FINM 35000 Problem Set 3: Stress Testing

Instructor: Joanna Harris, TA: Lisheng Su

Due November 9, 2022, 6PM

Submission instructions: please submit one copy of the assignment per group. The submission should include a PDF or Word document with the written results, tables and figures and a separate code file (in a programming language of your choosing). Please make sure to write the names of all group members at the top of the writeup. Make sure your code would run on a third person's computer and submit your input files with your homework. The idea is that Lisheng can run your files to ensure that your code can run properly.

Stress testing an equity portfolio

Project market value changes of an equity portfolio from time0 to time1 based on the changes in the macroeconomic variables (MEVs) from the severely adverse economic domestic scenario of the Federal Reserve's Comprehensive Capital Analysis and Review (CCAR) 2021. Time0 is year-end 2020 and time1 is year-end 2021. To make the projections, you may need to map the changes of MEVs from time0 to time1 to the change in values of the stocks from time0 to time1. In addition to the scenario given above,

- Investment instruments: a portfolio of 20 stocks, 10 million share in each stock.
- Additional scenarios and historical data of the MEVs in the Fed scenarios. The Federal Reserve also provide scenario description narratives.
- Equity and Fama-French factor historical data (total returns)

a. Build and compare three approaches: CAPM, Fama-French, and a "general multi-factor" model.
   - The data file, wrds_data.xlsx (returns tab), contains historical equity and market data for CAPM and Fama-French. The Fed historical data also contains equity market data. You may need to reconcile the different equity market indices and choose one to use. The price tab in wrds_data.xlsx contains the historical prices of the stocks.
   - In the stress test, you will need to build a two-step regression for the Fama-French model. Use the 3-factor Fama-French model. In the first step, regress Fama-French factors as functions of the MEVs in the Fed scenario. In the second step, combine your regressions into the Fama-French model and project the time1 portfolio value in the scenario.
   - The general multi-factor model: Model the equity portfolio's scenario values directly as a function of the MEVs provided in the Fed scenario and project the time1 portfolio value in the scenario.
b. Conduct performance testing
   i. Stationarity.
   ii. Goodness of fit.

   iii. Residual analysis.

 c. Model risk assessment and controls

   i. Outcome analysis

- Discuss whether the beta coefficients used in forecasting should be derived from the "normal times" or from the "stressed times", or else?
- Back-test your portfolio value projections and discuss the reasonableness of each model's projections.
- Discuss the benchmarking results by comparing the reasonableness of each model's projections. Which model performs the best? Why?

   ii. Discuss the potential model risks in the forecasting process

- Model complexity and interpretability
- Discuss how bias and noise in the data might affect model performance
- Discuss how model search might cause uncertainties in the forecasts
- Which model is more prone to the Law of Small Numbers?

 d. Repeat steps a – c for the [supervisory baseline domestic scenario](#) and compare to the forecasting results from the severely adverse scenario.

Due on Canvas at or before 6:00PM Chicago time, Wednesday 11/9/2022.

Appendix.

- Ken French publishes on his website [SMB and HML returns with risk free rate](#). You may need to read the [construction method](#). The [website](#) also contains additional information.
- Recommended text for multi-factor modeling: ISLR, G.James, D. Witten, T.Hastie, R.Tibshirani, Springer 2013