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ANALYSIS OF LONG TERM SUGARCANE CULTIVATION IN TAMILNADU

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Abstract:

The work presented in this paper determines the forecast of the cultivation of Sugarcane which is the major cash crop of Tamil Nadu. This paper work demonstrates how the data for last decades could be used to predict future demand to cultivate the sugarcane. The best fitted model corresponds to the ARIMA(Auto Regressive Integrated Moving Average) with seasonal effect. The major problem of sugarcane in Tamil Nadu is based on monsoon and water supply. This study analyses the production and reasons for the changes in cultivation of sugarcane.The performance is evaluated by the statistical Package for the Social Science (SPSS) These results will predict the area to be cultivated for the sugarcane the next ten decades with the best fit for ARIMA Methods.

Keywords: **Auto Regressive Integrated Moving Average, cultivation, Time series, SPSS.**

I.INTRODUCTION

India ranks first among sugarcane-growing countries of the world in both extent and production of cane. Sugarcane is the second most important industrial crop in the country is grown about 5 million hectares. Sugarcane is one of the traditional crops grown abundantly across the state of Tamil Nadu. Tamil Nadu is a state in southern India. The climate of Tamil Nadu is essentially tropical. Sugarcane is grown chiefly in the main season (December - May) in the entire State. In parts of Tiruchirapalli, Perambalur, Karur, Salem, Namakkal and Coimbatore districts, it is also raised during the special season (June - September). To improve the productivity and efficiency of the sugarcane production system, new varieties and technologies were introduced in the state to shift the productivity horizon. The growth of sugarcane agriculture in the country is consistent during the past seven decades. Among the sugarcane growing states in India, Tamil Nadu ranks third in area and production. Currently, 352,000 hectares are under cane cultivation and this is increasing annually due to the increased consumption of sugar and also the growing demand from mills for sugar cane as a raw material.

The climatic and soil conditions as well as other facilities like irrigation have facilitated increased sugarcane cultivation in Tamil Nadu. To improve sugarcane cultivation, the following measures are recommended:

1. Introduce high-yielding varieties of sugarcane
2. Supply planting materials in time
3. Reduce the gap in yield
4. Introduce short-duration varieties
5. Encourage cultivation of organic sugarcane
6. Strengthen agricultural research
7. Look into the farmers' interests
8. Ensure timely harvesting

As the state of Tamil Nadu has shown, even a smaller area under cultivation can produce high yields through better productivity. Thus by following a few best practices, even the existing acreage under sugarcane cultivation can be used to vastly improve India's sugar output.

This research work is an endeavour to study the International and domestic sugar industry .This research is based on assumptions about general economic conditions, agricultural policies, population growth, weather conditions, and technological changes.

Abdullah[1] developed "ARIMA model for gold bullion coin selling prices forecasting" and had concluded by suggesting that the gold bullion coin selling prices are in upward trends and could be considered as a worthy investment. Alam[2] has explained about the Sugarcane production and sugar crisis. Al-Zeaud, H.A.[3] studied Modeling &Forecasting Volatility using ARIMA model . Chen,et.al [9] analysed about Forecasting time series with outliers in 1993. Macedo, I.C[18] discussed about Sugarcane's energy: Twelve studies on Brazilian sugarcane Agribusiness and its sustainability in 2005. Smith, B. L., Williams ,et.al [19] in 2002 studied about Comparison of parametric and nonparametric models for traffic flow forecasting. Al-Zeaud[3], H.A. introduced about Modeling &Forecasting Volatility using ARIMA model. M. As'ad[4] analyzed about Finding the best ARIMA model to forecast daily peak electricity demand. Azad, A.K. and Mahsin.M [5] evaluated about Forecasting Exchange Rates of Bangladesh using ANN & ARIMA models. Banerjee[6] studied Forecasting of Indian stock market using time-series ARIMA model. Brockwelland Davis[7] wrote a book on Introduction to time series and forecasting in 1996. Chen, C., and Liu, L.[8] studied about Forecasting time series with outliers in 1993. Chen, H., and Grant-Mueller, S.[9] elabatored about the Use of sequential learning for short-term traffic flow forecasting in 1995. Contreras, J., Espinola, R., Nogales, F.J. and Conejo, A.J.[11] analyzed about ARIMA models to predict Next Day Electricity Prices in 2003. Datta, K.[13] discussed about ARIMA Forecasting of Inflation in the Bangladesh Economy in 2011. Fuller, W. A.[14] wrote a book on Introduction to statistical time series in 1996. Goldemberg n et.al [15] studied about the sustainability of ethanol production from sugarcane- Energy. Kumar, K.; Yadav, A.K.; Singh, M.P.; Hassan, H. and Jain V.K.[16] analyzed about Forecasting Daily Maximum Surface Ozone in 2004. Liv, Q.; Liu et.al [17] discussed about Forecasting incidence of hemorrhagic fever with renal syndrome in China using ARIMA model in 2011. Macedo, I.C.[18] analyzed about Sugarcane's energy: Twelve studies on Brazilian sugarcane Agribusiness and its sustainability in 2005. Smith, B. L., Williams, B. M., and Oswald, R. K.[19] studied about the Comparison of parametric and nonparametric models for traffic flow forecasting in *2002*. Williams[20] worked about Modeling and forecasting vehicular traffic flow as a seasonal stochastic time series process in 1992. Williams[21] studied about the Multivariate vehicular traffic flow prediction: Evaluation of ARIMAX modelling in 2002.

II. OBJECTIVE OF STUDY

To forecast the area cultivation of sugarcane using time-series ARIMA Model. This study is based on secondary data.The data demonstrates the efficiency of the prediction in Sugarcane Cultivation .The aim of this paper is to study the different models of ARIMA and obtain the Best Fit model.

III. PRELIMINARIES

A. Autocorrelation

It is defined by ACF = corr(X_t , X_{t+k}) i.e. relationship between each other. Here X_t is the current observation and X_{t+k} is observation after k period. It ranges from -1 to +1.

B. Partial Auto-Correlation

Another important characteristic is a partial autocorrelation function (PACF) which is conditional correlation of X_{t+k} with X_t. PACF is defined for positive lag only, their value also lies between -1 and +1. Both the characteristic, ACF & PACF are equally important, but ACF is relatively easier to calculate than PACF.

C.Stationary Test

First of all the collected data was tested for stationarity which is an initial step of suitability for time series analysis. To understand the nature of data, Durbin- Watson Test was carried out. Durbin and Watson (1951) developed this test to detect the presence of serial correlation for an appropriate for regression analysis. Suitable time lag and serial correlation between the values with are simultaneously important for modelling.

D. Moving Average Method

The moving average method is an improvement over the semi average method and short-term fluctuations are eliminated by it. A moving average is defined as an average of fixed number of items in the time series which move through the series by dropping the top items of the previous averaged group and adding the next in each successive average.

Let (t_1, y_1), (t_2, y_2), …, (t_n, y_n) denote given time series $y_1, y_2, \ldots, y_n$ are the values of the variable y; corresponding to time periods $t_1, t_2, \ldots, t_n$, respectively.

The moving averages of order m are defined as

$$y_1+y_2+\ldots+y_{mm}\,;\; y_2+y_3+\ldots+y_{m+1}$$

Here $y_1+y_2+\ldots+y_m$, $y_2+y_3+\ldots+y_{m+1}$,… are called moving totals of m.

IV. DATA & METHODOLOGY

The ARIMA forecasting equation for a stationary time series is a *linear* (i.e., regression-type) equation in which the predictors consist of *lags of the dependent* variable and/or *lags of the forecast errors*.

Predicted value of Y = a constant and/or a weighted sum of one or more recent values of Y and/or a weighted sum of one or more recent values of the errors.

If the predictors consist only of lagged values of Y, it is a pure autoregressive ("self-regressed") model, which is just a special case of a regression model and which could be fitted with standard regression software. For example, a first-order autoregressive ("AR(1)") model for Y is a simple regression model in which the independent variable is just Y lagged by one period .If some of the predictors are lags of the errors, an ARIMA model it is NOT a linear regression model, because there is no way to specify "last period's error" as an independent variable: the errors must be computed on a period-to-period basis when the model is fitted to the data. From a technical standpoint, the problem with using lagged errors as predictors is that the model's predictions are not linear functions of the coefficients, even though they are linear functions of the past data. Thus coefficients in ARIMA models that include lagged errors must be estimated by *nonlinear* optimization methods ("hill-climbing") rather than by just solving a system of equations.

The acronym ARIMA stands for Auto-Regressive Integrated Moving Average. Lags of the stationaried series in the forecasting equation are called "autoregressive" terms, lags of the forecast errors are called "moving average" terms, and a time series which needs to be differenced to be made stationary is said to be an "integrated" version of a stationary series. Random-walk and random-trend models, autoregressive models, and exponential smoothing models are all special cases of ARIMA models.

SPSS (Statistical Package for the Social Sciences) is a versatile and responsive program designed to undertake a range of statistical procedures. The SPSS software package was created for the management and statistical analysis of social science data. It was originally launched in 1968 by SPSS Inc., and was later acquired by IBM in 2009. In this paper ,SPSS is the software used in the forecasting the cultivation area required for the sugarcane production in Tamil Nadu.

V. ANALYSES OF METHOD

A time series is a sequence where a metric is recorded over regular time intervals. Time series forecasting models are mostly used to predict demand. ARIMA, short for 'Auto Regressive Integrated Moving Average', is a forecasting algorithm based on the idea that the information in the past values of the time series can alone be used to predict the future values.

The classical ARIMA approach becomes prohibitive, and in many cases, it is impossible to determine a model, when seasonal adjustment order is high or its diagnostics fail to indicate that time series is stationary after seasonal adjustment. In such cases, the static parameters of the classical ARIMA model are considered the principal constraint to forecasting high

variable seasonal demand. Another constraint of the classical ARIMA approach is that it requires a large number of observations to determine the best fit model for a data series.

An ARIMA model is labeled as an ARIMA model (p,d,q), wherein:

_ p is the number of autoregressive terms;

_ d is the number of differences; and
_ q is the number of moving averages.
The accuracy of the developed model was evaluated by comparing the experimental and the simulated production in the same period.
As test statistics indicate the suitability of time-series analysis, we can move further in our finding to fulfill our objective of forecasting using ARIMA Model. The first steps involved in finding out autocorrelation and partial auto-correlation between the values of the data.

To build an ARIMA model, we use steps as below:
Step 1. Identification.
Using autocorrelation function (ACF) and partial autocorrelation function (PACF), degree of differencing and appropriate autoregressive and moving average terms are determined.

Step 2. Parameter Estimation.
Parameters of ARIMA model in step 1 are estimated . Non-significant terms are deleted and the final model has all terms significant.

Step 3. Diagnostic Checking.
Q-statistics for residuals of ARIMA model in step 2 is calculated. If the Q statistic is significant then the model is not adequate, go to step 1 and if the Q-statistics is not significant then the fitted ARIMA model is appropriate.

Step 4. Forecasting.
Use ARIMA model in step 3 to obtain forecasts for next five years .

VI. PROBLEM PRESENTATION

The main objective of this problem is to predict the future sugar trends to maximize the production.Data on Sugarcane area cultivation during the period 2005-2020 were taken from the published sources.The aim of the paper is to determine the prediction with Time series Analysis.

VII. Area Under Sugarcane Cultivation

Year	Area Productivity ('000 ha)
2005-2006	335
2006-2007	391
2007-2008	354
2008-2009	309
2009-2010	293
2010-2011	316
2011-2012	346
2012-2013	348
2013-2014	313
2014-2015	263
2015-2016	252
2016-2017	218
2017-2018	172
2018-2019	260

2019-2020	230

Model Fit

Fit Statistic	Mean	SE	Minimum	Maximum	Percentile 5	10	25	50	75	90	95
Stationary R-squared	.535	.	.535	.535	.535	.535	.535	.535	.535	.535	.535
R-squared	.535	.	.535	.535	.535	.535	.535	.535	.535	.535	.535
RMSE	44.015	.	44.015	44.015	44.015	44.015	44.015	44.015	44.015	44.015	44.015
MAPE	12.924	.	12.924	12.924	12.924	12.924	12.924	12.924	12.924	12.924	12.924
MaxAPE	36.815	.	36.815	36.815	36.815	36.815	36.815	36.815	36.815	36.815	36.815
MAE	34.560	.	34.560	34.560	34.560	34.560	34.560	34.560	34.560	34.560	34.560
MaxAE	67.903	.	67.903	67.903	67.903	67.903	67.903	67.903	67.903	67.903	67.903
Normalized BIC	8.111	.	8.111	8.111	8.111	8.111	8.111	8.111	8.111	8.111	8.111

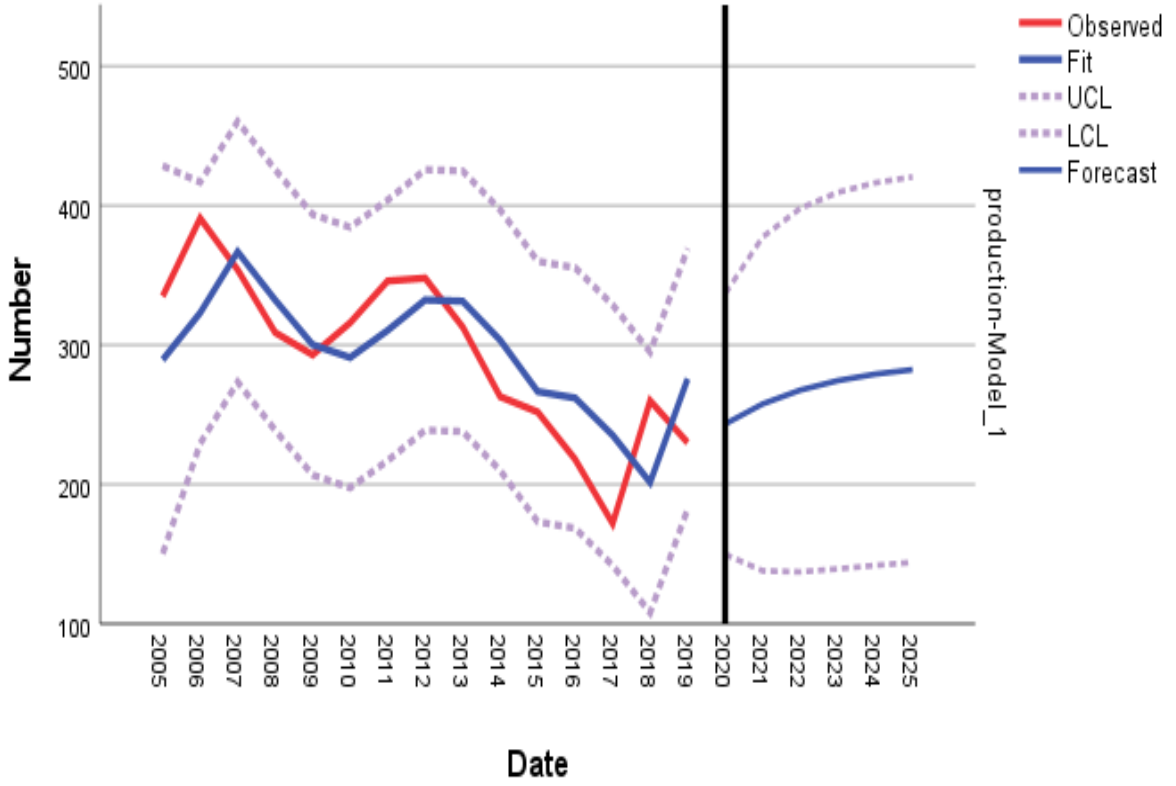

Figure 1:Forecast of the area to be cultivated in the sugarcane

Model Description

			Model Type
Model ID	Production	Model_1	ARIMA(1,0,1)

VIII. RESULT & DISCUSSION

This study has examined the relative efficiency in the determination of Sugarcane cultivation in terms of time series analysis. The forecast is shown upto the year 2025 represents the cultivation of the sugarcane will remain to be the range of area between 300 '000 ha using time series forecasting which is really useful when we have to take future decisions or we have to do analysis .ARIMA in SPSS made the evaluations very easy and approximately correct with the factors influencing the cane cultivation.Figure 1 shows the gradual variations and a steady increase in the need for cultivate Sugarcane.

IX. Conclusion

The analysis of the secondary data on production of sugarcane in India has revealed that there were variations in production. It was evident from the results that there were fluctuations in the production of sugarcane in India, no uniform pattern of growth was observed.

Analysis of performance of the cultivation in sugarcane from preceding 5 years traded value in ARIMA (1, 0, 1) model which helps us in predicting the future values of cultivation in sugarcane. ARIMA (1, 0, 1) was chosen from different model parameters as it provides the best model which satisfies all the criteria of fit statistics. The analysis of the secondary data on production of sugarcane in India has revealed that there were variations in production. It was evident from the results that there were fluctuations in the production of sugarcane in India, no uniform pattern of growth was observed.

REFERENCES

[1] L. Abdullah, "ARIMA model for gold bullion coin selling prices forecasting," *International Journal of Advances in Applied Sciences*, vol. 1, no. 4, pp. 153-158, 2012.
[2] Alam, S.M.**,** Sugarcane production and sugar crisis. *Economic Review*, FindArticles.com., 2007.
[3] Al-Zeaud, H.A. ,"Modeling &Forecasting Volatility using ARIMA model", European Journal of Economics, Finance & Administrative Science, Issue 35,2011, pp. 109-125.
[4] M. As'ad, "Finding the best ARIMA model to forecast daily peak electricity demand," in *Proc. the Fifth Annual ASEARC Conference*, 2012.
[5] Azad, A.K. & Mahsin, M., "Forecasting Exchange Rates of Bangladesh using ANN & ARIMA models: A comparative study, International Journal of Advanced Engineering Science & Technologies, Vol. No. 10, 2011, Issue No. 1, pp. 031-036.
[6] D. Banerjee, "Forecasting of Indian stock market using time-series ARIMA model," in *Proc. Conference Paper, ICBIM-14*, 2014.
[7] C. Chatfield, "The analysis of time series an introduction", 2003.
[8]Brockwell, P. J., and Davis, R. A, *Introduction to time series and forecasting*, 1996, Springer, New York.
[9]Chen, C., and Liu, L., ''Forecasting time series with outliers.'' *J.Forecasting*, 1993,3–36.
[10]Chen, H., and Grant-Mueller, S., ''Use of sequential learning for short-term traffic flow forecasting.'' *Transp. Res. Emerg.Technol.*, 1995, 319–336.
[11] Contreras, J., Espinola, R., Nogales, F.J. and Conejo, A.J. "ARIMA models to predict Next Day Electricity Prices," IFEE Transactions on power system, Vol. 18, No. 3, 2003, pp 1014-1020.
[12] Concentrations in Brunei Darussalam- An ARIMA Modeling Approach", Journal of Air & Waste Management and Association, Volume 54, pp 809-814.
[13] Datta, K., "ARIMA Forecasting of Inflation in the Bangladesh Economy", The IUP Journal of Bank Management, Vol. X, No. 4, 2011, pp. 7-15.
[14] Fuller, W. A., *Introduction to statistical time series*, 2nd Ed., 1996, Wiley, New York.
[15] Goldemberg, Jose, Suani, Teixeira Coelho and Patricia, Guardabassi**,** The sustainability of ethanol production from sugarcane- Energy Policy, *J. Sci. Direct*, Elsevier Ltd,2007.
[16] Kumar, K.; Yadav, A.K.; Singh, M.P.; Hassan, H. and Jain, V.K."Forecasting Daily Maximum Surface Ozone", 2004.
[17] Liv, Q.; Liu, X.; Jiang, B. & Yang, W.,"Foreca sting incidence of hemorrhagic fever with renal syndrome in China using ARIMA model", Biomed Central, 2011, pp. 1-7.
[18] Macedo, I.C., Sugarcane's energy: Twelve studies on Brazilian sugarcane Agribusiness and its sustainability. Unia˜o da Agroindu´ stria Canavieira de Sa˜o Paulo, Sa˜o Paulo, p. 195, 2005.
[19] Smith, B. L., Williams, B. M., and Oswald, R. K., ''Comparison of parametric and nonparametric models for traffic flow forecasting.'' *Transp. Res., 2002*, 257–321.
[20] Williams, B. M., ''Modeling and forecasting vehicular traffic flow as a seasonal stochastic time series process.'' PhD dissertation, Univ. of Virginia, Charlottesville, Va,1992.
[21] Williams, B. M.,''Multivariate vehicular traffic flow prediction: Evaluation of ARIMAX modeling.'' *Transportation Research Record 1776*, Transportation Research Board, Washington, D.C.,2002, 194–200.