Financial Econometrics 2026
Shanghai Jiao Tong University
Summer School 2026
Quiz 3

Reading time: 10 minutes. **Writing time:** 60 minutes.
Total marks: 100. **Calculators are permitted.**
Instructions: Answer **all** questions. In Section A, circle the letter of the single best answer. In Sections B and C, show your working and write in clear sentences. Standard errors are as stated in each question.

Structure:

- **Section A** — Multiple choice: 20 questions, 2.5 marks each (**50 marks**).
- **Section B** — One analytical problem in five parts (**30 marks**).
- **Section C** — One short interpretation (**20 marks**).

Useful facts. $t = \dfrac{\text{estimate} - \text{claimed value}}{SE}$; 95% CI = estimate $\pm\, 1.96\, SE$; annualised quarterly growth $= 400\,\Delta \ln(\text{level})$; first-difference slope $= \dfrac{\sum \Delta X\, \Delta Y}{\sum (\Delta X)^2}$; sign of omitted-variable bias $= \text{sign}\big[\text{corr}(X, Z) \times \text{effect of } Z \text{ on } Y\big]$; AR(1) long-run mean $= \dfrac{\beta_0}{1 - \beta_1}$; one-step forecast $\widehat{Y}_{T+1|T} = \widehat{\beta}_0 + \widehat{\beta}_1 Y_T$; forecast error = actual − forecast; 95% forecast interval = forecast $\pm\, 1.96\,$RMSFE, with RMSFE $\approx$ SER in large samples; $\text{BIC}(p) = \ln\big(SSR(p)/T\big) + (p+1)\frac{\ln T}{T}$, and AIC replaces $\ln T$ with 2; 5% critical values of F: 3.84 ($q = 1$), 3.00 ($q = 2$).

Section A: Multiple Choice (20 questions × 2.5 marks = 50 marks)

1. In a panel regression, entity fixed effects control for:

(A) omitted factors that vary over time within each entity.

(B) omitted factors that are constant over time within each entity.

(C) omitted shocks that hit every entity in the same period.

(D) measurement error in the regressor of interest.

2. A researcher estimates entity fixed effects for a panel of 300 firms by the dummy-variable method, keeping the intercept in the regression. To avoid perfect multicollinearity she must include:

(A) 300 firm dummies.

(B) 1 firm dummy.

(C) 301 firm dummies.

(D) 299 firm dummies.

3. Two banks are observed in 2015 and 2020. Bank North: leverage X goes $10 \to 12$, ROE Y goes $12 \to 10$. Bank South: X goes $16 \to 18$, Y goes $16 \to 13$. The first-difference (within) slope estimate is:

(A) -1.25.

(B) $+1.25$.

(C) -0.63.

(D) -2.50.

4. In the two-way model $Y_{it} = \beta_1 X_{it} + \alpha_i + \lambda_t + u_{it}$, the time effects λ_t absorb:

(A) shocks in period t that are common to all entities, such as a market-wide movement.

(B) each entity's permanent characteristics, such as its home country.

(C) entity-specific factors that change from period to period.

(D) serial correlation in the regression's error terms.

5. A fixed-effects slope is -0.60. The ordinary standard error is 0.20; the standard error clustered by entity is 0.40. Using the appropriate standard error, the t-statistic and the 5% verdict are:

(A) $t = -3.0$; reject $H_0 : \beta_1 = 0$.

(B) $t = -1.5$; reject $H_0 : \beta_1 = 0$.

(C) $t = -1.5$; do not reject $H_0 : \beta_1 = 0$.

(D) $t = -3.0$; do not reject $H_0 : \beta_1 = 0$.

6. Even with entity *and* time fixed effects, a panel regression still fails to control for:

(A) permanent differences in culture across entities.

(B) a common shock that hits all entities in one period.

(C) fixed geographic traits of each entity.

(D) a confounder that varies both across entities and over time.

7. Across all states and years, the slope of the traffic fatality rate on the beer tax is $+0.36$; with state fixed effects it is -0.66. By the omitted-variable-bias sign rule, this pattern is consistent with an omitted *fixed* state trait that:

(A) raises road deaths and is negatively correlated with the beer tax.

(B) raises road deaths and is positively correlated with the beer tax.

(C) raises road deaths but is uncorrelated with the beer tax.

(D) lowers road deaths and is positively correlated with the beer tax.

8. A firm's regressor X takes the values 4, 6, 8 over three years. After entity demeaning (the within transformation), the firm's transformed values are:

(A) $4,\ 6,\ 8$.

(B) $0,\ 2,\ 4$.

(C) $-2,\ 0,\ 2$.

(D) $-4,\ -2,\ 0$.

9. The reason standard errors must be clustered by entity in a panel is that:

(A) the slope estimate is biased unless the errors are independent.

(B) the errors are correlated across different entities in the same period.

(C) clustering shrinks the standard errors and so raises power.

(D) an entity's errors are serially correlated, so ordinary standard errors are too small.

10. In a firm fixed-effects regression, the coefficient on a regressor that never changes within any firm (for example, the firm's country of incorporation):

(A) is estimated more precisely, because the variable is stable.

(B) cannot be estimated, because demeaning removes the variable entirely.

(C) is numerically identical to the pooled OLS coefficient.

(D) is estimated consistently provided the standard errors are clustered.

11. Quarterly real GDP rises from 15,382 to 15,428 (billions). The growth rate at an annual rate, $400\,\Delta\ln(GDP)$, is closest to:

(A) 1.20%.

(B) 0.30%.

(C) 0.075%.

(D) 4.80%.

12. The first autocorrelation of quarterly GDP growth is 0.34. This means that:

(A) 34% of the variance of growth is explained by the previous quarter.

(B) growth this quarter is expected to be 0.34 points higher than last quarter.

(C) above-average growth quarters tend to be followed by above-average growth.

(D) the series is nonstationary, because its memory has not died out at lag one.

13. An AR(1) for GDP growth is $\widehat{Y}_t = 1.991 + 0.344\,Y_{t-1}$. The last observed value is $Y_T = 0.15$, and the next quarter's actual outcome is 1.1. The forecast error is closest to:

(A) +0.9.

(B) +1.1.

(C) −0.9.

(D) +2.0.

14. The one-step forecast error has two sources: the future shock u_{T+1} and coefficient-estimation error. As the estimation sample grows very large:

(A) both sources shrink towards zero.

(B) the estimation part shrinks, but the future-shock part remains.

(C) the future-shock part shrinks, but the estimation part remains.

(D) neither source of error is reduced.

15. A one-step forecast of GDP growth is 2.0% with RMSFE = 3.16. The 95% forecast interval is closest to:

(A) (1.6, 2.4).

(B) (−1.2, 5.2).

(C) (−3.2, 7.2).

(D) (−4.2, 8.2).

16. A 95% forecast interval for Y_{T+1} is much wider than a 95% confidence interval for the regression line at the same point because:

(A) it must also cover the future shock u_{T+1}, not just the estimated mean.

(B) it uses the small-sample t cutoff in place of 1.96.

(C) it is centred on the long-run mean rather than on the forecast.

(D) it must be computed with clustered standard errors.

17. A stationary AR(1) is estimated as $Y_t = 1.2 + 0.6\,Y_{t-1} + u_t$. The long-run (unconditional) mean of Y is:

(A) 1.2.

(B) 2.0.

(C) 0.75.

(D) 3.0.

18. In an ADL model of GDP growth with two lags of the term spread, the F-statistic on the two spread lags is 4.43 (the 5% critical value for $q = 2$ is 3.00). The correct conclusion is that:

(A) movements in the spread cause movements in GDP growth.

(B) past values of the spread help predict growth, given growth's own lags.

(C) past values of growth also help predict the term spread.

(D) the two spread coefficients are each individually significant at 5%.

19. For an AR(1) with $T = 204$, the fit term is $\ln\big(SSR(1)/T\big) = 2.289$ and $\frac{\ln T}{T} = 0.026$. The BIC is:

(A) 2.289.

(B) 2.315.

(C) 2.341.

(D) 2.309.

20. An AR(1) fitted to 516 months of excess stock returns gives a slope of 0.050 with standard error 0.051 and $\bar{R}^2 = 0.0006$. The best reading of this output is that it is:

(A) consistent with efficient markets: past returns carry no usable forecast power.

(B) a sign the model needs more of its own lags before it is informative.

(C) evidence of momentum that a low-cost trader could exploit.

(D) a sign that the sample of 516 months is too short for reliable inference.

Section B: Analytical Problem (30 marks)

An analyst at a London asset manager studies the profitability of European banks and then turns to forecasting her own firm's business.

Part 1 (panel). She has a balanced panel of 40 banks observed yearly over 2010 to 2024. She regresses each bank's return on equity ROE (in %) on its leverage ratio LEV (assets/equity) and obtains:

Specification	Slope on LEV	Standard error
Pooled OLS	$+0.25$	(0.06)
Bank fixed effects, ordinary SE	-0.40	(0.15)
Bank fixed effects, clustered by bank	-0.40	(0.25)

Part 2 (forecasting). She then fits an AR(1) to $T = 120$ quarters of the firm's growth in assets under management, g_t (in % per quarter):

$$\widehat{g}_t \;=\; 0.90 \;+\; 0.55\, g_{t-1}, \qquad \bar{R}^2 = 0.30, \quad \text{SER} = 1.80,$$

and the most recent observation is $g_T = 5.0$.

(a) **[6 marks]** The slope on LEV changes from $+0.25$ (pooled) to -0.40 (bank fixed effects). Explain what the fixed effects control for, and use the omitted-variable-bias sign rule to describe an omitted bank trait that could produce this pattern.

(b) **[6 marks]** Compute the t-statistic for the fixed-effects slope using the ordinary standard error and again using the clustered standard error. State which inference is valid, why, and the 5% conclusion.

(c) **[6 marks]** Give one example of a confounder that survives *bank* fixed effects, and explain what adding *year* fixed effects would control for and what it still would not.

(d) **[6 marks]** Using the AR(1), compute the one-quarter-ahead forecast $\widehat{g}_{T+1}$ and the long-run mean of g_t. Is the process stationary? Explain in one sentence why the forecast lies between the latest value and the long-run mean.

(e) **[6 marks]** Construct an approximate 95% forecast interval for g_{T+1}, taking the RMSFE to be the SER. Name the two components of the RMSFE, say which one the SER captures here and why the other is small, and explain in one sentence why such a wide interval is the honest way to report this forecast.

Section C: Interpretation (20 marks)

Read the following and answer in **no more than five sentences**. Use the concepts from the course; you do not need any calculation.

An adviser at a wealth manager markets a "return-timing model" for a stock index. Using 20 *years of monthly excess returns, he fitted AR models with one to twelve lags and kept the specification with the highest $\bar{R}^2$: an AR(11) with $\bar{R}^2 = 0.09$ and three individually significant lag coefficients. His brochure concludes that "the market is predictable and subscribers will beat it." A colleague reruns the exercise and reports two findings: the BIC selects zero lags; and when the AR(11), estimated on the first fifteen years only, is used to forecast the final five years, its RMSFE is larger than the RMSFE of simply forecasting the historical average return every month.*

Question [20 marks]. Explain why the adviser's in-sample evidence does not establish predictability, what each of the colleague's two findings shows, and how the efficient-markets view accounts for all of these results. Answer in at most five sentences.