The characteristics of demand for fresh shrimp in Semarang City, Indonesia

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Abstract. The people of Semarang City as a coastal community are relatively fond of seafood, including shrimp. The relatively high selling price of shrimp push some fishermen to set shrimp as the target to be caught. There are several factors that influence shrimp demand in Semarang City. This study aimed to determine the characteristics of shrimp demand in the Semarang City. The research was conducted through survey of 720 respondents. The statistical analysis in this study used regression (both linear and non-linear) and correlation. The researchers conducted several analysis, including the demand function modeling, price elasticity, expenditure elasticity, and consumer preference using quantitative descriptive approach. The results showed that fresh shrimp commodity is elastic and classified as normal goods (especially basic need goods). The demand for fresh shrimp in Semarang City can be estimated with the linear model, logarithmic model and polynomial model developed in this study.
Key Words: demand, elasticity, expenditure, price, shrimp.

Introduction. Semarang City is the capital of Central Java Province (Indonesia) and is located on the north coast of Java Island. According to Husnayaen et al (2018) and Bott & Braun (2019), most big cities in the world are located in coastal areas and the population in coastal areas continues to increase significantly due to migration. More than 10% of the world's population lives in lowland areas (below 10 meters above sea level) and most of them are in Asia, including Semarang City. The total population of Semarang City was 1,814,110 people in 2019 (BPS-Statistics of Semarang Municipality 2020). In general, coastal communities (including people of Semarang City) tend to like seafood, including shrimp. According to Cisneros-Montemayor et al (2016), per capita seafood consumption of coastal communities can be 15 times higher than non-coastal communities. Therefore it is important to set the optimal policies in the management of shrimp commodities, both supply and demand side in Semarang City.

Demand trend for fishery commodities (including shrimp) is increasing, both at the global, national and regional levels. Tran et al (2017) made projection that fish supply and demand in Indonesia will continue to increase which capture fisheries and aquaculture production can reach 18.8 million tons in 2030. The growth of aquaculture is an important factor to meet the increasing demand for fishery products (including shrimp), because capture fisheries production has stagnated. Then, the price of capture fisheries products could increase and it could decreased fish consumption. According to Merino et al (2012), around two-thirds of global fishery production is directly consumed by humans and the others is processed to produce fish meal and fish oil for the aquaculture and livestock industry.

Shrimp supply in Semarang City comes from shrimp farming and capture fisheries. Shrimp is one of the main products of aquaculture in Indonesia. Production of whiteleg shrimp (*Litopenaeus vannamei*) and tiger shrimp (*Penaeus monodon*) cultivated in brackish water ponds has a significant contribution to aquaculture production in Indonesia, reaching 10% and 5% respectively (Henriksson et al 2017; Wijayanto et al 2017). However, shrimp farming in Semarang City is relatively undeveloped. This is because the poor water quality in Semarang City to support shrimp farming and the

coastal area of Semarang is prioritized for other uses, including airport, seaport, industries and settlements. Capture fisheries activities in Semarang City are also undeveloped. According to BPS-Statistics of Semarang Municipality (2020), there are 1,575 fishermen households in Semarang City (0.3% of the total household), where all fishermen in Semarang City are traditional fishermen with simple fishing gear using small outboard motor boats (size less than 5 GT). Their fishing trip is one-day fishing. Fishermen in Semarang City have fishing base at Tambak Lorok Fish Landing Place (FPL) and Mangkang FLP with inadequate industrial scale capture fisheries facilities. Therefore, most of the shrimp supply for the Semarang City people is imported from outside the Semarang City. For the Semarang City Government, the shrimp demand policy is more necessary than the policy to increase shrimp production from within Semarang City.

There are several factors that influence the demand for fishery commodities, including shrimp. Some of these factors include commodity prices, supply, human population, consumption patterns and income (Vassilopoulos et al 2012; Tran et al 2017; Lomboy et al 2019). Demand for shrimp can affect shrimp prices, production and fisherman welfare. Shrimp is a fishery commodity with a relatively high selling price. Therefore, some fishermen make shrimp as the catch target. Shrimp tends to be consumed by the middle to upper income population due to the relatively high price. In developing policies regarding shrimp, information is needed about the characteristics of shrimp demand in Semarang City. The purpose of this study was to determine the characteristics of shrimp demand in the Semarang City, including budget (which is influenced by income), consumer tastes and shrimp prices that influence shrimp demand.

Material and Method. The research was conducted in Semarang City (Figure 1) in 2019. We conducted a survey (using cluster sampling) with a total of 720 respondents in 16 sub-districts.

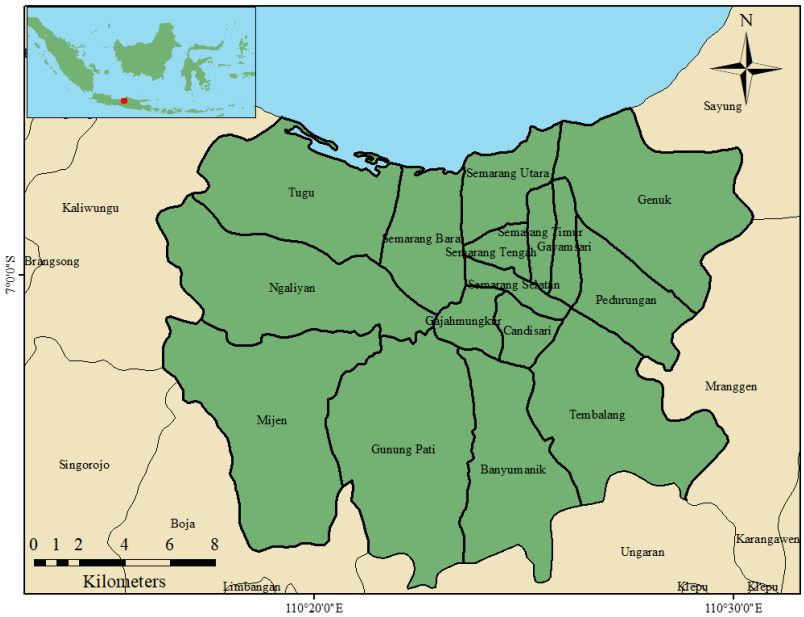


Figure 1. Map of Semarang City.

Data analysis was performed using statistical analysis, including regression (linear and non-linear) and correlation analysis. The study of demand estimation which is influenced by willingness to pay (WTP) was conducted by using regression analysis (linear and non-linear). Price elasticity is the percentage change in demand if commodity prices change by 1%. If the price elasticity value is more than one, the commodity is categorized as inelastic. Meanwhile, if the price elasticity value is less than one, then the commodity is categorized as elastic (Dornbusch et al 2004). The value of price elasticity can be

estimated by regressing Ln demand (as the dependent variable) and Ln price (i.e. Ln WTP) as the independent variable, where the slope value is the price elasticity value.

Meanwhile, the expenditure elasticity is the percentage change in demand if the expenditure budget changes 1%. Expenditure elasticity is used as a substitute approach to income elasticity. Some respondents tend not to be willing to answer questions about income, but were willing to explain family expenses. Family income and family expenditure have a positive correlation, while family income and demand for fisheries commodities tend to be negatively correlated (Virgantari et al 2011). In the income elasticity, if the value is less than zero (negative), then the commodity is categorized as an inferior goods. Meanwhile, if the income elasticity is more than zero (positive), then the commodity is categorized as normal goods. The income elasticity value between 0 and 1 applies to types of basic need goods or essential goods (Dornbusch et al 2004). The value of expenditure elasticity can be found by regressing Ln demand (as the dependent variable) and Ln budget (as the independent variable), where the slope value is the expenditure elasticity value. The relationship between the factors related to the characteristics of demand is tested by correlation analysis. The preferences of the Semarang City people for shrimp were analyzed using quantitative descriptive methods. Demand modeling in the research used the model in Table 1.

Table 1

Demand model

Type of demand model	*Equations*
Linear	$D = a - b P$
Logarithm	$D = a - b \ln P$
Polynomial (Order of Two)	$D = a - b P + c P^2$

Note: D = demand; P = price. Notation of a, b and c are constants.

Correlation analysis was carried out between several variables, including household budget (IDR per month), budget for fresh shrimp (IDR per month), shrimp quantity buying (kg per month), age, number of family members and perceived reasonable price for fresh shrimp. The amount of the budget reflects income, which higher income push higher expenditure. The perception of reasonable price reflects the respondent's WTP. The correlation relationship between variables can be positive or negative. The strength of correlation refers to the following guidelines (Table 2).

Table 2

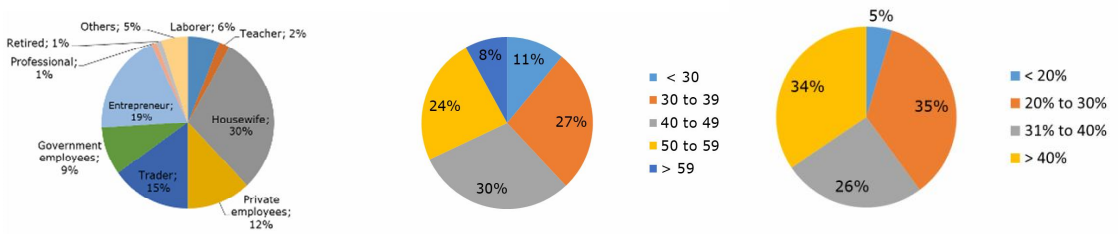
Correlation categories

Absolute value of correlation coefficient	*Notes*
≤ 0.35	Weak correlation
0.36 to 0.67	Moderate correlation
0.68 to 0.89	High correlation
≥ 0.90	Very high correlation

Source: Taylor (1990).

Results and Discussion. According to Henriksson et al (2017), the Republic of Indonesia is an archipelago state and part of its population consumes fish with high frequency, including Semarang City. The population of Semarang City tends to increase in time series. The total population of Semarang City in 2014 was 1,673 thousand and increased to 1,814 thousand in 2019 with 521,961 households (BPS-Statistics of Semarang Municipality 2018, 2020). Semarang City has a land subsidence problem that affects fishermen's livelihoods and fishery infrastructure (Husnayaen et al 2018). This shows the complexity of the problems in the coastal area of Semarang City. An increase in the population of Semarang City has the potential to increase demand for shrimp from residents of Semarang City because there is a positive correlation between population and demand for fishery commodities, including shrimp (Lomboy et al 2019).

Respondents. The composition of respondents in this study can be seen in Figure 2. The composition of respondents is relatively diverse in age, occupation and location of residence (16 sub-districts). The diversity of respondents can provide information about the characteristics of demand for fresh shrimp in the city of Semarang.



a. Based on occupation b. Based on age (year) c. Based on percentage of budget for food

Figure 2. The composition of respondents.

The percentage of the budget for food consumption can be an indicator of the respondent's economic welfare. Low-income people tend to have a higher percentage of their budget for food consumption as a basic need. This is in accordance with Engel's Law (Chai & Moneta 2010). Most of the respondents buy fresh shrimp at the traditional market near where they live (Figure 3). This shows that the role of traditional markets in the trade of fishery commodities in Semarang City is still very significant compared to modern markets. Relatively few respondents buy fresh shrimp directly from fishermen or fish auction place. Shrimp buyers at fish auction places are dominated by fish traders who sell fish and shrimp wholesale at fish market or sell them retail in traditional markets. Mobile fish sellers buy shrimp at fish auction place or fish market to be sold directly to consumers.

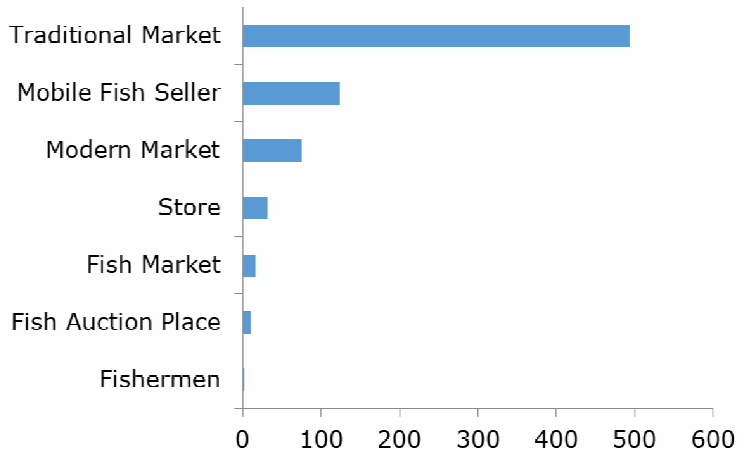


Figure 3. Location of purchase of shrimp by respondents.

The fondness of shrimp. The survey results showed that the people of Semarang City tend to like shrimp. The survey results showed that only 9% percent of respondents said they did not like shrimp (Figure 4). The main reason respondents do not like shrimp is because of allergies. Some respondent's dislike shrimp because of its high cholesterol content, high price, and fishy smell. Meanwhile, the main reason respondents like shrimp is because they like the taste of shrimp and appreciate the nutritional content of the shrimp. According to Merino et al (2012), fishery commodities are a major source of protein, essential amino acids and minerals, especially in low-income countries. Other considerations from respondents who like shrimp include easy cooking, easy access, affordable prices, shrimp texture, lots of meat and attractive shrimp color (Figure 5).

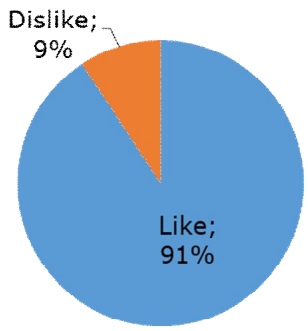
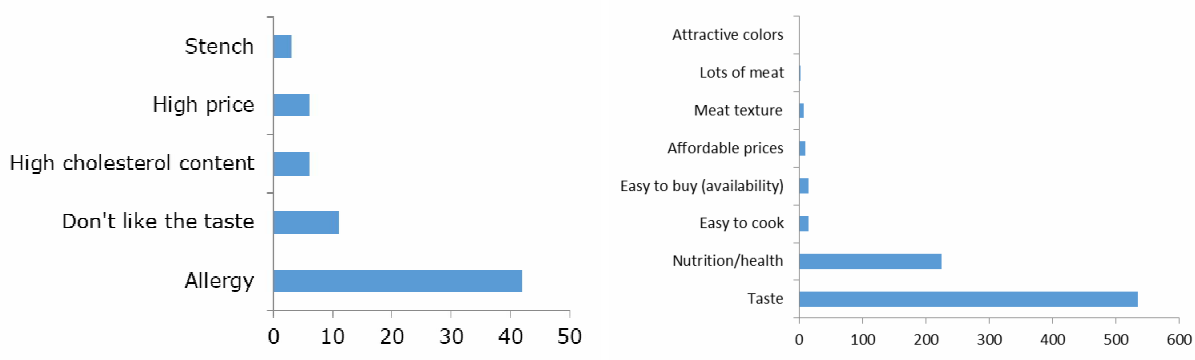


Figure 4. Percentage of respondents who like/dislike shrimp.



a. Reason for disliking b. Reason for liking

Figure 5. Reasons for respondents who like and dislike of shrimp.

According to Kamrath et al (2019), communication and promotion of healthy food choices is adjusted to the level of consumer involvement by considering the role of health motivation in consumer purchasing decisions. In this study, respondents who like shrimp assess that shrimp meat has a savory, sweet, distinctive taste, soft texture and crunchy texture when fried. Several respondents considered that the nutritional content of shrimp was very good for children's brain development. According to Hughner et al (2009), fishery products provide attractive nutrition for cognitive development and heart health. The survey results above indicate that the positioning of shrimp consumers towards shrimp is good taste and high nutrition. This can be optimized by fresh shrimp commodity stakeholders to maintain and increase the demand for fresh shrimp in Semarang City. The survey results showed that respondents processed fresh shrimp into various kinds of food according to their respective tastes, including: fried shrimp, sweet and sour shrimp, shrimp nuggets, oyster sauce shrimp, sauteed kale, gimbal shrimp, balado shrimp, Padang sauce shrimp, shrimp chili sauce, shrimp crackers, shrimp dumplings and shrimp bakwan. Several complaints from respondents related to shrimp supply that must be anticipated by business actors in shrimp production and trading include freshness and the price of shrimp, which is considered expensive. Regarding the highly perishable nature of shrimp, a cold chain handler is needed starting from post-harvest processing, distribution and storage in consumers' homes.

There are several factors that influence the choice of household food quality, such as food expenditure, age, gender and education level of the head of the household (Vassilopoulos et al 2012). According to Kamrath et al (2019), there are several factors that influence food purchasing decisions, namely utilitarian (including economic, rational and functional goals), signs (including social goals, self-concept, and impression management) and hedonic (including sensory pleasures and experience goals). Shrimp producers and traders need to pay attention to all the factors that influence consumers in buying shrimp.

Correlation test. The results of the correlation test between the variables studied can be seen in Table 3. The number of family members affects the quantity of shrimp purchased. Family spending has a positive correlation with the amount of shrimp spending (consistent with the results of the study by Can et al 2015), although the correlation value is relatively low. This is because many factors influence fresh shrimp trading. The price of shrimp, which is considered expensive, causes not all respondents to prioritize buying shrimp. The results of this study are consistent with the results of research by Vassilopoulos et al (2012). Although the respondents like shrimp, not all respondents prioritize shrimp for consumption because it is influenced by taste and the presence of substitute products, including chicken, beef and fish. In general, if income increases, the expenditure budget tends to increase and the shrimp expenditure budget also increases, so that the number of shrimp purchased also increases. The results of Rozalina & Bahagia's research (2017) also show that income has a positive effect on the demand for fishery commodities.

Table 3

Correlation test

Correlation test	*Correlation coefficient*	*Notes*
Household budget and shrimp purchased quantity	0.21	Positive and weak correlation
Household budget and shrimp budget	0.20	Positive and weak correlation
Shrimp budget and shrimp purchased quantity	0.83	Positive and high correlation
Member of family and shrimp purchased quantity	0.03	Positive and weak correlation
Shrimp purchased quantity and WTP of shrimp	0.39	Positive and moderate correlation
Age and shrimp purchased quantity	-0.02	Negative and weak correlation

There is a positive correlation between the amount of shrimp spending and the perception of shrimp reasonable prices. If the price of shrimp is considered reasonable, then consumers are willing to buy, and vice versa. There is a negative relationship between age and quantity of shrimp spending. In the old age group, shrimp is starting to be abandoned because it is considered to have a high cholesterol content. The results of this study are consistent with the results of research by Vassilopoulos et al (2012).

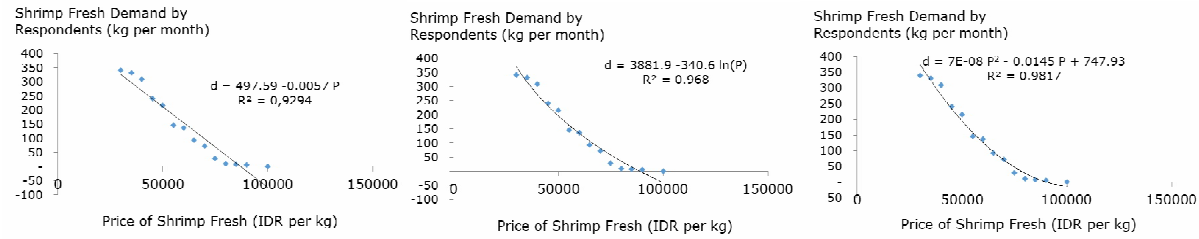
Demand estimation. The results of the analysis show that the demand for fresh shrimp in Semarang City is estimated to reach an average of 1.45 kg per month per family. The results of demand function for fresh shrimp can be seen in Table 4, Figure 6 and Figure 7. The relatively high R^2 value indicates that the demand model is relatively good for use in making projections of demand for fresh shrimp in Semarang City which is influenced by price factors.

Table 4

The estimation of fresh shrimp demand function in Semarang City

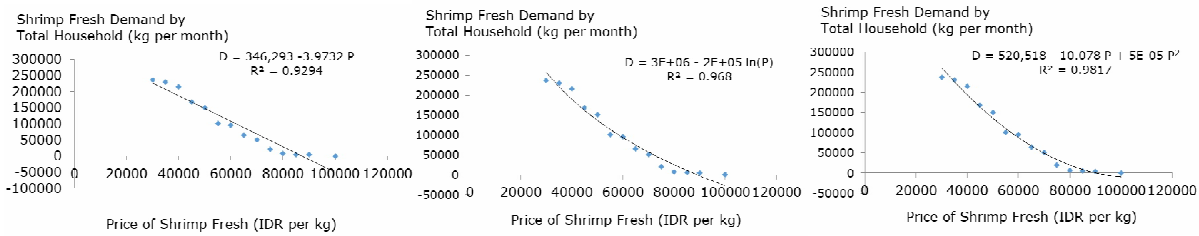
Type of demand model	*Respondent*	*Estimation in population of household*	*R^2*
Linear	$d = 497 - 0.006\ P$	$D = 346{,}293 - 3.97\ P$	92.9%
Logarithm	$d = 3882 - 340.6 \ln P$	$D = 3.10^6 - 2.10^5 \ln P$	96.8%
Polynomial	$d = 7.10^{-8} - 0.014\ P + 748\ P^2$	$D = 520{,}518 - 10.08\ P + 5.10^{-5}\ P^2$	98.2%

Notes: d = fresh shrimp demand of respondents; D = fresh shrimp demand of total household; P = price of fresh shrimp.



a. Linear model b. Logarithm model c. Polynomial model

Figure 6. The estimation of fresh shrimp demand in respondents.



a. Linear model b. Logarithm model c. Polynomial model

Figure 7. The estimation of fresh shrimp demand in total household.

The demand for fishery product (including shrimp) is influenced by human population, income and diet pattern of people (Tran et al 2019). According to Arthatiani et al (2018), household consumption patterns in Indonesia can reach 9.58 kg per capita per year for fresh shrimp. There is a relationship between the price and the quantity of fish availability, which the relationship is opposite (Hardle & Kirman 1995). According to Gobillon & Wolff (2020), fish prices may increase in the short run due to higher quality. In Indonesia, decisions on food served at home is mainly influenced by socioeconomic status and preference of family (Rachmi et al 2018).

Price elasticity and expenditure elasticity. The results of the analysis of price elasticity and expenditure elasticity for fresh shrimp in Semarang City can be seen in Table 5.

Table 5

Price elasticity and expenditure elasticity

Type of elasticity	*Values*	*Notes*
Price elasticity	-4.43	Elastic
Expenditure elasticity	0.18	Normal goods (especially basic need goods)

The results showed that shrimp was an elastic product, that is, if the price increased by 1%, then the demand for fresh shrimp could decrease by 4.43%. The existence of substituted products can affect the value of price elasticity, which the more substituted products push more elastic the product. Shrimp substitution products in Semarang City are relatively diverse. The types of non-shrimp fishery commodities in Indonesia are very diverse. According to Ferdian et al (2012), freshwater fish and sea water fish can substitute each other. In addition, the presence of beef, mutton, chicken, and chicken eggs can be substitute products for shrimp if the price of shrimp increases. The relatively high price of shrimp can also cause the shrimp commodity to become elastic. The results of this study are consistent with the results of research by Virgantari et al (2011).

According to Arthatiani et al (2018), fishery commodities are normal goods and the demand have negative relation to prices. The government could push the fishery product consumption level further through increasing fishery product availbility. Therefore, it is important to make policies that can increase fishery production and optimize effectiveness of fishery product distribution. The results of this study also indicate that shrimp is a normal goods, especially basic need goods, which if the budget

increases by 1% (which is influenced by income), the demand for shrimp can increase by 0.18%. The results of this study are consistent with the results of research by Virgantari et al (2011), which the elasticity of consumption fish group expenditure tends to be positive. Because shrimp and fish are basic needs, therefore the phenomenon of decreasing fish resource population due to overfishing needs to be anticipated by stakeholders. According to Lomboy et al (2019), the decline in fish populations in several waters not only threatens fishermen' income, but also threatens food security. Then, fish and shrimp scarcity can affect commodity prices and consumer purchasing power.

According to Colozza & Avendano (2019), there are several changes in food demand that are in line with nutrition transition preferences. This condition also needs to be anticipated by shrimp suppliers in Semarang City. According to Brécard et al (2009), there is increasing public awareness in the world about environmentally friendly labeling on fishery products. Ecological problems regarding fisheries are closely related to consumer information, intrinsic motivation and socioeconomic status. Marine resources are essential for the survival of coastal indigenous peoples, and their needs must be explicitly included in management policies (Cisneros-Montemayor et al 2016). According to Merino et al (2012), marine ecosystems may be able to supply the current capita consumption rates to 2050. Therefore, it is important to implement fisheries management and technology adaptation related to fishery resources.

Conclusions. The demand for fresh shrimp in the Semarang City can be estimated with the linear model, logarithmic model and polynomial model. The results showed that the people of Semarang City relatively liked shrimp with the main consideration of liking the taste of shrimp and the nutritional content of the shrimp. The results of analysis in price elasticity and income (expenditure) elasticity indicate that fresh shrimp is elastic and is classified as normal goods (especially basic need goods).

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