Analysis of onion prices at wholesale level in India – an application of Rescaled Range Analysis

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Abstract. India is the second largest producer of onions next to China contributing to about 22.4% of world’s production. The sharp rise in the price of onion has caused much concern in the country. This sudden price rise is due to the failure of new kharif and late kharif crops which was unprecedented. This paper evaluates the persistence level of the onion prices using Rescaled Range Analysis to find out if there is bais behaviour in the onion price. The investigation was carried out on the onion prices for the period of 7 years stating from Jan 2013 till Dec 2019.

1. Introduction
India has the biggest producer of onions, 5.54 lakh hectares (2008-09), representing around 22.40% of the world onion zone. As far as creation, India is second after China representing 19% of the worldwide onion production. Besides India and China, the other major onion producing countries are Turkey, Pakistan, Brazil, US, Iran, Spain and Japan. India produces three assortments of onions – red, yellow and white. In certain pieces of the nation, onions are produced in all the three seasons. In the northern part of the nation, onion is generally developed in the winter (rabi) season. Be that as it may, in the southern and western conditions of Andhra Pradesh, Karnataka, Tamil Nadu, Gujarat and Maharashtra, it is developed in winter (rabi) just as in the blustery (kharif) seasons. Right now kharif onion is making progress in the northern part of the nation. In this manner, onion is cultivated and sent to the household customers all through the year. During the agricultural year 2008-09, onions were grown in an area of 8,34,000 hectares with a production of 1,35,65,000 tonnes in the country. 30% of total onion is produced by Maharashtra, closely followed by Karnataka, Gujarat and Bihar. In almost all important states growing onions, there was an increase in both area and production by twofold or more between 1998-99 and 2008-09. The increase in production is attributed to an improvement in yield as well.

2. Literature Survey
The Rescaled Range Analysis is a non-parametric methodology, for developed by H.E.Hurst (1) to distinguish between biased or fractal time series Mandelbrot (2) had computed a statistical
methodology for non-periodic cycles from the Covariance to R/S Analysis. Khaled H. Hamed (3), present the Improved limited example Hurst type gauges utilizing rescaled extend examination. This paper manages the correlation of the changed estimator with different options shows that the altered estimator offers an extraordinary improvement over the traditional rescaled estimator as far as inclination and root mean square error, which makes it comparable to other main estimators. Ladislav Kristoufek and Petra Lunackova (4), present the “Long-term memory in electricity prices: Czech market evidence” analyses long-term memory properties of hourly prices of electricity in the Czech Republic between 2009 and 2012. Purushottam Sharma (5) pointed out that the recent sharp rise in the prices of onions can be attributed to a decline in kharif production on account of unseasonal rains at harvest time in the major onion producing states. Priyadarshini. E (6) has analysed the persistence of earthquakes in Indonesia using Rescaled Range methodology.

3. Methodology

3.1. Rescaled Range Analysis

It was proved by Einstein that 
\[ R = \sqrt{T} \]  
(1)

where R represents distance covered and T represents the time taken by any random particle to cover the distance. For a time series of length n, the Rescaled Range calculated by Hurst is given by

\[ (R/S)_n = K \cdot n^H \]  
(2)

where K is a constant. H is known as the Hurst constant in honour of H.E. Hurst. Taking log on both sides,

\[ \log (R/S)_n = \log K + H \cdot \log (n) \]  
(3)

Depending on the value of H, the time series can be classified as random time series, persistent or anti-persistent time series.

For H = 0.50, the time series is a random one in which the long term dependence is absent. R/S analysis is a nonparametric method. If the range of H is between 0.50 and 1, it is a persistent one which is accompanied by long term memory detection. That is if the current trend is found to be positive, then it is more likely that it will go on to be positive in the future. Otherwise if it is negative, then the chances are that it will continue to be negative in the future. If the range of H is between 0 and 0.5, it can be termed as anti – persistent which reverses very often than random time series. In real world problems, persistence of time series is very common.

3.2. V-Statistic

Testing of stability of the time series was done by using V-Statistic which is given by the formula

\[ V_n = \frac{(R/S)_n}{\sqrt{n}} \]  
(4)

For independent random time series, the line chart of V_n against Log n will be horizontal whereas for a persistent time series, it will be sloping upwards and for anti-persistent time series, it will be sloping downwards. Using this technique, the discernment of cycles can be done including both periodic and non-periodic cycles.

3.3. Correlation in between periods

This can be evaluated as:

\[ C_N = 2^{(2H-1)} - 1 \]  
(5)
Zero correlation implies that the time series is a random one. A persistent time series is reflected positive correlation while against constant time arrangement is reflected in negative connection. $C_N$ can be considered as the quantitative proportion of long memory in the arrangement.

4. Data Analysis
The analysis was carried out on the onion prices for the period of 7 years starting from Jan 2013 till Dec 2019 (Figure.1). The line of best fit was found to be $y= 0.659x - 0.063$, in which the Hurst $H=0.659$

An upward inclining bend that has less number of inversions taking after a straight line which shows that they are diligent patterns is shown in Figure 2. The current qualities are predominantly impacted by the previous ones and are unmistakably fractals. The onion costs information for the India was broke down for the period 2013-2019 utilizing rescaled run and the Hurst consistent $H$ was seen as 0.659 which shows a reasonable degree of constancy in the value ascent of onion in the coming years. figure 3 shows the diagram of $V$ statistic measurement are inclining upwards which demonstrates constant patterns which are depended to memory of the past costs. Correlation in between periods $C_N$ was found to be 0.25 indicating that the time series under analysis has 25% long term memory.
5. Conclusion

As it can be seen that the Hurst value ranges between 0.5 and 1, the price value ascent of onion shows an increasing trend in the future. Hence it very well may be reasoned that this time arrangement has 25% long term memory and there will be an increase in the price of onion in India in the coming years.

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