

Instruction:

- You will need to submit a document AND your codes, just like regular homework;
- Please write all document into one single pdf file and upload it to E3. For the code, please zip them into one zip file, also submit to E3.
- If you have any question, feel free to email me.
- **DUE TIME: June 25th, 00:00 AM.**
- If, after the final project, your score is lower than pass, I will send a make-up project to you by July 1st, and you will have to finish it before July 5th.
- Last day of score submission: July 10th.

Problem 1. GARCH and SV models (40%)

For this problem, use the dataset **Dataset-GARCH.txt**. The dataset consists monthly return of Intel stock from 1973 to 2003.

- (5%): Transform the returns into log-return, and plot-out the time series of the log-return (note that the usual return is $\frac{P_{t+1}-P_t}{P_t}$, and the log return is $\log \frac{P_{t+1}}{P_t}$.)
- (10%): Build a GARCH model on this data.
- (5%) Based on the GARCH model you fit, compute 1-step to 5-step ahead volatility forecasts at the forecast origin December 2003.
- (10%) Now build an SV model on this data instead.
- (5%) Based on the SV model you fit, compute 1-step to 5-step ahead volatility forecasts at the forecast origin December 2003.
- (5%) For this data, between the GARCH and SV models, which one will you prefer? Why?

Problem 2. VAR model and Cointegration (30%)

For this problem, use the dataset **Dataset-VAR.txt**. The dataset consists the monthly U.S. 1-year (first column) and 3-year (second column) Treasury constant maturity rates from April 1953 to March 2004.

- (10%): Fit a VAR model on this data.
- (10%): Use the fitted VAR model to produce 1-step to 12-step ahead forecasts of the interest rates, assuming that the forecast origin is March 2004.
- (10%): Are the two interest rate series cointegrated? Use 5 % significance level to perform the test.

Problem 3. ARIMA model and Kalman Filter (30%)

For this problem, use the dataset **Dataset-ARIMA.txt**. The dataset consists the realized daily volatility series of Alcoa stock returns from January 2, 2003 to May 7, 2004. The volatility series is constructed using 20-minute intra-daily log returns.

- (a) (10%): Fit an $ARIMA(0, 1, 1)$ model on this data.
- (b) (10%): Estimate the local trend model in Equations (11.1) and (11.2) in the slide Week 11-1.
- (c) (5%): Obtain time plots for the filtered variables with pointwise 95 % confidence interval.
- (d) (5%): Obtain time plots for the smoothed variables with pointwise 95 % confidence interval.