Econometric Study to Predict the Meat Gap in Egypt Using ARIMA (Box-Jenkins) Method

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Abstract : The study aims to predict the population number, the production and consumption of red meat, poultry meat and fish meat in Egypt until 2025 using the model (Box - Jenkins), a probabilistic model. The results indicated that the ARIMA model (1, 1, 2) is the best model for forecasting the population number, while the ARIMA model (2, 1, 1) is the best model for the production of red meat, and the ARIMA model (0, 1, 1) is the best model for prediction of the consumption of red meat and production and consumption for both of poultry, and fish meat. The results showed the efficiency of these models and estimates of landmarks in the process of expectation based on the analysis of residuals (error). The results have been as close as possible to reality. Where the study predicted that the population number increase by about 29.1% in year 2025 compare to year 2014. The amounts of production of red meat will be decreased in year 2025 by about 66.7% compared to 2014, and consumption and the size of gab of red meat in year 2025 will be increased by about 48.3%, 323.9% respectively compared to 2014. The study expected that the amounts of the production, consumption and the size of gap of white meat in 2025 will be increased by 47.7%, 78.4%, 246.3% compared to 2014. The study expected that the amounts of production and consumption of fish meat in 2025 will be increased by 64.4%, 43%, and the size of gab of fish meat will be drop in year 2025 by about 71.4% compared to 2014.

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Key Words: Econometric, Predict, Gap, Autoregressive (AR) Integrated Moving Average (IMA).

1. Introduction

The agricultural sector is an important one in the Egyptian economy, so the State has an interest in agricultural production, both plant and animal, in order to provide the food needs for the community. The provision of food security is in the forefront of programs, to which the State give interest in the agricultural development strategy because of the gap between production and consumption, in particular that the production of meat (red, poultry and fish), is the essential foundation to achieving food security as it is the main source of animal protein **(EL-Santresy and El-Shatla, 2007 and El-Shatla. *et al* 2009)**

A future induction is required to identify the possible changes in the evolution of the economic variables in the coming years, and this is useful in formulation of policies and economic plans of the state, and there are many standard methods to predict the different economic variables in the future. Both static and dynamic forecasting approaches could be applied. Static forecasting includes analysis of the general trend, and exponential smoothing, while dynamic forecasting focuses in measuring the future movements of the dependent variable **(El-Shatla *et al.*, 2009 and Abo Ragab 2010).**

Research Problem

Policy makers and planners need the forecasts of some important variables in the Egyptian economy to adjust their policies and plans to achieve some goals in the future. Hence this research is using ARIMA model to get these future information replacing other methods dominating the research environment.

Objectives of the Research

The study aims to forecast the population number and the size of meat gap in Egypt through the identification of the best standard models used to forecast, and thus obtain the prediction close to reality **(Seddik *et al*., 2010)**.

2. Methodology

The study has adopted the standard functions of the regression trend for the time-series (ARIMA- box-jenkins) forecasting models, ARIMA box-jenkins model is multi-equation and depends on extracting the arithmetic average of the variable model to predict the future, but after calming the data, both in terms of contrast, on the one hand, and then estimate directional residuals (random error), Maximum Likelihood Estimation (MLE) which maximize logs probabilities of the Autoregressive Integrated Moving Average (ARIMA) (Abo Ragab S., 2010) ,where the model contains a Autoregressive [AR (p)], a Moving Average [MA (q)], and the degree of Difference (d). Example following function:

$$Y_{it} = \beta_0 + \beta_1 y_{it-1} + \beta_2 y_{it-2} + \dots + \beta_n y_{it-n} + E_1 + Ø_1 E_{it-1} + Ø_2 E_{it-2} + \dots + Ø_n E_{it-n}.$$

And pass this method the following phases:

1- Identification Stage.
2- Model Specification Stage.
3- Estimation Stage.
4- Diagnostic Stage.

5- Forecasting Stage (**Ragab, and Said 2008**).

Data Sources

The study depends on secondary data, published in the Central Agency for Public Mobilization and Statistics.

3. Results and Discussion

Table (1) The statistical description of the variables under study, including shows that changes in production and consumption of red meat is more stable.

Table (1): Description of the statistical variables of the study during the period 1990-2013. (Thousand tons)

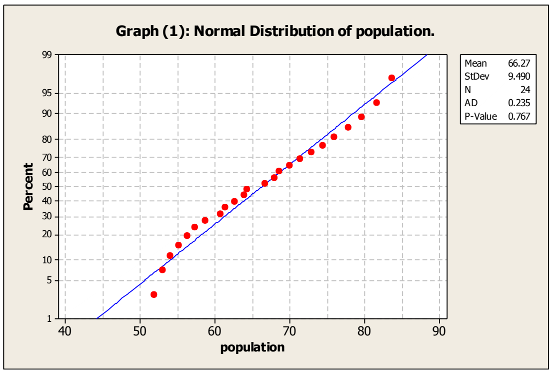
Variable	Coding	Average	The lowest level	The highest level	Standard deviation
Population	**(P)**	66270	51910	83670	9490
Production of Red meat	**(PR)**	779	548	1012	156
Consumption of red meat	**(CR)**	966	569	1305	184
Production of poultry meat	**(PP)**	734	215	1187	306
Consumption of poultry meat	**(CP)**	808	430	1376	291
Production of fish meat	**(PF)**	776	293	1454	377
Consumption of fish meat	**(CF)**	1027	394	1872	499

Source: Compiled and calculated from the table data 1 Appendix.

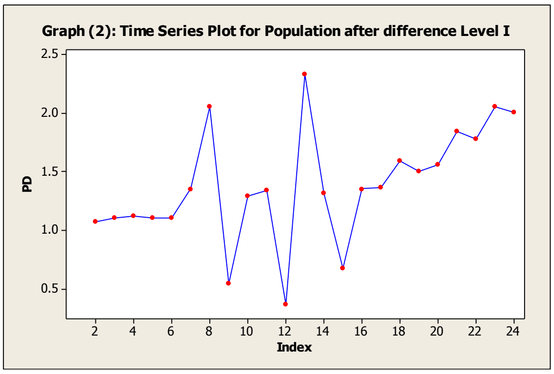
1- Identification Stage

A graph of the original data for the production and consumption of meat with the average for the same data illustrated by the graphs that:

a) Population: The graph (1) shows the data of the series population distributed normally, the graph indicate that there is an upward tendency in series population as they are non-stationary. It means that we must remove this pattern of non-stationary by using the first differencing. The graph (2) shows the data of the series population first differencing. The series of population seems stationary.

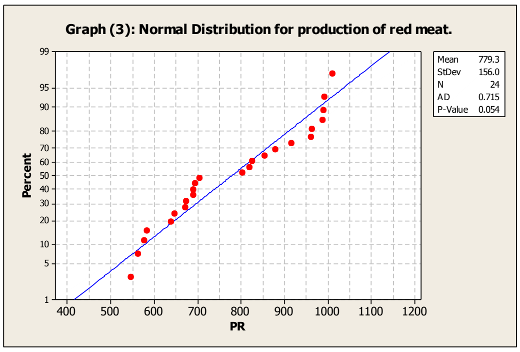


Graph (1): Normal Distribution of population.

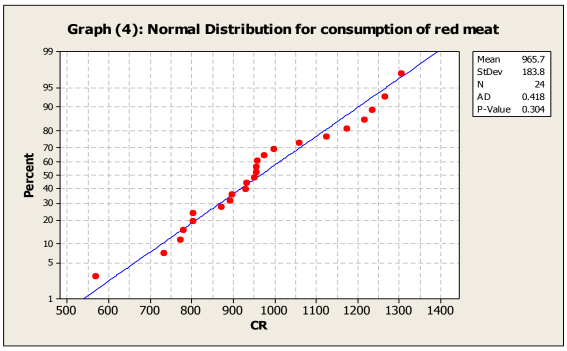


Graph (2): Time Series Plot for Population after difference Level I

b) Production and consumption of Red Meat: The graphs (3, 4) show the data of the series distributed normally, the graphs indicate that there are an upward tendency in series production and consumption of red meat as they are non-stationary. It means that we must remove this pattern of non-stationary by using the first differencing. The graph (5, 6) show the data of series production and consumption of red meat first differencing. The series seem stationary.

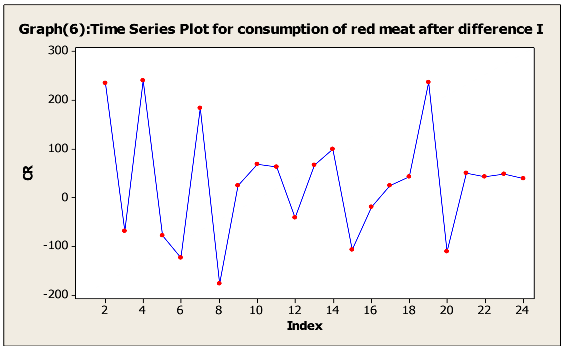


Graph (3): Normal Distribution for production of red meat.



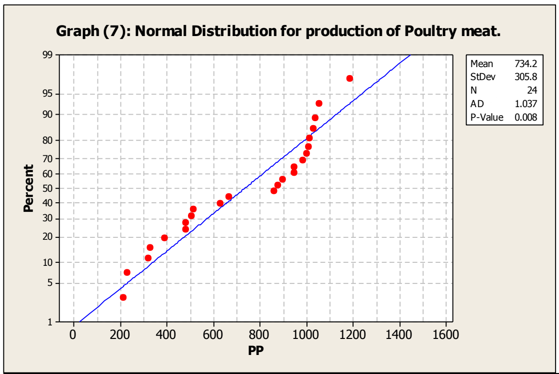
Graph (4): Normal Distribution for consumption of red meat

Graph (5): Time Series Plot for production of red meat after difference I

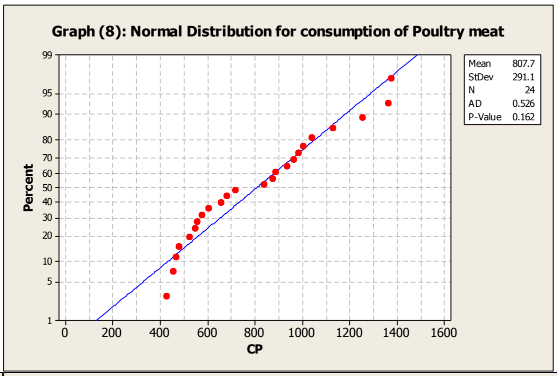


Graph(6):Time Series Plot for consumption of red meat after difference I

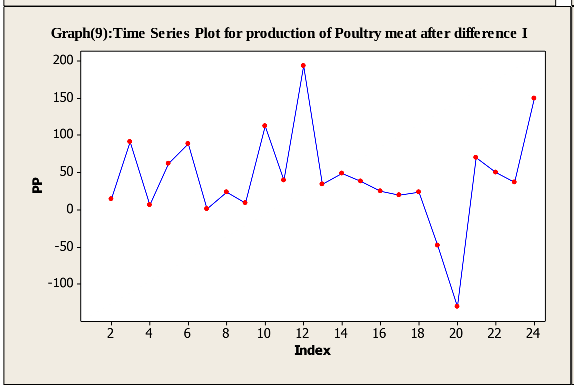
c) Production and consumption of poultry Meat: The graphs (7, 8) show the data of the series distributed normally, the graphs indicate that there are an upward tendency in series production and consumption of poultry meat as they are non-stationary. It means that we must remove this pattern of non-stationary by using the first differencing. The graph (9,10) show the data of series production and consumption of poultry meat first differencing. The series seem stationary.



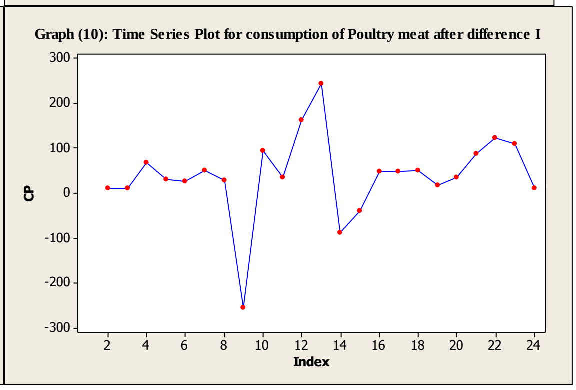
Graph (7): Normal Distribution for production of Poultry meat.



Graph (8): Normal Distribution for consumption of Poultry meat

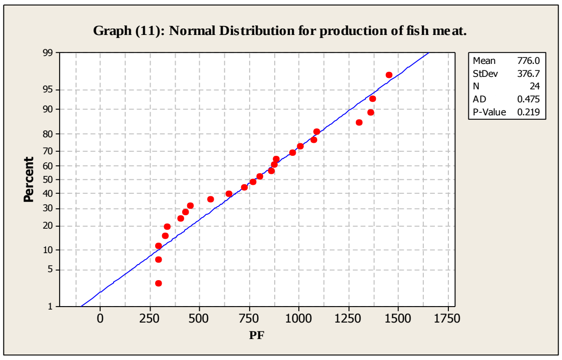


Graph(9):Time Series Plot for production of Poultry meat after difference I

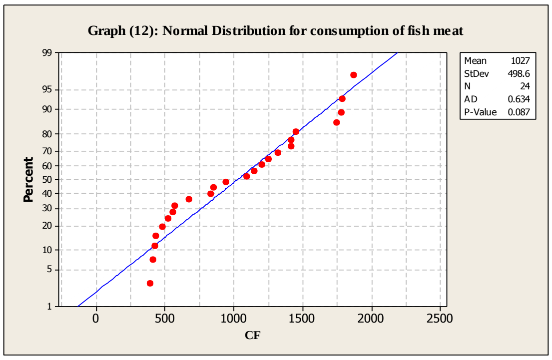


Graph (10): Time Series Plot for consumption of Poultry meat after difference I

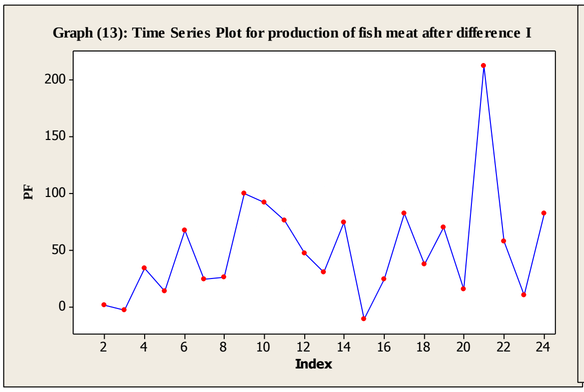
d) Production and consummation of Fish Meat: The graphs (11, 12) show the data of the series distributed normally, the graphs indicate that there are an upward tendency in series production and consumption of fish meat as they are non-stationary. It means that we must remove this pattern of non-stationary by using the first differencing. The graph (13,14) show the data of series production and consumption of fish meat first differencing. The series seem stationary.



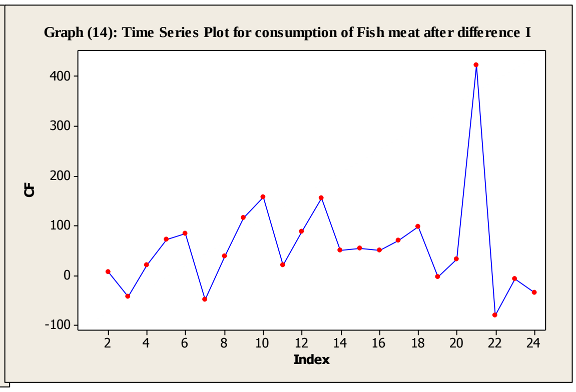
Graph (11): Normal Distribution for production of fish meat.



Graph (12): Normal Distribution for consumption of fish meat



Graph (13): Time Series Plot for production of fish meat after difference I



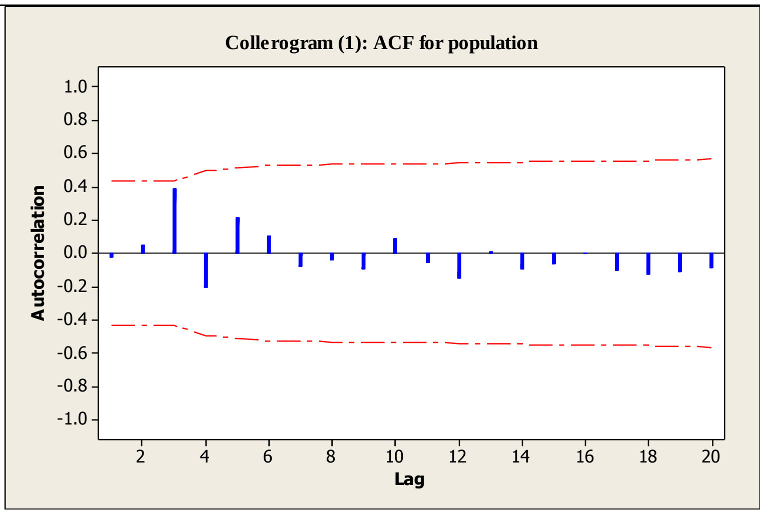
Graph (14): Time Series Plot for consumption of Fish meat after difference I

2- Model Specification Stage

Autocorrelations Function (ACF) and Partial Autocorrelation functions (PACF) for population, Production and consumption of red meat, Production and consumption of poultry meat and **Production and consumption of fish meat.**

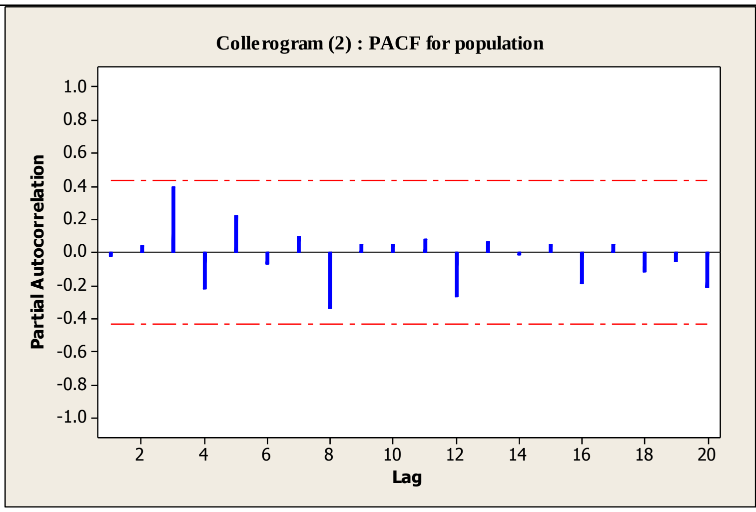
a) **Population:** The collerogram (1),(2) for Population number, indicated that the ACF for 20 lags where ACF range from 0.38 to -0.215 is significantly the corresponding t-statistic range from 1.86 to -0.86. This pattern is typical to a MA process. The PACF for 20 lags where PACF Ranges from 0.39 to -0.21 is significantly different from zero the corresponding t-statistic range from 1.87, -1.05. This pattern is typical to an MA process.

Lag	ACF	T	LBQ
1	-0.021560	-0.10	0.01
2	0.043514	0.21	0.06
3	0.388202	1.86	4.40
4	-0.205183	-0.86	5.67
5	0.215562	0.88	7.16
6	0.101347	0.40	7.50
7	-0.082417	-0.32	7.75
8	-0.040623	-0.16	7.81
9	-0.096562	-0.38	8.19
10	0.087844	0.34	8.53
11	-0.057601	-0.22	8.69
12	-0.148444	-0.57	9.84
13	0.004304	0.02	9.85
14	-0.092017	-0.35	10.39
15	-0.065460	-0.25	10.69
16	0.001386	0.01	10.70
17	-0.099054	-0.37	11.64
18	-0.122454	-0.46	13.36
19	-0.113549	-0.42	15.21
20	-0.089127	-0.33	16.74



Collerogram (1): ACF for population

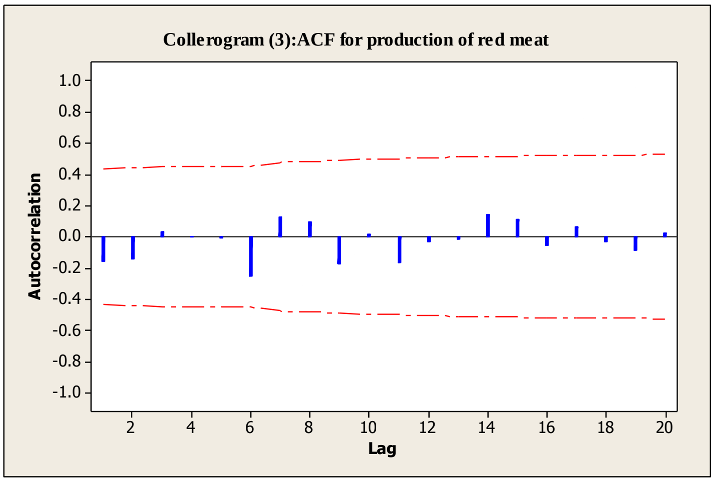
Lag	PACF	T
1	-0.021560	-0.10
2	0.043069	0.21
3	0.390935	1.87
4	-0.218212	-1.05
5	0.223409	1.07
6	-0.068838	-0.33
7	0.096579	0.46
8	-0.337843	-1.62
9	0.048086	0.23
10	0.046625	0.22
11	0.075909	0.36
12	-0.270625	-1.30
13	0.061888	0.30
14	-0.012374	-0.06
15	0.050750	0.24
16	-0.192132	-0.92
17	0.049331	0.24
18	-0.118141	-0.57
19	-0.054387	-0.26
20	-0.215227	-1.03



Collerogram (2) : PACF for population

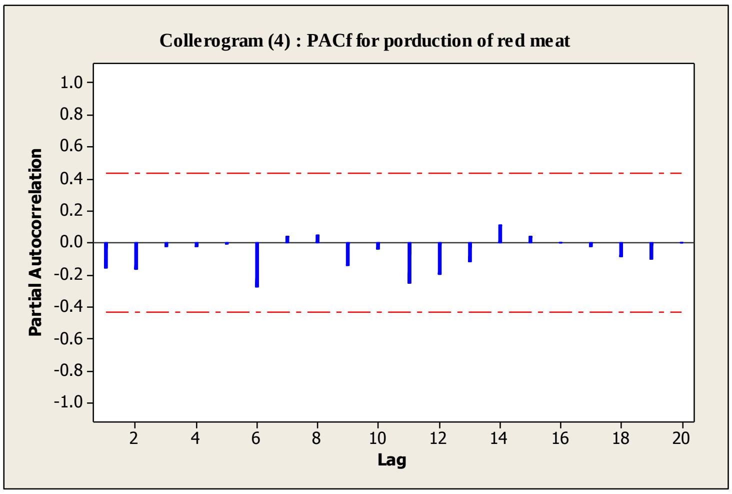
b) Production and consumption of Red meat. The collerogram (3),(4),(5),(6) for Production and consumption of Red meat, indicated that This pattern is typical to an MA process.

Lag	ACF	T	LBQ
1	-0.154522	-0.74	0.62
2	-0.138982	-0.65	1.15
3	0.032036	0.15	1.18
4	-0.000759	-0.00	1.18
5	-0.005815	-0.03	1.18
6	-0.253683	-1.17	3.36
7	0.129045	0.56	3.96
8	0.091561	0.39	4.28
9	-0.175839	-0.75	5.55
10	0.015957	0.07	5.56
11	-0.163357	-0.68	6.84
12	-0.028017	-0.11	6.88
13	-0.018552	-0.08	6.90
14	0.143513	0.58	8.22
15	0.108793	0.44	9.07
16	-0.053341	-0.21	9.30
17	0.061283	0.24	9.66
18	-0.029755	-0.12	9.76
19	-0.090299	-0.36	10.93
20	0.0220150	0.09	11.03



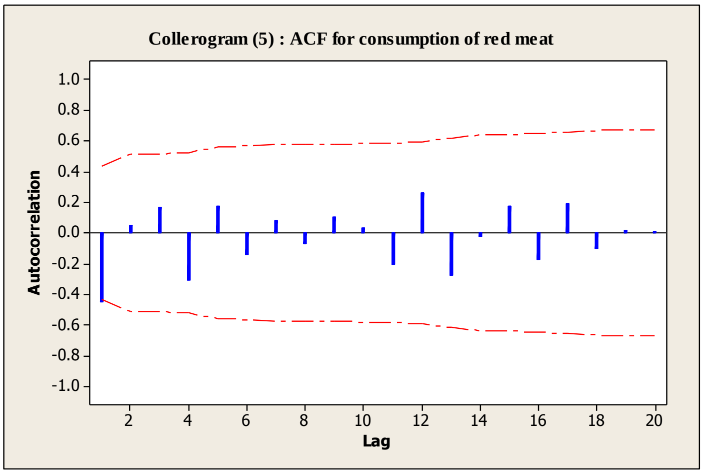
Collerogram (3):ACF for production of red meat

Lag	PACF	T
1	-0.154522	-0.74
2	-0.166843	-0.80
3	-0.019815	-0.10
4	-0.022796	-0.11
5	-0.007625	-0.04
6	-0.272794	-1.31
7	0.037385	0.18
8	0.044669	0.21
9	-0.141681	-0.68
10	-0.035673	-0.17
11	-0.252009	-1.21
12	-0.195818	-0.94
13	-0.118047	-0.57
14	0.109300	0.52
15	0.041774	0.20
16	-0.003602	-0.02
17	-0.024021	-0.12
18	-0.089758	-0.43
19	-0.102159	-0.49
20	-0.001582	-0.01



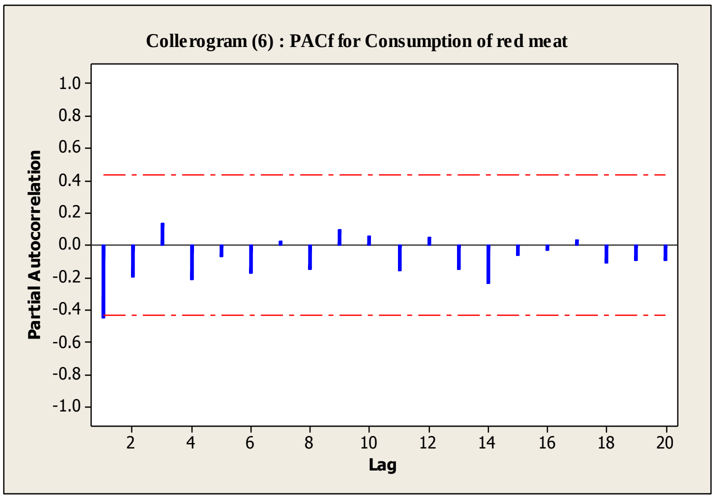
Collerogram (4) : PACf for porduction of red meat

Lag	ACF	T	LBQ
1	-0.450720	-2.16	5.31
2	0.043584	0.18	5.36
3	0.166920	0.67	6.16
4	-0.311061	-1.23	9.09
5	0.173223	0.64	10.05
6	-0.142247	-0.52	10.73
7	0.075641	0.27	10.94
8	-0.067302	-0.24	11.11
9	0.103829	0.37	11.56
10	0.034346	0.12	11.61
11	-0.208861	-0.75	13.70
12	0.260832	0.91	17.25
13	-0.278398	-0.94	21.71
14	-0.025147	-0.08	21.75
15	0.173265	0.56	23.91
16	-0.172908	-0.55	26.37
17	0.193140	0.61	29.94
18	-0.105795	-0.33	31.23
19	0.017259	0.05	31.27
20	0.007193	0.02	31.28



Collerogram (5) : ACF for consumption of red meat

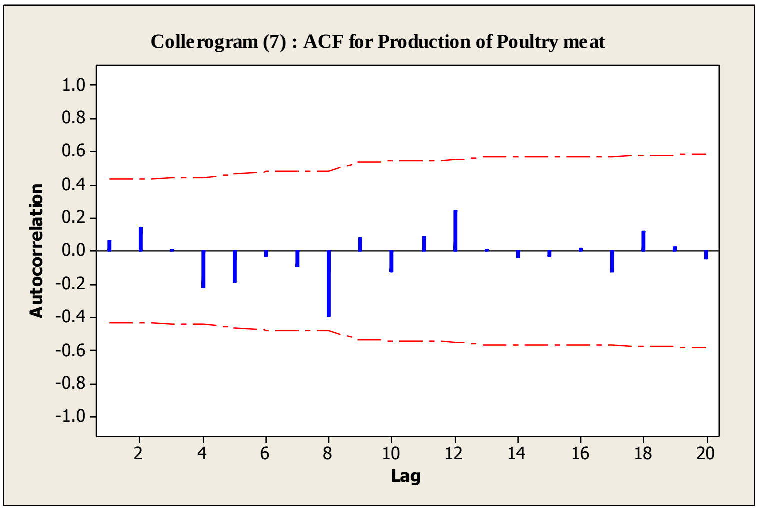
Lag	PACF	T
1	-0.450720	-2.16
2	-0.200244	-0.96
3	0.131055	0.63
4	-0.213414	-1.02
5	-0.068438	-0.33
6	-0.175883	-0.84
7	0.020506	0.10
8	-0.149039	-0.71
9	0.090775	0.44
10	0.058360	0.28
11	-0.161231	-0.77
12	0.044932	0.22
13	-0.153404	-0.74
14	-0.234427	-1.12
15	-0.061230	-0.29
16	-0.030606	-0.15
17	0.028332	0.14
18	-0.113220	-0.54
19	-0.095053	-0.46
20	-0.092821	-0.45



Collerogram (6) : PACf for Consumption of red meat

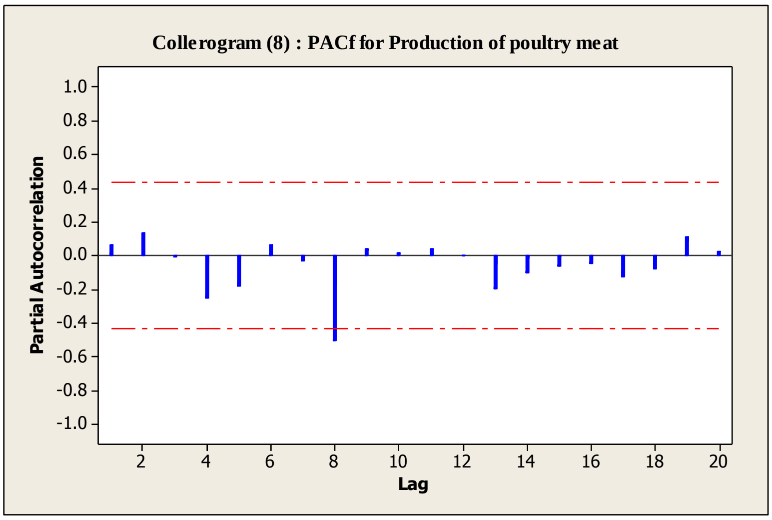
c) **Production and consumption of Poultry meat.** The collerogram (7) ,(8),(9),(10) for Production and consumption of poultry meat, indicated that This pattern is typical to an MA process.

Lag	ACF	T	LBQ
1	0.060084	0.29	0.09
2	0.140878	0.67	0.64
3	0.006019	0.03	0.64
4	-0.224794	-1.05	2.17
5	-0.192747	-0.86	3.35
6	-0.030275	-0.13	3.39
7	-0.096008	-0.42	3.72
8	-0.392884	-1.69	9.63
9	0.081125	0.31	9.90
10	-0.129226	-0.50	10.64
11	0.085267	0.32	10.99
12	0.242796	0.92	14.07
13	0.011129	0.04	14.08
14	-0.038481	-0.14	14.17
15	-0.034179	-0.12	14.26
16	0.015871	0.06	14.28
17	-0.126732	-0.46	15.82
18	0.119633	0.43	17.46
19	0.023027	0.08	17.54
20	-0.047938	-0.17	17.98



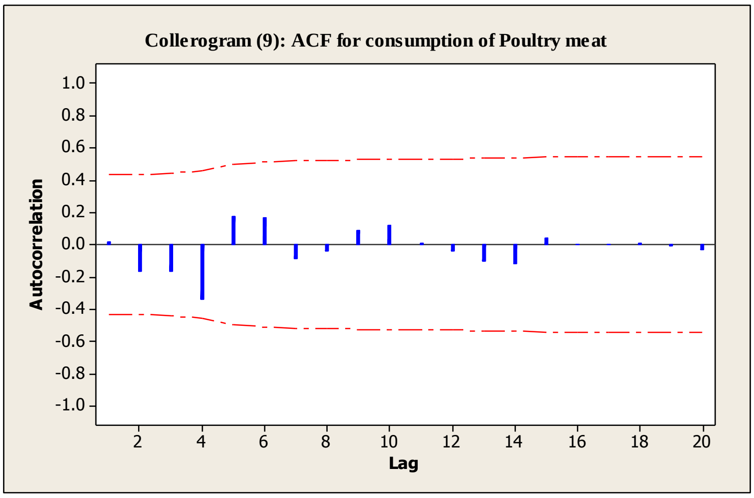
Collerogram (7) : ACF for Production of Poultry meat

Lag	PACF	T
1	0.060084	0.29
2	0.137765	0.66
3	-0.009777	-0.05
4	-0.249651	-1.20
5	-0.183180	-0.88
6	0.061337	0.29
7	-0.031910	-0.15
8	-0.502242	-2.41
9	0.035693	0.17
10	0.015229	0.07
11	0.036517	0.18
12	-0.003486	-0.02
13	-0.198054	-0.95
14	-0.100170	-0.48
15	-0.061920	-0.30
16	-0.044804	-0.21
17	-0.126367	-0.61
18	-0.080292	-0.39
19	0.111240	0.53
20	0.026976	0.13

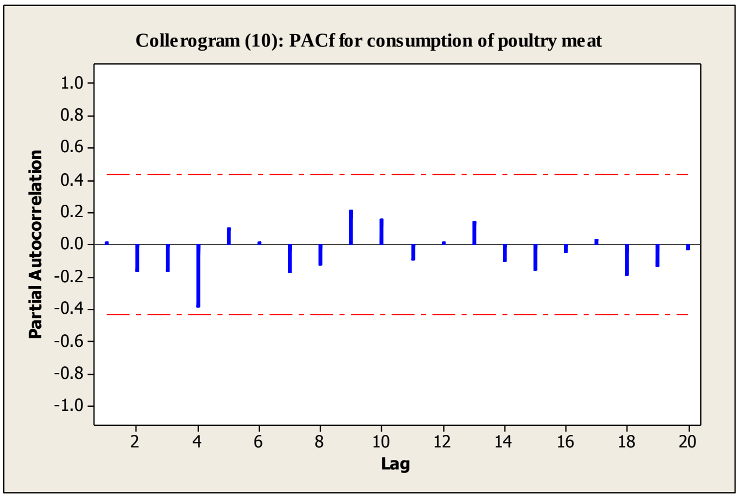


Collerogram (8) : PACf for Production of poultry meat

Lag	ACF	T	LBQ
1	0.012160	0.06	0.00
2	-0.168524	-0.81	0.78
3	-0.167441	-0.78	1.59
4	-0.337498	-1.53	5.03
5	0.170683	0.71	5.97
6	0.165360	0.67	6.89
7	-0.083628	-0.33	7.14
8	-0.042119	-0.17	7.21
9	0.088573	0.35	7.53
10	0.115693	0.45	8.12
11	0.009845	0.04	8.13
12	-0.041641	-0.16	8.22
13	-0.100816	-0.39	8.80
14	-0.121410	-0.47	9.75
15	0.036061	0.14	9.84
16	-0.001074	-0.00	9.84
17	0.000526	0.00	9.84
18	0.004043	0.02	9.84
19	-0.008312	-0.03	9.85
20	-0.028587	-0.11	10.01

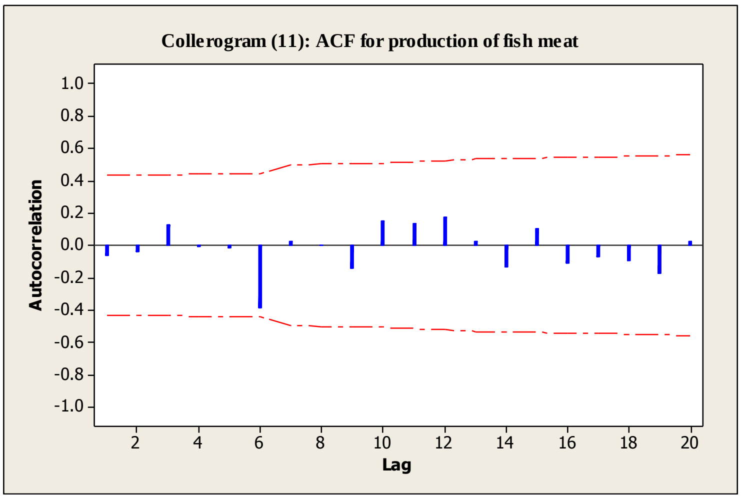


Lag	PACF	T
1	0.012160	0.06
2	-0.168697	-0.81
3	-0.167794	-0.80
4	-0.387527	-1.86
5	0.100784	0.48
6	0.012472	0.06
7	-0.173022	-0.83
8	-0.128951	-0.62
9	0.214622	1.03
10	0.155180	0.74
11	-0.097111	-0.47
12	0.015476	0.07
13	0.141707	0.68
14	-0.102900	-0.49
15	-0.158448	-0.76
16	-0.049393	-0.24
17	0.031537	0.15
18	-0.186735	-0.90
19	-0.132561	-0.64
20	-0.034348	-0.16

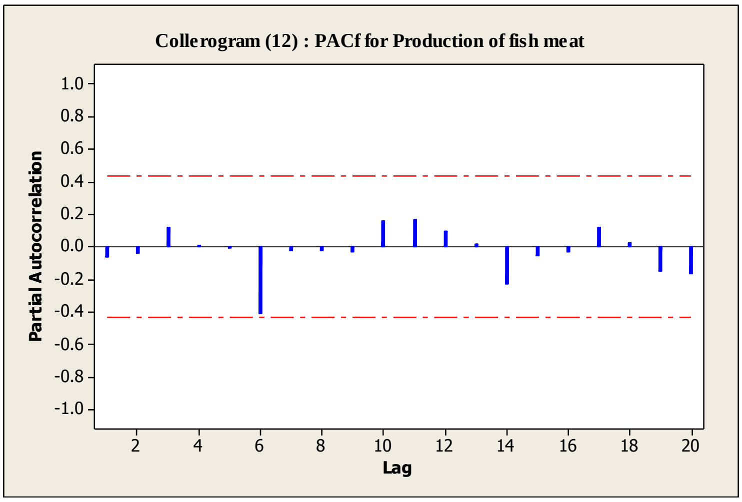


d) **Production and consumption of Poultry meat.** The collerogram (11) ,(12),(13),(14) for Production and consumption of poultry meat, indicated that This pattern is typical to an MA process.

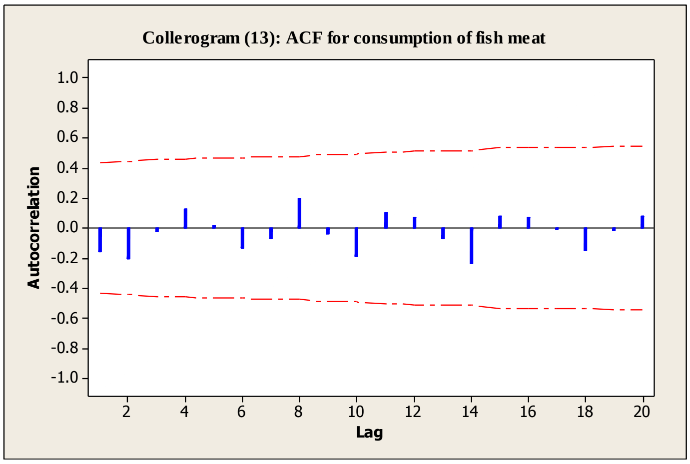
Lag	ACF	T	LBQ
1	-0.061626	-0.30	0.10
2	-0.038080	-0.18	0.14
3	0.122557	0.58	0.57
4	-0.008685	-0.04	0.57
5	-0.017204	-0.08	0.58
6	-0.386556	-1.82	5.64
7	0.026804	0.11	5.66
8	0.003617	0.01	5.66
9	-0.140031	-0.58	6.47
10	0.147078	0.60	7.43
11	0.134097	0.54	8.29
12	0.171418	0.68	9.82
13	0.023628	0.09	9.85
14	-0.130929	-0.51	10.95
15	0.103728	0.40	11.72
16	-0.107990	-0.41	12.68
17	-0.069040	-0.26	13.14
18	-0.098272	-0.37	14.25
19	-0.175667	-0.66	18.68
20	0.026029	0.10	18.81



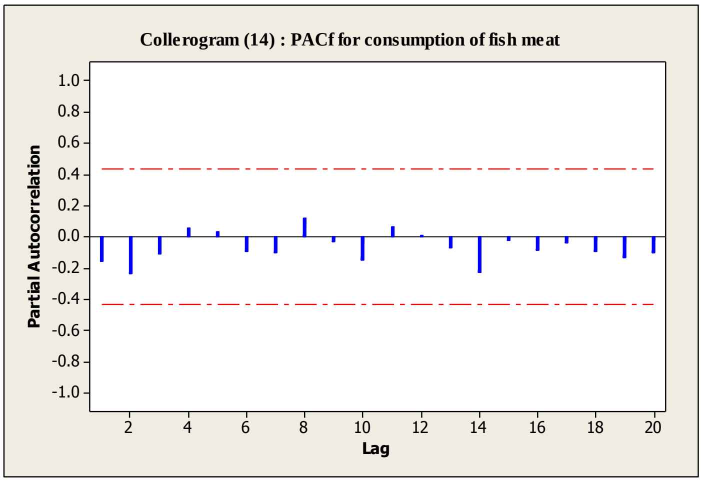
Lag	PACF	T
1	-0.061626	-0.30
2	-0.042037	-0.20
3	0.118178	0.57
4	0.004638	0.02
5	-0.008898	-0.04
6	-0.410773	-1.97
7	-0.027265	-0.13
8	-0.021236	-0.10
9	-0.032834	-0.16
10	0.156011	0.75
11	0.164315	0.79
12	0.092976	0.45
13	0.012625	0.06
14	-0.230670	-1.11
15	-0.056234	-0.27
16	-0.028102	-0.13
17	0.117039	0.56
18	0.025328	0.12
19	-0.147748	-0.71
20	-0.166423	-0.80



Lag	ACF	T	LBQ
1	-0.155745	-0.75	0.63
2	-0.208474	-0.98	1.82
3	-0.026871	-0.12	1.84
4	0.127661	0.57	2.34
5	0.017491	0.08	2.35
6	-0.132067	-0.59	2.94
7	-0.069810	-0.30	3.11
8	0.194504	0.85	4.56
9	-0.041673	-0.18	4.63
10	-0.192691	-0.81	6.28
11	0.100848	0.41	6.76
12	0.073701	0.30	7.05
13	-0.072179	-0.29	7.35
14	-0.237576	-0.96	10.95
15	0.077879	0.30	11.39
16	0.068329	0.26	11.77
17	-0.008114	-0.03	11.78
18	-0.150051	-0.58	14.37
19	-0.018154	-0.07	14.42
20	0.075923	0.29	15.52



Lag	PACF	T
1	-0.155745	-0.75
2	-0.238516	-1.14
3	-0.113267	-0.54
4	0.054856	0.26
5	0.028270	0.14
6	-0.091369	-0.44
7	-0.102523	-0.49
8	0.119246	0.57
9	-0.032850	-0.16
10	-0.152900	-0.73
11	0.061643	0.30
12	0.006242	0.03
13	-0.073622	-0.35
14	-0.227572	-1.09
15	-0.024515	-0.12
16	-0.089300	-0.43
17	-0.036905	-0.18
18	-0.090837	-0.44
19	-0.133552	-0.64
20	-0.100512	-0.48



Through the results of Autocorrelation (ACF) and Partial Correlation (PACF), the collerogram (1),(2) show the lags of changes in Population, while the collerogram (3),(4) show the lags of production and consumption of changes in red meat, while the collerogram (5),(6) show the lags of changes in production and consumption of poultry meat, and the collerogram (7), (8) show the lags of changes in production and consumption of fish meat, shape and value of the correlation coefficients are typical not only ACF but also PACF. PACF can be examined to determine the order of the process that order is equal to the number of significant PACF. And we can induct the ARIMA model.

3- Estimation Stage

a) Population : Through the sampling for partial correlation coefficient (PACF), we find that this coefficient is out of the significance area and therefore we must test the Autoregressive (AR) and the Moving Average (AM) models, and after multiple attempts clear that the best models is (1,1,2) to express the form of the function.

$$\hat{Y} = 0.073 - \underset{(3.02)}{0.56\, AR(1)} + \underset{(6.92)}{1.2\, MA(2)}$$

b) Production of Red Meat: Through the sampling for partial correlation coefficient (PACF), we find that this coefficient is out of the significance area and therefore we must test the Autoregressive (AR) and the Moving Average (AM) models, and after multiple attempts clear that the best models is (2,1,1) to express the form of the function.

$$\hat{Y} = -14.76 - \underset{(-5.63)}{1.25\, AR(1)} + \underset{(-348.5)}{1.05\, MA(1)}$$

c) Consumption of Red Meat: Depending on the results obtained it became clear that the model (0,1,1) ARIMA is the best model in the expression the form of the function.

$$\hat{Y} = 0.66 + \underset{(11.69)}{0.96\, MA(1)}$$

d) Production of Poultry Meat: Depending on the results obtained it became clear that the model (0,1,1) ARIMA is the best model in the expression the form of the function.

$$\hat{Y} = 0.96 + \underset{(6.32)}{1.1\, MA(1)}$$

e) Consumption of Poultry Meat: Depending on the results obtained it became clear that the model (0,1,1) ARIMA is the best model in the expression the form of the function.

$$\hat{Y} = 3.24 + \underset{(4.12)}{0.96\, MA(1)}$$

f) Production of Fish Meat: Depending on the results obtained it became clear that the model (0,1,1) ARIMA is the best model in the expression the form of the function.

$$Y = 2.29 + \underset{(4.64)}{0.92\, MA(1)}$$

g) Consumption of Fish Meat: Depending on the results obtained it became clear that the model (0,1,1) ARIMA is the best model in the expression the form of the function.

$$Y = 1.113 + \underset{(4.29)}{0.94\, MA(1)}$$

4- Diagnostic Stage

Through the examination of models by taking the estimated residuals of the models for production and consumption of red meat, poultry and fish, it appeared as shown Collerograms from number (1) to number (14) appendix to the Auto-correlation coefficient and partial correlation coefficient and the form of Auto-correlation of these residuals are all located within the 95% significance, including means that the Auto-correlation between self-limits the random non-significance, and therefore forms are appropriate.

5- Forecasting Stage

1- **Population: Table no (2)** shows the forecasting of population number which estimated by about 86, 88, 90, 92, 94, 96, 99, 101, 103, 106, 108 and 111 million people in years 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024 and 2025, where the population number increases by about 29.1% in year 2025 compared to year 2014.

2- **Red Meat:** From the results of prediction for the years 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024 and 2025 shown in **Table No (2)**, it is clear that the expectations of production, consumption and gap of red meat in year 2025 will reach to about 317, 2001, 1684 thousand tons respectively, an decrease by about 66.7% for the production of red meat in year 2025 compared to year 2014, while the consumption and gap in year 2025, an increase by about 48.3% 323.9% compared to 2014.

3- **Poultry Meat:** Through the results of prediction for the years 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024 and 2025 shown in **Table No (2)**, it is clear that the levels of production, consumption, and the gap of poultry meat in 2025 will reach to about 1824, 2607, 782 thousand tons respectively, an increase of about 47.7%, 78.4%, 246.3% for the production, the consumption and the gap of poultry meat compared to 2014.

4- **Fish Meat**: Through the results of prediction for the years 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024 and 2025 shown in Table No (2), it is clear that the expectations of production and consumption of fish meat increased with decreasing the size of the food gap, while it is expected that the levels of production, consumption, and gap of fish meat in 2025 will reach to 2515, 2597, 81 thousand tons respectively, an increase of about 64.4%, 43% for both production and consumption of fish meat compared to 2014, as the size of gap is expected to drop by about 71,4 compared to 2014.

Recommendations

1- Increasing the production capacity of meat through genetic improvement of local breeds to overcome the food gap of meat.

2- Expansion in the manufactured fodder and their development to provide it to farmers in high quality, and with suitable price.

3- Encouragement young graduates by facilitating loans to them to set up investment projects in breeding and fattening cattle.

4- The expansion in animal production projects, especially in new lands.

5- Increasing the current production of red, poultry and fish meat.

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Appendix

Table 1: The evolution of production and consumption of meat and the gap in Egypt during (1990-2013) period.

Years	**Population Millions**	**Red meat** (**thousand tons**)			**Poultry meat** (**thousand tons**)			**Fish meat** (**thousand tons**)		
		Production	**Consumption**	**Gap**	**Production**	**Consumption**	**Gap**	**Production**	**Consumption**	**Gap**
1990	52	548	569	-21	215	459	-244	295	430	-135
1991	53	564	804	-240	230	470	-240	296	436	-140
1992	54	579	735	-156	321	480	-159	293	394	-101
1993	55	584	976	-392	328	549	-221	327	415	-88
1994	56	674	897	-223	391	579	-188	340	487	-147
1995	57	692	773	-81	480	606	-126	407	571	-164
1996	59	640	957	-317	482	657	-175	431	523	-92
1997	61	647	780	-133	506	685	-179	457	562	-105
1998	61	673	804	-131	516	430	86	557	678	-121
1999	63	691	872	-181	629	524	105	649	836	-187
2000	64	705	934	-229	669	559	110	725	856	-131
2001	64	695	893	-198	863	721	142	772	943	-171
2002	67	820	960	-140	898	966	-68	802	1099	-297
2003	68	804	1060	-256	947	878	69	876	1149	-273
2004	69	827	952	-125	986	839	147	865	1203	-338
2005	70	855	932	-77	1012	888	124	889	1254	-365
2006	71	879	956	-77	1032	936	96	971	1324	-353
2007	73	917	998	-81	1056	987	69	1008	1421	-413
2008	74	961	1236	-275	1008	1005	3	1078	1417	-339
2009	76	1012	1125	-113	878	1041	-163	1093	1450	-357
2010	78	992	1175	-183	949	1130	-181	1305	1872	-567
2011	80	989	1218	-229	1000	1254	-254	1362	1792	-430
2012	82	990	1266	-276	1037	1365	-328	1372	1784	-412
2013	84	965	1305	-340	1187	1376	-189	1454	1750	-296
Average	66	779	966	-186	734	808	-74	776	1027	-251

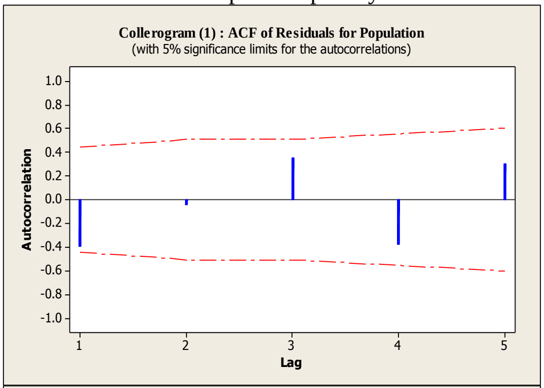
Source: the Central Agency for Public Mobilization and Statistics.

Table 2: Results of the best models to predict the dynamic (ARIMA).

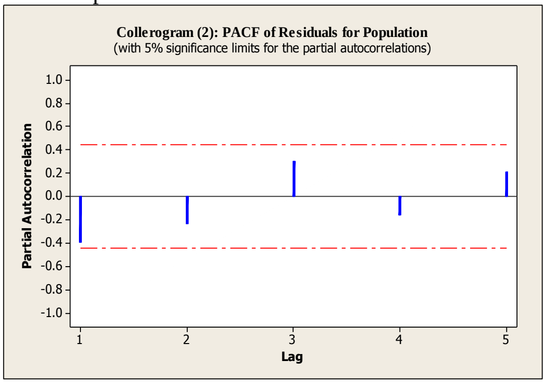
Forecasting Years	Population Millions	Red meat (thousand tons)			Poultry meat (thousand tons)			Fish meat (thousand tons)		
		Production	Consumption	Gap	Production	Consumption	Gap	Production	Consumption	Gap
2014	86	953	1350	-397	1235	1461	-226	1530	1814	-285
2015	88	916	1397	-481	1284	1549	-265	1608	1880	-272
2016	90	892	1447	-555	1333	1640	-307	1688	1947	-258
2017	92	844	1499	-655	1384	1734	-350	1771	2014	-243
2018	94	808	1553	-745	1436	1832	-396	1856	2083	-227
2019	96	747	1610	-862	1488	1933	-445	1943	2153	-210
2020	99	700	1669	-969	1542	2037	-495	2033	2224	-191
2021	101	628	1731	-1103	1597	2145	-548	2125	2297	-172
2022	103	568	1795	-1227	1652	2255	-603	2219	2370	-151
2023	106	484	1861	-1377	1708	2369	-661	2316	2444	-129
2024	108	413	1930	-1517	1766	2486	-720	2414	2520	-106
2025	111	317	2001	-1684	1824	2607	-782	2515	2597	-81

Source: calculated using the program Minitab.

Collerograms from (1) to (14): ACF and PACF of residuals for population, Production and consumption of red meat, Production and consumption of poultry meat and Production and consumption of fish meat.



Collerogram (1) : ACF of Residuals for Population
(with 5% significance limits for the autocorrelations)



Collerogram (2): PACF of Residuals for Population
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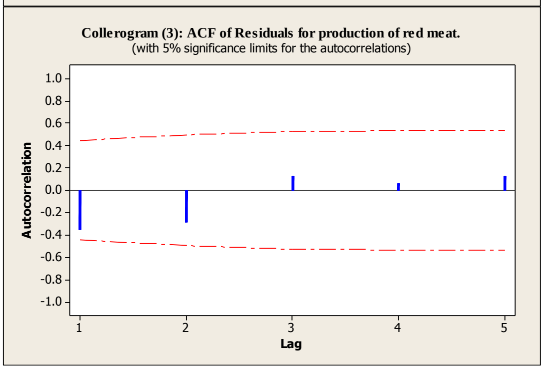
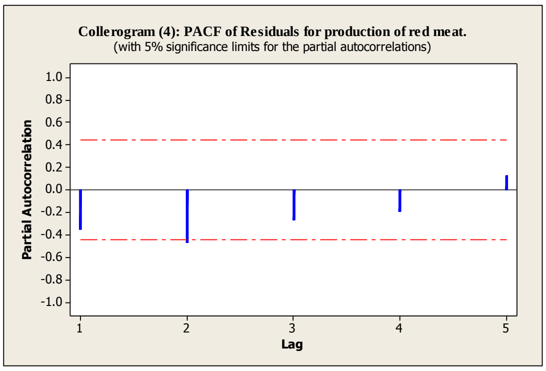


Collerogram (3): ACF of Residuals for production of red meat.
(with 5% significance limits for the autocorrelations)



Collerogram (4): PACF of Residuals for production of red meat.
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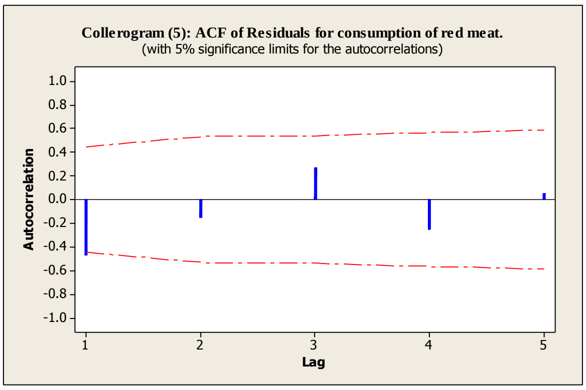
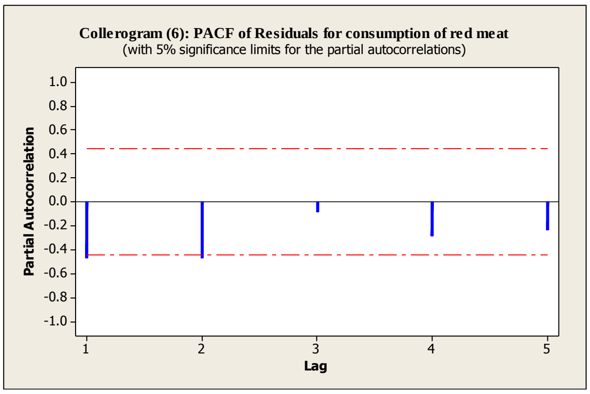
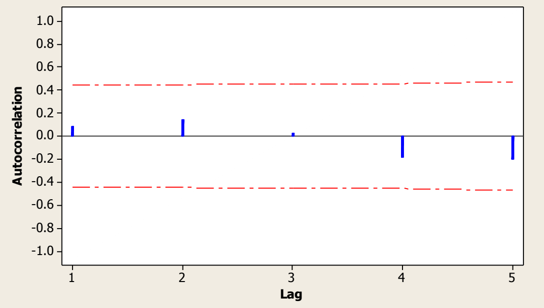


Collerogram (5): ACF of Residuals for consumption of red meat.
(with 5% significance limits for the autocorrelations)

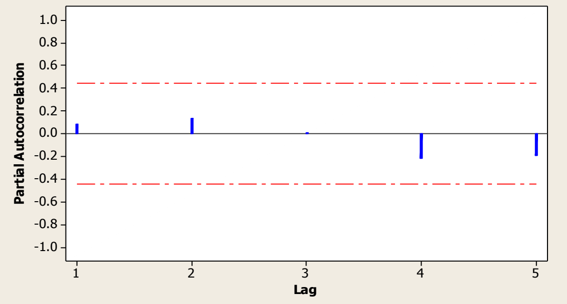


Collerogram (6): PACF of Residuals for consumption of red meat
(with 5% significance limits for the partial autocorrelations)

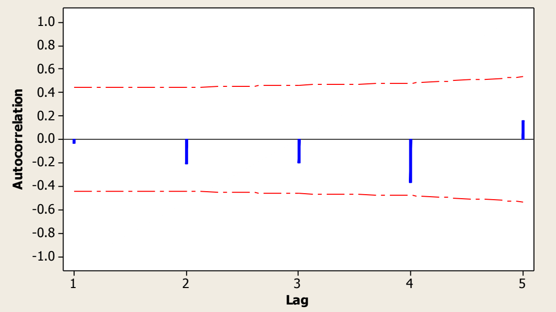
Collerogram (7): ACF of Residuals for production of poultry meat.
(with 5% significance limits for the autocorrelations)



Collerogram (8) : PACF of Residuals for production of poultry meat.
(with 5% significance limits for the partial autocorrelations)



Collerogram (9): ACF of Residuals for consumption of poultry meat.
(with 5% significance limits for the autocorrelations)



Collerogram (10): PACF of Residuals for consumption of poultry meat.
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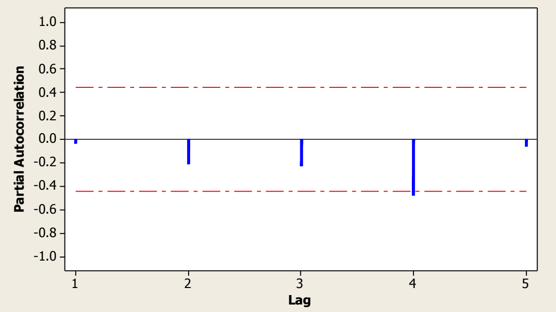
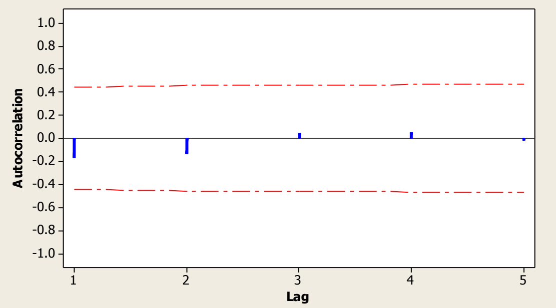
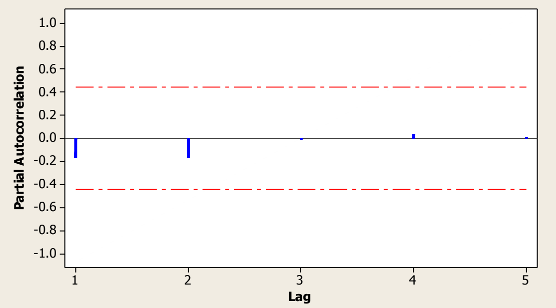


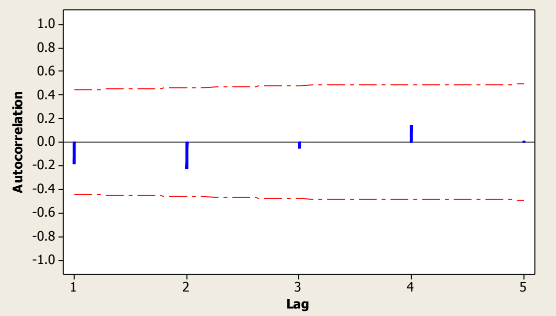
Collerogram (11): ACF of Residuals for production of fish meat.
(with 5% significance limits for the autocorrelations)



Collerogram (12): PACF of Residuals for production of fish meat.
(with 5% significance limits for the partial autocorrelations)



Collerogram (13): ACF of Residuals for consumption of fish meat.
(with 5% significance limits for the autocorrelations)



Collerogram (14): PACF of Residuals for consumption of fish meat.
(with 5% significance limits for the partial autocorrelations)