Market Regime Detection using Hidden Markov Model

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Chapter 1

Objective

There is always challenge for quantitative trader to find out the frequent behaviour of financial market due to change in government policy,negative news item,regulatory environment and other macroeconomics effects. Such periods are known as Market Regime. These various regimes lead to adjustments of asset returns via shifts in their means, variances, autocorrelation and covariances. This impacts the effectiveness of time series methods that rely on stationarity. There is a clear need to effectively detect these regimes. This aids optimal deployment of quantitative trading strategies and tuning the parameters within them.

This project is an attempt to find out such market regime and accordingly adjust the strategy. The pricipal method used to detect market regime is known as Hidden Markov Model which is a statistical time series techinique.

Chapter 2

What is Hidden Markov Model?

Before knowing about Hidden Markov Model, it important to understand Markov Model. The Markov Model is a stochastic state space model involves random transitions between states where the probability of the jump is only dependent upon the current state, rather than any of the previous states. The model is said to possess the Markov Property and is thus "memoryless".

Markov Models can be categorised into four broad classes depending upon the autonomy of the system and whether all or part of the information about the system can be observed at each state.

	Fully Observable	Partially Observable
Autonomous	Markov Chain	Hidden Markov Model
Controlled	Markov Decision Process	Partially Observable Markov Decision Process

If model is both autonomous and fully observable. It cannot be modified by actions of an agent as in the controlled processes and all information is available from the model at any point in time.

If the model is fully autonomous but only partially observable then it is known as a Hidden Markov Model. In such a model there are underlying latent states and probability transitions between them but

they are not directly observable. Instead these latent states influence the observations.

The HMM is more familiar in the speech recognition community and communication systems, but during the last years gained acceptance in finance as well as economics and management science.

Chapter 3

Implementation details

3.1 Programing Language

The project has been implemented in Python version 2.7. Python being a open source language is most popular for data analysis as it has wide range of available packages for data analysis,machine learning and statistical analysis. It is very popular language and easy to use.

3.2 Packages

The list of main packages used in this projects are as follows.

1. Python (v2.7)
2. Pandas (0.18.1)
3. Numpy (1.13.1)

4. Matplotlib (2.0.2)

5. hmlearn (0.2.0)

3.3 Strategy

As the main focus is on detection of market regime ,so I have used moving average strategy. As in case of HMM we can only have partially observable data, it become very important choose your observable data very carefully. For Moving average strategy I have choosen the daily returns as observable variable. We can also have daily std deviation ,daily volatility as observable variables.

In future work, I am going to add few more strategy with different observable variable.

3.4 Data

I have taken 120 days interaday data from Zerodha for the following script.

1. NIFTY50 Index

2. HDFCBANK

3. ICICIBANK

4. KOTAKBANK

5. ONGC

6. INFY

7. RELIANCE

8. HDFC

9. LT
10. IOC
11. SBIN
12. HINDUNILVR
13. MARUTI
14. ITC
15. TCS

It is always advisable to go for interaday data to get better result for detecting market regime using HMM.

Chapter 4

Backtesting Code

All the backtesting code is written in **backtest.py** file. The file is divided into two class namely **FinancialData** and **BacktestBase**.

Chapter 5

Strategy code without using HMM

Chapter 6

Strategy code with using HMM

Chapter 7

Findings

Chapter 8

Future Work

Chapter 9

Reference