Midterm 1
Financial Econometrics, Econ 40357
University of Notre Dame
Prof. Mark
Due 1:45 p.m. Thursday 13 October

100 points total. Here are the **rules**: Test is open book, open note, open internet, but you may not communicate with any other people in any way. Any such communication will be considered cheating. Do not cheat! Submit via Canvas, a pdf of your own work by 1:45 p.m. Thursday 13 October. No late submissions (no exceptions).

1. (5 points) Write-up entirely with word processor, organized, and name written at top of first page.

2. (10 points) In words, explain what is Newey-West and why we use it?

   `It is a formula for computing the regression slope coefficient standard errors when the regression error is serially correlate or exhibits conditional heteroskedasticity (or both).`

3. (10 points: 2 points each) Consider the time series

$$y_t = 0.015 + \epsilon_t + 0.9\epsilon_{t-1} + 0.9\epsilon_{t-2} + 0.8\epsilon_{t-3}$$

   where $\epsilon_t \overset{iid}{\sim} (0, 1)$. **Provide numerical answers.**

   (a) What is $E(y_t)$?

$$0.015$$

   (b) What is $\text{Var}(y_t)$?

$$3.26 = 1 + 0.9^2 + 0.9^2 + 0.8^2$$

   (c) What is the first-order autocorrelation of y_t?

$$2.43 = \gamma_1 = \mathrm{E}\left(\epsilon_t + 0.9\epsilon_{t-1} + 0.9\epsilon_{t-2} + 0.8\epsilon_{t-3}\right)\left(\epsilon_{t-1} + 0.9\epsilon_{t-2} + 0.9\epsilon_{t-3} + 0.8\epsilon_{t-4}\right)$$

$$0.745\,40 = \frac{2.43}{3.26} = \rho_1$$

   (d) What is the second-order autocorrelation of y_t?

$$1.62 = \gamma_2 = \mathrm{E}\left(\epsilon_t + 0.9\epsilon_{t-1} + 0.9\epsilon_{t-2} + 0.8\epsilon_{t-3}\right)\left(\epsilon_{t-2} + 0.9\epsilon_{t-3} + 0.9\epsilon_{t-4} + 0.8\epsilon_{t-5}\right)$$

$$0.496\,93 = \frac{1.62}{3.26} = \rho_2$$

   (e) What is the fourth-order autocorrelation of y_t?
   0

4. (10 points) Consider the model

$$\begin{aligned} y_t &= 0.1 + 0.5x_t + \epsilon_t \\ x_t &= 0.9x_{t-1} + u_t \end{aligned}$$

where $\epsilon_t \overset{iid}{\sim} (0,1)$ and $u_t \overset{iid}{\sim} (0,1)$. Suppose $x_t = 100$. What is the optimal (best) forecast for y_{t+1} conditional on information available at t? **Report only the numerical value of your forecast.**

$$45.1 = 0.1 + (0.5)(0.9)\,100$$

5. (25 points: 5 points each) Consult Sheet01 from the accompanying Eviews workfile. You will test the hypothesis that $r01$ is normally distributed.

   (a) What test statistic do you use for this test?

   Jarque-Bera Statistic

   (b) What departures from normality does this test statistic measure?

   It jointly examines skewness and kurtosis relative to the normal.

   (c) How is the test statistic distributed under the null hypothesis?

   Chi-square with 2 degrees of freedom

   (d) Report the test statistic for $r01$.

   138750.7

   (e) Explain the results of your test. Normality is strongly rejected. Primarily due to tail thickness.

6. (10 points) Consult Sheet01 from the accompanying Eviews workfile. The last observation for $r01$ is 05/10/2023. Using all the data, estimate an ARMA(2,2) model for $r01$. Use your results to forecast $r01$ for 05/11/2023 and 05/12/2023. **Report the numerical value of your forecasts.**

Here, $t = 05/10/2023. r_{t-1} = -0.00277, r_t = -0.02097, \epsilon_{t-1} = -0.003539628, \epsilon_t = -0.021084637, \rho_1 = 0.126226,$

$\rho_2 = 0.706492, \theta_1 = -0.114136, \theta_2 = -0.724068, c = 0.000440$

$$\begin{aligned} r_t &= c + \rho_1 r_{t-1} + \rho_2 r_{t-2} + \theta_1\epsilon_{t-1} + \theta_2\epsilon_{t-2} + \epsilon_t \\ E_t(r_{t+1}) &= c + \rho_1 r_t + \rho_2 r_{t-1} + \theta_1\epsilon_t + \theta_2\epsilon_{t-1} \\ E_t(r_{t+2}) &= E_t(c + \rho_1 r_{t+1} + \rho_2 r_t + \theta_1\epsilon_{t+1} + \theta_2\epsilon_t) \\ &= c + \rho_1 E_t(r_{t+1}) + \rho_2 r_t + \theta_2\epsilon_t \end{aligned}$$

$$\begin{aligned} E_t(r_{t+1}) &= 8.0551 \times 10^{-4} \\ &= 0.000440 + 0.126226(-0.02097) + 0.706492(-0.00277) + (-0.114136)(-0.021084637) + (-0.724068 \end{aligned}$$

$$\begin{aligned} E_t(r_{t+2}) &= 9.9325 \times 10^{-4} \\ &= 0.000440 + 0.126226\left(8.0551 \times 10^{-4}\right) + (0.706492)(-0.02097) + (-0.724068)(-0.021084637) \end{aligned}$$

7. (15 points: 5 points each) Consult Sheet02 from the accompanying Eviews workfile. rp is the daily rate of return on a portfolio and rf is the daily risk-free rate of return. These are stated as pure numbers (not percent).

   (a) **Report the numerical** mean excess return on the portfolio.

   `0.000266`

   Estimate a GARCH(1,1) model for rp

$$
\begin{aligned}
rp_t &= c + \epsilon_t \\
\epsilon_t &\sim N\left(0, \sigma_t^2\right) \\
\sigma_t^2 &= \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \beta \sigma_{t-1}^2
\end{aligned}
$$

   Convert the estimated conditional variance series to a conditional standard deviation series.

   (b) Using the mean excess return from part (a) and the estimated conditional standard deviation series from part (b), what was the Sharpe ratio on 2/24/2021?

$$\text{Sharpe} = 0.004\,336\,3 = \frac{0.000266}{0.061343058}$$

   (c) What was the Sharpe ratio on 12/17/2020?

$$\text{Sharpe} = 0.04414\,5 = \frac{0.000266}{0.006025659}$$

8. Event study. Use sheet03 in the Eviews workfile, or sheet3 in the Excel file. The event in question is the date at which a firm was included in an index. The data are abnormal returns $AR_{t,i}$, in event time, from the regression

$$r_{t,i} = \hat{\alpha}_i + \hat{\beta}_i r_{t,m} + AR_{t,i}$$

for firms $i = 1, ..., 5$. I've already estimated α and β with observations $1 - 259$ (the pre-event window). Observation 260 is the event date. We will use observations $260 - 290$ as the event window. Assume $AR_{t,i} \sim N\left(0, \sigma_i^2\right)$

   (a) (8 points) For each firm, individually test the hypothesis that the event had no effect on its cumulated abnormal return. Report the **numerical value** of the 5 test statistics and the results of each test (i.e., reject or do not reject).

-1.277010156
-0.490186042
-0.281442034
0.711562539
-1.780129866

   `Only one (firm 5) is significant at the 5 % level.`

   (b) (7 points) Test the null hypothesis that the event had no effect on the cumulated abnormal return, averaged across all firms. Report the **numerical value** of the test statistic and the result of the test.

$$-1.26542459$$

   `Does not reject`