Detecting Trends from Accumulated Changes in the Prices of a Stock

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Abstract – The paper presents a method to segment a time series by using trends estimated on it, trends that are formed by peaks and troughs produced by runs of increments and decrements. Each run measures the relative change produced by accumulating the increments or decrements from the previous run. A time series of daily stock prices is used to demonstrate the method. A series of consecutive price changes in the increasing or decreasing direction constitutes a run in the prices. In this view a run is broken when prices are repeated. Runs of price increases or decreases is used to estimate an increasing or decreasing trend in the prices. The trend is estimated between two points in the time series and relates the amount of accumulated change between the points to the number of data points between them.

The main contributions of the paper include a method to estimate the amount of linear change between the two points by using this accumulated change between two points in time. The linear change between the two points corresponds to an estimate of the average change in prices at each price change. A trend estimated over such runs in the prices also provides an estimate for the rate of return. It also provides an estimate for the average rate over time at which the prices rise or fall. The method also detects the size of a relative change in direction in the time series. This model of the trend is used to segment a time series of stock prices by detecting changes in the trend.

It serves as visual means to trade in the stock by providing information about the persistence of a series of price rises or falls, the relative size of each rise, fall or trend, the time interval of the trend and the rate at which trends change.

Keywords: Information, risk, volatility, trend, rate of return

I. INTRODUCTION

The paper develops a model of a trend that is used to segment a time series of stock prices. It also detects and measures a rising trend with rising peaks and troughs or falling trend with decreasing peaks and troughs. It detects changes in the trend by estimating the relative magnitude of a rise or fall in prices, an estimate for its steepness and the interval over the change.

Changes in this measure of the trend and the frequency of its changes can be used to generate signals to trade by observing past trends, measuring the relative steepness in the rises and falls in the prices, the variations in the trend and its period. It is a measure of variation in the variation in the prices or the time dependence of the volatility and its persistence over time.

II. A VISUAL MEASURE OF A TREND

Figure 1 depicts an example of a random walk. A segment where the accumulated changes are positive. It is used to illustrate the methods developed to detect trends and changes in trends in the time series.

Trends are detected by accumulating the changes in the data points over the period of the trend. In this view a trend is a series of increments or decrements. Those changes need not be linear. A difference between two points in the series can be used to estimate a linear trend where the changes are an average over the changes observed in that interval.

Each run measures the relative change produced by accumulating the increment or decrement from the previous run. The runs of increments and decrements can be depicted separately as in Figure 2. Each run is depicted as a vertical stem giving the accumulated change in the increasing or decreasing direction from the previous run. The time interval of the run is estimated by the separation between the trends.

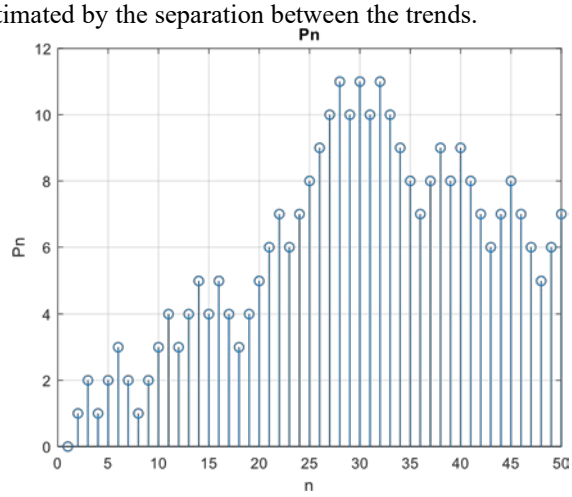

Figure 1. Random walk example of a random process

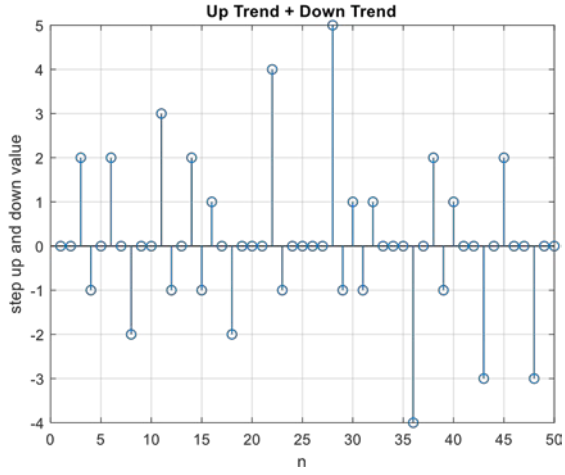

Figure 2. Accumulated changes in runs of increments and decrements

The runs in either direction can be combined over an interval to produce a series of data points that increase and decrease representing peaks and troughs observed over the interval. An interval defined by two points capturing the peaks and troughs over the interval of observation also forms a trend.

In the example of Figure 1, a trend is observed between data points 23 and 28. Another trend is observed between data points 18 and 22. These trends are depicted as stems of value 5 at n = 28 and 4 at n = 22 in Figure 2. These two trends can be combined to form a trend over a longer interval from n = 18 to n = 28 as observed in Figure 1.

When considering the trend defined by a line drawn between data points 18 and 28, the data point at n = 22 breaks the trend in to two segments.

The decision to join two adjacent trends to form a trend over a longer interval can be made by considering the incremental change in variation in the data points when one trend is merged with an adjacent trend to form a longer trend.

In this view, a linear trend is formed when the first differences in the series are equal, and the data points are evenly spaced in time. The variation in the first differences can be measured with respect to the mean of the first differences over an interval to estimate how well the data points form a linear trend.

This measure does not show each incremental change in either direction but can be used to assess the number of changes in direction over an interval.

Merging Trends over adjacent intervals

Trends can be merged to form a trend of longer length by accumulating the runs depicted in Figure 2 over a window. For example, a longer trend can be formed by accumulating the runs over a window formed over the interval [18, 28]. The change in value over the interval is 11 – 3 = 8, the change over the time axis is 28 – 18 = 10. The rate of change is 8/10 and the angle formed is 38.7 degrees.

The angle provides a measure of the steepness in the rise or fall between two points selected to define the trend. This is measure of the relative change between two data points in the time series including those intervening points where the changes can be both positive or negative.

III. DETECTING TRENDS AND CHANGES IN TREND

An interval of 100 consecutive days are selected from a 10 year period 2010 to 2020 of daily oil prices, depicted in Figure 3. It is intended to demonstrate the application of the method on traded oil prices.

Figure 4 captures the changes in trend in oil prices depicted in Figure 3 and shows the change in the accumulated change in the increasing and decreasing direction at the points where the trend changes direction. The peak at n = 11 demarcates a point where the trend changes direction after a series of price increases over the preceding interval [1,9]. The negative peak at n = 59 demarcates a point where the trend changes direction after a series of price decreases. Similarly, a peak can be demarcated between the negative peaks at n = 45 and n = 59 produced by the accumulated changes in prices between them. The peak at n = 59 is evidence of a series of price decreases over a relatively short time interval, a rapid decline in prices a measure of the time dependence in risk or change in volatility. The interval between the two points in time 48 days apart show periods of price increases and decreases where the trends are over shorter time scales. It shows the frequency at which the trend changes direction and the magnitude of the change in a direction. It can be used to estimate an average rate of price rise or fall over an interval. Its also a measure of the time variation in the volatility.

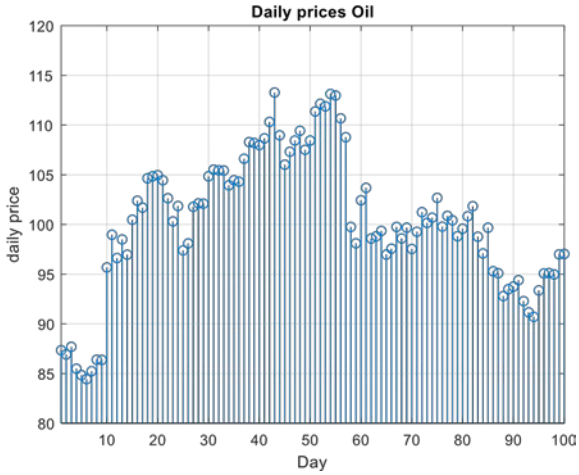

Figure 3. Daily Oil prices (USD)

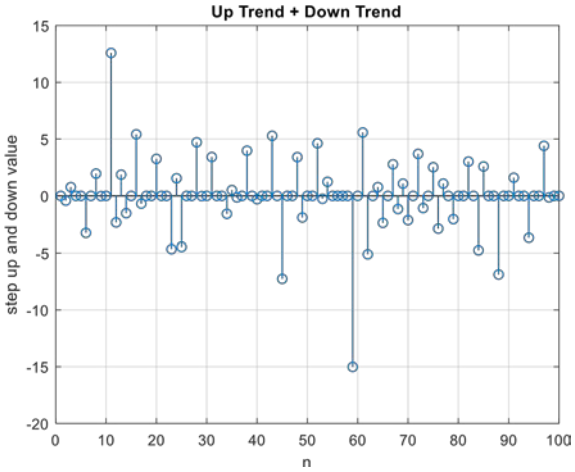

Figure 4. Trends and changes in trend in daily oil prices

IV. CONCLUSIONS

The paper developed a visual method to provide information about the direction of the trends and the variation in the trends in a time series of stock prices. It also provides a visual estimate of the time variation in the volatility in the prices and its clustering and the degree to which price trends vary over time. This visual method provides signals to trade by observing past trends and changes in the direction of the trend. It also provides information about periods of consecutive price rises and declines and of the periods where there is uncertainty in the direction of the trend.

References

[1] Prasad Niharika, Saurabh Singh and Jayant Gautam, Estimating volatility of national stock exchange of India using GARCH(1,1), Ann. Agric. Res. New Series Vol.40 (2): 218222 (2019).

[2] John J. Murphy, Technical analysis of financial markets, a comprehensive guide to trading methods and applications, 1999.