FORECASTING FOR THE AREA, AVERAGE YIELD AND PRODUCTION OF WHEAT CROP IN EGYPT AND BENI-SWEF GOVERNORATE USING ARIMA MODELS

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ABSTRACT

The paper describes an empirical study of modeling and forecasting time series data of the area, average yield and Production of wheat crop in Egypt and Beni-Swef Governorate. The Box Jenkins ARIMA methodology has been used for forecasting. The objective of the research is to find an appropriate ARIMA model for forecasting for area, average yield and the production of wheat crop. The diagnostic checking has shown that ARIMA(0,2,1) is appropriate for the area in Egypt, random walk model for the average yield and ARIMA(1,1,1) for the production. But, in the case of Beni-Swef Governorate the linear trend model is the best forecast model for the area, ARIMA(0,1,2) is the best forecast model for the average yield and linear trend model for the production The forecasts from 2007-2008 to 2012-2013 are calculated based on the selected best model by using time series from 1982-1983 to 2006-2007, which the values for the forecasts for the area about 3.2182 million fedan in 2007/2008 and 3.511 million fedan in 2012/2013, the average yield 18.3404 ardab/fed in 2007/2008 and 19.9925 ardab/fed in 2012/2013 and the production 58.6243 million ardab in 2007/2008 and 68.3664 million ardab in 2012/2013 for Egypt. In the case of Beni-Swef Governorate, the area about 142713 fedan in 2007/2008 and 161124 fedan in 2012/2013, the average yield 21.8916 ardab/fed in 2007/2008 and 23.6585 ardab/fed in 2012/2013 and the production 2.890 million ardab in 2007/2008 and 3.364 million ardab in 2012/2013. These forecasts would be helpful for the policy makers to foresee ahead of time the future requirements of grain storage import and/or export and adopt appropriate measures in this regard.

Key Words: Forecasting; Wheat area; Wheat average yield; Wheat production; ARIMA models.

INTRODUCTION

Wheat occupies about 33% of the total winter crop area and is the major staple crop, consumed mainly as bread. More than one-third of the daily caloric intake of Egyptian consumers and 45% of their total daily protein consumption is derived from wheat. The reforms and the introduction of higher-yielding wheat varieties have led to increased wheat crop area, yields, and production. Wheat output growth jumped from 1.9 percent in 1971-80 to 10.3 and 4.8 percent in 1981-90 and 1991-2000, respectively. This has led to a rise in the self-sufficiency ratio from about 21% in 1986 to on average 59% over the 2001-2003 period. The government has been able to increase the quantity of domestic wheat it procured (for its subsidy program for *baladi* flour and bread) from less than 0.1 million metric tonnes in 1986 to 2 million metric tonnes in 2004. Nevertheless, while wheat self-sufficiency is often cited as a goal of Egyptian wheat policy, imports averaged about 4.7 million tonnes per year between 2001 and 2003, (FAO, Agricultural and Development Economic Division, 2005).

Forecasts have traditionally been made using structural econometric models. Concentration have been given on the univariate time series models known as auto regressing integrated moving average (ARIMA) models, which are primarily due to world of Box and **Jenkins (1970)**. These models have been extensively used in practice for forecasting economic time series and are generalization of the exponentially weighted moving average process. Several methods for identifying special cases of ARIMA models have been suggested by Box-Jenkins and others. **Mohammadi, K. *et al.* (2005), and Haque,M. *et al.* (2006)** have discussed the methods of identifying univariate models. Among others **Akhlaq, T. (2005), Yule (1926, 1927), Bartlett (1964), Sabry, M. *et al.* (2007), Ljune and Bos (1978), Nochai, R. and Nochai, T. (2006), Bashier, A. and Talal, B. (2007)** and **Garcia, M. *et al.* (2008)** have also emphasized the use of ARIMA models.

In this study, these models were applied to forecast the area, average yield and the production of wheat crop in Egypt. This study would enable to predict expected the area, average yield and the production of wheat for the years from 2007/2008 onward. The forecasts would thus help save much of the precious resources of our country which otherwise would have been wasted.

MATERIALS AND METHODS

The most common approaches to forecasting or the prediction method which is based on an inferred study of past data behavior over time. In time series analysis, the observations taken at a constant interval of time are considered random variables. Any particular observed series is supported to be the only realization of all possible series that could be generated under the same set of conditions. ARIMA models in time series analysis can satisfactorily explain such processes according to **Box and Jenkins (1976).** The Box–Jenkins model authorizes us not only to expose the hidden patterns in the data but also to generate forecasts of the future based exclusively on historical values of the dependent variable. Moreover, the accuracy of forecast of time series models are good, convenient to use when seasonal or monthly patterns must be taken into account, supple enough to be modified hen strategy changes occur, the least data-intensive compared to many other models, and easily developed by means of various standard software packages. In addition, seasonal ARIMA models allow for randomness in the seasonal pattern, unlike the classical method approach based on linear regression. However, they are inaccurate when considerable changes in determining variables occur in the future and can be susceptible to their starting values, when carrying the greatest weight in the forecast. A general ARIMA model contains autoregressive (AR) and moving average (MA) parts. he AR part describes the relationship between present and past observations, whereas the MA part characterizes the autocorrelation structure of the error or disturbance series. In this paper, time series analyze; reference crop production {Yt} for forecasting and modeling as a function of time. The Box-Jenkins methodology refers to the set of procedures for identifying, fitting, and checking ARIMA models with time series data. Forecasts follow directly from the form of the fitted model **(Nochai, R. and Nochai, T., 2006).**

(1) The random walk model:

The random walk model is very simple. Without a constant, it uses the current value of the time series to forecast all future values, i.e.,

$$F_t(k) = Y_t \quad \text{for all } k \geq 1$$

This model is often used for data that does not have a fixed mean and for which the history of the process is irrelevant given its current position. The time series is thus equally likely to go up or down at any point in time. If a constant is included, then the forecast is given by

$$F_t(k) = Y_t + k\hat{\Delta}$$

where $\hat{\Delta}$ estimates the average change from one period to the next. The forecast function for such a model is a straight line with slope equal to $\hat{\Delta}$.

(2) The trend models:

The *Mean*, *Linear Trend*, *Quadratic Trend*, *Exponential Trend*, and *S-Curve* models all fit various types of regression models to the data, using time as the independent variable. The models are fit by least squares, resulting in estimates of up to 3 coefficients: *a*, *b*, and *c*. Forecasts from the models are as follows:

Mean model: $F_t(k) = \bar{Y}$

where $\bar{Y}$ is the average of the data up to and including time *t*.

Linear trend: $F_t(k) = \hat{a} + \hat{b}(t+k)$

Quadratic trend: $F_t(k) = \hat{a} + \hat{b}(t+k) + \hat{c}(t+k)^2$

Exponential trend: $F_t(k) = \exp(\hat{a} + \hat{b}(t+k))$

S-Curve: $F_t(k) = \exp(\hat{a} + \hat{b}/(t+k))$

Since they weight all data equally, regression models are often not the best methods for forecasting time series data.

(3) A pth-order autoregressive model: AR(p), which has the general form

$$Y_t = \Phi_0 + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \ldots + \Phi_p Y_{t-p} + \varepsilon_t.$$

Where:

Y_t = Response (dependent) variable at time *t*

$Y_{t-1}, Y_{t-2}, \ldots, Y_{t-p}$ = Response variable at time lags *t* — 1, *t* — 2,..., *t* — *p*, respectively.

$\Phi_0, \Phi_1, \Phi_2, \ldots, \Phi_n$ = Coefficients to be estimated

ε_t = Error term at time *t*

(4) A qth-order moving average model: MA(q), which has the general form

$$Y_t = \mu + \varepsilon_t - \theta_1\varepsilon_{t-1} - \theta_2\varepsilon_{t-2} - \ldots - \theta_n\varepsilon_{t-n}.$$

Where:

Y_t = Response (dependent) variable at time *t*

μ = Constant mean of the process

$\theta_1, \theta_2, \ldots, \theta_n$. = Coefficients to be estimated

ε_t = Error term at time *t*

$\varepsilon_t, \varepsilon_{t-1}, \varepsilon_{t-2}, \ldots, \varepsilon_{t-n}$. = Errors in previous time periods that are incorporated in the response *Yt*.

(5) Autoregressive Moving Average Model: ARMA(p, q), which has the general form

$$Y_t = \Phi_0 + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \ldots + \Phi_p Y_{t-p} + \varepsilon_t - \theta_1\varepsilon_{t-1} - \theta_2\varepsilon_{t-2} - \ldots - \theta_q\varepsilon_{t-q}.$$

We can use the graph of the sample autocorrelation function (ACF) and the sample partial autocorrelation function (PACF) to determine the model which processes can be summarized as follows:

Table (1): How to determine the model by using ACF and PACF patterns

Model	ACF	PACF
AR(p)	Dies down	Cut off after lag *q*
MA(q)	Cut off after lag *p*	Dies down
ARMA *(p, q)*	Dies down	Dies down

(6) Autoregressive integrated moving average model:

Denoted by ARIMA *(p, d, q)*. Here *p* indicates the order of the autoregressive part, *d* indicates the amount of differencing, and *q* indicates the order of the moving average part. If the original series is stationary, *d* = 0 and the ARIMA models reduce to the ARMA models. The difference linear operator (Δ), defined by

$$\Delta Y_t = Y_t - Y_{t-i} = Y_t - BY_t = (1 - B)Y_t$$

The stationary series W_t obtained as the *dth* difference (Δ^d) of Y_t,

$$W_t = \Delta^d Y_t = (1 - B)^d Y_t$$

ARIMA (*p, d, q)* has the general form:

$$\Phi_n(B)(1-B)^d Y_t = \mu + \Phi_n(B)\varepsilon_t.$$

$$\text{or} \quad \Phi_n(B)W_t = \mu + \Phi_n(B)\varepsilon_t.$$

(7) Model Checking:

In this step, model must be checked for adequacy by considering the properties of the residuals whether the residuals from an ARIMA model must has the normal distribution and should be random. An overall check of model adequacy is provided by the Ljung-Box *Q* statistic. The test statistic *Q* is

$$Q_m = n(n+2)\sum^{m} r_k^2(e)/(n-k) \sim \chi^2_{m-r}$$

where $r_k(e)$= the residual autocorrelation at lag *k*

n= the number of residuals

m= the number of time lags includes in the test

If *the* p-value associated with the *Q* statistic is small *(p*-value < *a*), the model is considered inadequate. The analyst should consider a new or modified model and continue the analysis until a satisfactory model has been determined.

RESULTS AND DISCUSSION

As stated above, the annual area, average yield and production of wheat crop have been used for modeling purposes. The used data associated with wheat crop which denoted in Table (2) is for the years from 1982-83 to 2006-7. The modeling of the time series involved the steps of model specification, model estimation, diagnostic checking and forecasts. Table (3). show the estimated autocorrelations between values of area, average yield and production at various lags. The lag k autocorrelation coefficient measures the correlation between values of production at time t and time t-k. Also shown are 95.0% probability limits around 0. If the probability limits at a particular lag do not contain the estimated coefficient, there is a statistically significant correlation at that lag at the 95.0% confidence level. In all analysis, 2 of the 24 autocorrelation coefficients are statistically significant at the 95.0% confidence level, implying that the time series may not be completely random (white noise), except the case of average Yield for Beni-Swef Governorate 1 of the 24 autocorrelation coefficients are statistically significant at the 95.0% confidence level, implying that the time series may not be completely random (white noise). Figures (1,2,3 and 4), show that the time series plot and estimated autocorrelations for Egypt and Beni-Swef Governorate.

Table (4) introduced the estimation period for statistical parameters, which estimated by using the Statgraphics statistical computer package, the root mean squared error (RMSE), the mean absolute error (MAE), the absolute percentage error (MAPE), the mean error (ME) and the mean percentage error (MPE). Table (5) and figures (5,6) show that the best forecast models summary, which for the area (Egypt) an autoregressive integrated moving average (ARIMA) model has been selected. This model assumes that the best forecast for future data is given by a parametric model relating the most recent data value to previous data values and previous noise. Terms with P-values less than 0.05 are statistically significantly different from zero at the 95.0% confidence level. The P-value for the MA(1) term is less than 0.05, so it is significantly different from 0. The estimated standard deviation of the input white noise equals 0.155399. For the average yield (Egypt), a random walk model has been selected. This model assumes that the best forecast for future data is given by the last available data value. But the production (Egypt), an autoregressive integrated moving average (ARIMA) model has been selected. This model assumes that the best forecast for future data is given by a parametric model relating the most recent data value to previous data values and previous noise. Terms with P-values less than 0.05 are statistically significantly different from zero at the 95.0% confidence level. The P-value for the AR(1) term, MA(1) term and the constant term are less than 0.05, so it is significantly different from 0. The estimated standard deviation of the input white noise equals 2.32649. The area **(Beni-Swef Governorate)**, a linear trend model has been selected. This model assumes that the best forecast for future data is given by the a linear regression line fit to all previous data. The output summarizes the statistical significance of the terms in the forecasting model. Terms with P-values less than 0.05 are statistically significantly different from zero at the 95.0% confidence level. In this case, the P-value for the linear term is less than 0.05, so it is significantly different from 0. In the case of average yield **(Beni-Swef Governorate)**, an autoregressive integrated moving average (ARIMA) model has been selected. This model assumes that the best forecast for future data is given by a parametric model relating the most recent data value to previous data values and previous noise. Terms with P-values less than 0.05 are statistically significantly different from zero at the 95.0% confidence level. The P-value for the MA(2) term and for the constant term are less than 0.05, so it is significantly different from 0. The estimated standard deviation of the input white noise equals 1.31379 .

Also, the production **(Beni-Swef Governorate)**, a linear trend model has been selected. This model assumes that the best forecast for future data is given by the a linear regression line fit to all previous data. Terms with P-values less than 0.05 are statistically significantly different from zero at the 95.0% confidence level. In this case, the P-value for the linear term is less than 0.05, so it is significantly different from 0 .

Table (6), introduced the forecasts for the area, average yield and the production for wheat crop in Egypt and **Beni-Swef Governorate** through the period from 2007/2008 to 2011/2012 with 95% confidence interval are calculated according to best forecasting models.

Table (2): The data for the area, average yield and production wheat crop in ARE and Beni-Swef Governorate (1982/1983- 2006/2007).

Year	Egypt			Beni-Swef Governorate		
	Area million fedan	Average yield ardab	Production million ardab	Area fedan	Average yield ardab	Production million ardab
1982/1983	1.32	10.08	13.3056	53149	10.06	0.534739
1983/1984	1.178	10.27	12.09806	53420	11.05	0.590541
1984/1985	1.186	10.53	12.48858	50560	11.66	0.589695
1985/1986	1.206	10.66	12.85596	52196	12.19	0.636381
1986/1987	1.373	13.22	18.15106	59169	17.64	1.04371
1987/1988	1.422	13.31	18.92682	61148	16.5	1.008889
1988/1989	1.533	13.85	21.23205	64900	15.66	1.016259
1989/1990	1.955	14.56	28.4648	86162	17.02	1.466298
1990/1991	2.215	13.49	29.88035	95802	15.25	1.460704
1991/1992	2.092	14.72	30.79424	80488	16.24	1.307398
1992/1993	2.171	14.84	32.21764	94848	16.53	1.567499
1993/1994	2.111	14.01	29.57511	92654	16	1.48279
1994/1995	2.512	15.19	38.15728	104974	15.26	1.602173
1995/1996	2.421	15.79	38.22759	104488	15.86	1.65718
1996/1997	2.486	15.68	38.98048	114350	16.72	1.911906
1997/1998	2.421	16.76	40.57596	102265	18.69	1.911333
1998/1999	2.379	17.71	42.13209	110375	19.47	2.149
1999/2000	2.463	17.7	43.5951	122114	17.21	2.101674
2000/2001	2.342	17.43	40.82106	118965	18.1	2.153267
2001/2002	2.45	17.98	44.051	110219	18.3	2.017008
2002/2003	2.506	18.18	45.55908	112594	19.55	2.201213
2003/2004	2.606	18.31	47.71586	121686	19.53	2.376528
2004/2005	2.985	18.11	54.05835	134651	21.5	2.894997
2005/2006	3.064	17.98	55.09072	142998	21	3.002958
2006/2007	3.145	18.01	56.64145	126949	21.5	2.729544

Source: Economic Affairs Sector, Ministry of Agriculture and Land Reclamation, ARE.

Table (3): Estimated Autocorrelations for the area, average yield and Production wheat.

Location	The model	Lag	Autocorrelation	Stnd. Error	Lower 95.0% Prob. Limit	Upper 95.0% Prob. Limit
Egypt	*Area* ARIMA(0,2,1)	1	0.859602	0.2	-0.391994	0.391994
		2	0.701324	0.314823	-0.617042	0.617042
		3	0.531728	0.372104	-0.729313	0.729313
		4	0.404088	0.401348	-0.78663	0.78663
		5	0.294712	0.417305	-0.817904	0.817904
		6	0.175629	0.425549	-0.834062	0.834062
		7	0.0925272	0.428438	-0.839725	0.839725
		8	0.0338973	0.429237	-0.841291	0.841291
	Average Yield	1	0.862543	0.2	-0.391994	0.391994
		2	0.733222	0.315466	-0.618302	0.618302
		3	0.603378	0.377528	-0.739943	0.739943
		4	0.43212	0.41431	-0.812035	0.812035
		5	0.349182	0.431962	-0.846632	0.846632
		6	0.258442	0.443109	-0.868479	0.868479
		7	0.176105	0.449098	-0.880217	0.880217
		8	0.115111	0.451851	-0.885614	0.885614
	Production ARIMA(1,1,1)	1	0.871306	0.200000	-0.391994	0.391994
		2	0.737530	0.317386	-0.622066	0.622066
		3	0.594130	0.379803	-0.744401	0.744401
		4	0.465068	0.415318	-0.814010	0.814010
		5	0.367044	0.435652	-0.853863	0.853863
		6	0.259714	0.447850	-0.877772	0.877772
		7	0.177034	0.453835	-0.889502	0.889502
		8	0.101077	0.456589	-0.894900	0.894900
Beni-Swef Governorate	Area Linear trend	1	0.867234	0.2	-0.391994	0.391994
		2	0.716758	0.316493	-0.620315	0.620315
		3	0.581222	0.375855	-0.736663	0.736663
		4	0.477691	0.410235	-0.804047	0.804047
		5	0.378147	0.431911	-0.846532	0.846532
		6	0.278773	0.444957	-0.872102	0.872102
		7	0.142339	0.45189	-0.885689	0.885689
		8	0.0506485	0.453679	-0.889197	0.889197
	Average Yield ARIMA(0,1,2)	1	0.724195	0.2	-0.391994	0.391994
		2	0.52145	0.286281	-0.561101	0.561101
		3	0.326399	0.32204	-0.631187	0.631187
		4	0.148362	0.335011	-0.656611	0.656611
		5	0.170435	0.337629	-0.661742	0.661742
		6	0.16954	0.341053	-0.668453	0.668453
		7	0.104495	0.344408	-0.675028	0.675028
		8	0.112684	0.345674	-0.677509	0.677509
	Production Linear trend	1	0.858872	0.2	-0.391994	0.391994
		2	0.694201	0.314663	-0.61673	0.61673
		3	0.536869	0.370899	-0.72695	0.72695
		4	0.415466	0.40078	-0.785515	0.785515
		5	0.340149	0.417652	-0.818585	0.818585
		6	0.282307	0.42859	-0.840023	0.840023
		7	0.183377	0.435965	-0.854477	0.854477
		8	0.120954	0.439039	-0.860503	0.860503

Source: Calculated from table (2).

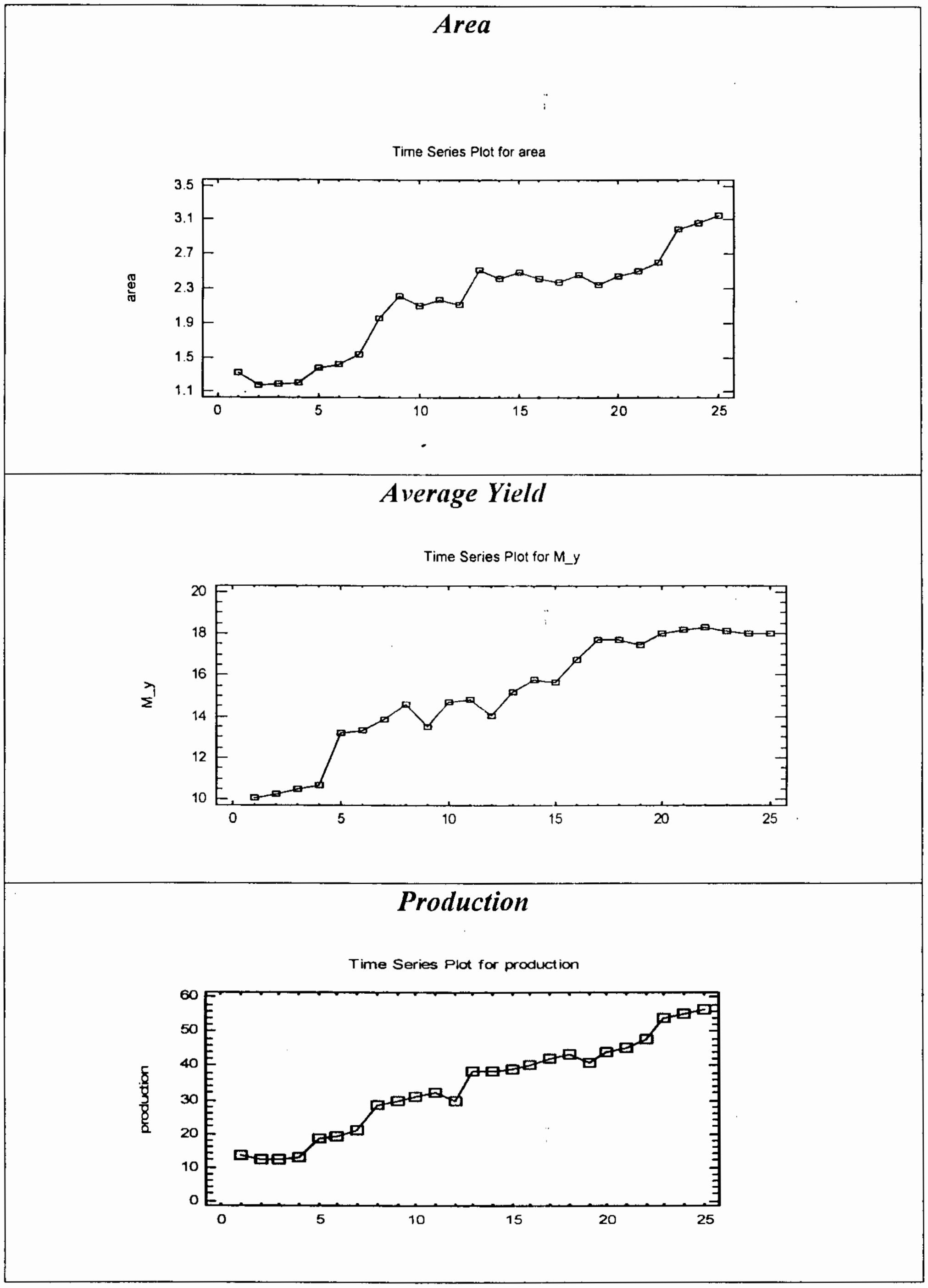
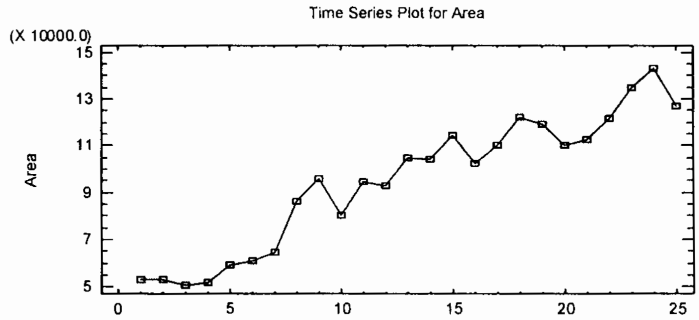
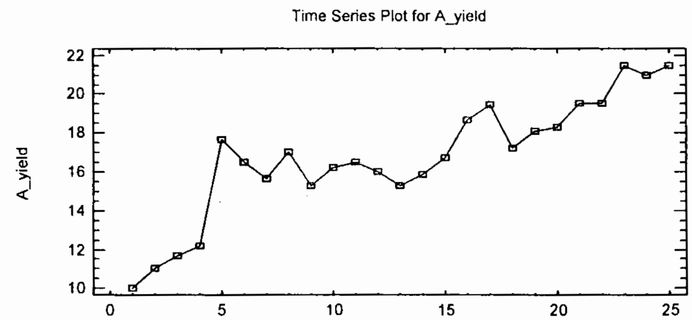


Fig. (1): Time series plot for Egypt

Area



Average Yield



Production

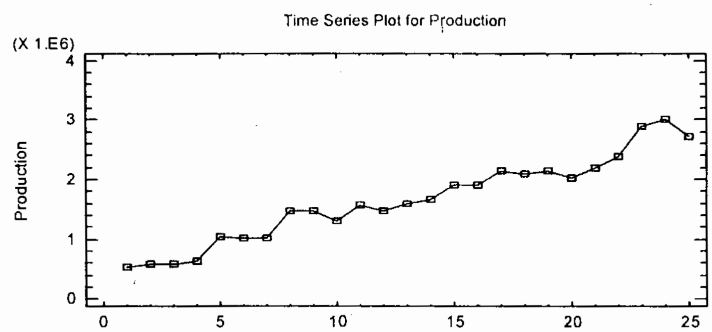


Fig. (2): Time series plot for Beni-Swef Governorate

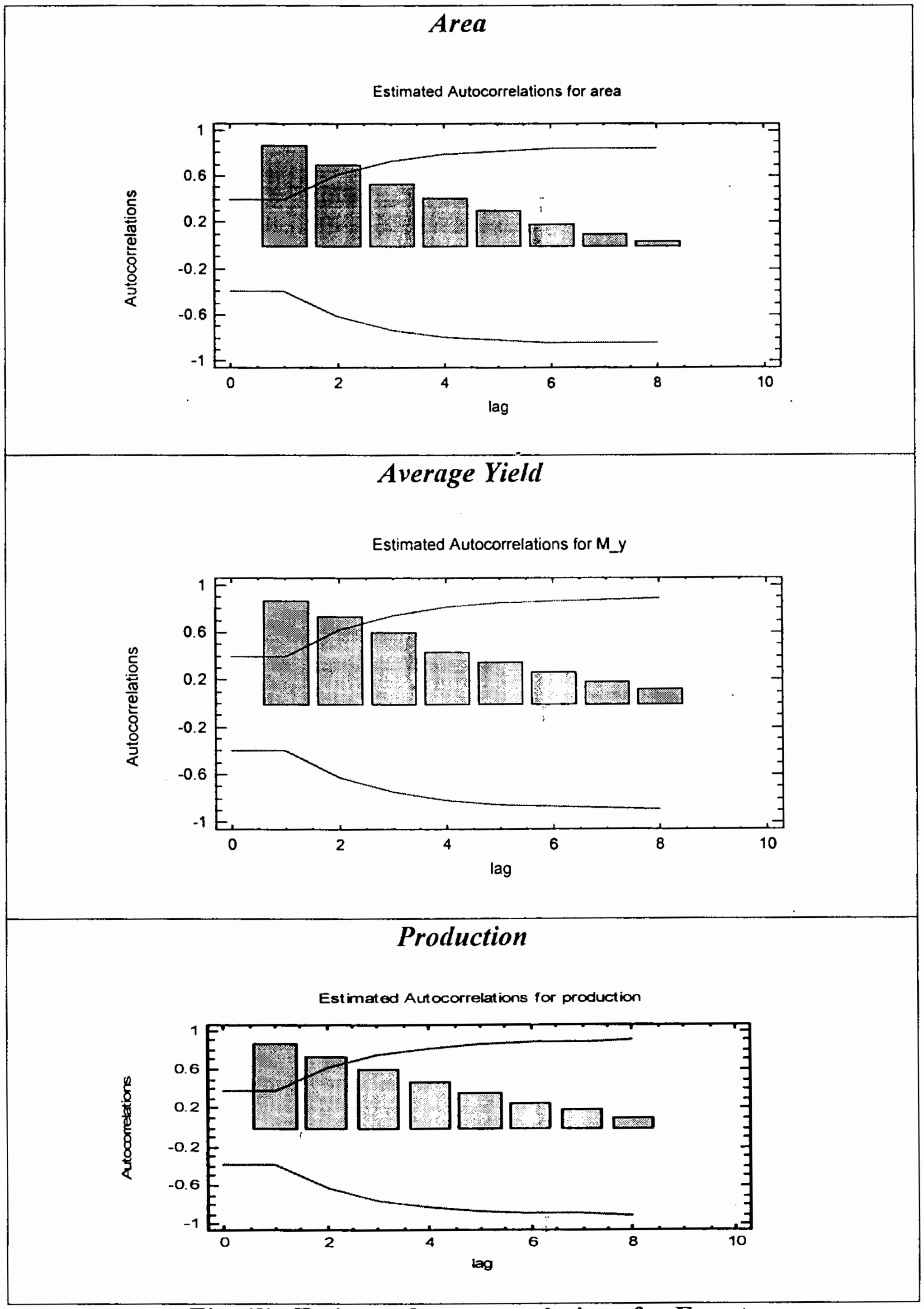


Fig. (3): Estimated autocorrelations for Egypt.

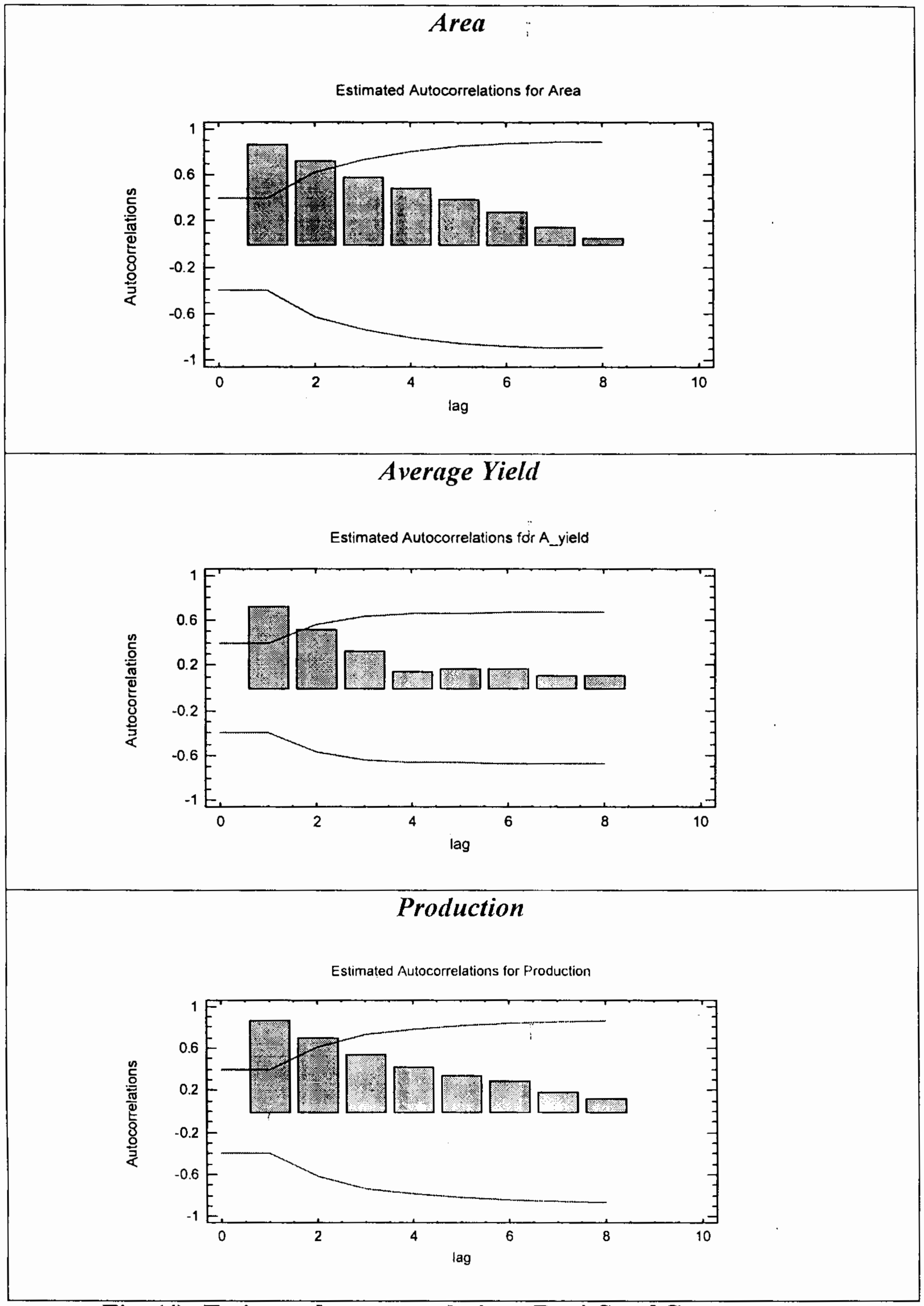


Fig. (4): Estimated autocorrelations Beni-Swef Governorate.

Table (4): ***Estimation Period for the area, average yield and the production for wheat crop in ARE and*** **Beni-Swef Governorate**

Location	***Statistic***	***Area***	***Average Yield***	***Production***
Egypt	RMSE	0.148736	0.722914	2.27369
	MAE	0.103359	0.535521	1.70921
	MAPE	4.85791	3.60583	6.3122
	MSE	0.00682376	-4.44089E-16	0.026894
	MPE	0.0253464	0.0266188	-1.2204
Beni-Swef Governorate	RMSE	0.00817674	1.26649	0.15491
	MAE	0.00698507	0.900783	0.121505
	MAPE	7.89612	5.39931	8.05329
	MSE	-2.05391E-17	0.234605	3.33067E-16
	MPE	-1.10046	0.959866	-1.18155

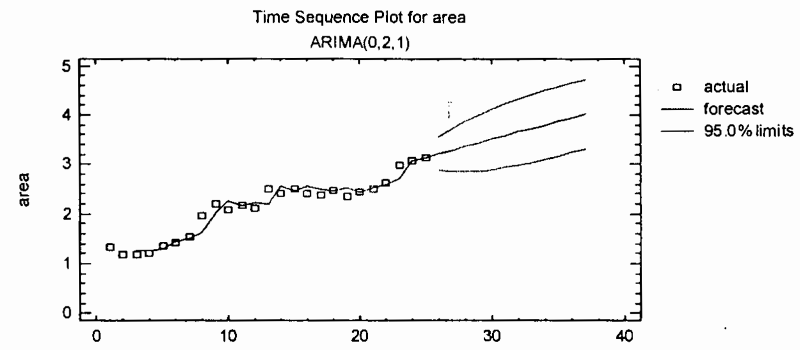
Source: Calculated from table(2).

Table (5):The best Forecast Model Summary

Location	Variable	*Parameter*	*Estimate*	*Stnd. Error*	*t*	*P-value*	*SD*
Egypt	*Area* ARIMA(0,2,1)	MA(1)	1.07644	0.0101935	105.6	0.000000	0.15539
	Average Yield	Forecast model selected: Random walk with drift = 0.330417					
	Production ARIMA(1,1,1)	AR(1)	0.448629	0.209354	2.14292	0.043990	2.32649
		MA(1)	1.10222	0.0485688	22.694	0.000000	
		Mean	1.94186	0.0446118	43.528	0.000000	
		Constant	1.07069				
Beni-Swef Governorate	*Area* Linear trend	Constant	0.046977	0.003444	13.6408	0.000000	
		Slope	0.003682	0.000232	15.8946	0.000000	
	Average Yield ARIMA(0,1,2)	MA(1)	0.595105	0.175521	3.3905	0.002759	1.31379
		MA(2)	0.573661	0.226348	2.53442	0.019286	
		Mean	0.41618	0.021144	19.6833	0.000000	
		Constant	0.41618				
	Production Linear trend	Constant	0.42322	0.065244	6.4867	0.000001	
		Slope	0.09487	0.004388	21.6165	0.000000	

Source: Calculated from table(2).

Area



Average Yield

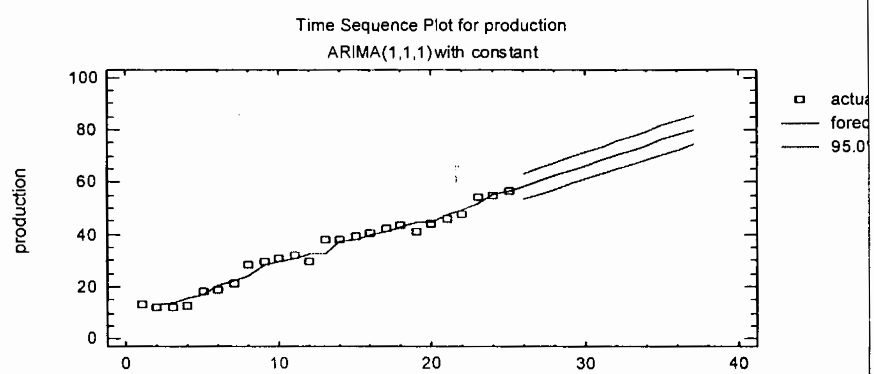
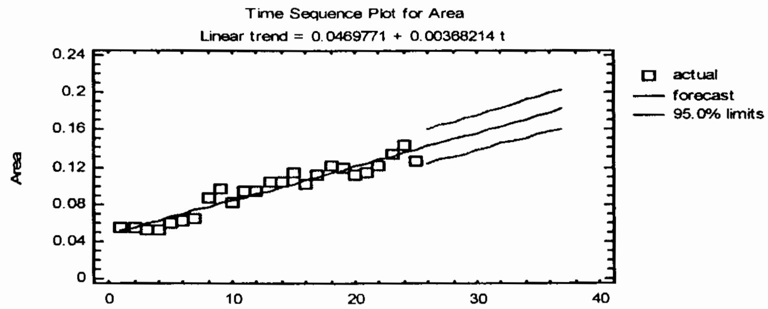
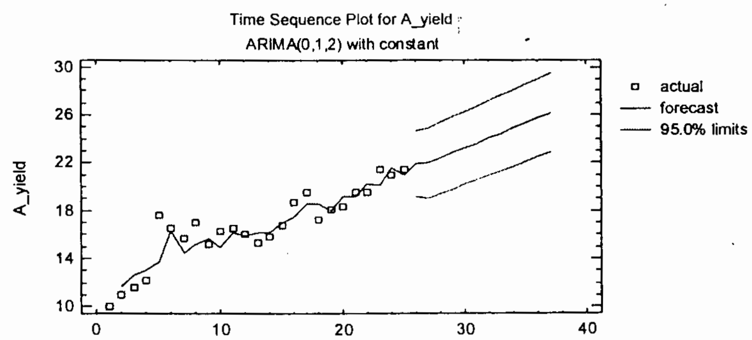


Fig. (5): Time sequence plot for Egypt.

Area



Average Yield



Production

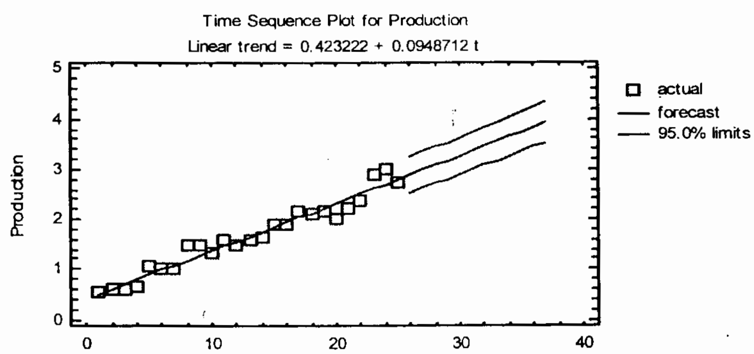


Fig. (6): Time sequence plot for Beni-Swef Governorate.

Table (6): The forecasts for the area, average yield and the production for Wheat crop in ARE and Beni-Swef Governorate

Location	Variable	Year	Forecast	Lower 95% Limit	Upper 95% Limit
Egypt	*Area* ARIMA(0,2,1)	2007/08	3.2182	2.8959	3.5405
		2008/09	3.2914	2.8527	3.7301
		2009/10	3.3646	2.8479	3.8813
		2010/11	3.4378	2.8645	4.0111
		2011/12	3.5110	2.8956	4.1264
		2012/13	3.5842	2.9374	4.2310
	Average Yield	2007/08	18.3404	16.8128	19.8680
		2008/09	18.6708	16.5104	20.8312
		2009/10	19.0013	16.3553	21.6472
		2010/11	19.3317	16.2764	22.3869
		2011/12	19.6621	16.2462	23.0780
		2012/13	19.9925	16.2506	23.7344
	Production ARIMA(1,1,1)	2007/08	58.6243	53.7861	63.4625
		2008/09	60.5846	55.4643	65.7049
		2009/10	62.5347	57.4080	67.6615
		2010/11	64.4803	59.3395	69.6210
		2011/12	66.4238	61.2403	71.6073
		2012/13	68.3664	63.1226	73.6102
Beni-Swef Governorate	*Area* Linear trend	2007/08	142713	124023	161403
		2008/09	146395	127540	165250
		2009/10	150077	131046	169108
		2010/11	153759	134542	172976
		2011/12	157441	138028	176854
		2012/13	161124	141505	180743
	Average Yield ARIMA(0,1,2)	2007/08	21.8916	19.1594	24.6238
		2008/09	21.9938	19.0461	24.9414
		2009/10	22.4100	19.4265	25.3934
		2010/11	22.8261	19.8072	25.8450
		2011/12	23.2423	20.1884	26.2962
		2012/13	23.6585	20.5700	26.7470
	Production Linear trend	2007/08	2.890	2.536	3.244
		2008/09	2.985	2.627	3.342
		2009/10	3.080	2.719	3.440
		2010/11	3.174	2.810	3.538
		2011/12	3.269	2.901	3.637
		2012/13	3.364	2.992	3.736

Source: Calculated from table (2).

REFERENCES

Akhlaq, T. (2005). "Panel model for wheat prices", Journal of statistics., Vol:12, No.1:59-67.

Bartlett, M.S., (1964). "On The Theoretical Specification of Sampling Properties of Autocorrelated Time Series". *J. Roy. Stat. Soc.*, B 8: 27–41.

Bashier, A. and Talal, B. (2007). "Forecasting foreign direct investment inflow in Jordan: univariate ARIMA model". Journal of social sciences 3(1): 1-6.

Box, G.E.P. and D.A. Pierce, (1970). "Distribution of Residual Autocorrelations in Autoregressive-Integrated Moving Average Models." *J. American Stat. Assoc.*, 65: 1509–26.

Box, G.E.P. and G.M. Jenkins, (1976). "*Time Series Analysis Forecasting and Control*. Rev. Ed. San Francisco. Holden-Day.

FAO, Agricultural and Development Economic Division, (2005). "Measuring Technical Efficiency of Wheat Farmers in Egypt" ESA Working Paper No.05-06.

Garcia, M. Caballero, P. and Fernandez, M. (2008). "Price trends in greenhouse tomato and pepper and choice of adoptable technology". Spanish Journal of Agricultural Research, 3(6): 320-332.

Haque, M.., Imam, M. and Awal , M.. (2006). " Forecasting shrimp and frozen food export earning of Bangladesh using ARIMA model" Pakistan Journal of Biological Sciences. Vol.9(12):2318-2322.

Ljunge, G.M. and G.E.P. Box, (1978). "On a Measure of Lack of Fit in Time Series Models". *Biometrika,* 65: 67–72.

Mohammadi, K., Eslami, H. and Dardashti, S. (2005). "Comparison for regression, ARIMA AND ANN models for reservoir inflow forecasting snowmelt equivalent (a case study of Karaj)" J. Agric. Sci. Technol. Vol.7:17-30.

Nochai, R. and Nochai, T. (2006). "ARIMA model for forecasting oil palm price" Proceedings of the 2nd IMT-GT Regional Conference on Mathematics, Statistics and Applications Universiti Sains Malaysia, Penang, June 13-15, 2006.

Quenouille, M.H., (1949). "Approximate Tests of Correlation in Time-Series. *J. Roy. Stat. Soc.,* B11: 68–84.

Sabry, M., Abd-El-Latif, H. and Badra, N. (2007). "Comparison between regression and arima models in forecasting traffic volume". Australian Journal of Basic and Applied Sciences,1(2):126-136.

Yule, G.U., (1926). "Why Do We Sometimes Get Nonsense – correlations Between Times Series. A study in Sampling and the Nature of Series". *J. Roy. Stat. Soc.,* 89: 1–69.

Yule, G.U., (1927). "On a method of Investigation Periodicities in Disturbed Series, With Specia; Reference To Wolfer's Sunspot Number". *Phill. Trans.,* A 226: 267–98.

التنبؤ للمساحة، متوسطِ إنتاج وإنتاج محصولِ القمح في مصر ومحافظةِ بني سويف باستخدام نماذج ARIMA .

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الملخّص

تتميز الإنتاجية الفدانية للحاصلات الزراعية بصفة عامة بخضوعها لتغيرات مستمرة تختلف في الاتجاة والمقدار ويرجع ذلك لتأثر الإنتاجية بعوامل جوية لا يمكن التحكم فيها بالإضافة إلي العوامل الحيوية والزراعية والاقتصادية التي يمكن السيطرة عليها وبالتالي تتأثر المساحات المنزرعة من هذه الحاصلات في العام التالي بالارتفاع أو الانخفاض وكذلك تختلف نسبة تأثيرها علي محصول معين من فترة زمنية إلي أخرى. إن دراسة طبيعة وشكل واتجاه التغيرات السنوية في المساحة والإنتاجية في محاصيل الحبوب والتي من أهمها محصول القمح باعتباره أهم محاصيل الحبوب خلال فترة زمنية معينة وتحليل هذه التغيراتِ وقياس أهميتها النسبية، يعتبر أساس للدراسات الموضوعية التي ترمى إلي تقويم الجهود التي بذلت خلال فترة زمنية معينة للنهوض بمستويات إنتاجية لمحصول القمح أو المحافظة عليها والتي تهدف إلي عمل تنبؤات دقيقة لمستويات الإنتاجية في السنوات المقبلة. ومن هذا المنطلق تَصِفُ الورقةُ دراسة تجريبية مِنْ عرض وتنبؤ بياناتِ سلسة زمنيةٍ لبيانات المساحةِ، متوسطِ إنتاج وإنتاجِ محصولِ القمح في مصر ومحافظة بنى سويف. باستخدام منهج Box Jenkins لنماذج ARIMA للتنبؤ، كانّ الهدفَ من البحثِ أنْ يَجِدَ نموذجَ ARIMA الملائم للتنبؤ بالمساحةِ، متوسط إلا نتاج والإنتاج الكلي لمحصول القمح في مصر ومحافظة بنىسويف. وكان أفضل نموذج ARIMA (١،٢،٠) ملائمُ للمساحةِ، نموذج المشي عشوائي لمتوسطِ الإنتاج وARIMA(١،١،١) للإنتاج الكلي بالنسبة لمصر. ولكن، في حالة محافظة بنىسويف، نموذج الاتجاه الخطي أفضل نموذج تنبؤ للمساحةِ، ARIMA (٢،١،٠) أفضل نموذج تنبؤ لمتوسط الإنتاج ونموذج الاتجاه الخطي للإنتاج الكلي. وتم حساب التنبؤات للمساحة ومتوسط الإنتاج والإنتاج الكلي في مصر ومحافظة بنىسويف للفترة منْ ٢٠٠٧-٢٠٠٨ إلي ٢٠١٢-٢٠١٣ طَبقا لأفضل النماذج للتنبؤ المتحصل عليها من التحليلات باستعمال السلسلة الزمنيةِ مِنْ ١٩٨٢-١٩٨٣ إلى ٢٠٠٦-٢٠٠٧. فنجد في حالة المساحة بلغت هذه القيم حوالي ٣,٢١٨٢ مليون فدان لعام ٢٠٠٧/٢٠٠٨ و ٣,٥١١ مليون فدان لعام ٢٠١٢/٢٠١٣، ومتوسط المحصول بلغت ١٨,٣٤٠٤ إردب/فدان لعام ٢٠٠٧/٢٠٠٨ و ١٩,٩٩٢٥ إردب/فدان لعام ٢٠١٢/ و الإنتاج الكلي بلغت القيمة المتنبأ بها حوالي ٥٨,٦٢٤٣ مليون إردب في عام ٢٠٠٧/٢٠٠٨ بينما بلغت ٦٨,٣٦٦٤ مليون إردب لعام ٢٠١٢/٢٠١٣ وذلك في حالة الجمهورية. بينما في حالة محافظة بنى سويف، بلغت قيم التنبؤ للمساحة ١٤٢٧١٣ فدان لعام ٢٠٠٧/٢٠٠٨ وحوالي ١٦١١٢٤ فدان لعام ٢٠١٢/٢٠١٣، وفي حالة متوسط المحصول بلغت ٢١,٨٩١٦ إردب/فدان لعام ٢٠٠٧/٢٠٠٨ وحوالي ٢٣,٦٥٨٥ إردب/فدان لعام ٢٠١٢/٢٠١٣ وفي حالة الإنتاج كانت القيمة ٢,٨٩ مليون إردب لعام ٢٠٠٧/٢٠٠٨ و٣,٣٦٤ مليون إردب لعام ٢٠١٢/٢٠١٣. هذه التوقعاتِ سَتَكُونُ مساعدة لصُنّاع السياسة لاتخاذَ الإجراءات الملائمة بهذا الخصوص نحو المتطلبات المستقبلية للاستيراد أو الإنتاج.