

Using Artificial Neural Networks for Predicting New Drug Induced Psychosis Cases at Kwekwe General Hospital in Zimbabwe

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Abstract - In this research paper, the ANN approach was applied to analyze monthly cases of drug induced psychosis at Kwekwe General Hospital (KGH) in Zimbabwe. The employed data covers the period January 2010 to December 2019 and the out-of-sample period ranges over the period January 2020 to December 2021. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the applied model indicate that the model is stable in forecasting monthly cases of drug induced psychosis at KGH. The results of the study indicate that it is possible to win the war against the scourge of drug induced psychosis with the catchment area of KGH. A 4-fold policy recommendation has been suggested in order to address the problem of drug induced psychosis in the KGH catchment area.

Keywords: ANN, Forecasting, Psychosis.

I. INTRODUCTION

In 2013, the African Union Plan of Action on Drug Control and Crime Prevention reported that, substance abuse was an increasing problem in Africa. The World Health Organization (WHO) in 2011, also noted that in Africa there is a high burden of mental health disorders, which are leading to disruptions in the people's quality of life, the majority of them are brought about by substance abuse. Substance abuse has become a major Public health problem as it leads to physical and mental problems, Cubbins et al (2012). Of the mental health problems induced are psychosis, which in later times develops into schizophrenia (Kendler et al, 2019; Murrie et al, 2019).Kendler et al (2019), carried out a study to clarify the etiology of substance-induced psychotic disorder and its progression to schizophrenia in a Swedish national sample. He found out that drug-induced psychotic disorders were high in individuals at high familial risk for substance abuse. Murrie et al (2019) did a study to predict the proportion of people with substance-induced psychoses who transitioned to schizophrenia and he found that drug induced psychoses associated with cannabis, hallucinogens, and amphetamines have a large risk of transition to schizophrenia. Caton et al (2006), studied rates and predictors of psychosis remission at 1-year follow-up for all emergency admissions spotted with drug-induced psychoses and primary psychotic disorders. Results highlighted that vulnerable individuals despite their age, were likely to have psychotic disorders due to their socio-economic conditions. In Zimbabwe there has been the substantial growth in this problem, with recent studies by Rudatsikira et al (2009); Wini-Dari et al (2017); Cubbins et al., (2015) and Nhunzi et al (2019) highlighting the need for authorities and the general population to take heed. The causes of these disorders have been seen highly brought about by risk factors such as poverty, unemployment, low socioeconomic status, and an unsupportive environment especially for the youth, Nhunzi et al (2019). Botes & Schenck, (2015), also highlighted that substance abuse was associated with masculinity, enhanced sexual pleasure, and risky sexual behaviors, and is to some extent an accepted form of leisure for Zimbabwean men.

1.1 OBJECTIVES OF THE STUDY

- i. To assess new drug induced psychosis cases at KGH over the period January 2010 to December 2019.
- ii. To predict drug induced psychosis cases for KGH over the period January 2020 to December 2021.
- iii. To determine whether drug induced psychosis cases are increasing or decreasing for KGH over the out of sample period.

II. METHODOLOGY

The Artificial Neural Network (ANN), which we are going to employ is a data processing system consisting of a large number of simple and highly interconnected processing elements resembling a biological neural system and has the capability of

learning from an experimental or real data set to describe the nonlinear and interaction effects with great accuracy. ANN-based curve fitting approach is one of the extensively applied artificial intelligence methods that are used for forecasting and prediction purpose. It consists of three layers i.e., input layer, hidden layer, and output layer, the present paper includes the number of months as input layer and the monthly drug induced psychosis cases at KGH as output data for the network. In this research paper, our ANN model is based on the hyperbolic tangent function.

2.1 Data Issues

This study is based on newly diagnosed monthly drug induced psychosis cases [for all age groups] (referred to as P series in this study) at KGH. The data covers the period January 2010 to December 2019 while the out-of-sample forecast covers the period January 2020 to December 2021. All the data employed in this paper was gathered from KGH Health Information Department.

III. FINDINGS OF THE STUDY

3.1 DESCRIPTIVE STATISTICS

Table 1: Descriptive statistics

Summary Statistics, using the observations 2010:01 - 2019:12 for the variable P (120 valid observations)

Mean	Median	Minimum	Maximum
0.91667	1.0000	0.0000	5.0000
Std. Dev.	C.V.	Skewness	Ex. kurtosis
1.0969	1.1966	1.3548	1.6641
5% Perc.	95% Perc.	IQ range	Missing obs.
0.0000	3.0000	1.0000	0

3.2 ANN Model Summary

Table 2: ANN model summary

Variable	P
Observations	108 (After Adjusting Endpoints)
Neural Network Architecture:	
Input Layer Neurons	12
Hidden Layer Neurons	12
Output Layer Neurons	1
Activation Function	Hyperbolic Tangent Function
Back Propagation Learning:	
Learning Rate	0.005
Momentum	0.05
Criteria:	
Error	0.113595
MSE	0.099566
MAE	0.246864

Residual Analysis for the Applied Model

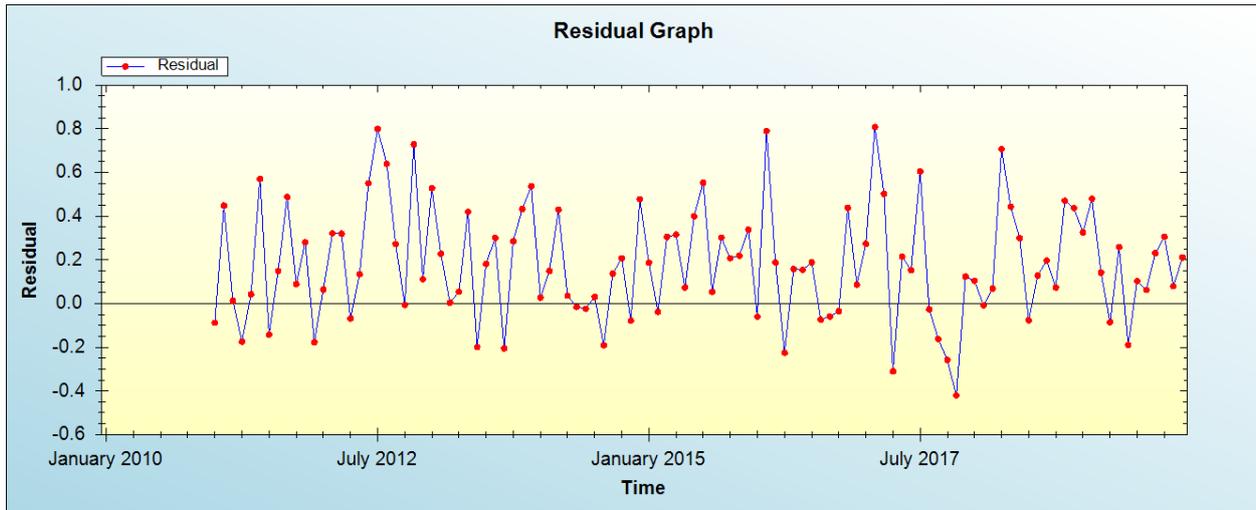


Figure 1: Residual analysis

In-sample Forecast for P

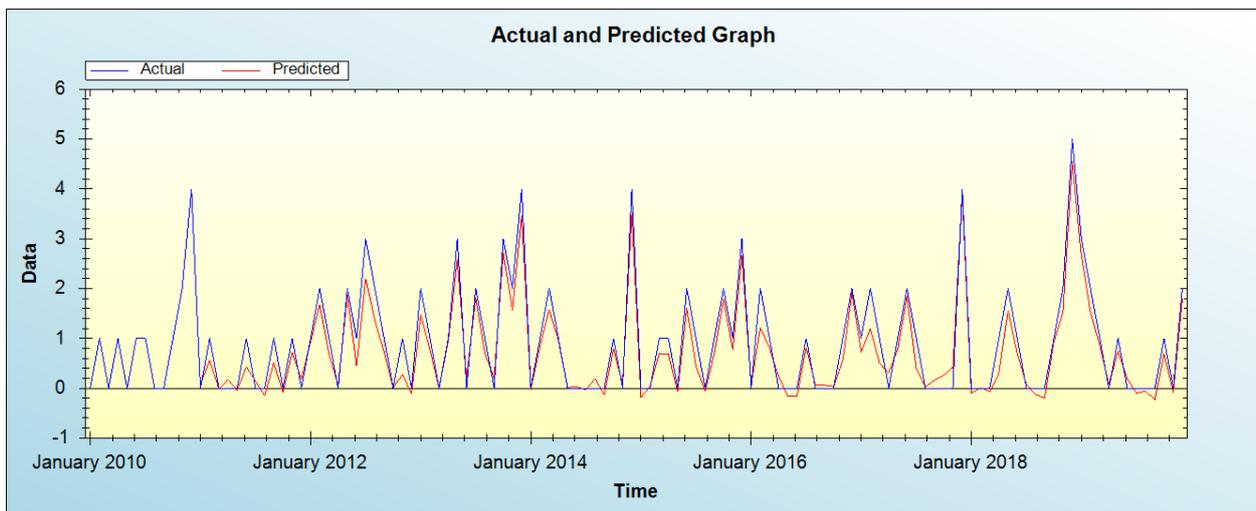


Figure 2: In-sample forecast for the P series

Out-of-Sample Forecast for P: Actual and Forecasted Graph

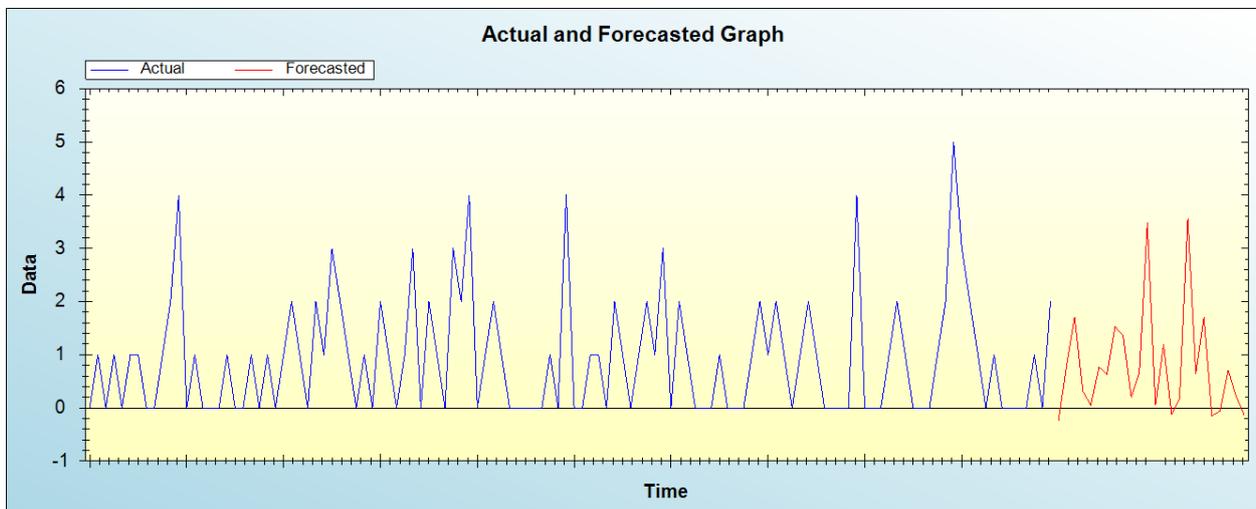


Figure 3: Out-of-sample forecast for P: actual and forecasted graph

Out-of-Sample Forecast for P: Forecasts only

Table 3: Tabulated out-of-sample forecasts

Month-Year	Forecasts
January 2020	-0.2401
February 2020	0.7965
March 2020	1.7095
April 2020	0.3171
May 2020	0.0518
June 2020	0.7682
July 2020	0.6235
August 2020	1.5275
September 2020	1.3560
October 2020	0.2057
November 2020	0.6644
December 2020	3.4741
January 2021	0.0535
February 2021	1.1901
March 2021	-0.1234
April 2021	0.1865
May 2021	3.5508
June 2021	0.6355
July 2021	1.7033
August 2021	-0.1503
September 2021	-0.0542
October 2021	0.7120
November 2021	0.2144
December 2021	-0.1346

3.3 DISCUSSION OF THE RESULTS

Table 1 shows descriptive statistics while table is the ANN model summary and basically shows the ANN (12, 12, 1) neural network model, which has been based on the hyperbolic tangent function as its activation function. The “criteria” are the evaluation statistics and they just indicate the model is adequate. Figure 1 shows the residuals of the model and since the residuals are as close to zero as possible, the model is stable and acceptable. Figure 2 shows the in-sample forecast of the model and it can be inference that the model simulates the data. Figure 3 and table 3 are out of sample forecasts. While we generally project at least I case per month, of induced drug psychosis at KGH, it is important to note that in most months there will be no cases of drug-induced psychosis over the out-of-sample period.

3.4 RECOMMENDATIONS

- i. Government to come up with occupational transition mechanisms that ensure that the youth are not idle at home and are prepared for their next stage. Examples include sporting activities, internships and career guidance and entrepreneurial skills development programs that allow them to stay occupied. Sporting groups could help the pensioners too.
- ii. There is need for KGH to come up with rehabilitation programs for psychotic patients who unemployed and or have been disengaged from social activities over a long term. Counselors should be appointed patients they engage with regularly and make follow ups.
- iii. Advise is for the Ministry of Health and Child Care (MOHCC) to train more qualified mental health practitioners in order to improve mental health service delivery not only at KGH but also Zimbabwe at large.
- iv. Awareness campaigns on the effects of drug abuse and its possible progression to schizophrenia should be conducted at KGH and the country as a whole so as to help people desist from abusing drugs.

IV. CONCLUSION

Drug-induced psychoses are a serious and common condition which is associated with a substantial risk for transition to schizophrenia. With schizophrenia come high costs of treatment and care especially to those already vulnerable groups. It is the hope of this paper that drug-induced psychotic cases are reduced, as this has since been declared a public health problem in Zimbabwe. Hence it was the aim of this study to predict drug-induced cases at KGH, this is also in a bid to proffer early interventions to those with substance-induced psychosis are experiencing symptoms and for KGH to be better equipped for such cases in the future.

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