

MIT SLOAN SCHOOL OF MANAGEMENT

Analytics of Finance
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15.450
Spring 2023

Problem Set 4

(Due: 1:00 PM, Thursday, April 20)

Instructions:

- Please submit your homework on Canvas. List the names of all of your team members and their IDs in your writeup. Each team only needs to submit once.
- Submit the following files: (1) a PDF file for the writeup of your answers to all the questions; (2) for each question that involves coding, a separate zip file with the code and data for that question.

1. Interview questions.

- (a) True or false (explain in words, not formula): A longer estimation window helps us estimate the baseline model coefficients more precisely, which in turn reduces the variance of the abnormal returns in the event window. Thus, we should make the estimation window as long as possible.
- (b) In an event study of stock returns around earnings announcements, how should we deal with the fact that multiple firms could announce their earnings on the same days?

2. Suppose that the daily log return of a security follows the model

$$r_t = 0.01 + 0.1r_{t-2} + \varepsilon_t$$

where ε_t is IID normal with mean zero and variance 0.02.

- (a) What are the mean and variance of the return series r_t ?
- (b) Compute the lag-1 and lag-2 autocorrelations of r_t .
- (c) Assume that $r_{100} = -0.01$, and $r_{99} = 0.02$. Compute the 1- and 2-step-ahead forecasts of the return series at the forecast origin $t = 100$. What are the associated standard deviations of the forecast errors?

3. Inflation Forecasting.

In the latest Labor Department release this week, the consumer-price index rose 5% in March from a year earlier, down from February's 6% increase and the smallest gain since May 2021. But will inflation keep falling in the coming months? This is a critical question facing the Federal Reserve and all market participants. As the WSJ puts it, *"U.S. inflation eased in March to its lowest level in nearly two years, but underlying price pressures likely keep the door open for the Federal Reserve to consider another interest-rate increase at its May meeting."*

Here, we will build a time series model to make our own inflation forecasts.

- (a) From [FRED](#), download the "Consumer Price Index for All Urban Consumers: All Items in U.S. City Average" (seasonally adjusted). In each month, compute the inflation rate as percentage change in the price index from a year ago: $\pi_t = P_t/P_{t-12} - 1$, where P_t is the price index level in month t . Plot the series of π_t . Also plot the autocorrelation function ρ_k from 1 to 12 lags.

$$\rho_k = \frac{Cov(x_t, x_{t-k})}{\sqrt{Var(x_t)}\sqrt{Var(x_{t-k})}}$$

- (b) In the sample that ends in December 2020, estimate an AR(1), AR(2), and AR(3) for inflation rates. Use AIC to select the best model.
- (c) Use the selected model in Part (b) and all the data available by Mar 2023 to forecast inflation rates in the next five months.