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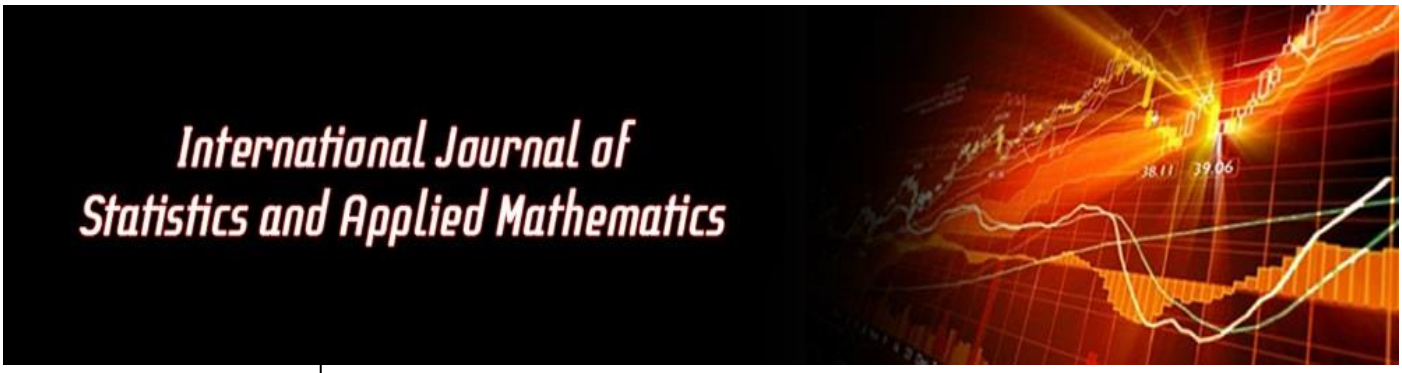

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Time-series analysis of seasonality in arrivals and prices of tender coconut in Maddur market of Karnataka

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Abstract
India ranks first in the production and productivity of coconut and ranks third in the area under coconut. Karnataka stands third in production of coconuts and Maddur is one of the world's largest tender coconut hubs. In the present study, an analysis of seasonality in market arrivals and prices was carried out by finding seasonal indices using the Ratio-to-Moving Average method for the monthly arrivals and price data of tender coconut in the Maddur market during the period from April 1997 to March 2018. The results of seasonal indices indicated the existence of strong seasonality and a high level of inconsistency in the arrivals of tender coconut in the Maddur market. The result shows that arrivals of tender coconut to the market were higher during March and April as the demand for tender coconut would be naturally higher during the summer season, with lowest arrivals during July, as the demand for the tender coconut declines due to rainy seasons. A Seasonal index for prices of tender coconut reveals that very little fluctuation in prices of tender coconut across the months, more uniformity and less fluctuation in prices indicated prices of tender coconut are insensitive to arrivals.

Keywords: Tender coconut, seasonality, time-series analysis, moving average, centred moving- average, arrivals and prices, Maddur APMC, Karnataka

1. Introduction
The coconut palm tree (*Cocos nucifera* Linn.) is one of the most natural and valuable gifts to mankind. Considering the versatile nature of the crop and the multifarious uses of its products, the coconut palm is eulogised as Kalpavruksha (the Tree of Heaven). Coconut fruit is considered as Lakshmi Phal, (The Fruit of wealth). Coconut is a source of food, beverage, medicine, natural fibre, fuel, wood and raw materials for units producing a variety of goods. India being the largest coconut producing country in the world occupies 31 per cent of global production. Coconut palm provides food security and livelihood opportunities to more than 12 million people in India. More than 15,000 coir-based industries employ nearly 6 lakh workers of which 80 per cent are women. The crop contributes around Rs. 2,50,000 million to the country's GDP and earns export revenue of around Rs.43,654 million (Anonymous, 2016) [1]. Coconut is grown in more than 93 countries in the world in an area of 12.19 million ha with an annual production of 69836.36 million tonnes of nuts. India ranks first in production (21,665 million nuts) and productivity (10,119 nuts/ha.) of coconut and ranks third in the area (2,141 thousand ha.) under coconut. Indonesia stands first in area (3610 thousand ha.) under coconut, ranks second in production (16354 million nuts) and productivity (4530 nuts/ha.) and the Philippines ranks second in the area (3502 thousand ha.) under coconut, ranks third in production (14696 million nuts) and productivity (4196 nuts/ha.). The largest share of coconut production in 2014 was recorded in India (31.02%) followed by Indonesia (23.42%) and Philippines (21.04%) and other countries 24.52 per cent (Anonymous, 2014) [2].
Traditional areas of coconut cultivation in India are the states of Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Goa, Orissa, West Bengal, Puducherry, Maharashtra and the Island territories of Lakshadweep and Andaman & Nicobar. Coconut cultivation has also spread to non-traditional tracts like Bihar, Chhattisgarh, Gujarat, West Bengal and North Eastern states. Karnataka stands third in production of coconuts by producing 5128.84 million nuts, which

constitutes 23.13 per cent of India's production after Kerala - 7429.39 million nuts (33.51%) and Tamil Nadu 6171.06 million nuts (27.83%) during the year 2015-16. The four southern states *viz*. Kerala, Tamil Nadu, Karnataka and Andhra Pradesh are the major coconut-producing states in India accounting for more than 90 per cent of area and production (Anonymous, 2016) [1].

Nowadays, tender coconut is becoming more popular as a health and energy drink by replacing artificial soft drinks. Coconut water is highly recommended by fitness and nutrition experts as a rehydrating agent. It has a caloric value of 17.4 per 100 gm. On a percentage basis, coconut water is 94.5 per cent water, the rest would contain: Protein (0.15 to 0.55%), fat (0.10%), ash (0.46%), and carbohydrates (4.40%). Tender coconut water is not merely a thirst-quenching drink but a mineral drink that cures most human diseases and helps one regain lost health. Tender coconut water has been given intravenously to cholera epidemic victims in Sri Lanka, Indonesia, Bangladesh and India. Tender coconut water being rich in potassium and other minerals plays a major role in increasing urinary output (Ravi Kumar, 2012) [3].

In Karnataka, about 14 per cent of the total production of coconut is harvested in the form of tender nuts, which is confined to Mandya, Bengaluru, Mysore and Hassan districts. The production of coconut is localized while the consumption is spread throughout the country. Though Kerala tops the list at the national level for coconut production, it is largely used for oil extraction while the fruits from Mandya, Ramanagaram and Tumkur are known for their high-water content.

Maddur is one of the world's largest tender coconut hubs. Every day, about four million tender coconuts are brought to an exclusive market set up by the Agricultural Produce Marketing Committee on the Bengaluru-Mysore highway. The nuts are brought by farmers and harvesters from Maddur, Mandya, Chamarajnagar, Kollegal, Malavalli, Bannur, Nagamangala, Pandavapura, K. R. Pet and Srirangapatna. Over 60 per cent of these tender coconuts are loaded onto 300 trucks and sent to New Delhi, Mumbai, Pune, Kolkata, Goa, Hyderabad, Ahmedabad and other places. The rest are sold within Karnataka.

Marketing of tender coconut plays a significant role in the movement of commodities from the producer to the consumer and stabilizing prices. The planned increase in agricultural output must be coordinated with changes in the demand and supply for agricultural commodities and marketing. This can be achieved only when the producer's share in the consumer's rupee increases considerably irrespective of the volume of the marketable surplus produced by the farmers. The coconut market in India is always unstable and uncertain due to frequent fluctuations in prices. Usually, fluctuation in price occurs due to changes in market conditions created in response to seasonal and annual variations in production (Mohan Kumar *et al.,* 2009) [4]. The seasonal variation in prices of tender coconut is more due to supply factors than due to demand factors. Usually, the magnitude of fluctuation is higher during the lean period compared to the peak period. To this end, analysis of market arrivals and prices using the estimation of seasonal monthly indices is one of the widely accepted sophisticated statistical tools for the analysis of time series data. The seasonal fluctuation is a regularly recurring pattern that is completed once in twelve months. Such seasonality is seen in the arrivals as well as in the prices of farm products (Mohan Naidu, 2014) [5]. It arises from the nature of production, supply and demand in the markets and price formations for crops, seasonal variations that arise from climatic factors and biological growth processes of plants. Following the seasonality in production and arrivals, the prices also exhibit seasonal variations. Normally the prices of storable produce are lower at harvest time and then rise as the season progresses, reaching their peak just before the next harvest. The study of seasonal fluctuations is considered to be important as a guide to the producer to market his produce and to the consumer to purchase his needs at the right time. It also serves as a guide to the government to operate its policy measures (procurement and buffer release) at the appropriate time. Keeping these points in view, our objective of the study is to analyze the seasonality of arrivals and the prices of tender coconut in the Maddur market.

2. Materials and Methods

The data for the study are confined to arrivals and prices of tender coconut in the tender coconut market, Maddur, which is situated on the premises of the Agricultural Produce Market Committee (APMC), Maddur, Mandya district. The secondary data about monthly arrivals (in thousand nuts) and monthly prices (in rupees per thousand nuts) of tender coconuts for the period of April 1997 to March 2018 were collected from APMC, Maddur. Monthly arrivals are the total arrivals in a month and monthly prices are the modal prices in a month.

2.1 Estimation of Seasonal Indices for Monthly Arrivals and Prices:

Data obtained from arrivals and prices of tender coconut are measured and arranged in chronological order, such data constitute time-series data. Such data is usually envisaged as generated by certain regulated base causative sources such as long-time forces, cyclical forces usually with a periodicity of longer duration than a year, annual fluctuation associated with the season of a year and many other sources of fluctuations producing random effects.

The time plot of such a time-series data gives an idea about the nature of fluctuations in the value of the variable over time. The fluctuations have the combined effect of various causes such as the ones mentioned above which sometimes induce sharp rises and falls. Segregating these various types of fluctuations in the time series is known as analysis of time series.

Time-series analysis was mainly used to analyze the variation in arrivals and prices of tender coconut in the Maddur market. A time series is a complex mixture of four components namely Trend (T_t), Seasonal (S_t), Cyclical (C_t) and Irregular (I_t) components. These four types of movements are frequently found either separately or in combination in a time series (Makridakis and Wheelwright, 1978) [6]. The relationship among these components is assumed to be additive or multiplicative, but the multiplicative model is the most commonly used, which can be represented as:

Monthly data: $Y_t = T_t * S_t * C_t * I_t$
Yearly data: $Y_t = T_t * C_t * I_t$

Where
Y_t- Original observation (Arrivals or Prices) at time period t
T_t- Secular trend at time period t
S_t - Seasonal variations at time period t
C_t- Cyclical movements at time period t
I_t- Irregular fluctuations at time period t

Short-term fluctuations observed in time-series data, particularly in a specified period, usually within a year, are called seasonal variations. The Ratio-to-Moving Average (MA) method is mainly used to determine seasonal variations. To measure the seasonal variations in arrivals and prices, seasonal indices were calculated by employing the twelve-month Ratio-to-Moving average method.

The seasonal indices were calculated by adopting the following steps

1. Generate a series of 12 months of moving totals
2. Generate a series of 12 months' moving averages: A series of 12 months moving averages is generated by dividing 12 months moving totals by 12.
3. Generate a series of centred 12-month moving averages (2x12MA). This step involves taking averages of pairs of two subsequent 12 months' moving averages and entering between each pair. There are no corresponding moving averages for the first six and last six months.
4. Express each original value as a percentage of the corresponding centred moving average. The percentage of moving average represents indices of seasonal and irregular components combined.
5. The next step involves removing the irregular component.
6. Arrange the percentages of moving averages in the form of monthly arrays.
7. Next, the average index for each month is calculated.
8. These averages are to be adjusted in such a way that their sum becomes 1200. This can be done by working out the correction factor and multiplying the average for each month by this correction factor. The correction factor (*K*) is worked out as.

$$K = \frac{1200}{S}$$

Where *K* is the correction factor and *S* is the sum of average indices for 12 months, multiply *K* by the percentage of the moving average for each month to obtain the seasonal indices. In this process, we do not have a moving average for the first six and last six months.

2.2 Coefficient of Average Seasonal Price and CV (%):

The magnitude of seasonal variations in arrivals and prices was estimated with the help of the Coefficient of Average Seasonal Variation (ASV%) and Coefficient of Variations (CV%) using the following formula:

$$\overset{\text{ASV\%}}{=} \frac{Highest\ value\ of\ Seasonal\ Index\ -\ Lowest\ value\ of\ Seasonal\ Index}{Highest\ value\ of\ Seasonal\ Index + Lowest\ value\ of\ Seasonal\ Index} X100$$

$$Coefficient\ of\ Variations\ (CV\%) = \frac{\sigma}{\bar{X}} X100$$

Where σ is the estimated value of the standard deviation of seasonal indices and $\bar{X}$ is the Arithmetic mean of seasonal indices. Since the arithmetic mean of seasonal price indices is always 100, the standard deviations in themselves were the coefficient of variations (Verma *et al*. 2017) [7].

3. Results and Discussions

The seasonality in arrivals and prices is a cause of the availability of produce and its demand in various seasons. Therefore, if the arrivals are more, supplies are more and prices are less and vice versa. Thus, it is an inverse relationship between demand and supply in which both the law of demand and the law of supply are in operation. Seasonality in price movement refers to regularly occurring price behavioural patterns coinciding with the sowing and harvest months of the commodity. This is reflected through regularly spaced peaks and troughs with consistent direction and magnitude within each year. The monthly arrivals and price data of tender coconut in the Maddur market during the period from April 1997 to March 2018 were utilized to compute the seasonal indices. The seasonality in arrivals and prices of tender coconut is captured by computing seasonal indices for all 12 months. The final estimated stabilised seasonal indices are presented in Table 1 and plotted against the months in Fig 1.

i) Arrivals of tender coconut

The results of seasonal indices in Table 1 indicated the existence of strong seasonality in the arrivals of tender coconut in the Maddur market. The seasonal indices reveal that arrivals of tender coconut to the market were observed higher in March (154.96) followed by April (139.25) whereas arrivals to the market were observed low in the month of July (56.37) followed by August (60.56). Further, the result shows that arrivals of tender coconut to market look like a wave undulation, the arrivals start increasing in January month (106.26), reaching a peak arrival during March (154.96) as the demand for tender coconut would be naturally higher during the summer season, then start declining from May (107.68) then reach their lowest arrivals in July (56.37), as the demand for the tender coconut decline due rainy seasons, after that again arrivals increase during October month (100.25) due to excessive production, to this end, Naveena and Arun Kumar (2016) [8] also observed similar results in the arrival of tender coconut. The coefficient of ASV and CV for the arrivals of tender coconut to the market during the study period was recorded at about 46.65 per cent and 30.29 per cent indicating a high level of inconsistency in the arrivals of tender coconut to the market.

ii) Prices of tender coconut

A seasonal index for prices of tender coconut reveals that very little fluctuation in prices of tender coconut across the months, which shows price is not influenced by due to arrivals. Even though there is not much fluctuation in the prices of tender coconuts, the prices were high during December (101.52), February (100.58), March (100.37), April and May (100.36) and the lowest prices of tender coconuts were observed during the months of September (98.67), followed by August (98.91), October (99.09), November (99.22) and July (99.95). The coefficient of ASV and CV of prices during the study period was recorded at about 1.42 per cent and 0.94 per cent indicating a high level of consistency in prices which indicated prices of tender coconut are insensitive to arrivals.

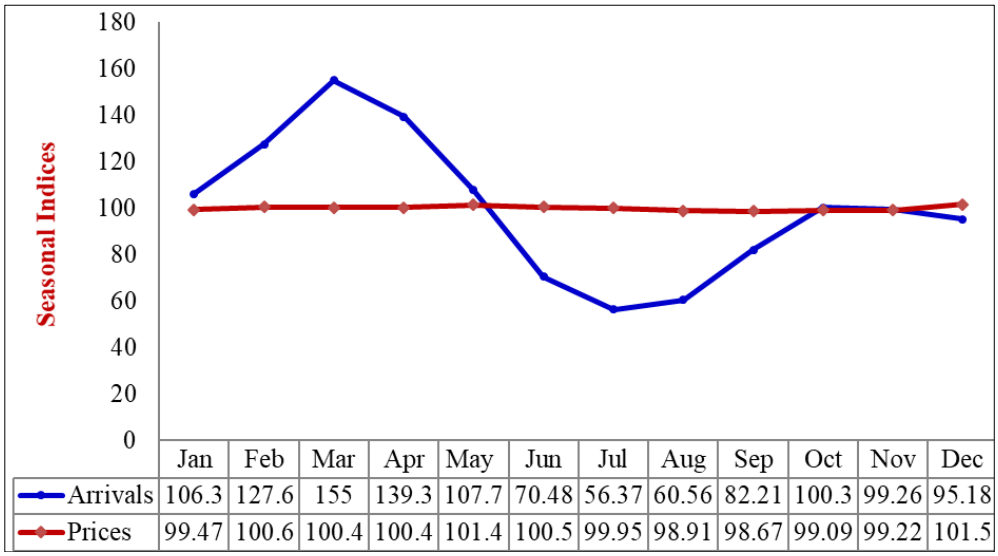

Fig 1: Seasonal Indices of arrivals and prices of tender coconut in the Maddur market for the period from April 1997 to March 2018

Table 1: Seasonal Indices of arrivals and prices of tender coconut

Months	Arrivals	Prices
January	106.26	99.47
February	127.55	100.58
March	154.96	100.37
April	139.25	100.36
May	107.68	101.36
June	70.48	100.5
July	56.37	99.95
August	60.56	98.91
September	82.21	98.67
October	100.25	99.09
November	99.26	99.22
December	95.18	101.52
ASV	46.65%	1.42%
CV (%)	30.29%	0.94%

4. Conclusions

In the present study, an analysis of seasonality in market arrivals and prices was carried out by finding seasonal indices using the Ratio-to-Moving Average method for the monthly arrivals and price data of tender coconut in the Maddur market during the period from April 1997 to March 2018. The results of seasonal indices indicated the existence of strong seasonality in the arrivals of tender coconut in the Maddur market. The seasonal indices reveal that arrivals of tender coconut to the market were observed higher in March followed by April, whereas low in the month of July followed by August. Further, the result shows that arrivals of tender coconut to the market were higher during March as the demand for tender coconut would be naturally higher during the summer season, with lowest arrivals during July, as the demand for the tender coconut declines due to rainy seasons. The coefficient of ASV and CV for the arrivals of tender coconut to the market during the study period indicated a high level of inconsistency in the arrival of tender coconut to the market.

A seasonal index for prices of tender coconut reveals that very little fluctuation in prices of tender coconut across the months, which shows price is not influenced by due to arrivals. Even though there is not much fluctuation in the prices of tender coconuts, the prices were high from December to May (100.36) and the lowest prices during the months of July – November. The coefficient of ASV and CV of prices during the study period indicated more uniformity and less fluctuation in prices indicated prices of tender coconut are insensitive to arrivals.

5. References

1. Anonymous. Horticultural Statistics at a Glance. Horticulture Statistics Division, Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India; c2016.
2. Anonymous. Statistical Year Book. Asian and Pacific Coconut Community (APCC); c2014.
3. Ravi Kumar NS. Marketing of tender coconut in Maddur APMC of Mandya district. M. Sc. (Agri) Thesis, University of Agricultural Sciences, Bangalore; c2012.
4. Mohan Kumar TL, Munirajappa R, Chandrashekar H, Surendra HS. Seasonality in arrivals and prices of important vegetable crops in Bangalore market. Mysore Journal of Agricultural Sciences. 2009;43(4):738-743.
5. Mohan Naid, G. A statistical study on arrivals and prices of cotton in Karimnagar district of Andhra Pradesh. Int. J Agricult. Stat. Sci. 2014;10(2):321-324.
6. Makridakis S, Wheelwright S. Forecasting: Methods and Applications. John Wiley & Sons, New York; c1978.
7. Verma DK, Sharma L, Singh H, Suman J. A study on price behaviour of soybean in Southern Rajasthan. Economic Affairs. 2017;62(3):531-535.
8. Naveena KP, Arunkumar YS. Economic analysis of the world's largest fresh coconut market in India. International Journal of Agriculture Sciences. 2016;8(52):2394-2398