressive methodology opens a high range of applications to the modeling of any time series of data. Data for the model obtained for the deceased were taken from State Statistics Office.

RESULTS AND DISCUSSION

Below it is shown the total correlograms and the partial autocorrelations of Deceased variable (Table 1 and 2). As it can be seen a white noise is presented.

Table 1. Correlograms of deceased variable

Autocorrelations

Series: Deceased

Lag	Autocorrelation	Std.Error[a]	Box-Ljung Statistic Value	Box-Ljung Statistic df	Box-Ljung Statistic Sig.[b]
1	.309	.323	.918	1	.338
2	.114	.289	1.074	2	.584
3	-.212	.250	1.791	3	.617
4	-.300	.204	3.949	4	.413

a. The underlying process assumed is independent (white noise).

b. Based on the asymptotic chi-square approximation.

Table 2. Partial autocorrelograms of deceased series

Partial Autocorrelations

Series: Deceased

Lag	Partial Autocorrelation	Std.Error
1	.309	.408
2	.021	.408
3	-.279	.408
4	-.192	.408

Then, there is no information in previous steps in the series allowable to predict the future; however the methodology ROR (Osés and Grau, 2011) is applied to the deceased variable obtaining the following model.

The model is perfect, it explains the 100% of variance, and the model has not errors (Table 3).

Table 3. Summary of the model for the quantity of deceased

Model Summary[c,d]

Model	R	R Square[a]	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	1.000[b]	1.000	.	.	1.998

a. For regression through the origin (the no-intercept model), R Square measures the proportion of the variability in the dependent variable about the origin explained by regression. This CANNOT be compared to R Square for models which include an intercept.

b. Predictors: Lag2Deceased, DI, NoC, DS

c. Dependent Variable: Deceased

d. Linear Regression through the Origin

In Table 4 the model parameters can be shown. The tendency NoC of the deceased is to diminish at about 29 persons, the deceased depend on the quantity of deceased two years backwards (Lag2deceased).

Table 4. Model Parameters of deceased at National level

Coefficients[a,b]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	DS	826.886	.000	.801	.	.
	DI	823.773	.000	.798	.	.
	NoC	-29.250	.000	-.186	.	.
	Lag2Deceased	.045	.000	.049	.	.

a. Dependent Variable: Deceased

b. Linear Regression through the Origin

As the standard errors are zero in table 4, the statistical value T of Student (t) and its meaning cannot be obtained. As it is known: $t_1 = B_1 / S_{b\,1}$, according to Sánchez and Torres (1986), where B, are the coefficient of the regression and $S_{b\,1}$ are the standard errors and t_1 is the student t test parameters'; that is why to calculate t of each coefficient is impossible, because a division by zero must have been developed; for this it is suggested to use the calculus form according to Osés (2007), in which it is presented how to operate "Cristosols numbers" (numbers divided by zero). Another work that can be consulted in relation to this, it can be seen in Osés (2012f) in which are presented numbers seen as a ring and as a group. Through these numbers new statistics and prediction models can be obtained. The prognosis for 2012 and 2013 is the following table.

Table 5. Results of the model

Unstandardized Predicted Value
Unstandardized Residual

Case Summaries[a]

		Year	Deceased	Unstandardized Predicted Value	Unstandardized Residual
1		2006.00	855.00	.	.
2		2007.00	775.00	.	.
3		2008.00	778.00	778.00000	.00000
4		2009.00	742.00	742.00000	.00000
5		2010.00	716.00	716.00000	.00000
6		2011.00	682.00	682.00000	.00000
7		2012.00	.	654.68182	.
8		2013.00	.	620.77273	.
Total	N	8	6	6	4

a. Limited to first 100 cases.

Conclusion

Through modeling ROR, information has been obtained for the future projection of data series, which provides a new and important way, promising for the series that behave as a white noise, because this gives new information for the series and its behavior. Deceased tendency is to diminish at about 29 persons; deceased persons depend on quantity of deceased two years backwards. Through Cristosols Numbers new statistics and prediction models can be obtained.

Acknowledgement

Special recognition for the enormous contribution made by Prof. Jaime Wilfrido Aldaz Cárdenas, Ph.D., illustrious son of Guaranda, Bolivar Province, Ecuador; Beautiful place of the center of the country, located in the western Andean mountain range, where beauty and simplicity seem to walk, since without its support from the economic and scientific point, it would not have been possible the concrescence of such research.

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