Forecasting Area, Yield And Production Of Groundnut Crop In New Andhra Pradesh Using- R

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ABSTRACT: *Groundnut is king of oilseeds. Groundnut is the largest oilseed produced in the world and stands second largest oilseed in India. The Indian agricultural Sector accounts for 15.4% of India's gross domestic product (GDP) and employs just a little less than 44% of the country's labour force. The Andhra Pradesh Agricultural sector accounts for 34% of New Andhra Pradesh state' s gross domestic product(GDP) and employs just a less than 55% of the state's labour force. Prices of groundnuts liable to change rapidly and unpredictably, hence farmers need a reasonable forecasting of harvest period price to decide on the acreage under groundnut. Time series data covering the period of 2003-2018 was used of New Andhra Pradesh was used for the study. The study is to identify the best ARIMA model, which is for fitting and forecasting of groundnut area, yield and production in New Andhra Pradesh respectively. Based on results collected some conclusions are made about the forecast production of groundnut crop by using ARIMA with R- software.*

Keywords: ARIMA, Forecasting, Auto Correlation Function, Akaike Information Criterion, R-software..

I. INTRODUCTION

Time series modelling is a dynamic research vicinity which has attracted the attention of researcher's community over closing few decades. Forecasting lays a floor for reducing the threat in all choice making because many of choices and need to be made below uncertainty. Forecasting is an art of making an estimate of future stipulations on a systematic basis the usage of available expertise and information, i.e., it is a rationally worked out estimate about future. Forecast might also limit future uncertainty via extrapolating the past systematically. Forecasting is completed on distinct assumptions and is usually made with probability. Forecasting according to Neils Bohr(Danish Physicist), "It is difficult to make Predictions, especially about the future" Douglas C Montogremy, Cheryl L Jennigs and Murat Kulachi, *,(2018)[1]*.

Agriculture is back bone of the Indian Economy. Groundnut is important oilseeds crop and oil content material of the seed varies from 44-50%, relying on varieties and agronomic conditions. Groundnut is additionally of price as a rotation crop. The production are centred in the four states of Gujarat, Andhra Pradesh, Tamilnadu and Karnataka. Groundnut is grown in the course of the tropics and its cultivation is extended to the subtropical nations mendacity between 45° North and 35° South and up to an altitude of 1,000 meters. The whole amount of rainfall required for presuming operations (preparatory) is 100 mm, for sowing it is 150 mm and for flowering and pod development an evenly distributed rainfall of 400-500 mm is required Madhusudana B et al(2013) [2] along with novel innovative technology like meghamadhanam, rain guns, drip irrigation, excellent of seeds, soil test, pesticides, fertilizers , non-stop keen observation etc.

New Andhra Pradesh state is made up of the two major regions of Rayalaseema, in south western part of the state, and Coastal Andhra to the east and northeast, bordering the bay of Bengal. The state consists thirteen districts in total, nine of which are located in Coastal Andhra and four in Rayalaseema. Coastal Andhra is located in the jap area of the state of Andhra Pradesh on Coromandel Coast, In Andhra Pradesh groundnut is grown majorly in Srikakulam and Vishakapatnam districts of Coastal Andhra Region. Rayalaseema , meaning 'rocky region', Especially, groundnut is the solely essential industrial crop in the drought susceptible district of Anantapuramu in Rayalaseema region of Andhra Pradesh. So, the district headquarter of Anantapuramu is called as 'Groundnut City' . Groundnut is an important protein supplement for cattle and poultry rations. It is also consumed as confectionery product. The cake can be used for manufacturing artificial fibre. The haulms are fed to livestock .

Crop area estimation and forecasting of crop yield are an indispensible technique in aiding policy decision related to land use allocation, food security and environmental issues. Statistical techniques able to grant crop forecast with practical precisions properly in advanced. Various procedures have been used for forecasting such agricultural systems. Concentration have been given on the uni-variate time series Auto Regressive Integrated Moving Average (ARIMA) Models, which primarily due to World of Box and Jenkins(1970). Among the stochastic ARIMA types which are powerful, effective and popular as they can correctly describe the found facts and can make forecast with minimum forecast error. These types of models are very difficult to pick out and estimate. Muhammed et al(1992) conducted an empirical of modelling and forecasting time series data of rice production in Pakistan[3], G. Shruthi, et al**,** (2017) Production and Productivity of Groundnut Crop in Telengana, Agric. Sci. Digest.,37(2):151-153[4]**,** Najeeb Iqbal et al. (2005) for forecasting wheat area and production in Pakistan [5], M.K Debnath et al. (2013)for forecasting Area, production, and Yield of Cotton in India using ARIMA Model [6], M. Hemavathi et al.(2018) ARIMA Model for Forecasting of Area, Production and productivity of Rice and Its Growth Status in Thanjavur District of Tamil Nadu, India[7], also use the ARIMA Model . The study is to identify the best ARIMA model, which is for fitting and forecasting of Groundnut Area, Yield, Production in Ceded region respectively. Conclusions are drawn and found the forecasting for the future. The R-Software is used to analyse and graphical representation of the results.

R- software: The R- language is widely used among statistician and data miners for developing statistical software and data analysis. R is a commonly used free Statistics software. R allows you to carry out statistical analyses in an interactive mode, as well as allowing simple programming. The R- language is widely used among statistician and data miners for developing statistical software and data analysis. . Although R has a command line interface, there are several graphical user interfaces, such as R studio, an integrated development environment. R is a programming language and environment commonly used in statistical computing, data analytics and scientific research. It is one of the most popular languages used by statisticians, data analysts, researchers and marketers to retrieve, clean, analyze, visualize and present data.

Advantages of R Programming headed **by** open source, exemplary support for data wrangling, The array of packages, quality plotting and graphing , highly compatible, platform independent, eye-catching

reports, machine learning operations, statistics etc. On other side disadvantages headed by weak origin, Data handling, Basic security, complicated language , Lesser speed, Spread across various packages. Applications of R in the discipline Finance, Banking, Healthcare, Social Media, E-commerce, Manufacturing, Moreover, real-life use cases of R language in Face book, Ford motor Company, Google, Foursquare, John Deere, Microsoft, Mozilla, New York Times, Thomas Cook, National Weather Service, Twitter, Trulia, ANZ Bank etc.

II. MATERIALS AND METHODS

A. Data collection:

The study has utilized secondary source of data. The time series data on yearly kharif and Rabi seasons totals area, yield and production of groundnut crop from 2003-2004 to 2017-2018 of 15 years data required for the study was collected from the DIRECTORATE OF ECONOMICS AND STATISTICS, HYDERABAD . The 15 years of data of groundnut producing Rayalaseema districts viz., Anantapuramu, Kurnool, cuddapah, chittoor districts of Andhra Pradesh and Coastal Andhra Andhra districts viz., Srikakulam, Vizianagaram, Visakhapatnam, East Godavari, West Godavari,Krishna, Guntur, Prakasam, and Nellore districts. Coastal Andhra borders Rayalaseema regions of the state and the states of Telangana, Odisha. The presence of the Krishna River Godavari River and Penna River makes the area fertile for irrigation.

Fig:1 (A) Area, Yield and Production of Groundnut Crop in New Andhra Pradesh

(B) Auto Regressive Integrated Moving Average (ARIMA) model (Box-Jenkins model):

One of the most popular and frequently used stochastic time series models is the Auto Regressive Integrated Moving Average (ARIMA) model was introduced by Box and Jenkins. The basic assumption made to implement this model is that considered time series is linear and follows a particular known statistical distribution, such as the Normal Distribution. ARIMA model has subclasses of other models, such as Auto Regressive (AR), Moving Average (MA) and Auto Regressive Moving Average(ARMA) models. For seasonal time series forecasting , Box and Jenkins had proposed a quite successful variation of ARIMA model, viz. the Seasonal ARIMA (SARIMA). The popularity of the ARIMA model is mainly is due to its flexibility to

represent several varieties of time series with simplicity as well as the associated Box-Jenkins(1994) methodology for the optimal model building process.

The term ARIMA stands for "Auto-Regressive Integrated Moving Average." Lags of the differenced series appearing in the forecasting equation are called "auto-regressive" 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 (i.e., exponential weighted moving averages) are all special cases of ARIMA models. A non seasonal ARIMA model is classified as an "ARIMA (p, d, q)" model, where p is the number of autoregressive terms, d is the number of non seasonal differences, and q is the number of lagged forecast errors in the prediction equation. The Box-Jenkins methodology seeks to transform any time series data to be stationary; and then apply the stationary process for forecasting by using past uni-variate time series process for future forecast with a host of selection and diagnostic tools.

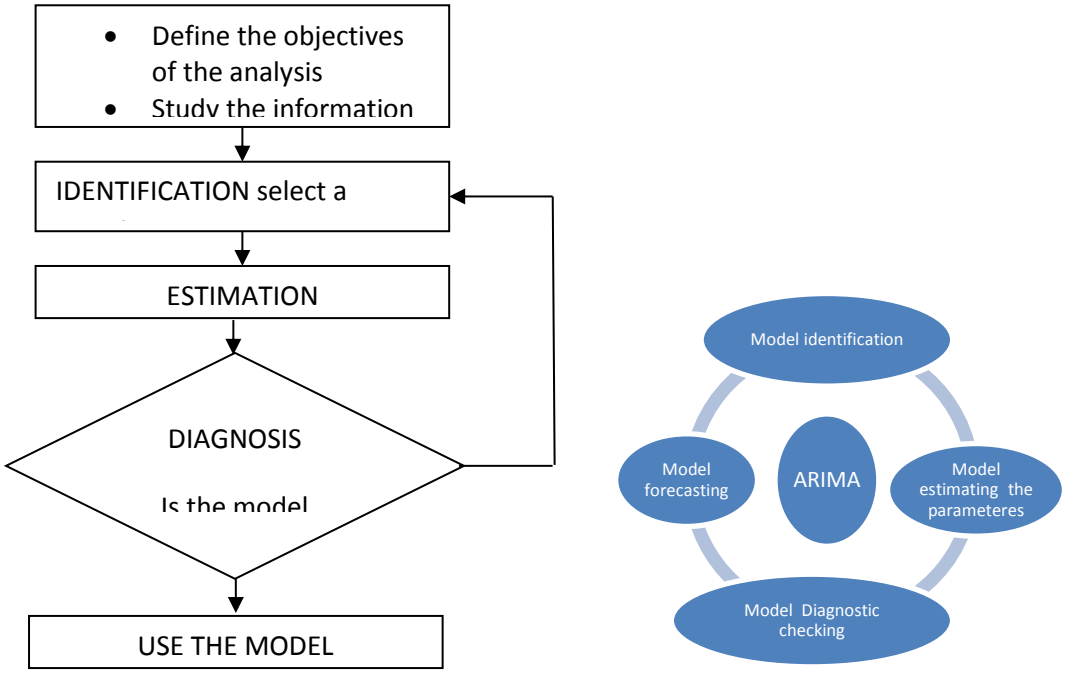


Fig: 1(B) **Auto Regressive Integrated Moving Average (ARIMA) model (Box-Jenkins model process**

1) Model Identification : This stage involves the specification of the correct order of ARIMA model by determining the appropriate order of the AR, MA and the integrated parts or the differencing order. The major tools in the identification process are the (sample) autocorrelation function and partial autocorrelation function. The identification approach is basically designed for both stationary and non-stationary processes. Spikes represent in the line at various lags in the plot with length equal to magnitude of autocorrelations and these spikes distinguish the identification of a stationary and non stationary process. The main objective in fitting ARIMA model is to identify the stochastic process of the time series and its stationarity counterpart. The main objective in fitting ARIMA models is to identify the stochastic process of the time series and predict the future

values accurately. Ansari and Ahmad (2001)[19] worked with application of ARIMA modelling and co-integration analysis on time series of tea price. Different stages in forecasting model are given below. Identification: A good starting point for time series analysis is a graphical plot of the data . It helps to identify the presence of trends. Before estimating the parameters p and q of the model, the data are not examined to decide about the model which best explains the data. This is done by examining the sample ACF, and PACF. Both ACF and PACF are used as the aid in the identification of appropriate models. There are several ways of determining the order type of process, but still there was no exact procedure for identifying the model.

2) Model Estimating the parameters: After tentatively identifying the suitable model is not "estimating a second time series", it is filtering it. The function accuracy gives multiple measures of accuracy of the model fit, ME(mean error), RMSE(root mean squared error), MAE(mean absolute error), MPE(mean percentage error), MAPE(mean absolute percentage error), MASE(mean absolute scaled error) , And ACF (auto correlation function) It is up to you to decide, based on the accuracy measures, whether you consider this a good fit or not. For example, mean percentage error of nearly -70% does not look good to me in general, but that may depend on what your series are and how much predictability you may realistically expect. It is often a good idea to plot the original series and the fitted values, and also model residuals. You may occasionally learn more from the plot than from the few summarizing measures such as the ones given by the accuracy` function. Depending on the ACF and PACF of these sequence plots a model is run with appropriate software (R-Software). The best fitting model must also have few parameters as much as possible alongside best statistics of the model according to the information selection criteria.

3) Model Diagnostic Checking: After having estimated the parameters of a tentatively identify ARIMA model, it is necessary to do diagnostic checking to verify that the model is adequate. Examining ACF And PACF considered random when all their ACF and PACF considered random when all their ACF were within the limits. Model checking in time series can be done by looking at the residuals. Traditionally the residuals given by Residuals = observed values – fitted values. These results should be normally distributed with zero mean, uncorrelated, and should have minimum variance or dispersion, if indeed a model fits the well. That is model validation usually consist of plotting residuals overtime to verify the validation.

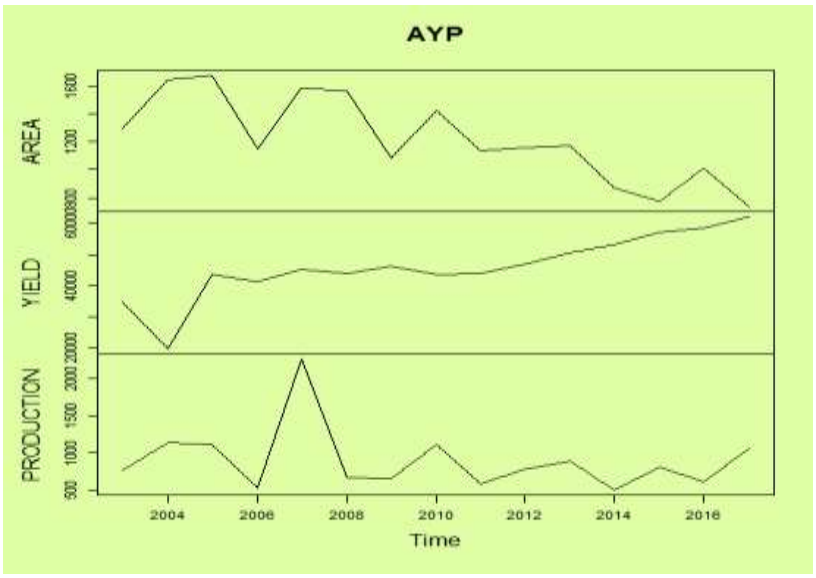
4) Model Forecasting: After satisfying about the adequacy of the fitted model, it can be used for forecasting future values. This was done with the help of R- Software.

III. RESULTS AND DISCUSSION

Analysis of Time series data regarding agricultural oriented groundnut crop area, yield and production using R software tabulated along with necessary graphical presentations mentioned below, Groundnut is an important protein supplement for cattle and poultry rations. It is also consumed as confectionery product. The cake can be used for manufacturing artificial fibre. The haulms are fed to live stock . Groundnut shell is used as fuel for manufacturing coarse boards. Cork substitutes. Groundnut is also valued as a rotation crop. Being a legume with root nodules, it can synthesize with atmospheric nitrogen and thereby improve soil fertility. All investors are timely cautious about crop production with updated technology.

Table-1

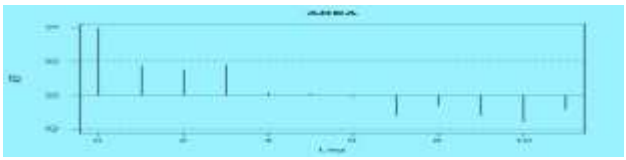
AREA, YIELD AND PRODUCTION OF GROUNDNUT CROP IN NEW ANDHRAPRADESH



	Andhra Pradesh			
	YEAR	Area (in 000'ha.)	Yield (in Kg/ha.)	Prod. (in 000'tones)
1	2003-2004	1298	34613	762
2	2004-2005	1647	19704	1142
3	2005-2006	1677	43443	1110
4	2006-2007	1155	41221	523
5	2007-2008	1589	45298	2259
6	2008-2009	1565	43781	659
7	2009-2010	1087	46280	647
8	2010-2011	1427	43475	1105
9	2011-2012	1136	44012	582
10	2012-2013	1158	46833	777
11	2013-2014	1176	50589	881
12	2014-2015	874	53273	493
13	2015-2016	775	57257	801

Fig:3 Area- ACF(NEW ANDHRAPRADESH)

Fig: 4 AREA- PACF(NEW ANDHRAPRADESH



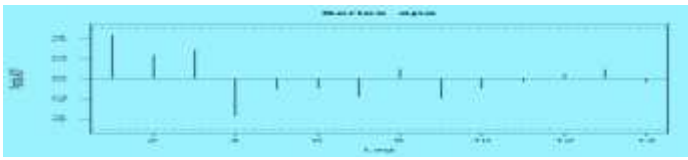
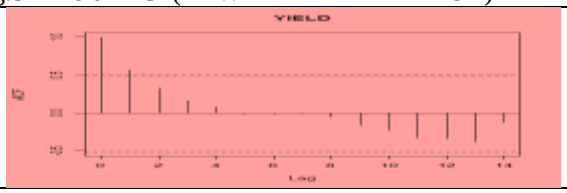


Fig:5 Yield- ACF(NEW ANDHRAPRADESH)

Fig: 6 YIELD - PACF(NEW ANDHRAPRADESH)



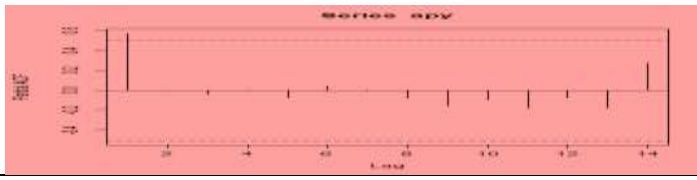
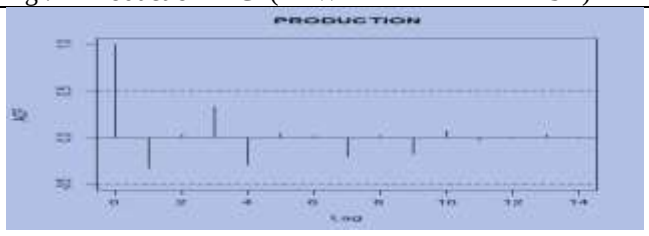


Fig : 7 Production -ACF(NEW ANDHRAPRADESH)

Fig:8 PRODUCTION- PACF(NEW



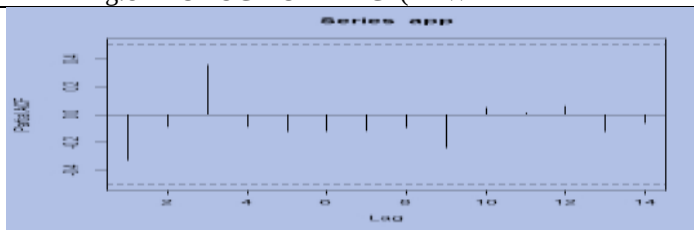


TABLE-2

Area, Yield and Production ACF and PACF(NEW ANDHRAPRADESH)

	Area, Yield and Production ACF and PACF(NEW ANDHRAPRADESH)					
Lag	ACF (area)	PACF (area)	ACF (YIELD)	PACF (YIELD)	ACF (PROD)	PACF (PROD)
0	**1.000**	**0**	**1.000**	**0**	**1.000**	**0**
1	0.438	0.438	0.573	0.573	-0.330	-0.330
2	0.382	0.236	0.330	0.003	0.031	-0.088
3	0.452	0.289	0.163	-0.042	0.334	0.357
4	0.041	-0.370	0.082	0.006	-0.294	-0.089
5	0.025	-0.104	-0.010	-0.074	0.047	-0.123
6	-0.026	-0.094	-0.010	0.040	0.019	-0.120
7	-0.301	-0.182	-0.007	0.006	-0.204	-0.118
8	-0.152	0.095	-0.052	-0.079	0.023	-0.093
9	-0.299	-0.196	-0.167	-0.161	-0.177	-0.240
10	-0.392	-0.095	-0.232	-0.095	0.075	0.050
11	-0.211	-0.030	-0.329	-0.181	-0.034	0.011
12	-0.260	0.043	-0.338	-0.074	-0.010	0.060
13	-0.168	0.092	-0.380	-0.178	0.029	-0.123
14	-0.028	-0.035	-0.123	0.275	-0.008	-0.061

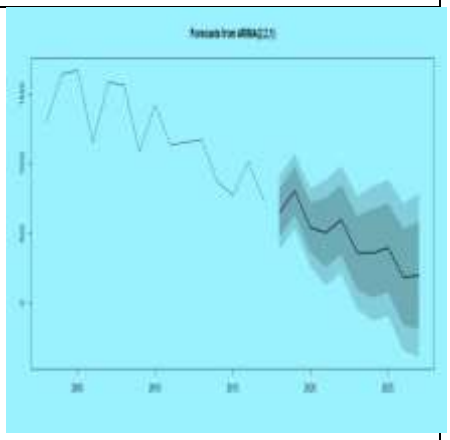
Table -3

AREA, YIELD, AND PRODUCTTION POINT FORECAST(NEW ANDHRAPRADESH)

Area Point Forecast of Groundnut (NEW ANDHRA PRADESH)

Year	Area Point forecast	Lo 80	Hi 80	Lo95	Hi 95
2018	646.2523	471.59499	820.9096	379.13700	913.3676
2019	806.7025	631.81376	981.5913	539.23323	1074.1718
2020	543.3448	361.35500	725.3347	265.01539	821.6743
2021	506.4474	256.27879	756.6159	123.84755	889.0472
2022	600.1272	348.41451	851.8398	215.16588	985.0885
2023	361.5507	93.47126	629.6301	-48.44142	771.5428
2024	356.5948	39.08866	674.1010	-128.98897	842.1787
2025	395.4990	73.77729	717.2206	-96.53188	887.5298
2026	186.4222	159.43919	532.2836	-342.52716	715.3716
2027	198.1025	-187.74065	583.9457	-391.99368	788.1987

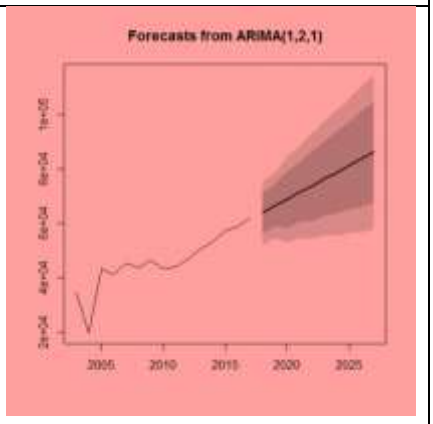
Fig: 9 Area forecast



Yield Point Forecast (NEW ANDHRA PRADESH)

Year	Yield point forecast	Lo 80	Hi 80	Lo95	Hi 95
2018	63793.57	56274.73	71312.41	52294.50	75292.64
2019	66751.33	58890.24	74612.41	54728.83	78773.82
2020	68840.08	58468.04	79212.12	52977.42	84702.75
2021	71587.11	60537.35	82636.87	54687.97	88486.26
2022	73835.50	61008.08	86662.92	54217.65	93453.34
2023	76461.61	62742.52	90180.69	90180.69	97443.13
2024	78801.59	63605.47	93997.70	55561.13	102042.04
2025	81358.31	65148.21	97568.42	56567.10	106149.53
2026	83750.85	66209.76	101291.95	56924.06	110577.65
2027	86267.76	67645.97	104889.56	57788.19	114747.34

Fig:10 Yield forecast



Production Point Forecast((NEW ANDHRA PRADESH)

Year	Production Point forecas	Lo 80	Hi 80	Lo95	Hi 95
2018	683.0075	112.766000	1253.249	-189.1016	1555.117
2019	754.3179	184.070862	1324.565	-117.7997	1626.436
2020	859.9895	225.418346	1494.561	-110.5033	1830.482
2021	677.8114	-65.650633	1421.273	-459.2157	1814.838
2022	763.4817	1.966639	1524.997	-401.1551	1928.119
2023	748.5797	-93.237024	1590.396	-538.8679	2036.027
2024	678.6164	-225.314523	1582.547	-703.8267	2061.060
2025	722.1400	-223.079372	1667.359	-723.4483	2167.728
2026	684.1822	-333.596080	1701.960	-872.3754	2240.740
2027	661.7591	-409.888882	1733.407	-977.1851	2300.703

Fig:11 Production forecast

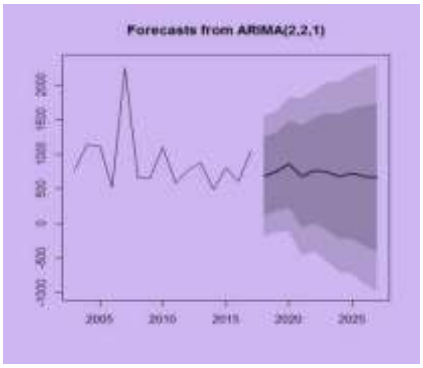


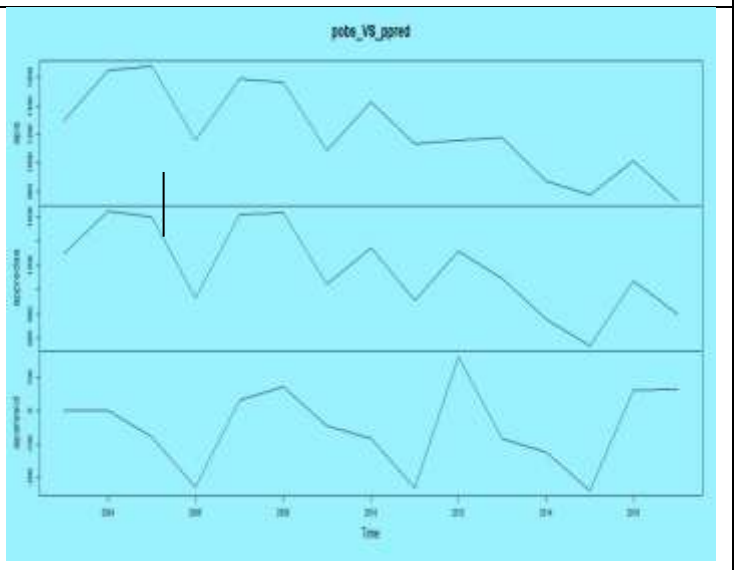
Table-4

Residuals & Predictive values of Area, Yield and Productions(NEW ANDHRA PRADESH)

AREA (NEW ANDHRAPRADESH)

Year	AREA observed	Area expected	Area residual
2003	1298	1298.5805	0.5804823
2004	1647	1646.0390	-0.9610333
2005	1677	1597.8501	-79.1498831
2006	1155	927.9243	-227.0756780
2007	1589	1620.7148	31.7147715
2008	1565	1636.9827	71.9827025
2009	1087	1042.6179	-44.3820906
2010	1427	1344.0553	-82.9446992
2011	1136	906.3874	-229.6126345
2012	1158	1319.0065	161.0064506
2013	1176	1093.7090	-82.2910376
2014	874	751.3835	-122.6164709
2015	775	536.6926	-238.3074213
2016	1013	1074.1454	61.1454393
2017	735	799.7689	64.7689477

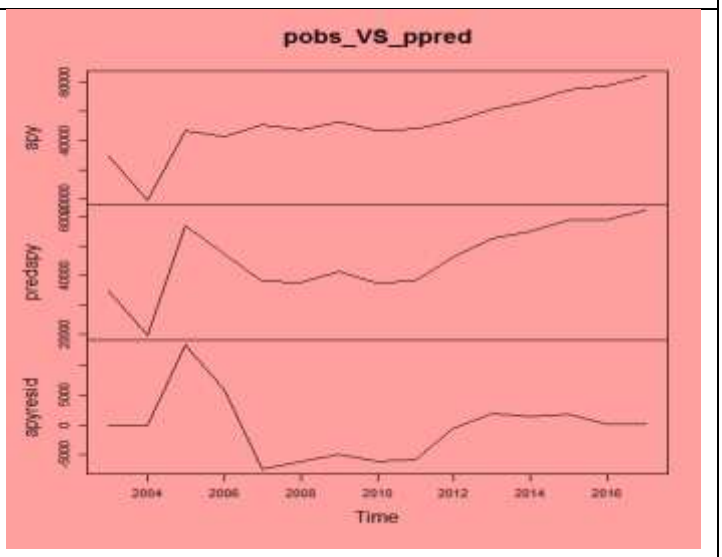
Fig:12 Area forecast



Yield Point Forecast (NEW ANDHRAPRADESH)

Year	observed	predective	residual
2003	34613	34628.48	15.47939
2004	19704	19624.23	-79.77494
2005	43443	56900.81	13457.80589
2006	41221	47058.45	5837.44623
2007	45298	37779.87	-7518.12925
2008	43781	37660.70	-6120.29708
2009	46280	41298.23	-4981.77197
2010	43475	37315.10	-6159.90206
2011	44012	38159.15	-5852.85051
2012	46833	46260.15	-572.84541
2013	50589	52597.89	2008.88652
2014	53273	54727.51	1454.51431
2015	57257	59040.02	1783.02128
2016	58658	58756.47	98.46651
2017	61983	62042.30	59.29785

Fig:13 Yield forecast



Production Forecast(NEW ANDHRAPRADESH)

Year	observed	predective	residual
2003	762	762.34078	0.3407765
2004	1142	1141.82738	-0.1726215
2005	1110	966.24179	-143.7582108
2006	523	103.51737	-419.4826296
2007	2259	3256.20690	997.2068998
2008	659	171.50377	-487.4962309
2009	647	-59.29467	-706.2946652
2010	1105	654.65613	-450.3438694
2011	582	587.24194	5.2419440
2012	777	790.94606	13.9460574
2013	881	946.57006	65.5700641
2014	493	394.42941	-98.5705910
2015	801	856.17452	55.1745167
2016	603	561.45623	-41.5437654
2017	1048	1528.99011	480.9901138

Fig:14 Production forecast

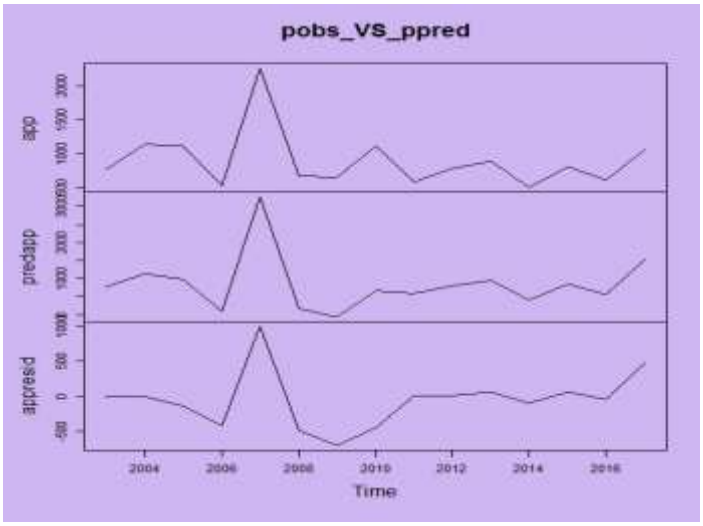


Table-5

Area, yield , and Production predictive (NEW ANDHRAPRADESH)

year	Area predictive	Yield predictive	Prod. predective
2018	136.2858	63793.57	683.0075
2019	136.4664	66751.33	754.3179
2020	142.0074	68840.08	859.9895
2021	195.2076	71587.11	677.8114
2022	196.4124	73835.50	763.4817
2023	209.1835	76461.61	748.5797
2024	247.7514	78801.59	678.6164
2025	251.0408	81358.31	722.1400
2026	269.8771	83750.85	684.1822
2027	301.0750	86267.76	661.7591
2028	307.3067	88690.46	671.1442
2029	330.4853	91184.53	639.6995
2030	357.5448	93624.53	630.5986
2031	367.2004	96105.49	622.8790
2032	393.1889	98555.43	600.7965
2033	417.9795	101028.86	592.2726
2034	431.1764	103484.49	578.5367
2035	458.8516	105953.61	562.1345
2036	482.5785	105953.61	551.4264
2037	499.1651	110879.16	536.5741

Table-6

Time series data values of Area, Yield and Production(New Andhra Pradesh)

Year	TIMESERIESDATA-area	TIMESERIES DATA-yield	TIMESERIES DATA-prod.
2003	1298.5805	34628.48	762.34078
2004	1646.0390	19624.23	1141.82738
2005	1597.8501	56900.81	966.24179
2006	927.9243	47058.45	103.51737
2007	1620.7148	37779.87	3256.20690
2008	1636.9827	37660.70	171.50377
2009	1042.6179	41298.23	-59.29467
2010	1344.0553	37315.10	654.65613
2011	906.3874	38159.15	587.24194
2012	1319.0065	46260.15	790.94606
2013	1093.7090	52597.89	946.57006
2014	751.3835	54727.51	394.42941
2015	536.6926	59040.02	856.17452
2016	1074.1454	58756.47	561.45623
2017	799.7689	62042.30	1528.99011

Fig: 15 **Time series data values of Area, Yield and Production(NEW ANDHRAPRADESH)**

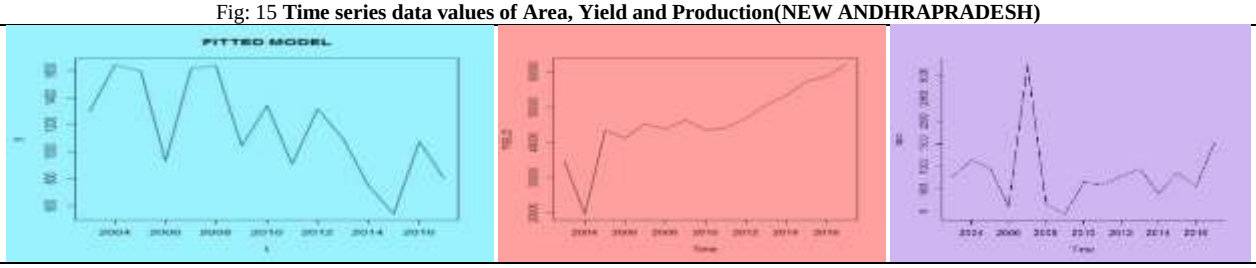


Table-7

Area, yield and Production Training Set error measure

New Andhra Pradesh	ARIMA	Training set error measures						
		ME	RMSE	MAE	MPE	MAPE	MASE	ACF
AREA	(2 ,2, 1)	-47.74281	125.9741	99.90265	-4.728684	9.44764	0.4083612	-0.13955
YIELD	(0, 2, 1)	-438.0435	5265.392	3733.366	-1.01153	8.379935	0.7437407	0.4398127
PRODUCTION	(2, 2,1)	-48.61281	398.3907	264.4089	-15.78939	30.07084	0.5313988	-0.1187427

IV. CONCLUSIONS

A. AREA OF GROUNDNUT CROP CONCLUSION

Table-8

Identification of ARIMA(p,d,q) MODEL for AREA in New Andhra Pradesh

Identification of ARIMA(p,d,q) MODEL for AREA (NEW ANDHRAPRADESH)							
Model	YIELD ARIMA	Coefficients	SE	Intercept	σ^2	log likely-hood	AIC
(2,2,1)	AR1	-1.0433	0.1414		18311	-85.55	179.1
	AR2	-0.8656	0.1101				
	MA1	-0.8942	0.4141				
(2,1,2)	AR1	-1.1678	0.1220		26352	-92.53	195.06
	AR2	-0.9494	0.0856				
	MA1	0.7294	0.3841				
	MA2	0.4773	0.3684				
(1,1,1)	AR1	-0.3133	0.3215		57500	-96.84	199.67
	MA1	-0.3966	0.2297				
(1,0,0)	AR1	0.4983	0.2347	1196.9099	67597	-104.84	215.67
				127.2865			
(0,0,1)	MA1	0.5232	0.3433	1205.5276	71404	-105.26	216.53
				103.1382			
(1,0,1)	AR1	0.8787	0.1594	1183.4789	58576	-103.93	215.87
	MA1	-0.4905	0.2247	195.4863			
(1,2,0)	AR1	-0.5541	0.2255		179063	-97.25	198.5
(2,0,1)	AR1	1.0555	0.4667	1163.4530	28207	-100.95	213.9
	AR2	-0.1345	0.4232	262.5888			
	MA1	-1.2608	0.4541				
	MA2	1.0000	0.3731				
(1,2,2)	AR1	-0.3732	0.2706		33640	-89.48	186.96
	MA1	-1.7125	0.3584				
	MA2	1.0000	0.3438				
(0,2,1)	MA1	-1.0000	0.2229		94307	-94.22	192.44
(1,2,1)	AR1	-0.4942	0.2474		68501	-92.66	191.32
	MA1	-1.0000	0.2419				

In the present study, the ARIMA (2,2,1) in New Andhra Pradesh the best fitted model through the minimum value of AIC, then used for prediction up to 10 years of the area of groundnut in various districts using 15 years time series data i.e. from 2003-2004 to2017-2018. ARIMA(2,2,1) in New Andhra Pradesh are used because the reason of its capability to make prediction using time series data with any kind of patterns and with auto correlated successive values of the time series. The study was also validated and statistically tested that the successive residuals in the fitted ARIMA (2, 2,1) in New Andhra Pradesh are not correlated, and the residuals appear to be normally distributed with the mean zero and constant variance. Hence, it can be a satisfactory predictive model for the groundnut area in ceded districts in Andhra Pradesh for the period of 2018 to 2027. The ARIMA (2,2,1) in New Andhra Pradesh models projected an increment in the area for the duration of 2018 to 2027. The prediction of 2027 is resulted approximately **301. 0735 ha**. Like any other predictive models for forecasting , ARIMA model has also limitations on accuracy of the predictions yet it is widely used for forecasting the future values for time series.

B. YIELD OF GROUNDNUT CROP CONCLUSION

Table-9

IdeIdentification of ARIMA(p,d,q) MODEL for YIELD (NEW ANDHRAPRADESH)

Model	YIELD ARIMA	Coefficients	SE	Intercept	σ^2	log likely-hood	AIC
(2,0,1)	AR1	0.0330	0.2296	45304.31	41531363	-153.9	317.8
	AR2	0.8151	0.2027	10282.32			
	MA1	0.4788	0.3491				
(2,1,0)	AR1	-0.3983	0.2276		38508192	-142.75	291.5
	AR2	0.4577	0.2846				
(1,1,1)	AR1	-0.8861	0.1908		41892512	-143.11	292.23
	MA1	0.4258	0.3220				
(1,0,0)	AR1	0.7035	0.1980	46575.365	55387870	-155.35	316.7
				5663.246			
(0,0,1)	MA1	0.4859	0.1961	46438.300	70966511	-157	320
				3177.972			
(1,0,1)	AR1	0.8948	0.1557	46247.173	50792482	-154.89	317.78
	MA1	-0.3105	0.2654	8379.973			
(1,1,0)	AR1	-0.5469	0.2458		46324521	-143.6	291.2
(2,1,1)	AR1	-0.0294	0.6440		36854947	-142.55	293
	AR2	0.7291	0.3614				
	MA1	-0.4581	0.9043				
(1,1,2)	AR1	-0.1434	0.3553		27306221	-141.93	291.86
	MA1	-0.5113	0.2962				
	MA2	0.9999	0.3655				
(0,1,1)	MA1	-0.3643	0.2032		52033012	-144.31	292.62
(1,2,1)	AR1	-0.7575	0.2047		31989130	-133.05	272.1
	MA1	-0.9999	0.3751				

In the present study, ARIMA (0, 2 ,1) in New Andhra Pradesh are the best fitted models through the minimum value of AIC, then used for prediction up to 10 years of the yield of groundnut in various districts using 15 years time series data i.e. from 2003-2004 to 2017-2018. ARIMA (0, 2 ,1) used because the reason of its capability to make prediction using time series data with any kind of patterns and with auto correlated successive values of the time series. The study was also validated and statistically tested that the successive residuals in the fitted ARIMA (0,2 ,1) New Andhra Pradesh are not correlated, and the residuals appear to be normally distributed with the mean zero and constant variance. Hence, it can be a satisfactory predictive model for the groundnut yield in ceded districts in Andhra Pradesh for the period of 2018 to 2027. The ARIMA (0,2,1) New Andhra Pradesh model projected an increment in the yield for the duration of 2018 to 2027. The prediction of 2027 is resulted approximately **86267.76 'kg/ ha** (New Andhra Pradesh). Like any other predictive models for forecasting, ARIMA model has also limitations on accuracy of the predictions yet it is widely used for forecasting the future values for time series.

C. PRODUCTION OF GROUNDNUT CROP CONCLUSION

TABLE-10
Identification of ARIMA(p,d,q) MODEL for PRODUCTION (NEW ANDHRAPRADESH)

Model	PROD. ARIMA	Coefficients	SE	Intercept	$\sigma^{\wedge 2}$	Log likelihood	AIC
(1,0,1)	AR1	-0.2485	0.4798	892.4116	158413	-111.13	230.27
	MA1	-0.0754	0.4513	77.5723			
(2,2,1)	AR1	-0.9999	0.2089		183133	-100.08	208.17
	AR2	-0.5810	0.1956				
	MA1	-1.0000	0.2858				
(1,0,0)	AR1	-0.3143	0.2362	892.3982	158737	-111.15	228.3
				79.5474			
(2,0,2)	AR1	-0.5394	0.4920	891.2084	127034	-110.1	232.2
	AR2	-0.7691	0.3847	83.0299			
	MA1	0.2166	0.4661				
	MA2	0.8627	0.7988				
(1,2,1)	AR1	-0.5826	0.2086		325421	-102.91	211.82
	MA1	-1.0000	0.2145				
(1,1,1)	AR1	-0.3900	0.2719		185244	-105.55	217.1
	MA1	-0.7621	0.2262				
(0,0,1)	MA1	-0.2720	0.2058	892.5343	160889	-111.24	228.47
				77.3448			

In the present study, the ARIMA (2,2,1) in New Andhra Pradesh are the best fitted model through the minimum value of AIC, then used for prediction up to 10 years of the production of groundnut in ceded districts using 15 years time series data i.e. from 2003-2004 to 2017-2018. ARIMA (2,2,1) in New Andhra Pradesh are used because the reason of its capability to make prediction using time series data with any kind of patterns and with auto correlated successive values of the time series. The study was also validated and statistically tested that the successive residuals in the fitted ARIMA (2,2,1) in New Andhra Pradesh are not correlated, and the residuals appear to be normally distributed with the mean zero and constant variance. Hence, it can be a satisfactory predictive model for the groundnut yield in various districts in Andhra Pradesh for the period of 2018 to 2027. The ARIMA (2, 2, 1) in New Andhra Pradesh models projected an increment in the production

for the duration of 2018 to 2027. The prediction of 2027 is resulted approximately **661.7591'000 tonnes**. Like any other predictive models for forecasting, ARIMA model has also limitations on accuracy of the predictions yet it is widely used for forecasting the future values for time series. It is noticed that in Groundnut production New Andhra Pradesh.

The empirical **Forecasting area, yield and production of groundnut crop in New Andhra Pradesh using- R** findings of study could help to forecast any such commodities. The researchers and policy makers will thus get access for making further extensive research work. We firmly believe that this research has shed some important light on the subject area encompassing time series forecasts of selected agricultural crops in New Andhra Pradesh. These empirical findings can be an important source of information to many researchers and policy formulators as far as agricultural crops in New Andhra Pradesh are concerned.

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