Quiz 3 - *Latent Variable Models in Financial Asset Regime Detection*

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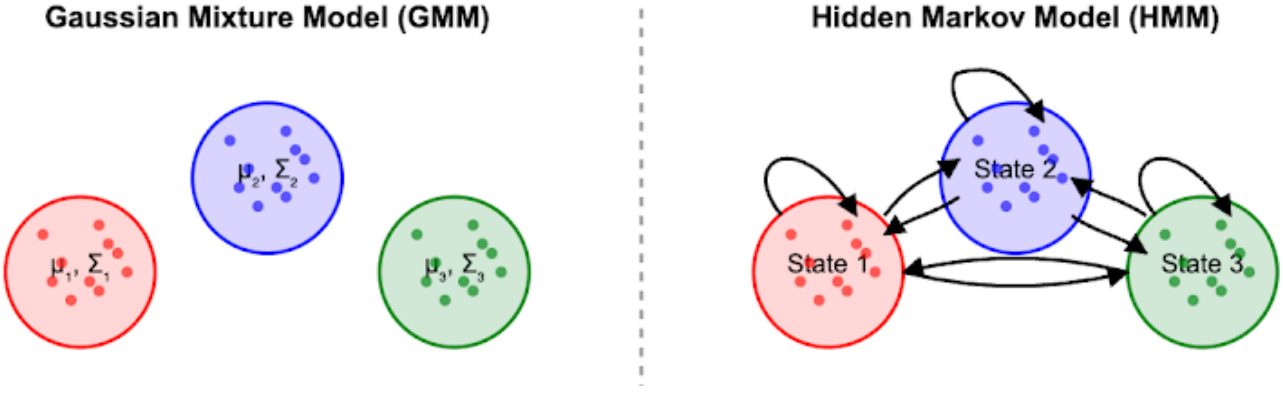
From GMMs to HMMs

What is the main limitation of Gaussian Mixture Models (GMMs) when modeling sequential data? 1 point



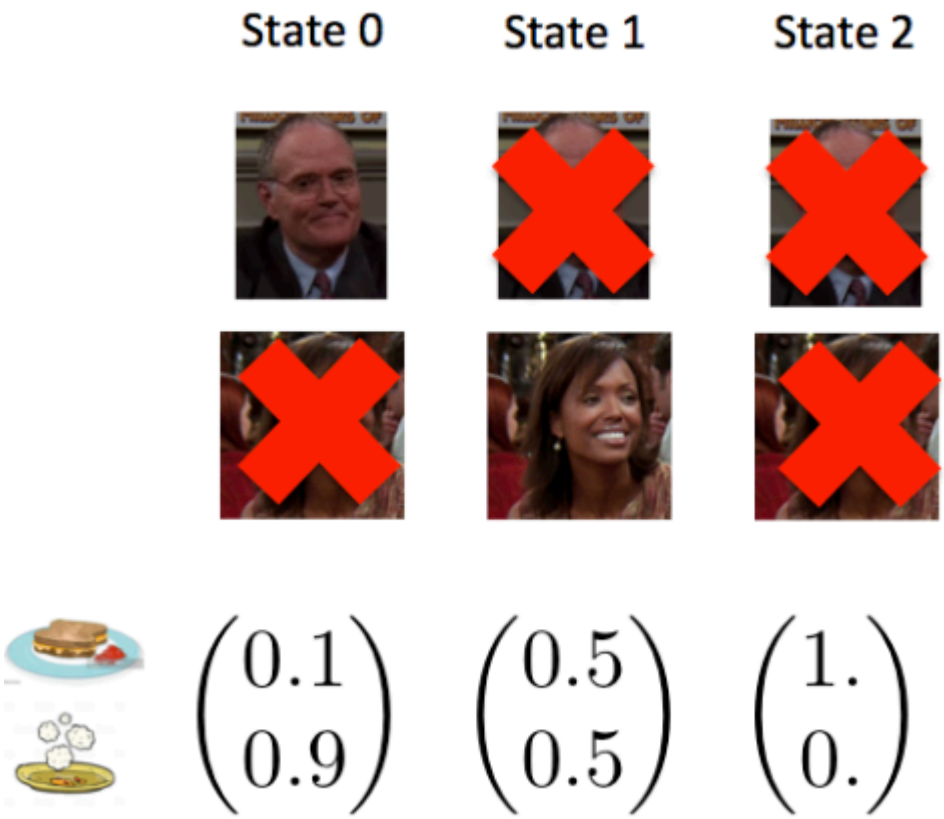
- ○ GMMs assume a fixed number of hidden states
- ○ GMMs require labeled data
- ◉ GMMs ignore temporal dependencies

In a Hidden Markov Model, the current observation X_t is conditionally independent of all other variables given the current hidden state H_t 1 point

- (●) True
- ( ) False

HMM Parameterization

In the sandwich example, if Ross observes his sandwich is safe today, what is the most likely hidden state? 1 point



- ( ) State 0
- ( ) State 1
- (●) State 2

For an HMM with M hidden states and D possible observations, how many parameters are needed to fully specify the model with discrete emissions? 1 point

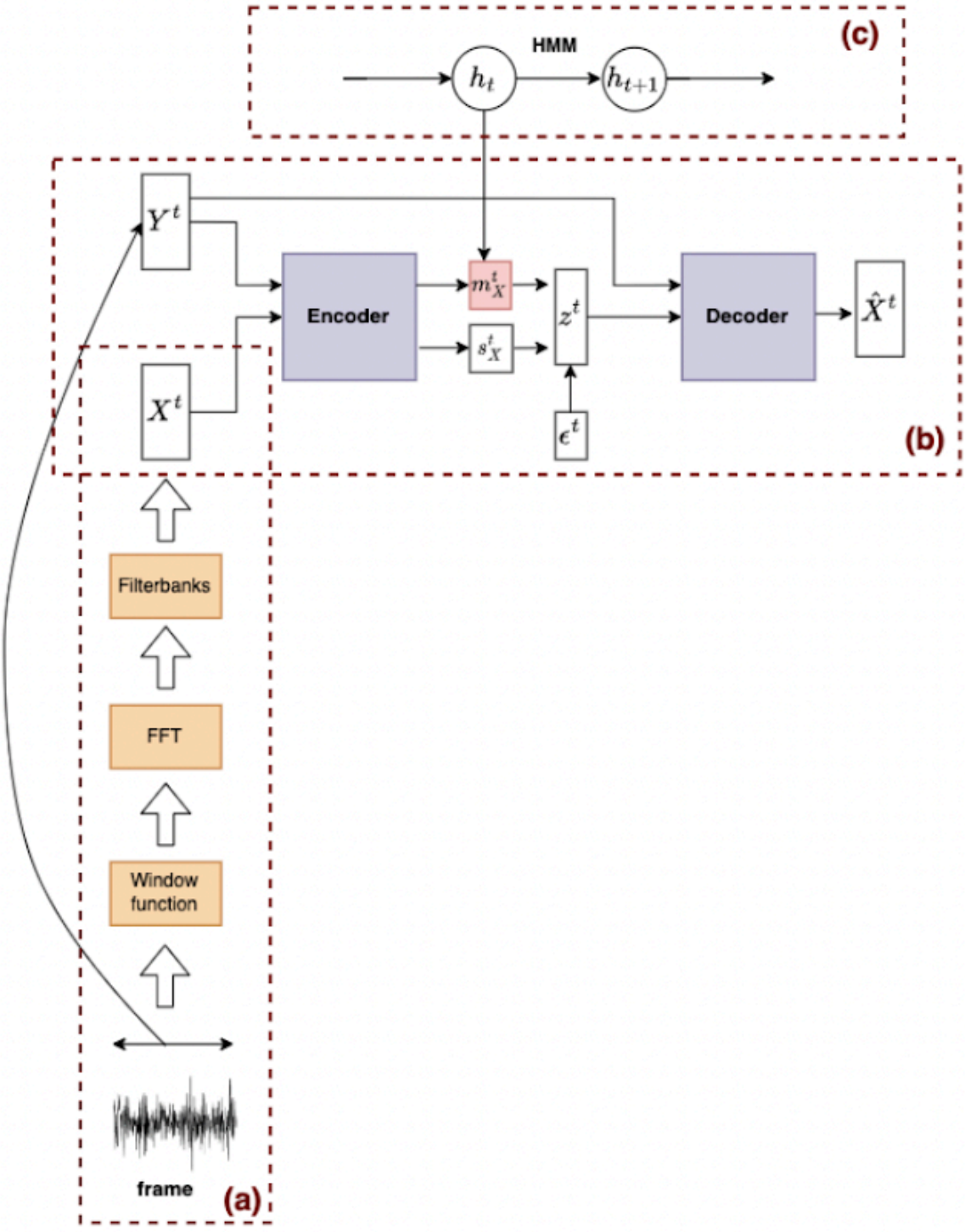
- (●) $M + M^2 + MD$
- ( ) $M + M + MD$
- ( ) $M \times M \times D$

Which parameter set fully specifies an HMM with continuous Gaussian emissions? 1 point

- ( ) π, Q, O
- (●) π, Q, μ, Σ
- ( ) π, μ, Σ

HMMs - Estimation Problems

In the Low Turbulence Model described in the slides, what is the role of Hidden Markov Models in the pipeline? 1 point

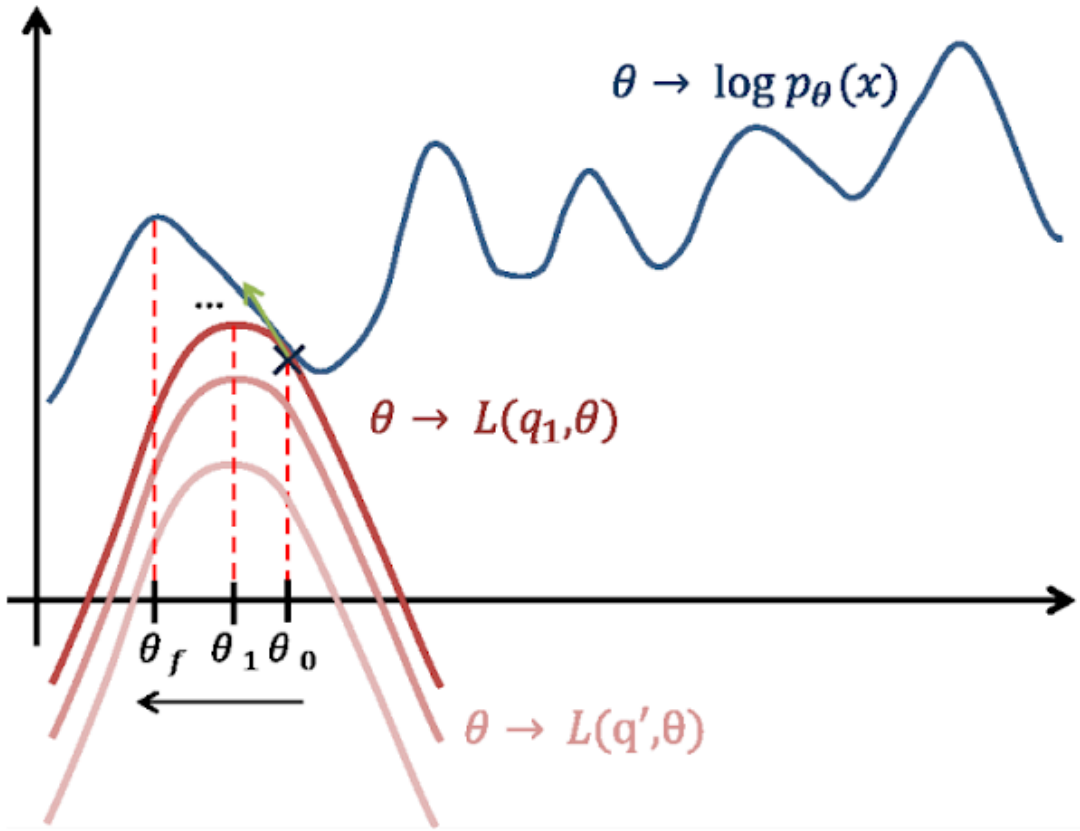


- To extract spectral information from return data
- To select individual assets
- To forecast market regimes

What problem does the Forward algorithm primarily solve in HMM estimation? 1 point

- [x] It efficiently computes the likelihood of an observation sequence without enumerating all possible hidden paths
- [ ] It directly estimates the model parameters from the observed data

What is the fundamental purpose of using the EM algorithm for HMMs? 1 point

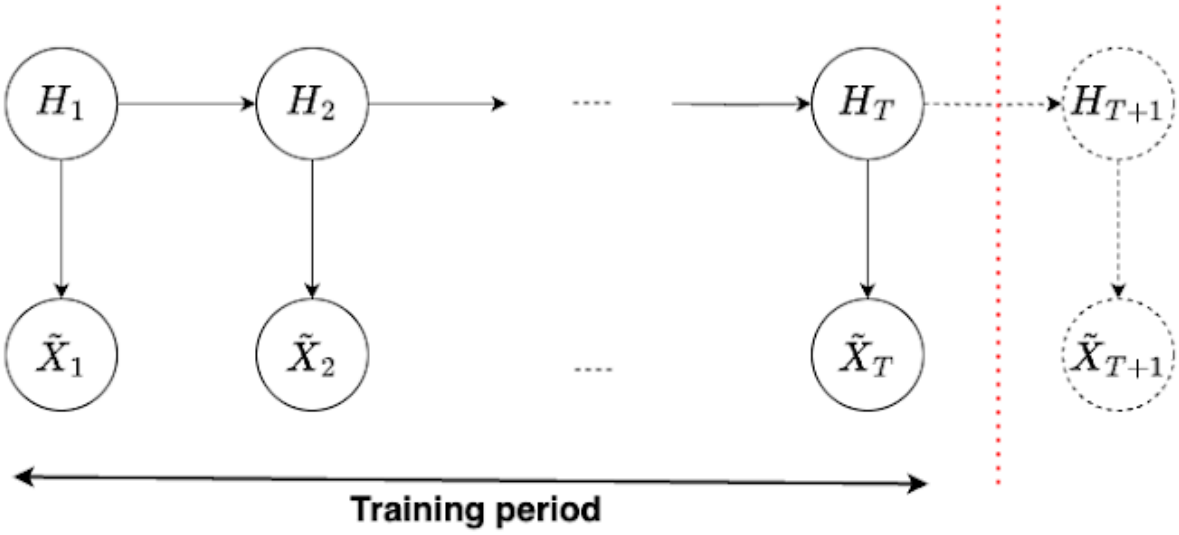


- [ ] To reduce the computational complexity of the Forward-Backward algorithm
- [ ] To convert continuous emissions to discrete emissions for easier processing
- [x] To estimate the parameters of the HMM

In the Expectation-Maximization (EM) algorithm for Hidden Markov Models, which probabilities are calculated and used during the E-step ? 1 point

- ○ Filtering probabilities only
- ◉ Smoothing probabilities only
- ○ Neither filtering nor smoothing probabilities

In a Hidden Markov Model, after observing a sequence up to time T, which specific probabilities are used to predict the distribution of the next hidden state (at T+1)? 1 point



- ○ All filtering probabilities ξ(1,·), ξ(2,·), ..., ξ(T,·) from time 1 to T
- ◉ Only the most recent filtering probability ξ(T,·)
- ○ The smoothing probabilities ψ(T,·)

Questions

Any comment ?