

# Stock Market Analysis and Prediction using Hidden Markov Models

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## ABSTRACT

### 1. INTRODUCTION

1. Problem Definition
2. Literature overview
  - (a) HMM VERY brief intro
  - (b) Left Right (Baskin) HMM
3. Approach
  - (a) Read data from sources
  - (b) build statistics
  - (c) compute  $\mu$  and  $\Sigma$  (mean and covariances)
  - (d) extend HMM for left-right HMM
  - (e) define an HMM (Section 4)
    - i. a four-state ( $N = 4$ ) HMM with ( $s_0 = open, s_1 = low, s_2 = high, s_3 = close$ )
    - ii. initialize  $\pi = \{1, 0, 0, 0\}$  as we always start with  $s_0$
    - iii. observation states are **continuous** so they could not be visualized
    - iv. initialize a proportion distribution  $\vec{C}_{1 \times 4}$
    - v. We have:

$$b_i(O_t) = \sum_{j=1}^{M_i} c_{ij} b_{ij}(O_t) \quad i = \{1, 2, \dots, N\} \quad (1)$$

where

- $M_i$  is the number of components in state  $i$
- $c_{ij}$  is the mixture coefficient for  $j$ -th mixture component in state  $i$  such that  $\sum_{j=1}^{M_i} c_{ij} = 1$

- $b_{ij}(O_t)$  is a 3-D multivariate Gaussian density with mean  $\mu_{ij}$  and covariance matrix  $\Sigma_{ij}$

- (f) train HMM (Section 6)
- (g) predict with HMM (Section 7)
4. Statistical Report
5. HMM Model
6. HMM Training
7. HMM Prediction
8. Experiment Results
9. Technology Overview
10. Conclusion
11. Acknowledgements

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