MScFE 660 RISK MANAGEMENT

Group Work Project # 1

[See grading rubric here](#).

Scenario

The 3 GWPs for Risk Management have two goals:

1. To work through examples of Bayesian nets
2. To help prepare you for your capstone project

Indeed, Risk Management is the last course you will take before your capstone. Let's get you prepared by guiding you through a mini-capstone project. Capstone projects require two big skills:

1. The selection and identification of a topic
2. Organizing your research skills into small, realistic tasks

For the 3 GWPs, we have done Step 1 for you: We have selected an example of a capstone that combines the topics of Bayesian networks and risk management. In this assignment, you'll focus on the second skill: how to complete a mini-capstone project step by step.

By the end of GWP1, you will have a thorough understanding of both the specific problem we are attempting to solve as well as the data needed to solve it. When completed, GWP1 looks like an introduction section that addresses the problem and a full description of the data used.

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.

By the end of GWP3, you will have added a results and interpretation section. The results should emphasize the findings from applying the methodology to the data and assessing whether the objective was fulfilled. The interpretation should analyze and evaluate the results and methodology.

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

Step 1

Individually, each student reads the following 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

Step 2

As a group, the team discusses and writes a 2–3 page problem formulation.

a. What is the problem the student's thesis attempts to solve?
b. Why are Bayesian networks well suited to solve it?
c. What are the advantages of using this methodology for this problem?

Step 3

Identify, import, structure, and graph macroeconomic, microeconomic, and geopolitical variables that affect the price of oil globally. Each person is assigned one group of data. Data is available at websites such as https://finance.yahoo.com/, .https://fred.stlouisfed.org/, https://www.sedar.com/search/search_form_pc_en.htm, https://www.eia.gov/opendata/, and https://data.world/datasets/oil.

Macroeconomic data focuses on data of countries and governments; microeconomic data on business and individual decisions; financial data on securities and markets.

Each person is responsible for identifying, importing, structuring, and graphing their data. Here are the roles:

a. Student A is the macroeconomic / geopolitical specialist
b. Student B is the microeconomic specialist
c. Student C is the financial specialist

Note: Groups of 2 students should eliminate one of the 2 choices (e.g. no microeconomic data)

Step 4

As a group, the team writes a dictionary of the data used and a table showing the data, frequency, source, start date, end date, and other relevant fields.

Step 5

Clean the data. Each person carefully reads Section 4.1 of the paper. Each person is responsible for one part of cleaning the data. Student A will do their part on ALL the data: macroeconomic, microeconomic, and geopolitical. Likewise, Student B will do their part on ALL the data. Likewise, Student C will do their part on all the data. This gives each person a chance to see all the data that was collected.

   a. Student A focuses on the "extreme outlier" part of cleaning. That is, they will identify values that are extreme compared to the rest of the data.
   b. Student B focuses on the "bad data" part of cleaning. That is, they will identify values that are wrong, questionable, or duplicated.
   c. Student C focuses on the "missing values" part of cleaning. That is, they will use a method of imputation, interpolation, or simulation, or some other method, to substitute reasonable values if and when there are missing values.

Step 6

As a group, all cleaning methods get combined to produce a "sterilized" version of the data. The group collaboratively writes why certain data points/events/periods of time were eliminated from the model's data.

Step 7

Run exploratory data analysis on the data. Each person addresses ALL datasets.

   a. Student A creates "distributional" plots.
   b. Student B creates "time series" plots.
   c. Student C creates "multivariate" plots (distributional and/or time series).

Step 8

As a group, answer the following questions on the cleaned data and plots:

   a. What makes oil prices look different from other asset prices? E.g., spikes, clustered volatility, seasonality, etc.
   b. What types of distributions do oil returns have?
   c. What type of autocorrelation do the oil returns have?
   d. What other stylized facts can you say about oil prices?

Step 9

Model. Each student writes a two-page summary of their respective topics. Please be sure to provide an overview of the big picture, NOT all the details. The two-page limit will be strictly enforced.

    a. Student A defines probabilistic graphic models. Be sure to distinguish belief networks and Markov networks.
    b. Student B illustrates parameter learning and distinguishes it from structure learning.
    c. Student C describes Markov chains and Markov blankets.

Step 10

As a group, the team writes their own pseudocode version of Algorithm1: Inferred Causality. This step requires that you combine pieces of step 9 (e.g., Markov blankets are needed to describe the Inferred Causality algorithm).

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 this is going to be part of your introduction to the mini-capstone project. Make sure that the write-up is a <u>cohesive, well-organized text</u> 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.
   - 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 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 GWP1 using the following rubric:

Quantitative Analysis (Open-Ended Questions) 40 Points	Technical and Non-Technical Reports 30 Points	Writing and Formatting 20 Points
The group is able to apply results, formulas, and their knowledge of theory to real-life finance scenarios by doing the following: ● 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.	Technical reports contain 3 parts: 1. **code** for each question (be sure to explicitly state the question number), 2. the corresponding output of that **code**, and 3. **interpretations** and/or **recommended courses of action** that reasonably follow from those results. **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.	A submission that looks professional should: ● 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.
	Non-technical reports contain 3 parts: 1. clear explanation of results; 2. the recommended course of action that follows; and 3. the identification of factors that impact each portfolio. **Note**: AVOID all references to model names, algorithms, and unnecessary details. Instead, focus on the investment decision.	