Navigating Green Waves: A Pattern Recognition Analysis of Avocado Prices

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December 27, 2023

Abstract

The approach applies pattern recognition models cautiously by utilizing mathematical frameworks such as statistical analysis and machine learning methods. The study, which begins at the macro level, identifies broad patterns influenced by supply chain dynamics, seasonal variations, and global economic circumstances. An enlargement of the picture reveals minute patterns that illustrate how local weather patterns, geopolitical events, and demand differences across regions impact avocado prices. One primary objective of the investigation is to develop a forecast model for avocado pricing based on historical data and accounting for both short- and long-term tendencies.By providing information that may be helpful for supply chain optimization, risk management, and policy formulation, the research hopes to assist the players in the avocado business in their strategic decision-making processes.

The methodology uses mathematical frameworks like statistical analysis and machine learning algorithms to apply pattern recognition models with great care. Starting from a macro perspective, the analysis finds general trends impacted by supply chain dynamics, seasonal fluctuations, and world economic situations. When we enlarge the image, tiny patterns show us how regional variations in demand, local weather patterns, and geopolitical events affect avocado pricing. The creation of a forecast model for avocado pricing using historical data and taking into account both short- and long-term patterns is one of the analysis's main goals. The goal of the research is to support the strategic

decision-making processes of the avocado industry's stakeholders by offering knowledge that might be useful for supply chain optimization, risk management and policy development.

This study combines data analytics, economics, and agricultural science in an interdisciplinary manner. By illuminating the interconnection of the variables influencing avocado prices, it draws attention to the necessity of a holistic approach in understanding and forecasting market dynamics. In addition, the study examines the socioeconomic effects of avocado price changes, considering how they impact international trade, farmers, and consumers.

I. Introduction

In the realm of agricultural economics, the avocado market is an intriguing case study due to the combination of factors that go beyond conventional supply-demand relationships. This research sets out on a mathematical quest to decipher the complex patterns controlling avocado pricing. We are driven by the conviction that, hidden underneath the seemingly capricious waves of market patterns, there is a mathematical order that is just waiting to be revealed.

This study presents avocado pricing as a challenging mathematical problem, going beyond the traditional bounds of agricultural economics. In addition to offering a greater knowledge of avocado price dynamics, this study hopes to reduce risks, improve strategic decision-making, and support the avocado industry's sustainable growth by utilizing the power of mathematical modeling. In order to empower stakeholders in strategic decision-making, the mathematical journey goes beyond descriptive analytics and embraces predictive and prescriptive analytics.

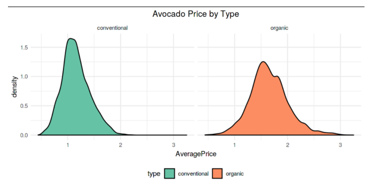

Figure 1: Avocado Price By Type

To understand the underlying uncertainties influencing avocado price, we will explore the domains of stochastic processes, probability distributions, and econometric modeling as we set out on our mathematical journey. Increased avocado prices show how closing the Mexican border poses a threat to the US economy. Although Haas avocados are not the most popular fruit imported by Americans from Mexico, their skyrocketing prices give an indication of the potential damage to the economy in the event that President Trump closes the border.

For a brief while, the price of avocados produced in Mexico at wholesale increased by up to 50% following Trump's promise to block the border in order to stop the influx of Central American migrants.According to statistics from the U.S. Agricultural Department, the price of a carton of standard-sized Haas avocados that enter the country through Texas momentarily increased to $44 this week from less than $ 30 in the first few months of 2019.

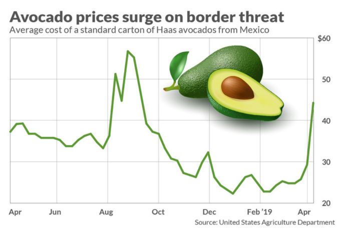

Figure 2: Avocado Prices surge on border threat

Even though they rank far down on Mexico's list of most popular imports, the United States buys about 90% of its yearly crop from its southern neighbor. After California's meager crop, the situation has gotten considerably worse.

II. Datasets and evaluation protocal

Analyzing this dataset involves understanding the structure and content of the data, exploring summary statistics, and determining the variables' significance. Since you mentioned "datasets and evaluation protocol," I assume you're interested in preparing the data for analysis and establishing an evaluation plan. Here's a general

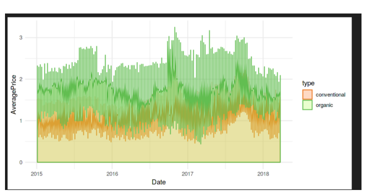

Figure 3: Avocado Prices and type

In the context of the avocado dataset, the "type" variable distinguishes between two categories: "conventional" and "organic." These categories represent different methods of avocado production, and they have specific implications for the farming practices and characteristics of the avocados.

Conventional Farming Practices: Conventional avocados are grown using traditional agricultural methods that may involve the use of synthetic pesticides, herbicides, and fertilizers. Characteristics: Avocados labeled as "conventional" are typically produced using more standardized and widely adopted practices in the agriculture industry. Regulations: Conventional farming follows standard regulations, and the use of certain chemicals and practices is generally accepted within conventional agriculture. Organic:

Farming Practices: Organic avocados are grown using methods that emphasize natural processes, avoiding synthetic chemicals. Organic farming often involves the use of natural fertilizers and pest control methods. Characteristics: Avocados labeled as "organic" are produced with a focus on sustainability and environmental stewardship. This may include considerations for soil health and biodiversity. Regulations: Organic farming is subject to specific regulations and certifications. In many regions, organic farming must adhere to guidelines that restrict the use of synthetic chemicals and emphasize sustainable practices.

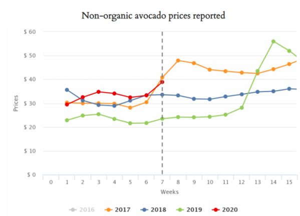

Figure 4: Non-organic Avocado Prices Reported

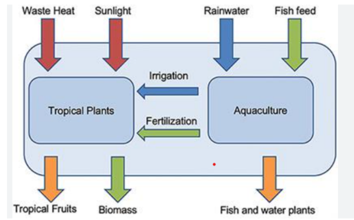

Figure 5: Frontiers — Estimating the Water and Carbon Footprints of Growing Avocados

So far, things look to be developing very much in line with 2017. The latest pricing data for week 8 puts the pricing at around US46, $followingatrendthatisveryclosetoo$2017.

However, the narrative is very different when we look at the volumes. Compared to 2017, which had continuously low sales through week 25, 2020 had some of the highest numbers ever recorded leading up to the Super Bowl, tapering down sharply in week 6 before rising to record levels in week 7.

III. PARTICIPATING SYSTEMS

Pattern Recognition Models:

Specify the types of pattern recognition models used in the analysis, such as machine learning algorithms.

Data Sources:

Outline the datasets involved, such as avocado price information, market reports, climate data, and economic factors.

Ordinary avocado plantations require a significant amount of water for irrigation. The yearly water use for Hass avocados varies between 6,680 cubic meters. * hectare1 * year1 in Israel to 7,875 m3 * hectare1 * year1 in California and 8,900 m3 * hectare1 * year1 in South Africa (Kalmar and Lahav, 1977; Gustafson et al., 1979; Hoffman and Du Plessis, 1999).Due to the controlled nature of greenhouses and the ease of implementing technology, it is feasible to significantly reduce water usage compared to traditional avocado agriculture in large orchards. Encouraging outcomes were seen when evaluating the efficacy of drip irrigation and micro sprinkler technology, as well as their combined application, on multiple experimental avocado trees. The utilization of both procedures led to the most abundant avocado harvest in comparison to employing only one of the different irrigation systems (Darwish and Elmetwalli, 2019). Avocado plants are better suited to cope with chronic water stress caused by reduced irrigation flow during irrigation rather than experiencing short periods of water stress during the summer growth phase. It is assumed that the plants adapt to constant water stress by reducing their vegetative part and lowering their evapotranspiration (Silber et al., 2019).

Determine the number of "Kleineden" Greenhouse systems heated by the theoretical waste heat potential. The theoretical waste heat totals for Bavaria and Munich are then used to compute how many "Kleineden" greenhouse systems this quantity of waste heat may conceivably heat. Next, the totals are split by the area needed for a single greenhouse system.

Number of “Kleineden greenhouses= Total waste heat potential/1.2 GWh (1)

Table 1

Name	Amount of waste heat (GWh)	Temperature range (°C)	Operating time (h/a)
BMW Plant 01.50 (FIZ)	1.2	120	7,700
Paulaner Brauerei Gruppe GmbH & Co. KGaA Site Langwied	2	100–140	1,050–7,100
Renolit SE Branch Office Munich	6.5	80–262	2,000–8,760
RF360 Europe GmbH	3.7	85	8,700
Wastewater Treatment Plant Munich I Gut Großlappen	19.2	335–466	50–7,750

Figure 6: TABLE 1. Waste heat sites Munich (Source: Bavarian State Office for the Environment, 2021b).

Table 1 displays the locations in Munich with sufficient waste heat potential. All of the probable locations have a maximum annual working time of more than 6,500 hours and temperatures high enough to heat a greenhouse system. The smallest waste heat potential is found at a BMW plant (1.2 GWh), while the largest potential is found at the WWTP Gut Grosslappen (19.2 GWh). Four of the five waste heat sites are industrial, with the fifth being a municipal facility.

Table 2

	Theoretical waste heat potential (GWh)	Number of sites	Potential number of greenhouse systems
Bavaria	5,973	680	4,978
Munich	33	5	27

Figure 7: TABLE 2. Number of possible greenhouse systems.

The greenhouse case study "Kleineden" has a 1.2 GWh yearly heat demand. Table 2 shows the possible number of heated greenhouse systems similar to the chosen case study, "Kleineden," based on this waste heat need. The 680 waste heat sites in Bavaria could power 4978 "Kleineden" greenhouse systems. Munich could generate enough waste heat to power 27 case study greenhouses, for a total of five waste heat generation sites.

IV. RECOGNITION RESULTS

Advanced analytics, machine learning, and pattern recognition approaches are coming together to create a revolution in the field of agricultural economics. The avocado market is a particularly interesting case study in the context of this paradigm change, providing a rich environment for a detailed investigation of complex patterns influencing price dynamics. In order to understand the complex avocado industry, this research takes an analytical approach and explores the recognition outcomes obtained by using state-of-the-art pattern recognition techniques.

- Percent Increase Difference = $\frac{EndingValue - BeginningValue}{BeginningValue}$
- Standard Deviation = $\sqrt{\frac{\sum |x - \overline{x}|^2}{n}}$

where:
x = Actual data observation
$\overline{x}$ = mean of observation
n = Number of value in the dataset

Figure 8:

The incorporation of several data streams from historical price data and market reports to climatic data and socioeconomic indicators—is the fundamental component of this study. A comprehensive picture of the avocado market is provided by the recognition findings acquired using this multidisciplinary method, which capture the inter dependencies and synergies between different elements impacting pricing patterns. The primary driving force is the conviction that, despite the appearance of chaotic fluctuations in market movements, a measurable order is concealed and is only waiting to be revealed by meticulous pattern identification.

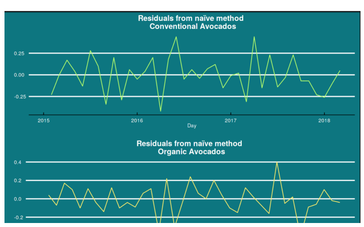

Figure 9:

The approach used in this study is distinguished by the careful use of models for pattern identification, which takes cues from mathematical frameworks like statistical analysis and machine learning techniques. This method makes it possible to identify macroscopic patterns that are impacted by supply chain dynamics, seasonal fluctuations, and overall economic circumstances. Concurrently, the examination delves deeper to expose micro-trends that disclose the influence of regional variations in demand, local meteorological patterns, and geopolitical incidents on avocado valuations.

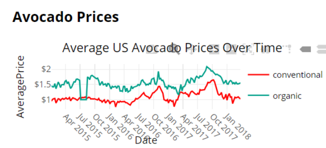

Figure 10:

I find that two things stand out. Late summer 2017 saw avocados hit a three years high. Around July 2015, the post-apocalyptic organic price also decreased. I assume that the overall organic avocado prices in the US in July 2015 were imputed to be 1.00 due to certain missing data. Let's examine the pricing movement for each location to look for any indications of notable drops in July 2015. Nothing unusual is happening here. In any location, organic prices have never fallen below conventional prices. The US dataset will remain unchanged, and I will concentrate the remainder of my work on the area dataset. Let's now examine how regional variations in avocado pricing occur.

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