**2nd Graded Problem Set: "Risk Measures with Stochastic Volatility Models"**

**Total Points:** 200

**Introduction**

In this problem set, you will implement and compare two different approaches for estimating financial risk measures:

1. Kalman Filter with Maximum Likelihood Estimation (MLE)
2. EGARCH model

You will use these methods to compute two important risk metrics:

* Value-at-Risk (VaR)
* Expected Shortfall (ES)

**Learning Objectives**

* Understand how to implement a Kalman Filter for stochastic volatility models
* Apply Maximum Likelihood Estimation (MLE) for parameter optimization
* Compare the Kalman Filter approach with EGARCH models
* Implement and interpret Value-at-Risk (VaR) and Expected Shortfall (ES)
* Assess model performance using coverage ratio analysis

**Evaluation Criteria**

To achieve a perfect score, your submission must include an accurate and convincing

1. Solution to KF\_ProblemSet\_Student\_MUSparsity.ipynb
2. Solution to KF\_ProblemSet\_Student\_Part2\_MUSparsity.ipynb
3. Report and slides (see Submission Requirements below)

**Submission Requirements**

Your submission must include:

* KF\_ProblemSet\_Student\_YOURNAMES.ipynb
* A **maximum** **five-page report** (11pt, including figures, tables, etc.).
* A **maximum of 12 presentation slides**, showcasing all relevant details.
  + **At least 5 slides must be non-Python-based** (motivation, theoretical explanations, visualizations, and insights).
  + **At least 3 slides must be Python-based**, demonstrating implementation and analysis.

**Final Notes**

* Ensure your report and presentation are **concise, well-organized, and professional**.
* Clearly justify all assumptions and methodological choices.
* Use high-quality visualizations to support your analysis.
* The Python code should be clean, efficient, and well-documented.
* We might pick a person by random to present the group’s solution

Good luck! 🚀