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Interpolation of beef price in Malang City during Eid Al-Adha 2017

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Abstract. The large demand for cows during Eid Al-Adha was likely to affect the beef prices. The current research aimed to create an interpolation of beef prices in Eid Al-Adha so that the researchers could predict the range of beef prices in Malang city (Malang and Batu cities as well as Malang districts), East Java, Indonesia. The results of this study suggested that the range of beef prices in Malang city was relatively stable between IDR 105,000 and IDR 115,000. The results also showed that the government had successfully maintained the price. However, the government needed to pay more attention to Batu city since it was found that the price in that area was higher than any other areas in Malang.

1. Introduction

Besides goats, cows are one of the most influential ruminants in Indonesia since Indonesian people love consuming the meat. Generally speaking, most of Indonesian food contains beef such as rendang, bakso, steaks, abon and many more. Rendang, Minangkabau food-West Sumatra, is a popular food in the world [1]. While bakso (Indonesian meatballs) can be easily got everywhere and it is also made from beef with no fat [2]. Interestingly, both are listed in 40 favorite foods of Indonesia and rendang was the most delicious food in the world [3]. That is why the demand for beef in Indonesia is high.

To meet the need of beef, which is very high, the beef production must be high as well. The data from BPS showed that the Indonesian beef production was 497,669 tons in 2014 and was 524,109 tons in 2016. See Figure 1 [4].
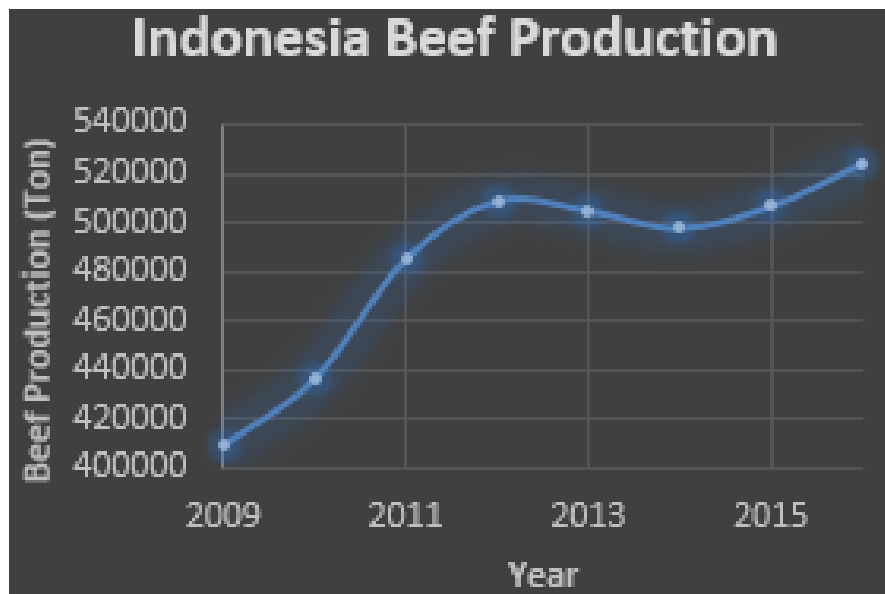
Figure 1. Indonesia beef production.

In 2017, Indonesia had run a deficit in beef production. Based on BPS data, the prognosis of beef production was 354.770 Tons, while the need for beef was 604.968 Tons. Therefore, importing beef or even cows was the only solution to meet the other 30% - 40% of the need [5].

In Indonesia, the demand for beef will extremely increase in Ramadhan to Eid Al-Fitr and Eid Al-Adha since most Indonesians are Muslim. The prognosis of beef production in Ramadhan to Eid Al-Fitr in 2017 was 62.400 Tons while the need was 106.407 Tons. To meet the need, the governments decided to import beef, feedlot cows, substitute beef with imported buffalo meat in BULOG [6]. That caused the increased beef price during those days. In some areas in Jakarta the price reached Rp. 130.000. However, the average beef price in East Java in Eid Al-Fitr July 2017 was just about Rp. 10.7348. If compared to that of East java in June 2017 which was Rp. 105.768, it can be said that the increase was not that big or stable.

Another event causing the increase of beef price was Eid Al-Adha, it is an event when Muslim people sacrifice their livestock animals, in Indonesia they could be cows or goats, which is then shared to those in need. Furthermore, it is an important annual event in Islam [7]. One of the verses conveying the message is in the letter of Al-Kautsar verse 2.

"So pray to your Lord and sacrifice [to Him alone]"

The large demand of cows during Eid Al-Adha possibly causes the change of beef price. Thus, the current research aimed to create an interpolation of beef price in Eid Al-Adha so that we could predict the range of beef prices in Malang city (Malang and Batu cities as well as Malang districts), East Java, Indonesia.

2. Materials and methods

This research used secondary data, which were beef prices from Malang markets obtained from a survey by Department of Industry and Commerce of East Java. Besides prices from Malang markets, prices from some other markets near Malang were also used in order to get better results in the interpolation process. Table 1 shows the list of markets whose prices were used in the research.

Table 1. List of the Markets

Area	Market
Batu City	Batu City Main Market
Batu City	Gentengan Market
Batu City	Selecta Market
Malang City	Blimbing Market
Malang City	Tawangmangu Market
Malang City	Oro-Oro Dowo Market
Malang City	Klojen Market
Malang City	Madyopuro Market
Malang Regency	Lawang Market
Malang Regency	Singosari Market
Malang Regency	Karangploso Market
Malang Regency	Kepanjen Market
Malang Regency	Turen Market
Blitar Regency	Wlingi Market
Pasuruan Regency	Sukorejo Market
Kediri Regency	Pamenang Market
Lumajang Regency	Pasirian Market
Mojokerto Regency	Mojosari Market
Jombang Regency	Ploso Market

The data of beef prices that were finally used were the results of a survey conducted on September 1 2017 which was Eid Al-Adha. Before analyzing the interpolation, the coordinates of the markets had to be found first.

Again, the researchers had just obtained the data from a few markets. That is why an interpolation was important to predict the beef prices for the areas which we had taken the samples from. Surface interpolation technique in geographic information system (GIS) is a powerful tool to predict the surface value [8]. This very technique was the one used to predict the beef prices in other locations we did not know. In fact, there are various methods of interpolation, such as; Distance Weighting, Global Polynomial Interpolation, Radial Basis Functions, Local Polynomial Interpolation, kriging interpolation and empirical bayesian kriging [9]. Kriging method is of some types, that is, simple kriging, ordinary kriging and universal kriging. There are some semiiviogram which can be used in all types of kriging method. They are circular, spherical, tetraspherical, pentaspherical, gaussian, rational quadratic, hole effect, k-bessel, j-bessel and stable.

All researches using interpolation must have a different method that fits most with the research condition(s). a previous study, for example, compared the accuracy of kriging to that of IDW to predict the value of groundwater arsenic concentrations in Texas. The results showed that IDW outperformed kriging [10]. Another comparative study also involved IDW and kriging but another method was involved, which was Multiquadric. It was about noise mapping in Isparta, Turkey. The results suggested that Kriging was the best method [11]. The other research used a lot more methods which were inverse distance weighting (IDW), local polynomial interpolation (LPI), radial basis function (RBF), ordinary kriging (OK) and Empirical Bayes kriging (EBK) to figure out the spatial distribution of soil organic carbon (SOC). It turned out then that the best method was Kriging by using RMSE as the comparison value [12]. In order to get the best interpolation method for the current research, the researchers used RMSE value. The one that was of the greatest RMSE value meant that it had the best prediction value compared to the other methods.

RMSE formula is as follows:

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(x_i - y_i)^2}{n}} \qquad (1)$$

X represents the observed value in i location, y represents prediction value of i location and n represents the number of locations being observed.

3. Results and discussions

Below are the results of obtaining the data from the Department of Industry and Commerce on September 1 2017 and the coordinates of the market locations:

Table 2. Beef prices in Malang Raya on September 1 2017.

Coordinate		Area	Market	Beef Price / Kg
X	Y			1-Sep-17
112.5325	-7.88236	Batu City	Batu City Main Market	IDR 115,000.00
112.5223	-7.86902	Batu City	Gentengan Market	IDR 115,000.00
112.5263	-7.82044	Batu City	Selecta Market	IDR 115,000.00
112.6372	-7.94007	Malang City	Blimbing Market	IDR 110,000.00
112.6289	-7.95985	Malang City	Tawangmangu Market	IDR 110,000.00
112.6227	-7.9631	Malang City	Oro-Oro Dowo Market	IDR 110,000.00
112.6347	-7.97286	Malang City	Klojen Market	IDR 115,000.00
112.669	-7.97412	Malang City	Madyopuro Market	IDR 110,000.00
112.6951	-7.83004	Malang Regency	Lawang Market	IDR 107,000.00
112.6645	-7.89418	Malang Regency	Singosari Market	IDR 110,000.00
112.5937	-7.8934	Malang Regency	Karangploso Market	IDR 106,000.00
112.5708	-8.12886	Malang Regency	Kepanjen Market	IDR 108,000.00
112.6898	-8.16584	Malang Regency	Turen Market	IDR 108,000.00
112.3253	-8.0758	Blitar Regency	Wlingi Market	IDR 115,000.00
112.7208	-7.71718	Pasuruan Regency	Sukorejo Market	IDR 100,000.00
112.19	-7.76471	Kediri Regency	Pamenang Market	IDR 95,000.00
113.1133	-8.2125	Lumajang Regency	Pasirian Market	IDR 105,000.00
112.557	-7.51536	Mojokerto Regency	Mojosari Market	IDR 100,000.00
112.2258	-7.45167	Jombang Regency	Ploso Market	IDR 98,000.00

The cheapest beef in Malang on September 1 2017 was IDR 106,000 and it was in Karangploso market while the most expensive one was IDR 115,000 and it was from markets in Batu areas. Some markets near Malang were selling beef below IDR 100,000. They were Jombang market (IDR 95,000) and Ploso market (IDR 98,000). Based on those data, the average price of beef in Malang city was IDR 110,692. This price was not significantly different (the difference was just IDR 599) from that of in Eid Al-Fitr (July 25 2017) which was IDR 110,133.

The results of analyzing the best method to figure out the spatial distribution of beef in Malang city using RMSE can be seen in Table 3.

Table 3. RMSE result.

Methods	RMSE
Inverse Distance Weighting	5369.679
Global Polynomial Interpolation	6548.449
Radial Basis Functions	4660.953
Local Polynomial Interpolation	5504.958
Ordinary Kriging	
- Semivariogram Circular	4701.221
- Semivariogram Spherical	4677.612
- Semivariogram Tetraspherical	4645.248
- Semivariogram Pentaspherical	4619.12
- Semivariogram Gaussian	4893.398
- Semivariogram Rational Quadratic	4539.018
- Semivariogram Hole Effect	5389.598
- Semivariogram K-Bessel	4918.642
- Semivariogram J-Bessel	5486.04
- Semivariogram Stable	4917.964
Empirical Bayesian Kriging	
- Semivariogram Linier	4647.535
- Semivariogram Power	4585.678
- Semivariogram Thin Plate Spline	5915.902

The best interpolation method to predict beef prices in Malang in Eid Al-Adha was Ordinary Kriging with Semivariogram Rational Quadratic. RMSE resulted by using the method was 4539.018.

In this method, the semivariogram rational quadratic resulted nugget value as much as 4164260 with the range of 0.7932133 and the partial sill was 50266767.101. in this case isotropy with sector type 8 sectors was used. The results of ordinary Kriging interpolation can be seen in Figure 2.
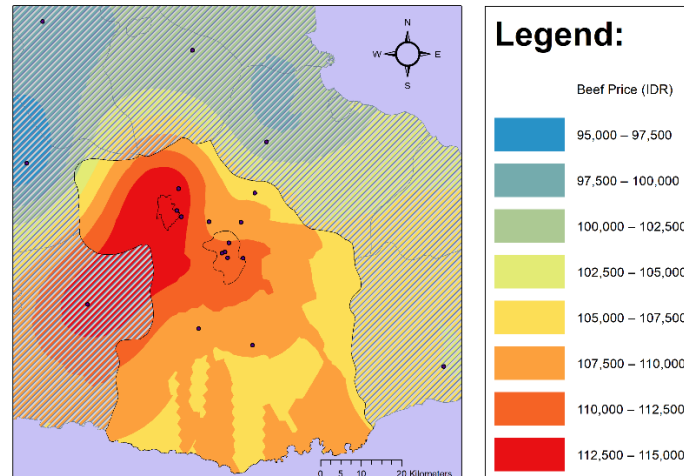

Figure 2. Beef price interpolation.

In figure 2, it can be seen that beef price in Malang city during Eid Al-Adha was between IDR 105,000 and IDR 115,000. Batu city was the area with the highest beef price that reached IDR 115,000. If compared to that of Eid Al-Fitr, it can be said the beef price in this Eid Al-Adha 2017 was not significantly changed and remained stable.

4. Conclusion
The range of beef price in Malang during Eid Al-Adha was relatively stable between IDR 105,000 and IDR 115,000. The results also showed that the government had successfully maintained the price. However, the government needed to pay more attention to Batu city since it was found that the price in that area was higher than any other areas in Malang.

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