Multivariate Analysis of Brazilian Agricultural Production

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Abstract

Agribusiness is one of the most important sectors for Brazil, expressing positive values in the trade balance, with a share of 23% of GDP, besides the great generation of employment along its chain. In this way, Brazil stands out due to the expressive volume of agricultural production, making it one of the largest exporters of food in the world. In this way, it sought to apply the multivariate analysis through multidimensional scaling between the area, production and gross value of agricultural products, in order to observe the similarities and dissimilarities between them, which resulted in three discrepant products, which are of great importance to the Brazilian economy, being soy, sugar cane and corn, besides the formation of two distinct groups of products with similar characteristics.

Keywords: Agribusiness, economics, multidimensional scheduling.

1. Introduction

In recent years, agribusiness has been contributing positively to the Brazilian economy. It accounts for 23% of GDP and is responsible for 46% of the exported products, besides offering 25% of the jobs in the country (MAPA, 2016).

Agribusiness GDP (inputs, primary production, agribusiness and services) grew in the last year, 2016, both in the agricultural and livestock sectors in which it registered a rise of 4.48%, resulting in the balance of the trade balance to be positive, differing from other sectors of the economy, which had accumulated negative indexes in the last 8 years (CEPEA, 2016; MAPA, 2016).

Among the main commodities of the sector that obtained growth in exports we can highlight two products derived from the sugar cane crop; refined sugar, with an increase of 52.7% (US $ 20 million) and raw sugar with 44.6% (US $ 863 million) (MAPA, 2017).

Regarding the product most exported by Brazil, we have soybeans in which, in addition to bran and oil, they are responsible for more than US $ 25 billion in exported value (EMBRAPA, 2017).

Soy and maize are components of the raw material for the manufacture of feed, the latter being responsible for more than 67.2 million tons produced in 2016, occupying the fifth place in exported volume (COLUSSI, 2016; SINDIRAÇÕES, 2017). The corn crop stood out in the harvest of 2014/2015, with a total production of 84 million tons, being the third in the world, in addition to exporting more than 22 million tons, reaching second place in the world ranking (DILLY et al., 2017).

Sugarcane is one of the most important crops for the Brazilian economy, although it is not for export trade. In this way, the country is the largest producer of culture in the world, driven by the production of ethanol, in which it supplies the domestic market for biofuels, in addition to the production of sugar, in which Brazil is responsible for more than half the world market (LIMA; CASTRO, 2016).

We also have other products that stand out in their production, such as coffee and beans. Coffee is a product that has its production with an international bias and historically linked to the Brazilian economy, however, was losing ground in the agricultural economy over the years due to the relative decline of its importance in revenues (BLISKA et al., 2009). Regarding the bean culture, which is considered a typical Brazilian food, its plantation is totally focused on the national supply, with the surplus not being significant to the final export values (ASSUNÇÃO; WANDER, 2015).

On the other hand, family farming is responsible for the production of agricultural products that have specific characteristics and regional characteristics. These cultures represent the diversity of products and are mainly associated with the national supply. Despite its economic importance for Brazil, it stands out for the variety of foods in its production (MALUF, 2004).

In this way, analyzed the system of agricultural production, destined for export and also the internal supply of the country. With the possession of area data for product planting, the quantities (tons) produced and the gross value of all products planted on national land, was performed, by the method of multidimensional scaling modeled by Euclidean distances, the relation of similarities and dissimilarities between them, trying to understand if these distances between the products in this model, have direct relation with the export of agricultural products and, with the local / regional supply of Brazil. With the data of the main exported products it was possible to consider that there is a relation between the groups constructed by the multidimensional scaling and the export data.

2. Materials and Method

In order to fulfill the objectives of the article, we developed a work of applied nature with quantitative approach, in which multidimensional scaling was used to analyze the factors planted area, production and production value for 59 Brazilian agricultural products in 2014, with data obtained from FAOSTAT.

The data were analyzed analogously to the methodology used by Góes et al. (2015), which consisted in the use of multivariate statistics using Minitab software, and for this work the use of XLSTAT software. The multidimensional scaling was performed to find, by measures of distances, the structure of the set of observations. The data are positioned to two or three dimensions, generally, so that their distances agree with the differences. In this work, we used the Euclidean distance model based on Kruskal's accepted values of stress (1) (GIL, 2002; HAIR et al., 2009).

Stress values are used to indicate the quality of the model and the adjustment data. Kruskal's Stress formula (1) was used, values smaller than 0.05 would be considered acceptable in this study. By recommendation of the Kruskal model, Stress of 20% or more are considered poor models; 10% considered reasonable; 5% are good models; and excellent 2.5% (HAIR et al., 2009; MARQUES, 2016).

The result in the analysis of multidimensional scaling, agricultural products were adopted as the variables interconnected by factors: planting area, production and gross value of production.

3. Results and Discussion

As in the work of Góes et al. (2015), after the multivariate analysis, it was possible to verify the relationship

between the factors studied, in this case: planting area, production and gross value of the production of Brazilian agricultural products, observ a similarity between them, in which it originated in the formation of two groups: one with 46 elements and the other with 10 elements, in addition to three other products with great disparity in relation to the others.

The multidimensional scaling, the Euclidean distances model, was performed with the purpose of analyzing the relations of the products by their distances in the two-dimensional model. To validate the technique, according to the recommendations of Cooper and Schindler (2011), two criteria should be accepted: Kruskal's stress index (1) and / or the coefficient of determination (R^2).

Thus, by realizing application with the data in the XLSTAT software, the model presented a Kruskal (1) stress index of 0.002, but the software did not calculate the R^2 value. Due to the low level of stress, the technique used presents high reliability as the results show (Figure 1).

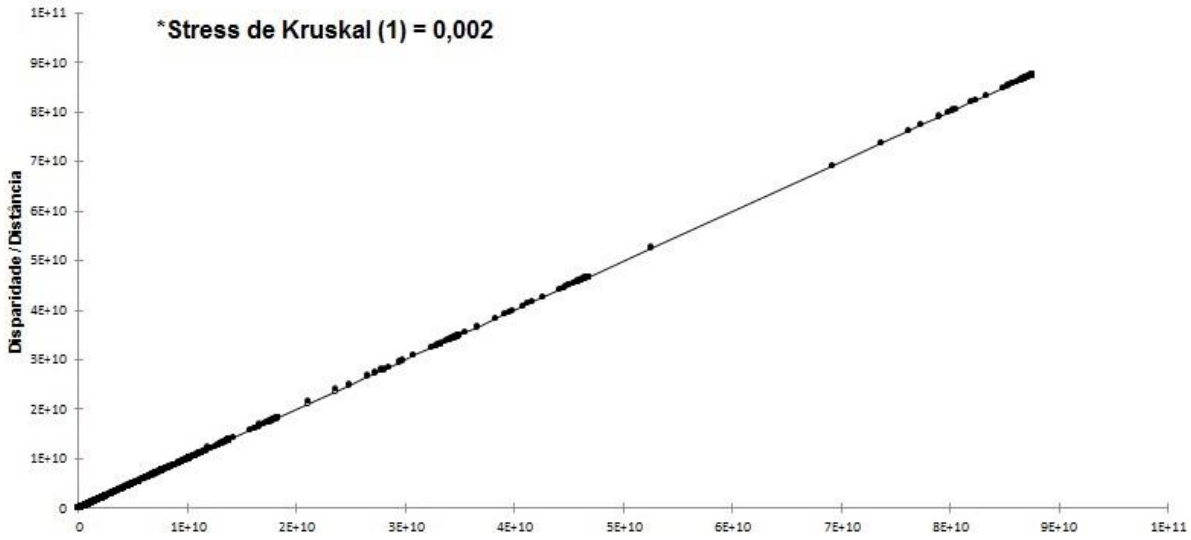

Figure 1. Shepard Diagram - Kruskal stress

Source: Prepared by the authors.

After analyzing the two-dimensional graph (Figure 2), it is possible to observe the disparity of the points, 49, 50 and 23, respectively represented by the soybean, sugarcane and corn crops, and that can be classified as products of great economic importance for Brazil, differing from the others. It also found the formation of two groups of agricultural products with characteristics of similarities between them, one with 10 elements and the other with the remaining Brazilian agricultural products, 46 in total.

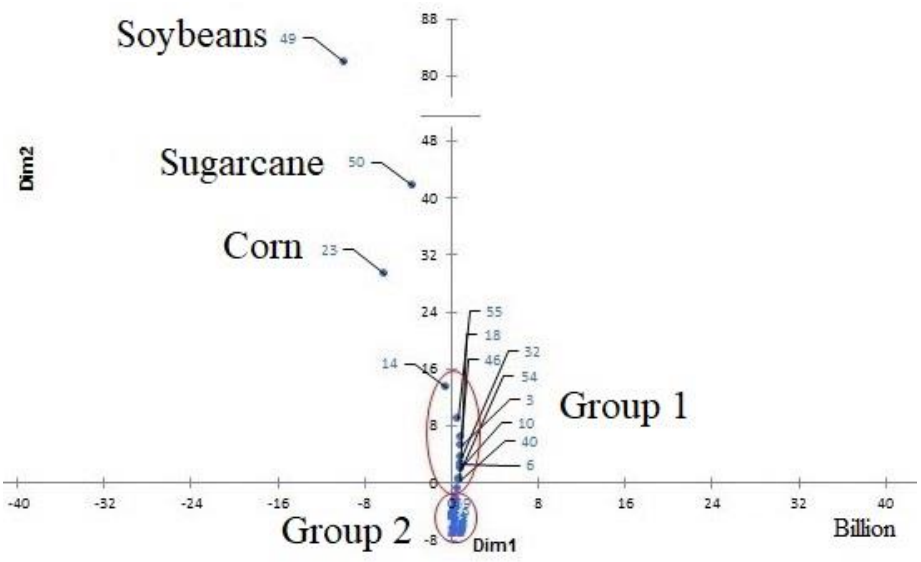

Figure 2. Two-dimensional analysis of Brazilian agricultural products.
Source: Prepared by the authors.

After determining the average of the factors of each element formed in the analysis, the superiority of the agricultural products, soybean, sugarcane and corn, in relation to the groups formed, as shown in Table 1, can be observed in numbers.

Table 1. Comparison of the mean of the groups with the discrepant products and export volume.

Products	Area (ha)	Production (tons)	Valor Bruto (10^6US$)	Exportação (ton.)
Milho	15.432.909	79.881.614	39.948.206.125	26.624.890
Soja	30.273.763	86.760.520	87.483.524.333	42.796.106
Cana-de-açúcar	10.419.67	736.108.487	46.757.611.094	0
Grupo 1 (10)	579.545	3.963.300	8.058.015.269	2.506.586
Grupo 2 (46)	38.373	201.749	253.901.013	2.790.416

Source: Prepared by the authors with database (FAO, 2017).

As observed in Table 1, soybean is the product with the highest export volume with 57.28%, followed by maize, together accounting for more than 92% of the volume exported, surpassing the US $ 29 billion. On the other hand, sugarcane, although not a crop destined for export, is surprised by the volume produced with more than 736 million tons.

Thus, a possible similarity factor among agricultural products belonging to group 1 (10 elements), is the production focused on foreign trade, since it has a larger area of planting for its crops besides representing 3.35% of agricultural exports, while the other products (group 2), for a total of 46, correspond to the percentage of 3.73 of the production destined for foreign trade, since it has a smaller production area.

5. Conclusion

The existence of three agricultural products in Brazil with great prominence in relation to the planted area, quantity produced and gross value of the production, are: soybean, sugarcane and corn, possessing expressive values of the factors studied the relation to agricultural products remaining.

Soybeans and corn, offer great production, besides being the two largest products of the country destined to the foreign market. On the other hand, sugarcane, although not a product aimed at foreign trade at its origin, the demand for production area is due to the use of biofuels with the adoption of flex fuel cars in 2008, being the Brazil is the largest producer of crops in the world and the second in the production of ethanol, in addition to the production of sugar abroad.

The data show us the formation of two groups of agricultural products with characteristics of similarity, a group with 10 products, in which they stand out by the volume of production destined for export, while the other with 46 included products is made to supply the domestic market. It is interesting the grouping originated by multidimensional scheduling, since we can observe the similarities between the products, and the discrepant points, standing out from the others.

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