Conference Paper

The Projection Model As an Early Warning of Food Price Commodity Fluctuation

Amin Pujiati, Shanty Oktavilia, and Nadia Damayanti

Universitas Negeri Semarang, In Semarang City, Central Java Province, Indonesia

Abstract

The price of food commodities are very significant to be analyzed because, apart from depicting the interaction between supply and demand, it also one of the most important elements of the economy of food resilience. Food price analysis is used to formulate the policy of price stabilization and product enhancement. This research aims to make observation and to technically analyze toward price fluctuation of some food commodities in Semarang city using ARIMA (Autoregressive Moving Average) Model analysis tool. ARIMA Model in this research is used to predict food price in short period of time, as well as an early warning detection of food price fluctuation. This research uses daily time series data in the span of 2015 to 2018. The source of the data is Commodity Price and Production Information System (SIHATI) Central Java Province, a publicized price survey. The research result shows that ARIMA Model that has been generated can predict price of some food commodities (i.e chicken meat, eggs, red chili peppers and shallots) in Semarang city.

Keywords: projection model, price, price commodity, ARIMA

Corresponding Author:
Amin Pujiati
amin.pujiati@mail.unnes.ac.id

Received: 7 August 2018
Accepted: 15 September 2018
Published: 22 October 2018

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the ICE-BEES 2018 Conference Committee.

1. Introduction

The availability of basic needs is important for human lives. People need basic need in their lives therefore, the price that circles around the basic needs fluctuates and shakes the economic situation. Generally, the correlation is influenced by the supply and demand of the situated market. When the supply is increased, usually, what happens in the market's demand is decreased with all other things being equal and vice versa. Basic needs that people consume are from agriculture and farm commodities. Those commodities are one of many staple goods that have irresponsive demand elasticity to price changes hence, it is called inelastic. If there is a price change to certain basic needs in a massive amount of change, the price of the good is considered stable (inelastic) to price change [1]. Since, there is a low price elasticity of demand mixed with the change of seasons in the production causes high price fluctuation [2]. The

How to cite this article: Amin Pujiati, Shanty Oktavilia, and Nadia Damayanti, (2018), "The Projection Model As an Early Warning of Food Price Commodity Fluctuation" in *International Conference on Economics, Business and Economic Education 2018*, KnE Social Sciences, pages 860–868. DOI 10.18502/kss.v3i10.3178

effect of that phenomenon is when there is a increased price change on certain basic need commodities will cause a shock effect, such as higher price change when there is a change on supply side.

The aim of this paper is to observe and do technical analysis to price fluctuation to certain basic food commodities in Semarang City using ARIMA (Autoregressive Integrated Moving Average) model as the analysis tool. Food price analysis is used to formulate price stability policy and increased production. Accurate public information can form an accurate policy by forecasters, also to reduce price variance in the market [3]. The application of ARIMA as an analysis tool of short-term prediction, hopefully, can anticipate and give an early warning message to food price fluctuation in the future. The more accurate policy formulation, the more it can prevent the shock of price to happen in the future. So, the shock could be prevented to either happen to consumers or producers. Consumers can still consume basic needs with reasonable price, and also for the farmers and stock farmers still can sell their commodities to the market with accurate policy. Same idea [4] that forecasting can help people on making accurate decision timely to face the uncertainty of price in the future.

In this paper, the ARIMA-forecasted commodities are chicken meat, eggs, chili, and shallots. This is because within the period of analysis starts from 1^{st} of August 2015 to 31^{st} of May 2018, all four of the commodities showed that the price fluctuated different than other commodities, especially it showed on the special periods such as at the end of the year. The analysis is meant as an early detection of price change, especially those basic needs for people. Price control is one of the effort to decrease the risk for producers (farmers). The form of price control is the way to forecast the price in the future. The result of this forecasting analysis can be used as part of the farmers' decision also for government as the policy maker.

In previous research, [5] stated that forecasting using ARIMA model can predict the price of staple goods on a national scale with an error rate of 2.22%. The study [6] compares the use of the Winter Smoothing model with the ARIMA model on Bulog's rice stock and concluded that the use of Winter Smoothing further yields Mean Square Error (MSE) smaller than ARIMA model. Also, [7] concluded that the deficiency in the ARIMA model cannot predict a downward or sharply moving data movement in the Consumer Price Index (CPI) due to external factor interventions such as the financial crisis.

Recently, the determination of price commodity involves the trial-error system so, the stability of chili commodity price becomes unattended and shows unstable price

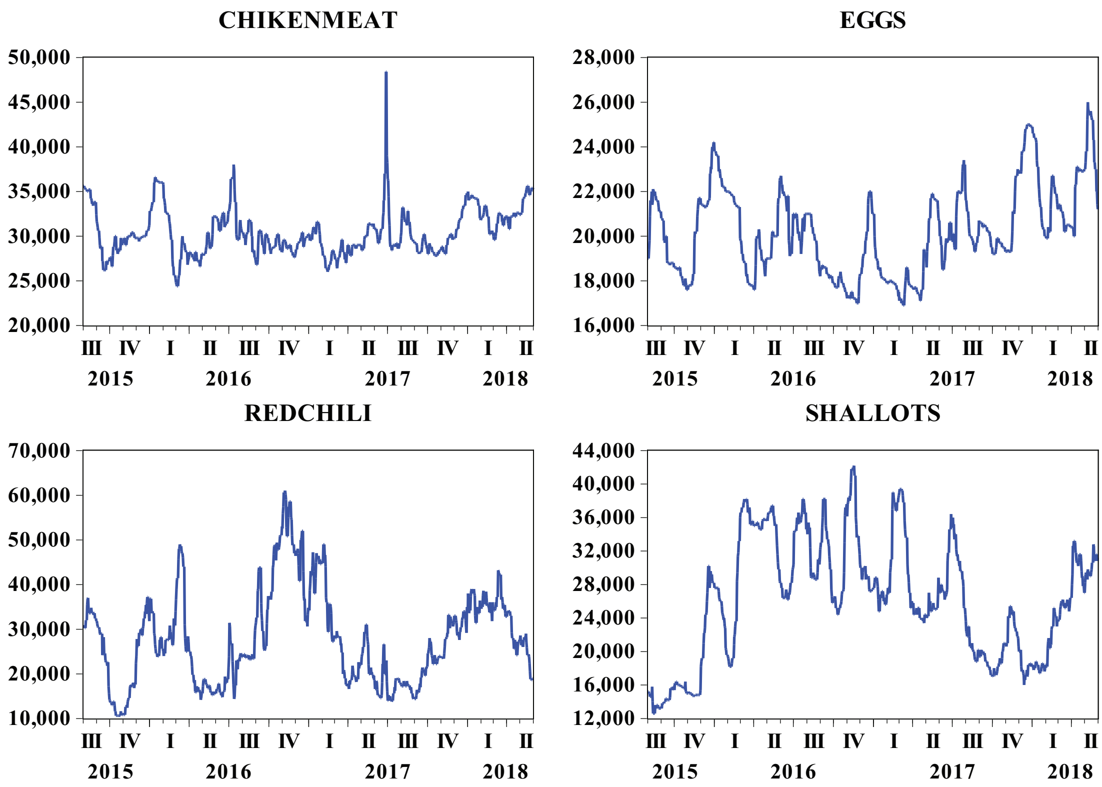


Figure 1: Food Price Growth In Jawa Tengah.

fluctuation. This is because the system still embraces fundamental analysis. Fundamental analysis of commodity involves each of product of commodity, generally, fundamental analysis of commodity includes something very staple and basic such as, supply and demand analysis, seasons, plagues, and natural disasters. This research is conducted in order to develop complementary models, especially in terms of data processing of food commodity price technically. In this study, the ARIMA model is used to predict the daily price of staple goods in Semarang City in the short term. ARIMA is suitable for time-series forecasting studies especially for short-term prediction [8, 9].

2. Method

The data used in this study used secondary data on Semarang City Food Commodity Price Daily from April 2015 to June 2018 obtained through the Central Java Inflation Control Team through pricejateng.org website. Data processing tools used in this study using E-Views.

This research uses Autoregressive Moving Average (ARIMA) model. The development and design of the ARIMA model as the forecasting tool of the known financial-economy variables is ARIMA Box-Jenkins (1976). Box-Jenkins finds the ARIMA model (p, d, q) that meets the stochastic procedure in which the sample originated. The Box-Jenkins procedure focuses on installing a mixed Autoregressive Integrated Moving Average (ARIMA) model into a set of data [10]. The Box-Jenkins methodology consists of four repetitive steps of model identification, parameter estimation, diagnostic test and model forecasting [4]. In the study [11], ARIMA model applications through three phases of model identification, parameter estimation, and diagnostic examination. The Box-Jenkins ARIMA model requires stationary procedures, as long as the data is not stationary, the time-series data identification step needs to be done in order to become stationary. A stationary procedure is a necessary condition in building an ARIMA model.

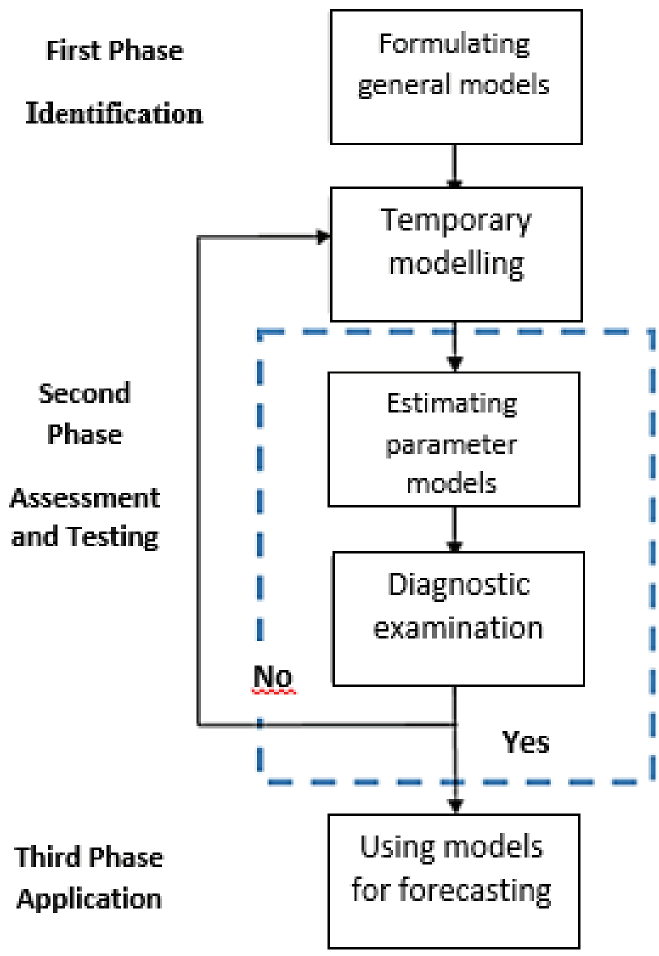


Figure 2: ARIMA Approaching Model Scheme.

3. Result and Discussion

Results of data plots on all four food products analyzed showed a recurrent pattern in time series data. This indicates the presence of seasonal elements in the data. The nature of food prices that depend on nature such as temperature and availability of fertilizer and food business intensity such as peak harvest and planting season and national holiday [12]. In further analysis, the stationary assumption of variance and means is necessary as both are the main requirements of forecasting in this ARIMA method. The test results on the stationary of the data show that the four commodities studied have been stationary, the test results show that the Augmented Dickey Fuller (ADF) test statistic, it is known that the CHICKENMEAT, REDCHILI, EGGS, and SHALLOTS variables at a real level of 1% have stationary at the level (table 1).

Table 1: Stationary Test.

variabel	ADF Test Statistic	KETERANGAN
CHICKENMEAT	-16,38809*	Stationer
REDCHILI	-27,38118*	Stationer
EGGS	-25,42486*	Stationer
SHALLOTS	-25,58626*	Stationer
*) test critical values α 1%: -3,436462		

By considering the stationary test, the next step can be identified plot Correlogram for estimation ARIMA Box Jenkins model of each commodity studied. Here is the Correlogram plot:

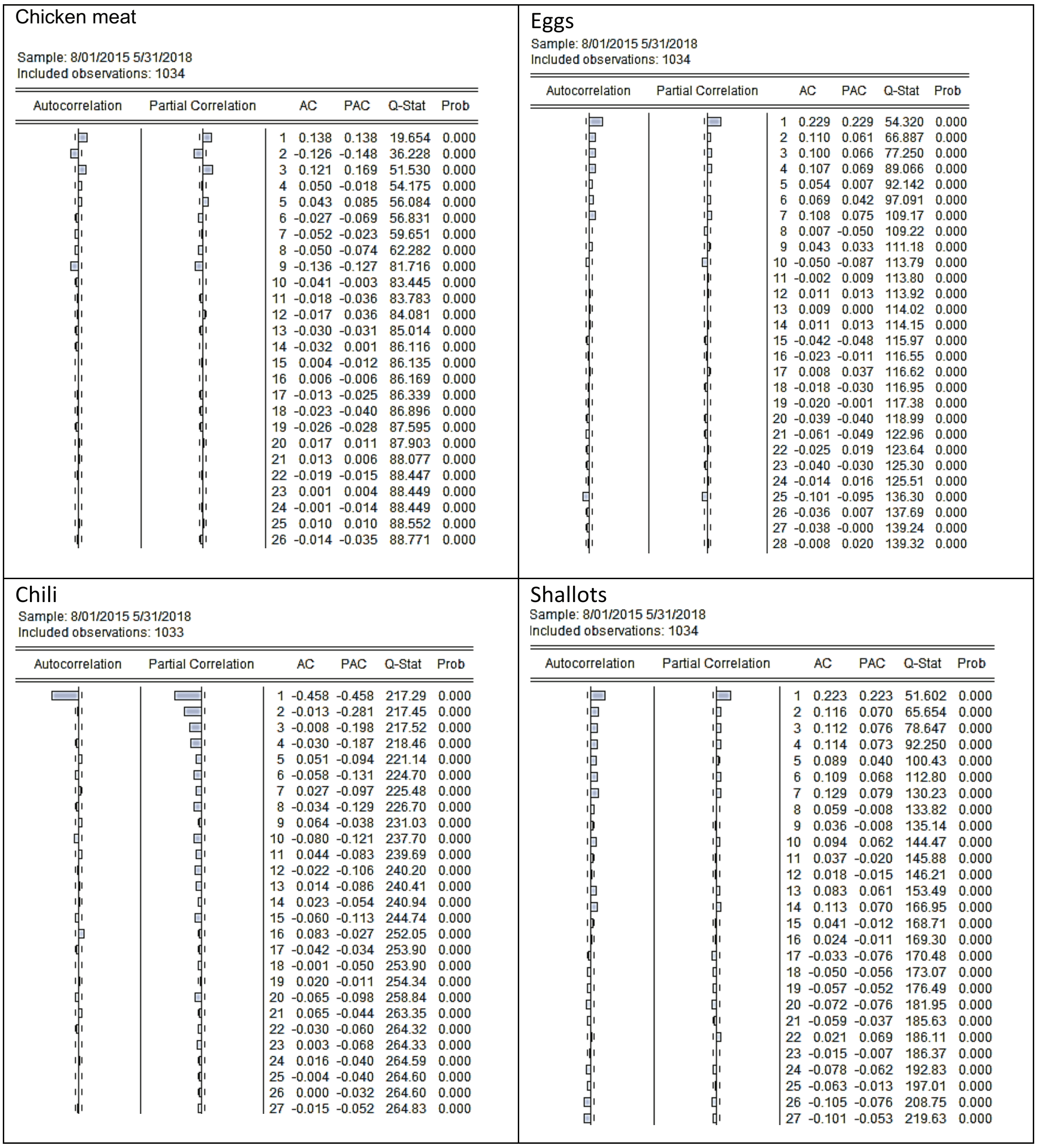
Considering the correlogram, the ARIMA model identification for each commodity is as follows:

Table 2: ARIMA Model Identification.

Variabel	**Pola ACF dan PACF**	**Model terpilih**
CHICKENMEAT	AR (1,2,3) MA (1,2,9)	AR1, AR2, MA1, MA2, MA9
REDCHILI	AR (1,2,4) MA(1,2,7)	AR1, AR2, MA1
EGGS	AR(1,2) MA (1)	AR1, AR2, MA1
SHALLOTS	AR (1), MA (1,7)	AR1, MA1, MA7

The estimation results from the four commodities are as follows:

Based on the estimation results used can be used to forecast for each food commodity in the period to come. Root Means Square Error (RMSE) and Mean Absolute Percent Error (MAPE) show significant results. MAPE is the most important part of statistics and can be used on observations and has the smallest variability from sample to sample [10]. MAPE can often be understood in user research, so MAPE is often used to report research results [13, 14]. The results of the model's ability to be used as forecasts for each commodity show that the resulting model can be used to make predictions, which is shown by the actual value pattern identical to the fitted value pattern.



Chicken meat

Sample: 8/01/2015 5/31/2018
Included observations: 1034

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.138	0.138	19.654	0.000
		2	-0.126	-0.148	36.228	0.000
		3	0.121	0.169	51.530	0.000
		4	0.050	-0.018	54.175	0.000
		5	0.043	0.085	56.084	0.000
		6	-0.027	-0.069	56.831	0.000
		7	-0.052	-0.023	59.651	0.000
		8	-0.050	-0.074	62.282	0.000
		9	-0.136	-0.127	81.716	0.000
		10	-0.041	-0.003	83.445	0.000
		11	-0.018	-0.036	83.783	0.000
		12	-0.017	0.036	84.081	0.000
		13	-0.030	-0.031	85.014	0.000
		14	-0.032	0.001	86.116	0.000
		15	0.004	-0.012	86.135	0.000
		16	0.006	-0.006	86.169	0.000
		17	-0.013	-0.025	86.339	0.000
		18	-0.023	-0.040	86.896	0.000
		19	-0.026	-0.028	87.595	0.000
		20	0.017	0.011	87.903	0.000
		21	0.013	0.006	88.077	0.000
		22	-0.019	-0.015	88.447	0.000
		23	0.001	0.004	88.449	0.000
		24	-0.001	-0.014	88.449	0.000
		25	0.010	0.010	88.552	0.000
		26	-0.014	-0.035	88.771	0.000

Eggs

Sample: 8/01/2015 5/31/2018
Included observations: 1034

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.229	0.229	54.320	0.000
		2	0.110	0.061	66.887	0.000
		3	0.100	0.066	77.250	0.000
		4	0.107	0.069	89.066	0.000
		5	0.054	0.007	92.142	0.000
		6	0.069	0.042	97.091	0.000
		7	0.108	0.075	109.17	0.000
		8	0.007	-0.050	109.22	0.000
		9	0.043	0.033	111.18	0.000
		10	-0.050	-0.087	113.79	0.000
		11	-0.002	0.009	113.80	0.000
		12	0.011	0.013	113.92	0.000
		13	0.009	0.000	114.02	0.000
		14	0.011	0.013	114.15	0.000
		15	-0.042	-0.048	115.97	0.000
		16	-0.023	-0.011	116.55	0.000
		17	0.008	0.037	116.62	0.000
		18	-0.018	-0.030	116.95	0.000
		19	-0.020	-0.001	117.38	0.000
		20	-0.039	-0.040	118.99	0.000
		21	-0.061	-0.049	122.96	0.000
		22	-0.025	0.019	123.64	0.000
		23	-0.040	-0.030	125.30	0.000
		24	-0.014	0.016	125.51	0.000
		25	-0.101	-0.095	136.30	0.000
		26	-0.036	0.007	137.69	0.000
		27	-0.038	-0.000	139.24	0.000
		28	-0.008	0.020	139.32	0.000

Chili

Sample: 8/01/2015 5/31/2018
Included observations: 1033

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.458	-0.458	217.29	0.000
		2	-0.013	-0.281	217.45	0.000
		3	-0.008	-0.198	217.52	0.000
		4	-0.030	-0.187	218.46	0.000
		5	0.051	-0.094	221.14	0.000
		6	-0.058	-0.131	224.70	0.000
		7	0.027	-0.097	225.48	0.000
		8	-0.034	-0.129	226.70	0.000
		9	0.064	-0.038	231.03	0.000
		10	-0.080	-0.121	237.70	0.000
		11	0.044	-0.083	239.69	0.000
		12	-0.022	-0.106	240.20	0.000
		13	0.014	-0.086	240.41	0.000
		14	0.023	-0.054	240.94	0.000
		15	-0.060	-0.113	244.74	0.000
		16	0.083	-0.027	252.05	0.000
		17	-0.042	-0.034	253.90	0.000
		18	-0.001	-0.050	253.90	0.000
		19	0.020	-0.011	254.34	0.000
		20	-0.065	-0.098	258.84	0.000
		21	0.065	-0.044	263.35	0.000
		22	-0.030	-0.060	264.32	0.000
		23	0.003	-0.068	264.33	0.000
		24	0.016	-0.040	264.59	0.000
		25	-0.004	-0.040	264.60	0.000
		26	0.000	-0.032	264.60	0.000
		27	-0.015	-0.052	264.83	0.000

Shallots

Sample: 8/01/2015 5/31/2018
Included observations: 1034

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.223	0.223	51.602	0.000
		2	0.116	0.070	65.654	0.000
		3	0.112	0.076	78.647	0.000
		4	0.114	0.073	92.250	0.000
		5	0.089	0.040	100.43	0.000
		6	0.109	0.068	112.80	0.000
		7	0.129	0.079	130.23	0.000
		8	0.059	-0.008	133.82	0.000
		9	0.036	-0.008	135.14	0.000
		10	0.094	0.062	144.47	0.000
		11	0.037	-0.020	145.88	0.000
		12	0.018	-0.015	146.21	0.000
		13	0.083	0.061	153.49	0.000
		14	0.113	0.070	166.95	0.000
		15	0.041	-0.012	168.71	0.000
		16	0.024	-0.011	169.30	0.000
		17	-0.033	-0.076	170.48	0.000
		18	-0.050	-0.056	173.07	0.000
		19	-0.057	-0.052	176.49	0.000
		20	-0.072	-0.076	181.95	0.000
		21	-0.059	-0.037	185.63	0.000
		22	0.021	0.069	186.11	0.000
		23	-0.015	-0.007	186.37	0.000
		24	-0.078	-0.062	192.83	0.000
		25	-0.063	-0.013	197.01	0.000
		26	-0.105	-0.076	208.75	0.000
		27	-0.101	-0.053	219.63	0.000

Figure 3: Correlogram Plot.

4. Conclusion

From the results of the research, for prediction data of chicken, egg, chili and red onion price using ARIMA time series model, based on Root Means Square Error (RMSE) and Mean Absolute Percent Error (MAPE) values, the four ARIMA models can be used as early warning model of commodity prices. The R-Squared values of all four models greater than 90% also indicate that ARIMA's overall model has a good performance to predict future prices, in anticipation of fluctuating market demand. The benefit of using this prediction model is that at the farmer / breeder level the relative will choose

Table 3: ARIMA Model Estimation Results.

Variabel	Hasil Estimasi	R^2	RMSE	MAPE
CHICKENMEAT	CHIKENMEAT = 0 + [AR(1)=0.746128202189, AR(2)=0.253687714401, MA(1)=0.448089479807, MA(2)=-0.135154031822,MA(9)=-0.112326367488	0.94	683,82	0,97%
REDCHILI	REDCHILI = 27628.0745422 + [AR(1)=1.52546016094, AR(2)=-0.534442706153, MA(1)=-0.384879131553	0.97	1539,23	3,21%
EGGS	EGGS = 20167.3834621 + [AR(1)=1.81617177758, AR(2)=-0.821601427631, MA(1)=-0.672717913042	0,98	260,02	0,68%
SHALLOTS	SHALLOTS = 25578.1160093 + [AR(1)=0.992525677226, MA(1)=0.186374751894, MA(7)=0.0849543289561	0,99	715,28	1,53%

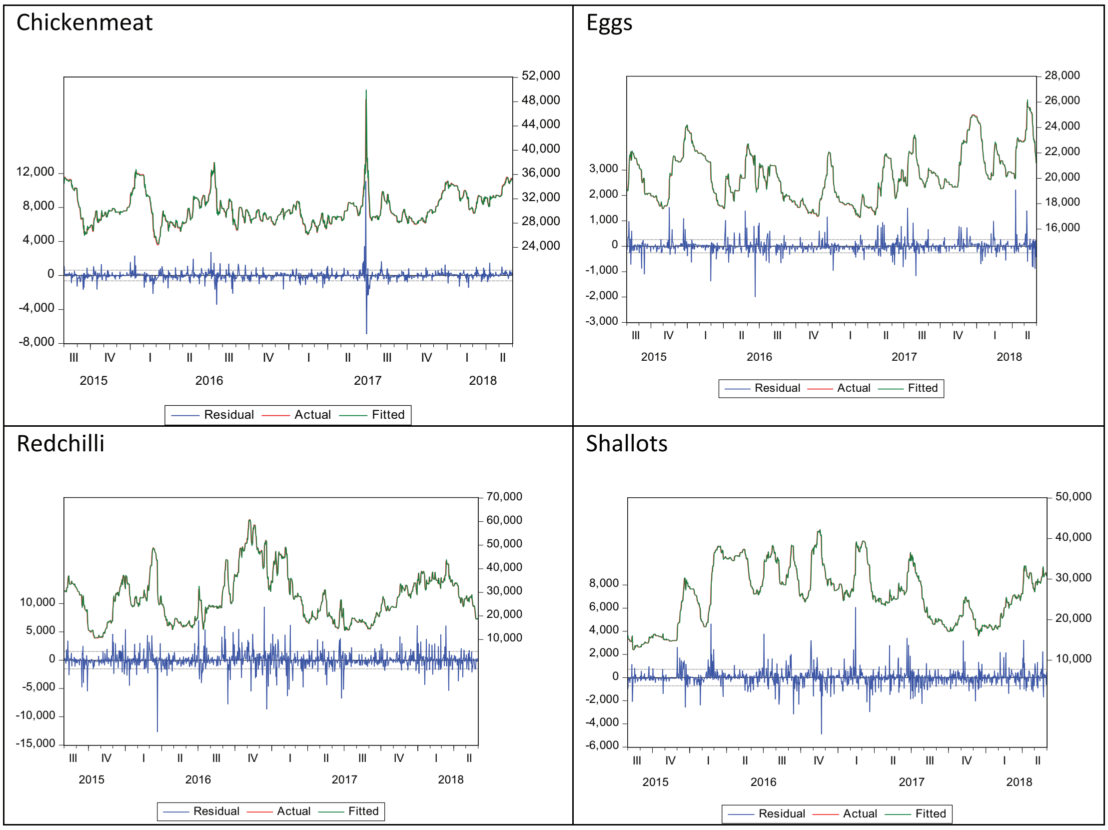


Figure 4: ARIMA Residual Model, Actual Pattern And Fitted Pattern.

the starting time of production at the high price, so it is expected to help increase the income of farmers. For the government, it can be used as guides in determining floor price and ceiling price so that it can be maintained conducive price in terms of demand and supply.

References

[1] Fridaus, M. (2012). Manajemen Agribisnis. Jakarta: Bumi Aksara. W433W9360

[2] Brandt, J.A and Bessler, D.A. (1983). "Price Forcasting and Evaluation: An Application in Agriculture," Journal of Forecasting vol. 2, pp. pp. 237-248.W433W9360

[3] Manfredo, Sanders, D.R, Mark, R. (2002). "USDA Production Forecasts for Pork, Beef, and Broilers: An Evaluation," Journal of Agricultural and Resource Economics 27(1), pp. pp. 114-127. W433W9360

[4] Gujarati, D.N and Porter, D.C. (2010). Essentials of Econometric 4th Edition. New York: McGraw-Hill. W433W9360

[5] Rasyidi, M.A. (2017). "Prediksi Harga Bahan Pokok Nasional Jangka Pendek Menggunakan ARIMA," Journal of Information Systems Engineering and Business Intelligence Vol. 3, No. 2, pp. 107-112. W433W9360

[6] Sugiarto, S, Gamal, M.D.H, Sanjaya, A. (2015). "Peramalan Stok Beras Bulog Pekanbaru Dengan Menggunakan Pemulusan Winter Dan ARMA (p,q),". Prosiding Semirata 2015 bidang MIPA BKS-PTN Barat. Semirata, Pontianak: Universitas Tanjungpura Pontianak.W433W9360

[7] Pimpi, L. (2013). "Penerapan Metode ARIMA Dalam Meramalkan Indeks Harga Konsumen (IHK) Indonesia Tahun 2013," Paradigma, pp. pp 35-46. W433W9360

[8] Kyungjoo, L, Schwan, Y, John, J. (2007). "Neural Network Model vs. SARIMA Model In Forecasting Korean Stock Price Index (KOSPI)," Information System vol. 8 no. 2, pp. pp 372-378. W433W9360

[9] Merh, N, Saxena, V.P, Pardasani, K.R. (2010). "A Comparison Between Hybrid Approaches of ANN and ARIMA For Indian Stock Trend Forecasting," Journal of Business Intelligence, vol. 3, no. 2, pp. pp 123-131. W433W9360

[10] Jadhav, V, Chinnappa Reddy, B.V, Gaddi, G.M. (2017). "Application of ARIMA Model for Forecasting Agricultural Prices," J. Agri. Sci. Tech., vol. 19, pp. 981-992.W433W9360

[11] Shahwan, T and Odening, M. (2007). "Forecasting Agricultural Commodity Prices using Hybrid Neural Networks," Computational Intelligence in Economics and Finance, vol. 2, pp. 63-74.W433W9360

[12] Weron, R. (2014). "Electricity price forecasting: A review of the state-of-the-art with a look into the future," International Journal of Forecasting, pp. pp. 1030-1081.W433W9360

[13] Farjam, A, Omid, M, Akram, A (et al). (2014). "A Neural Network Based Modeling and Sensitivity Analysis of Energy Inputs for Predicting Seed and Grain Corn Yields," J. Agr. Sci. Tech, vol. 16, pp. 767-778.W433W9360

[14] Jadhav, V, Chinnappa Reddy, B.V, Gaddi, G.M (et al). (2016). " Exploration of Different Functional Forms of Growth Models: A Censorious Analysis with Reference to Horticultural Sector in Karanataka," Int. J. Tropica. Agr, vol. 34, no. 4, pp. 1107-1116. W433W9360 W433 W433