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Forecasting chickpea production in India using ARIMA model

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ABSTRACT

India is the principal chickpea producing country. Chickpea as such contributes around 32 per cent of the total pulse production in the country. It is imperative to assess scientifically the accurate future production potentials of this crop on the basis of past trends. Chickpea production data for the period of 1950-51 to 2007-08 of India were analyzed by time-series methods. Appropriate Box-Jenkins autoregressive integrated moving average model (121) was fitted. Validity of the model was tested using standard statistical techniques. Thus the study has been made to forecast the production of chickpea in India up to the year 2020.

Key words : Chickpea, Production, ARIMA

Chickpea (*Cicer arietinum* L.)is one of the most important pulse legumes in many parts of the world. India is the largest producer and consumer of chickpea in the world, sharing 65 and 70 % of the total global area and production, respectively. Chickpea production has gone up from 3.65 to 5.63 million tonnes between 1950-51 and 2004-05, registering a growth of 0.58% annually.

An ARIMA process corresponds to the population mechanism that generates the time series. The model is based on sample data. Any ARIMA model build is a useful approximation of the true but unobservable underlying process. If a model is a good approximation of a process, the model tends to mimic the behaviour of the process. Thus, forecast from the model may provide useful information about future values of the series. Standard ARIMA analysis rests on the simplifying assumption that the process which generated a single time series is stationary. In this paper, an autoregressive integrated moving average model of chickpea production in India has been constructed. For that the data from1950-51 to 2007-2008 and finally applied the same to forecast the values of variable during the future 12 years.

METHODOLOGY

Respective time series data for this study were collected from Government publications (Agricultural Statistics at a glance, 2008).Box and Jenkins (1976) linear time series model was applied. Auto Regressive Integrated Moving Average (ARIMA) is the most general class of models for forecasting a time series. Different series appearing in the forecasting equations are called "Auto-Regressive" process. Appearance of lags of the forecast errors in the model is called "moving average" process. The ARIMA model is denoted by ARIMA (p,d,q), where "p" stands for the order of the auto regressive process, 'd' is the order of the data stationary and 'q' is the order of the moving average process. The general form of the ARIMA (p,d,q) can be written as described by Judge *et al*. (1988).

$$\Delta dyt = \delta + \theta 1\ \Delta dyt\text{-}1 + \theta 2\ \Delta dyt\text{-}2 + \text{——} + \theta pyt\text{-}p + e_{t-1}\ \alpha\ e_{t-1} - \alpha_2\ e_{t-2}\ \alpha_q\ e_{t-2} \quad (1)$$

where, Δd denotes differencing of order d,*i.e.*,

Δyt = yt-yt-1, $\Delta^2 yt = \Delta yt - \Delta t\text{-}1$ and so forth, Y t-1 —— y_{t-p} are past observations (lags), δ, θ1 ———— θp are parameters (constant and coefficient) to be estimated similar to regression coefficients of the Auto Regressive process (AR) of order "p" denoted by AR (p) and is written as

$$Y = \delta + \theta 1\ y\ t\text{-}1 + \theta 2\ y\ t\text{-}2 + \text{———} + \theta py\ t\text{-}p + et \quad (2)$$

where,et is forecast error, assumed to be independently distributed across time with mean è and variance θ2e, et-1, et- 2 ——— et-q are past forecast errors, α1, ———— αq are moving average (MA) coefficient that needs to be estimated. While MA model of order q (*i.e.*) MA (q) can be written as

$$Yt = et - \alpha 1\ \alpha t\text{-}1 - \alpha 2 et\text{-}2 \text{———} \alpha_q\ et\text{-}q \quad (3)$$

The major problem in ARIMA modeling technique

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