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

\* Indicates required question

1. Name \*

2. Email \*

From GMMs to HMMs

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



Mark only one oval.

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



4. In a Hidden Markov Model, the current observation X<sub>t</sub> is conditionally independent of all other variables given the current hidden state H<sub>t</sub>

Mark only one oval.

$\square$	True	
$\square$	False	

#### **HMM** Parameterization

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



Mark only one oval.

State 0 State 1

📃 State 2

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

Mark only one oval.



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

Mark only one oval.



HMMs - Estimation Problems

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



Mark only one oval.

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

9. What problem does the Forward algorithm primarily solve in HMM estimation?

Mark only one oval.

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

10. What is the fundamental purpose of using the EM algorithm for HMMs?

1 point



#### Mark only one oval.

To reduce the computational complexity of the Forward-Backward algorithm

To convert continuous emissions to discrete emissions for easier processing

To estimate the parameters of the HMM

1 point

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

Mark only one oval.

Filtering probabilities only

Smoothing probabilities only

- Neither filtering nor smoothing probabilities
- 12. In a Hidden Markov Model, after observing a sequence up to time T, which 1 point specific probabilities are used to predict the distribution of the next hidden state (at T+1)?



Mark only one oval.

All filtering probabilities  $\xi(1,\cdot)$ ,  $\xi(2,\cdot)$ , ...,  $\xi(T,\cdot)$  from time 1 to T

Only the most recent filtering probability  $\xi(T, \cdot)$ 

The smoothing probabilities  $\psi(T, \cdot)$ 

## Questions

### 13. Any comment ?

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