

MScFE 660 RISK MANAGEMENT

Group Work Project # 2

[See grading rubric here.](#)

Scenario

GWP2 is a continuation of the work you submitted for GWP1. That is, you are going to work towards the second and third sections of your mini-capstone. Recall that each student individually reads the paper:

Alvi, Danish A. *Application of Probabilistic Graphical Models in Forecasting Crude Oil Price*. 2018. University College London, Dissertation.

<https://arxiv.org/abs/1804.10869>

By the end of GWP2, you will have been deeply immersed in the Bayesian network methodology and how the model gets developed step by step. When completed, GWP2 looks like a literature review, as well as the methodology section of a mini-capstone project.

When all GWPs are completed, the combined three projects look like a mini-capstone.

Overview of GWPs

GWP 1: Problem Formulation. Data Collection.

GWP 2: Methodology Description. Model Development.

GWP 3: Interpretation of Results. Improving the Model.

Tasks

You will be implementing the four stages of Hidden Markov Model Algorithms.

Step 1

- a. Student A writes pseudocode for the forward algorithm and the backward algorithm, as well as a toy example.
- b. Student B writes pseudocode for the backward Viterbi algorithm, as well as a toy example.
- c. Student C writes pseudocode for the Baum-Welch algorithm, as well as a toy example

Step 2

- a. Student A will identify and illustrate examples of bull regimes.
- b. Student B will identify and illustrate examples of bear regimes.
- c. Student C will identify and illustrate examples of stagnant regimes.

Note: Groups of 2 can simply pick 2 of the 3 examples above.

Step 3

As a group, the team writes their own version of the paper's Definition 3: Hidden Markov Model (see section 2.1.2.1 in the dissertation). The team will find a different/updated reference. This should be no more than 1–2 pages.

Step 4

For the design, each person carefully studies Figure 3.1 from the paper.

- a. Student A writes up to 5 pages that discuss the macro research, indicator identification, dataset retrieval, and data cleaning process.
- b. Student B writes up to 5 pages that discuss the regime process and explain how the relevant code from *hmms* works.
- c. Student C writes up to 5 pages that discuss how the network is trained using *pgmpy* and how the parameters are tested and validated.

Note: Groups of 2 should work on a. and then either b. or c.

Step 5

As a group, the three papers are combined to form one narrative that should be between 10–15 pages.

Step 6

For regime detection, each person carefully re-reads 4.2 (through 4.2.5) of the dissertation.

- a. Student A writes 1–2 pages explaining the process of transforming the time series.
- b. Student B writes 1–2 pages explaining how the parameters are learned. The Baum-Welch algorithm can be treated as a black box.
- c. Student C writes 1–2 pages on finding the most likely sequence of hidden states as the underlying regimes that generated the sequence of observed emissions. The Viterbi algorithm should be treated as a black box.

Note: Groups of 2 students can simply pick 2 of the 3 examples above.

Step 7

As a group, the team identifies the latent meaning behind each hidden state.

Step 8

For the Hill working example, each person carefully re-reads Section 4.2.6 of the paper.

Step 9

As a team, the group:

- a. implements the minimal working example of a Hill Climb search, and
- b. identifies the latent meaning behind each hidden state.

Submission Requirements and Format

One team member submits the following on behalf of the entire group:

1. **1 PDF document*** of all writing EXCLUDING code
 - Remember these are going to be sections of the mini-capstone project. Make sure that the write-up is a cohesive, well-organized text instead of simply a question-and-answer format.
 - Use the available Report Template and fill out the required information on the first page
2. **A zipped folder** including:
 - An executable Jupyter notebook** that includes the code, its output, and the answer to each question along with the solution
 - A duplicate version of the Jupyter notebook above in PDF or HTML format. In order to include the output of the code, you must RUN the code before downloading the PDF.

** **Use Google Docs to collaborate.** Start by uploading the Report Template provided in the Course Overview. Once your report is completed, click File → Download → PDF Document (.pdf) to obtain the copy for your submission.*

*** **Use Google Colab or GitHub to collaborate** in completing the executable Python program.*

NOTE: The PDF document must be uploaded **separately** from the zipped folder that includes any other types of files. This allows Turnitin to generate a similarity report.

Rubric

Your instructor will evaluate your group submission for GWP2 using the following rubric:

Quantitative Analysis (Open-Ended Questions)	Technical and Non-Technical Reports	Writing and Formatting
40 Points	30 Points	20 Points
<p>The group is able to apply results, formulas, and their knowledge of theory to real-life finance scenarios by doing the following:</p> <ul style="list-style-type: none"> • Providing all the necessary information to support their arguments. • Presenting arguments that reflect group discussion and research. • Using authoritative references to support a position and provide updated information. • Concluding with practical takeaways for more insightful financial decision-making. 	<p>Technical reports contain 3 parts:</p> <ol style="list-style-type: none"> 1. code for each question (be sure to explicitly state the question number), 2. the corresponding output of that code, and 3. <u>interpretations and/or recommended courses of action that reasonably follow from those results.</u> <p>Note: Technical reports will include the technicalities of models, such as names, methods of estimation, parameter values, etc., and exclude generalities about the work done. It should NOT include names of Python code that were used.</p>	<p>A submission that looks professional should:</p> <ul style="list-style-type: none"> • Include all items from the Submission Requirements and Format list • Include the axes, labels, and scales in graphs. • Be free of significant grammatical errors or typos. • Be an organized, well-structured, and easy-to-read document. • Include proper citations and a bibliography in MLA format.
	<p>Non-technical reports contain 3 parts:</p> <ol style="list-style-type: none"> 1. clear explanation of results; 2. the recommended course of action that follows; and 3. the identification of factors that impact each portfolio. <p>Note: AVOID all references to model names, algorithms, and unnecessary details. Instead, focus on the investment decision.</p>	