MScFE 622 STOCHASTIC MODELING

Group Work Project # 2

See grading rubric here.

Scenario

The portfolio management, derivatives management, and risk management leaders have determined that the models need to be more relevant for 'new normals'. That is, they want the desk to test for, and model, regime switching time series models. Your group will be responsible for illustrating a particular case in detail. The data will start in pre-COVID times in 2019, run through the pandemic, and come up through the third quarter of 2022 (end of September 2022). The group's work will serve as a rich example for both the asset management and risk management teams.

Tasks

Step 1

Each team member works individually collecting 1 financial time series. All the time series should be from 2 or more different asset classes (e.g. equities, rates, credits, cryptocurrencies). All the time series should span the years 2019 – 2022. Note that series need not be prices, but can include returns, volatilities, default probabilities, yields, etc.

Step 2

In groups:

a. All team members collaborate to produce visualizations of the series. In particular, the graphs show any regime changes in the series. Since the data bookends the COVID pandemic, there are likely going to be several regimes in the series. Students will identify the approximate dates of the regimes, and the levels of the series. The group then decides on 1 series to model.

b. All team members collaborate to Estimate a Markov-regime switching model for the selected financial time series. Estimate the model under different assumptions:

    i. Different number of states.

ii. Allowing the expected realization of the time series to differ across states (different “mus”), but with constant variance (same “sigma”).

iii. Allowing the variance of the time series to change across states (different “sigmas”), but with constant expectation (same “mu”).

iv. Allowing for different expectations and variances across states.

Step 3

Individually, each team member compares the performance of each model using standard information criteria from the estimates of the likelihood (Akaike, Schwarz…).

a. Member A will compare the models that had different mu values.
b. Member B will compare the models that had different sigma values.
c. Member C will compare the models that had different expectations and variances.
d. All members collaborate on combining the results and ranking the models from best to worst.

Note: For Groups of 2, please use the responsibilities for Members A and B only.

Step 4

In groups, all members collaborate by estimating the models assuming that the time series arises from an autoregressive process whose autoregressive coefficient changes depending on the state, altogether with the variance of the perturbance term (See for instance, section 22.4 of Hamilton, 1994).

Submission Requirements and Format

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

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1. **1 zipped folder** including:
    a. An executable Jupyter notebook* that includes the code, its output, and the answer to each question along with the solution
    b. 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.
2. **1 PDF document** containing ONLY the answers to the questions, EXCLUDING code

a. Use the available Report Template and fill out the required information in the first page.

***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 GWP2 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 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.	