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Türkiye'de Tavuk Eti Üretiminin Genel Durumu ve Üretim Projeksiyonu

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ÖZ

Bu araştırmada, Türkiye'de tavuk eti üretim (ton) sektörünün genel durumunu ortaya konması ve gelecek on yıla ait üretim tahminini yapılması öngörülmüştür. Araştırmadaki veri seti Türkiye İstatistik Kurumu (TÜİK, 2024) tarafından yayınlamış olan 2001-2023 yılları arasında istatistiksel tablolardaki yıllara göre tavuk eti üretim (ton) miktarından elde edilmiş olup, zaman serisi analizlerinden Auto-Regressive Integrated Moving Average (ARIMA) model ve Çift Üstel düzeltme metodu analizleri yapılmıştır. Yapılan analizler sonucunda en uygun model Auto-Regressive Integrated Moving Average (ARIMA; 1,1,1) ve Çift Üstel Düzeltme metodunda da Türkiye'de tavuk eti üretim (ton) miktarının yıldan yıla artış eğiliminde olduğu tespit edilmiştir. Ayrıca Türkiye tavuk eti üretiminin (ton) 2026 yılında yaklaşık 936615 ton, 2033 yılında ise yaklaşık 885833 ton olacağı bildirmiştir.

General Situation and Production Projection of Chicken Meat Production in Türkiye

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ABSTRACT

This study aims to reveal the general status of the chicken meat production (tonnes) sector in Türkiye and to make a production estimate for the next ten years. The dataset in the study was obtained from the chicken meat production (tonnes) amount according to the years in the statistical tables between 2001-2023 published by the Turkish Statistical Institute (TUIK, 2024), and the Auto-Regressive Integrated Moving Average (ARIMA) model and Double Exponential Smoothing method analyses were performed from time series analyses. As a result of the analyses, it was determined that the chicken meat production (tonnes) amount in Türkiye tended to increase from year to year in the most appropriate model Auto-Regressive Integrated Moving Average (ARIMA; 1,1,1) and Double Exponential Smoothing method. It was also reported that Türkiye's chicken meat production (tonnes) would be approximately 936615 tons in 2026 and approximately 885833 tons in 2033.

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1. Introduction

In our age, poultry farming has an important place in the industry and still continues to develop. The chicken sector in Türkiye is one of the sectors that is growing steadily, significantly increasing its exports, contributing to agriculture and providing significant added value to the economy with its

structure that provides intensive employment. While it started as a family business in the 1970s, it continues to develop to this day with the transition to the contract production model in the 1980s and investment supports in the 1990s (Çobanoğlu et al., 2003).

Both the increase in nutrition-related diseases such as cardiovascular diseases and obesity and the fact that poultry meat prices are lower than red meat have increased the demand for poultry meat, and in addition, all essential amino acids known to be necessary for human nutrition in terms of protein quality are provided in sufficient and appropriate amounts. Therefore, poultry meat is important in Türkiye, as in the rest of the world (Civaner, 2007; Özer, 2008).

When it comes to poultry meat in Türkiye, broiler chickens have the most important place (Altınel, 1995). The number of broiler chickens and slaughtered poultry in Türkiye have increased significantly over the years; The number of slaughtered broiler chickens, which was 370 million in 2001, reached 1027 billion in 2023, with an increase of approximately 242.46 % (TUIK, 2024).

There are many technical and economic studies examining broiler chicken production in the world and in Türkiye (Lucy, 1990; Kelley, 1994; Gordon, 1997; Ertürk, 2001; Çiçek and Tandoğan, 2007; Tandoğan, 2014; Bars et al., 2018; Kozaklı et al., 2021). Keskin and Demirbaş (2012) emphasized that Türkiye has developed at a pace that can compete with the USA in broiler chicken production. The chicken meat sector in Türkiye has made significant progress over the years and has become one of the trade areas with a large share in the country's economy. For this reason, it has been stated that econometric analyzes should be conducted to better understand the production, consumption and marketing structure in the chicken meat sector (Dagdemir et al., 2004; Aşkan and Dağdemir, 2017).

This research examines the general status of the chicken meat production (tonnes) sector in Türkiye and future production estimates. Chicken meat production data in Türkiye between 2001-2023 were analyzed using Auto-Regressive Integrated Moving Average (ARIMA) model and Double Exponential Smoothing methods. The most important external dependency in the sector stems from feed costs, and therefore it is emphasized that domestic feed production should be increased. The research provides data that will guide decision makers for the sustainability of the sector and is important to use in future production planning.

2. Material and Methods

The data set in this research was obtained from the amount of chicken meat production (tonnes) according to the years in the statistical tables between 2001-2023 published by the Turkish Statistical Institute (TUIK, 2024). In the research, in order to reveal the general situation of the chicken meat production sector in Türkiye and to find the production estimate for the next ten years, the analysis was carried out with the help of Auto-Regressive Integrated Moving Average (ARIMA) model and Double Exponential Smoothing method from time series analysis.

Auto-Regressive Integrated Moving Average (ARIMA) model and Double Exponential Smoothing method; The most well-known stationarity analysis of the models are Box-Jenkins models. The model

applied to the series that are not initially stationary but are stationary as a result of the difference process are called Auto-Regressive Integrated Moving Average (ARIMA) models. This technique is used in modeling dynamic systems and discrete time series.

Mathematically, a typical Auto-Regressive Integrated Moving Average (ARIMA; p, d, q) model can be expressed as follows.

$$y_t = c_t + \sum_{i=1}^{p} \emptyset_m y_{t-i} + \sum_{j=1}^{q} \emptyset_n e_{t-j} \quad (1)$$

Here, p is the order of the model's autoregression (AR) and the number of lags of the differenced series. d is the order of the difference (I) to make the model stationary. q is the order of the model's moving average (MA) and the number of lags of the estimation errors (Zhang, 2003).

The Double Exponential Smoothing method mathematically corrects past data and gives high weight to the latest observation value in the data set and decreasing weight to the previous observation values. The Double Exponential Smoothing method is used for series with a certain trend. This correction method;

$$St = \alpha yt + (1 - \alpha)(St{-}1 + bt{-}1) \qquad 0 \leq \alpha \leq 1 \quad (2)$$

$$bt = \gamma(St - St{-}1) + (1 - \gamma)bt{-}1 \qquad 0 \leq \gamma \leq 1 \quad (3)$$

It can be formulated as (Yereli et al., 2012).

In this research, firstly;

H_0: The established model is not a suitable model.

H_1: The established model is a suitable model.

hypotheses were determined and the model was established as follows.

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 a_{t-1} \quad (4)$$

3. Result and Discussion

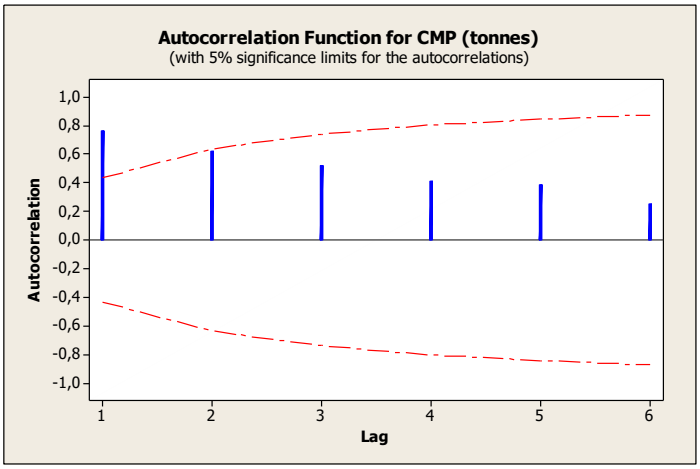
In this study, a 23-year (2001-2023) series of chicken meat production was considered and the most appropriate model for the series was tried to be determined. In the first stage, whether the data showed a normal distribution was determined with the Ryan-Joiner test, and the stationarity analysis of the series was performed using the Augmented Dickey Fuller (ADF) unit root test. This test shows that the series is stationary if the obtained Augmented Dickey Fuller (ADF) unit root test t statistic value is smaller than the MacKinnon critical values at the determined significance level (Saatcioğlu and Karaca, 2004). In this context, the Augmented Dickey Fuller (ADF) unit root test results of the series are given in Table 1; it is seen that the series is not stationary at the level. In the series where the first difference is taken, the Augmented Dickey Fuller (ADF) unit root t statistic value (5.108010) is smaller than the critical-t values at the 1%, 5% and 10% levels, indicating that the series is stationary.

Table 1. Augmented Dickey Fuller (ADF) unit root test results.

	Level Equality		First Difference	
	t- statistics	**Probability**	**t- statistics**	**Probability**
ADF t- statistics	-1.119273	0.6891	-5.108010	0.0005
1% at the level	-3.769597		-3.788030	
5% at the level	-3.004861		-3.012363	
10% at the level	-2.642242		-2.646119	

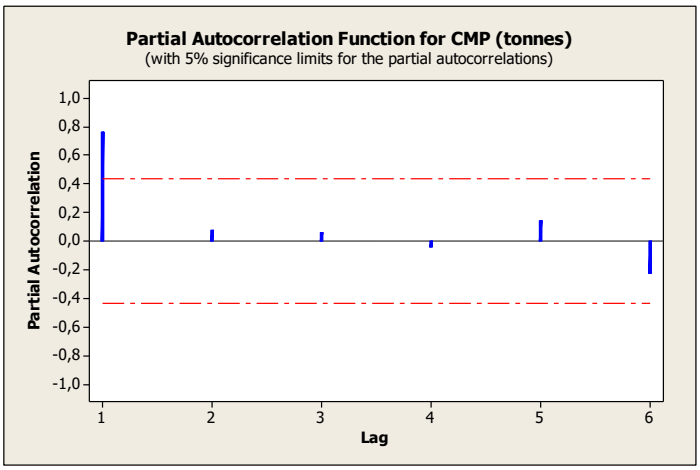
*MacKinnon (1996) one-sided p-values.

Since the Auto-Regressive Integrated Moving Average (ARIMA) model is applied to stationary series; the stationarity of the series was evaluated in the second stage. When the Autoregressive Correlation Function (ACF) and Partial Autoregressive Correlation Function (PACF) graphs were examined, it was seen that the series was not stationary. (Figure 1). The difference taking process was applied to make the series stationary and the Autoregressive Correlation Function (ACF) and Partial Autoregressive Correlation Function (PACF) graphs of chicken meat production whose first difference was taken are given in Figure 2. When these graphs were examined it was concluded that the series became stationary since there was no data exceeding the confidence interval. Figure 2,3,4 and Table 2, 3 are shown below.



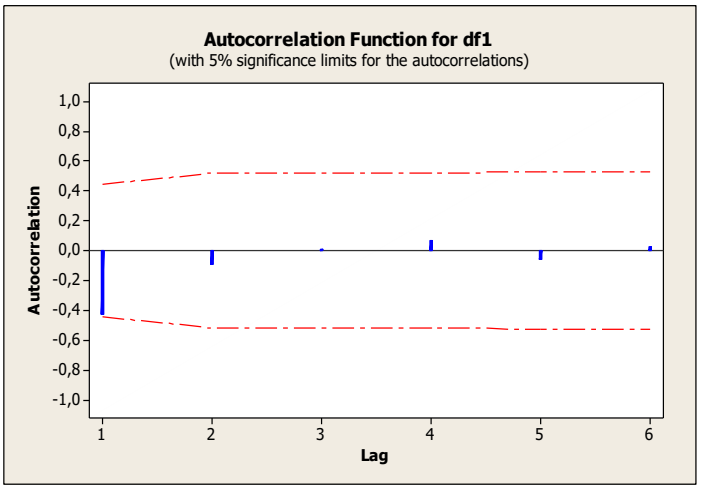
CMP: Chicken meat production (tonnes)

Figure 1. Autoregressive Correlation Function (ACF) graph of chicken meat production (tonnes).



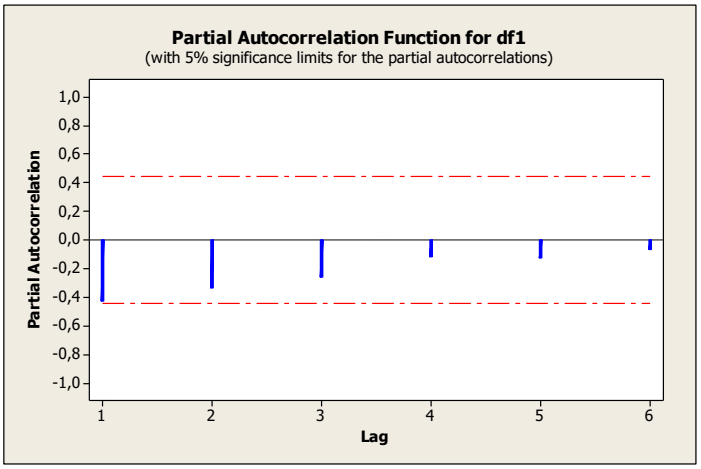
CMP: Chicken meat production (tonnes)

Figure 2. Partial Autoregressive Correlation Function (PACF) graph of chicken meat production (tonnes).



CMP: Chicken meat production (tonnes)

Figure 3. Autoregressive Correlation Function (ACF) graph of chicken meat production (tonnes) with the first difference taken.



CMP: Chicken meat production (tonnes)

Figure 4. Partial Autoregressive Correlation Function (PACF) graph of chicken meat production (tonnes) with the first difference taken.

Table 2. Coefficients related to the result of the Auto-Regressive Integrated Moving Average (ARIMA;1,1,1) model of chicken meat production (tonnes).

Model	Coefficient	Standard Error	t-value	P-value
AR1	-0.3028	0.2627	-1.15	0.026
MA1	0.9359	0.2145	4.36	0.000
Constant	-2539	201	1.26	0.022

In the model determination phase; Autoregressive Correlation Function (ACF) and Partial Autoregressive Correlation Function (PACF) graphs belonging to chicken meat production were examined. It is seen that the relationships in Autoregressive Correlation Function (ACF) and Partial Autoregressive Correlation Function (PACF) graphs gradually decrease as the number of lags increases. This situation shows that the appropriate model is the Autoregressive moving average model. Since the first lags are important in Autoregressive Correlation Function (ACF) and Partial Autoregressive Correlation Function (PACF) graphs and the first difference of the series is taken; it was concluded that

the p, d, q parameters belonging to the Auto-Regressive Integrated Moving Average (ARIMA) model are (1,1,1) and according to the estimation results, the obtained model is;

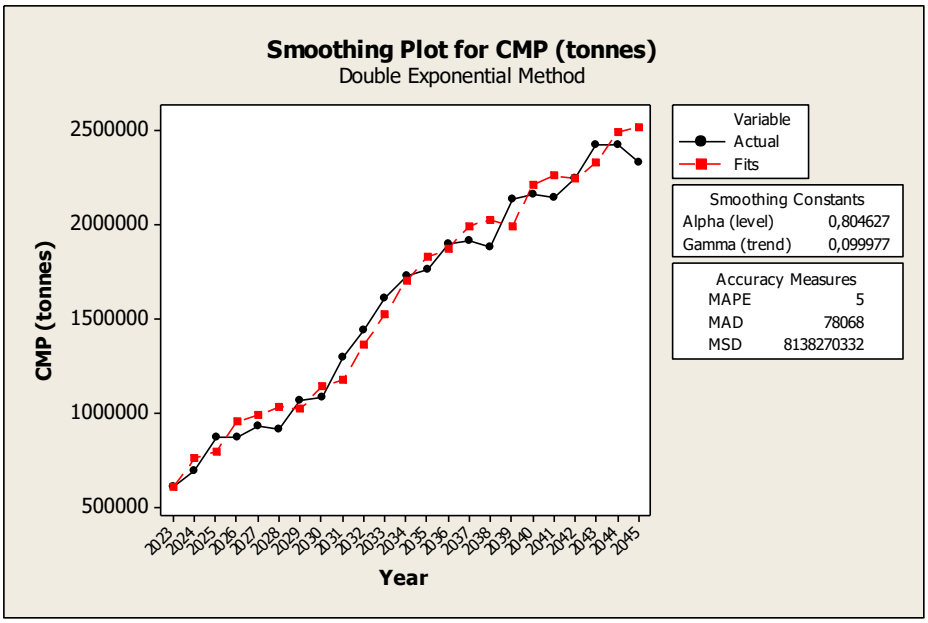
$$y_t = -2539 - 0.3028y_{t-1} + 0.9359a_{t-1} \quad (5)$$

The 10-year forecast of the Auto-Regressive Integrated Moving Average (ARIMA; 1,1,1) model for Türkiye's chicken meat production is given in Table 3. According to Table 3, 936615 tonnes of chicken meat is expected to be produced in 2026. Thus, an average increase in Türkiye's chicken meat production is predicted over the years between 2025 and 2033.

Table 3. Values for chicken meat production (tonnes) estimation are Auto-Regressive Integrated Moving Average (ARIMA; 1,1,1)

Years	Estimation (tonnes)	95% Confidence Lower Limit (tonnes)	95% Confidence Upper Limit (tonnes)
2025	1706155	1606155	1806155
2026	936615	926615	946615
2027	1310644	1210644	1410644
2028	477175	467175	487175
2029	1079604	979604	1179604
2030	117145	107145	127145
2031	972391	962391	982391
2032	71626	70626	72626
2033	885833	875833	895833

In addition, when making predictions with the double exponential smoothing method first, the Ryan-Joiner test was applied to the 23-year (2001-2023) series of chicken meat production and it was determined that the data followed a normal distribution. In the next stage, the double exponential smoothing method was applied to this normally distributed series. It is seen that the estimated values obtained tend to increase (Figure 5).



CMP: Chicken meat production (tonnes)

Figure 5. Double Exponential Smoothing method chicken meat production (tonnes) estimates by year.

As can be seen here, although chicken meat (tonnes) production in Türkiye tends to fluctuate over the years, the result may vary across different studies. Therefore, it is extremely important to add equations as much as possible to obtain a reliable parameter. On the other hand, it is important that chicken meat (tonnes) produced in Türkiye by year are easily interpretable and meaningful values for both producers and consumers. Since ignoring the problems that occurred in the past data set in determining the method will cause incorrect interpretations and choices, it will be statistically more accurate to create and consider the appropriate model by taking the differences of the data set.

4. Conclusion

It is known that per capita chicken meat consumption and exports have tended to increase over the years. Today, Türkiye has an increasing trend in chicken meat production and thus provides an advantage to potential export markets.

In addition, the increasing population from year to year shows that chicken meat consumption will increase. Considering these factors, it is very important to make future predictions in order to guide the decision makers in the sector and make production planning.

Predicting the developments in the chicken meat industry through scientifically based research is an opportunity that facilitates decision-making by relevant people and institutions. In this respect, there is a need to create a healthy database and then to make future predictions using appropriate time series analysis models.

In this study, Türkiye's 10-year chicken meat production amount was estimated for the 2023-2033 period by using Auto-Regressive Integrated Moving Average (ARIMA) model and Double Exponential Smoothing method from time series analyses. In the most appropriate model Auto-Regressive Integrated

Moving Average (ARIMA; 1,1,1) model and Double Exponential Smoothing method, it was determined that the amount of chicken meat production in Türkiye tends to increase from year to year. In addition, it was determined by the analysis that Türkiye's chicken meat production will be approximately 1706155 tonnes in 2026 and approximately 936615 tonnes in 2033.

In the data set obtained from the amount of chicken meat production according to years in the statistical tables between 2001 and 2023, published by the Turkish Statistical Institute (TUIK), One of the most important factors affecting chicken meat production is feed cost. In this context, considering the significant dependence on foreign sources in the feed industry; supports (premium, diesel oil and fertilizer, etc.) to increase the domestic production of feed raw materials, especially soybean and corn; It is important for the sustainability of the sector. Additionally, attention should be paid to general cost increases and population changes due to the economic crises that occurred in Türkiye.

Conflict of Interest

The authors declare that have no competing interest.

Consent for Publication

Authors declare that they have contributed equally (50%) to the article

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