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Hearing the Patterns of Time Series Data

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Introduction

We seek new perspectives on pattern finding in time series data through a variety of methods. First, we consider a method to map stock market data to musical data, allowing us to "listen" to emerging patterns. We then use this representation as part of a Markov chain model, which can be used to predict stock market changes. Finally, we consider potential methods for identifying individual chart patterns in stock data.

Methods for Pattern Finding

Converting to Musical Data

We begin by considering a semicircle with seven spokes. By assigning each of the seven spokes to a note in the diatonic scale, we create a map from angles to notes.

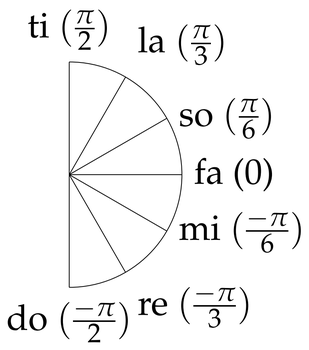

Figure 1: A semicircle with seven spokes.

Given a collection of simple time series data, such as the prices of a stock each day, we can easily find the slope between two particular points. Then we can convert this to an angle measure and use it to map the data to musical notes.

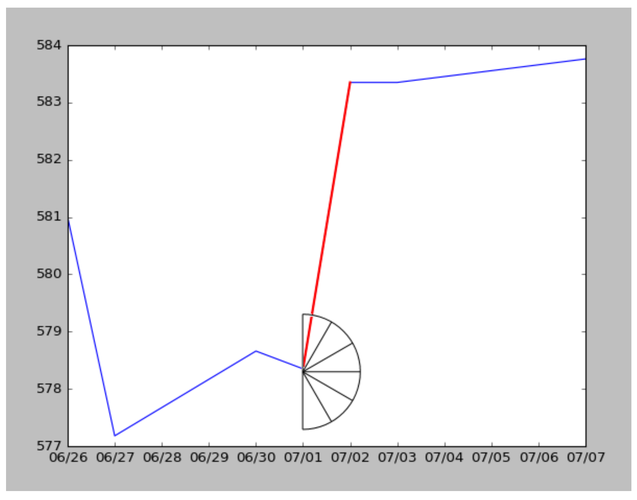

Figure 2: A graph showing the price of a certain stock over time. The overlaid semicircle shows that the line segment highlighted in red is closest to the top spoke, so the segment would be assigned an angle of $\pi/2$.

Building a Markov Model

We can now use our converted data to attempt to predict future data. To do this, we assume that the data has the Markov property and create a Markov chain. By using historical data, we can find the probability that a note will occur next, given the notes that have already occurred.

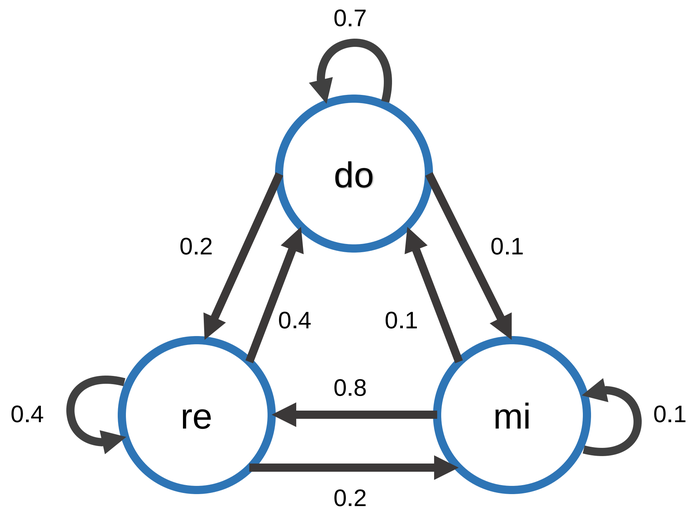

Figure 3: An example of a simple Markov chain created from musical data. With this method, we can predict whether the price of a stock will increase, decrease, or remain the same with a high degree of accuracy.

Looking for Chart Patterns

We can also look for *chart patterns*, specific patterns in stock data that are traditionally identified visually. By characterizing these patterns according to their local maxima and minima, as well as other distinguishing characteristics, we can automate our search for chart patterns.

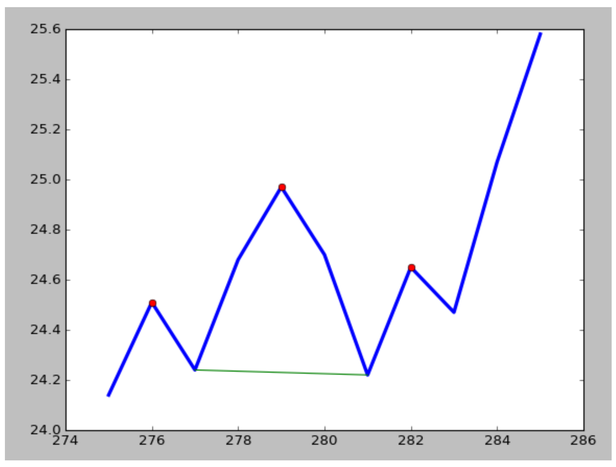

Figure 4: An example of a head and shoulders pattern found in stock data. The tops of the head and shoulders are indicated with red dots, while the neckline is drawn in green.

Conclusions

The methods for pattern finding presented here show that there is a great possibility for future work in this area. For example, the pattern finding algorithm can be expanded to identify other common chart patterns by analyzing canonical examples of these patterns. In addition, the correctness of the Markov chain algorithm could be better analyzed using more sophisticated statistical tools.

For Further Information

• Contact: `ztucker@hmc.edu`.

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