Information management for the projection of productive capacities articulated to export scenarios

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ABSTRACT

This article proposes the management of information through the study and analysis of Colombian export scenarios that serve as a reference to articulate strategic nodes, for which an epistemological approach is proposed from a perspective of triangulation of techniques that allows a comprehensive approach in relation to the study of the external market of Colombia. This process is achieved through a comparative and complementary analysis of three techniques: Markov chains, forecasting techniques and mathematical functions. The behavior of sales is transformed into estimates of future behavior that establish a guiding mapping of the production levels that make

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the supply chain more dynamic. It is recommended to use time series techniques for short- and medium-term forecasts, while Markov chains for prediction and analysis of the sales structure in medium- to long-term forecasts, supported by median predictions through the use of mathematical functions.

Keywords: Information Management, Productive Capacities, Projection, Markov Chains, Time series.

INTRODUCTION

Due to the fact that many of the strategic nodes lack information about the export scenarios, the export of Colombian coffee is taken as a reference as a representative product. According to (Dane, 2022), coffee represents in the year 2020, one of the first level export products, reaching 15.5% of the network of products with international output at the primary level of exploitation. This study has important inquiries about prediction methods to estimate the demand for green coffee, which allows to streamline the supply chain in relation to the internal and external market of Colombia.

In percentage, figures from the World Bank (2021) indicate that 7.7% of GDP (gross domestic product) is related to agriculture, forestry and fishing in Colombia, which establishes a representative figure in relation to the economic support of the country. In the aforementioned figure, green coffee is cataloged as one of the most important export products, which from another measurement has a representativeness of 16% of agricultural GDP (Anguera, 2018).

Thus, an important point in information management is the adequate study and analysis of the demand for its products and/or services, to link them to its productive capacities. Therefore, the study carried out incorporates the analysis of the demand for green coffee through three perspectives: Markov chains, forecasting techniques in time series and analysis through mathematical functions, based on the exports of green coffee from the year 2016 to the year 2019.

DEVELOPMENT

Methods

This study has a high level of methodology significance to establish epistemological routes for the development of studies that combine productive capacities to export scenarios under the management of information. For this, the multi-method or multi-technique approach suggested by (Agrawal et al., 2019) is taken. Figure 1 reveals the methodology that the researchers used to approach the study and analysis of coffee exports using the combination and complementation of multi-methods: Markov method, projection methods and methods based on equations.

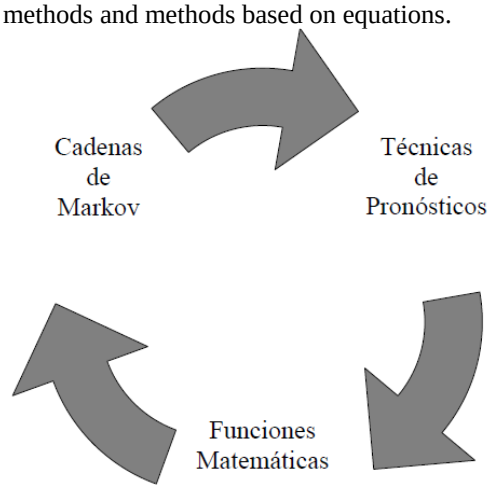

Figure 1. Combination and complement of multi-methods

The afore mentioned methods are applied in the unit of analysis corresponding to the thousands of bags of coffee 60 kilograms per month (2016 to 2019), data analyzed in the sampling plan. These data are shown in figure 2.

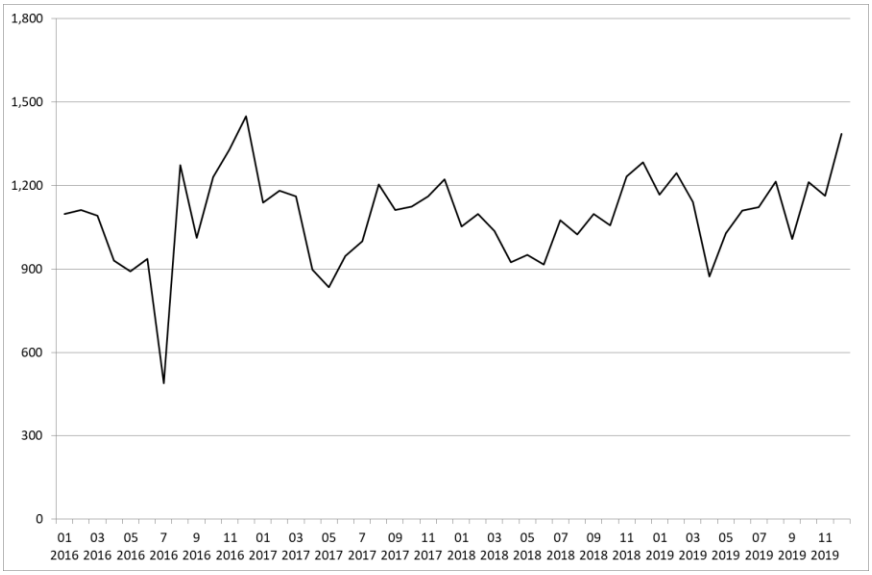

Figure 2. Coffee Export (Miles of 60 kg bags / month).
Source: FNC National Federation of Coffee Growers of Colombia (2021)

Results and discussion

The definition of states through descriptive statistics is developed through the transition diagram shown in figure 3. For this process, the procedure proposed by (Arumugam and Rajathi, 2020) (Li, 2008) (Gorener and Toker, 2013), (Schroeder et al, 2011) is taken.

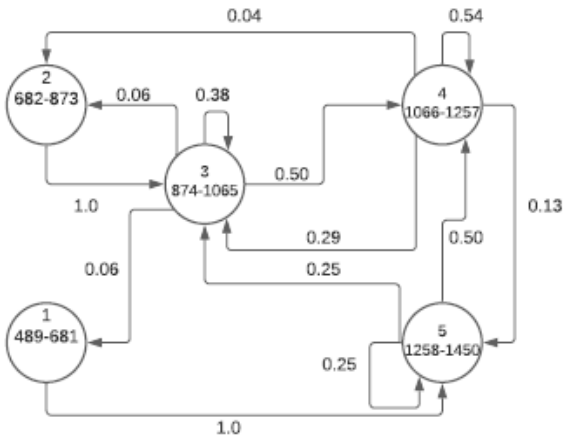

Figure 3. Transition diagram

When creating a system of stable states proposed by (Arumugam and Rajathi, 2020)

(Li, 2008) (Gorener and Toker, 2013),(Schroeder et al, 2011) and using the definitions of irreducible matrices creating a system of equations formulated under linear programming, the steady state probabilities are obtained. The result of the steady-state probabilities is summarized in figure 4, лi, for each state i = 1,2,3 or 4, associated with the states defined in figure 2, with class marks.

	пs1	пs2	пs3	пs4	пs5	Σ	Expected Value
Probability	0.021	0.042	0.339	0.489	0.110	1.000	1090
Thousand 60kg bags	585.3	777.5	969.6	1161.7	1353.9		

Figure 4. Probabilities for stable states

Projection methods

Krajewski et al (2010), Jacobs and Chase, 2009) and Schober et al. (2018) indicate methodological procedures for the analysis of forecasting techniques in demand patterns. The precision assessment of each of the selected projection methods is performed: simple exponential smoothing, moving average and weighted moving average, for which the calculation of the mean absolute deviation (MAD) and the mean absolute percentage error (MAPE). When using QM for Windows software, the following results are obtained by projection method. See Figures 5,6,7 and 8.

Measure Error Measures	Native Value
Bias	1.213
MAD	98.787
MSE	22399
MAPE	9.77%
Forecast next period	1130

Figure 5. Result Method (Native)

Measure Error Measures	n=2 Value
Bias	1.457
MAD	84.717
MSE	15050.3
MAPE	8.50%
Forecast next period	1082.5

Measure Error Measures	n=3 Value
Bias	1.637
MAD	90.778
MSE	15768.8
MAPE	9.10%
Forecast next period	1102

Figure 6. Result Moving Average Method (MA)

Measure Error Measures	w1=0.432 w2=0.568
Bias	1.4
MAD	83.955
MSE	14864
MAPE	8.43%
Forecast next period	1076

Measure Error Measures	w1=0.432 w2=0.568 w3=0
Bias	1.153
MAD	85.542
MSE	15190.3
MAPE	8.59%
Forecast next period	1076.04

Measure Error Measures	w1=0.416 w2=0.409 w3=0 w4=0.175
Bias	0.015
MAD	84.46
MSE	14844.47
MAPE	8.51%
Forecast next period	1075.045

Figure 7-8. Result Weighted Moving Average Method (WMA)

Equation-based methods

The following equation-based methods are used in equations used linear, exponential, polynomial (of order two and three), logarithmic and potential function. The results are shown in Figure 9. For the analysis of mathematical functions, the use and interpretation of the correlation and determination indices are key files 12. (Lind et al, 2019).

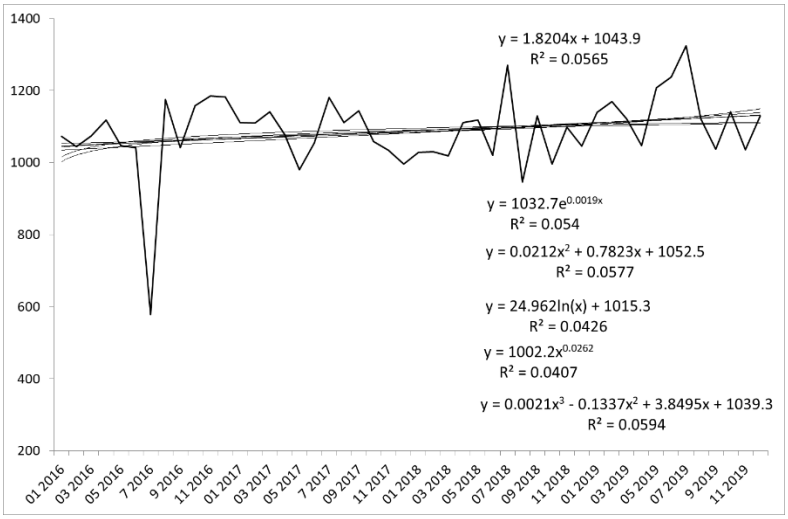

Figure 9. Result Method based on equations

Final considerations

For the Markov method, the representativeness of the stable state results for manufacturing scenarios that animate the supply chain can be summarized in a percentage and cumulative percentage representation according to figure 10.

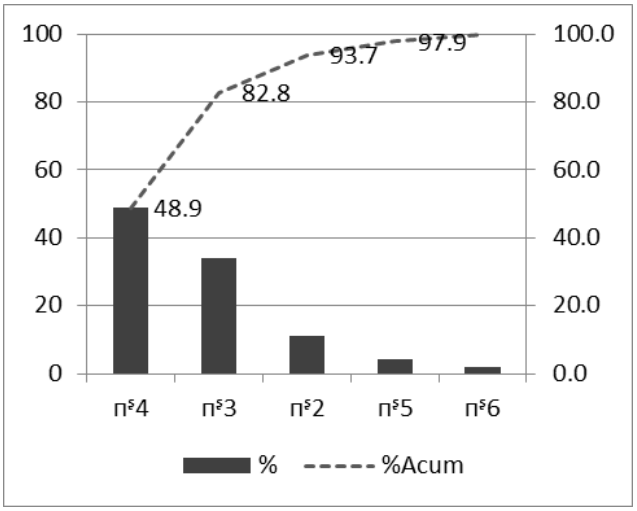

Figure 10. Representativeness of results of the Markov method

Regarding the projection methods, the smallest error was located in the exponential smoothing and in relation to the methods based on equations when making the equivalence to MAD and MAPE values, the suggested methods are linear and polynomial, but with higher error levels. to exponential smoothing.

Finally, the projection methods are proposed in short and medium-range predictions, the Markov method for predictions and inquiries of the structure in exports, supported by methods of use based on equations to medium-range scenarios.

CONCLUSIONS

Due to the lack of information on export scenarios of Colombian strategic nodes, this study has a high level of methodological significance to establish epistemological routes for the development of studies that combine productive capacities to export scenarios under information management.

Markov chains allow you to double expected levels of demand and make proposals at levels that can energize the supply chain. In this sense, the states or levels of export demand with the highest probability of occurrence are those related to the four states and three, which represents a net accumulated of 82.8% of the export market behavior in which production can be boosted. at average production levels. 1,135 thousand bags of 60 kilograms per month.

Forecasting techniques and mathematical functions are capable of defining prediction scenarios with acceptable levels of error (less than 10% in MAPE). In a comparative way, the simple exponential smoothing forecasting technique is the one that quantified the smallest distances between the forecast value and the actual demand

with $\alpha = 0$, for a MAPE of 7.48% and a MAD of 74.383.

From the perspective of medium-term analysis, the use of mathematical functions is recommended as they move directly to movement in time, which in forecasting techniques is only possible to the extent that we obtain new real data. Therefore, when considering the levels of precision obtained, the mathematical function with the highest precision in the medium term is the linear one and the polynomials of degree two and three.

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