Chapter 11 Discussion Problems

Jake Anderson

ECON 104 – UCLA

Outline

Problem 11.12: Wage Equation for Married Women

Suppose you want to estimate a wage equation for married women:

$$\log(WAGE) = \beta_1 + \beta_2 HOURS + \beta_3 EDUC + \beta_4 EXPER + \beta_5 EXPER^2 + e_1$$

where *WAGE* is the hourly wage, *HOURS* is number of hours worked per week, *EDUC* is years of education, and *EXPER* is years of experience.

Problem 11.12: Wage Equation for Married Women

Suppose you want to estimate a wage equation for married women:

$$\log(WAGE) = \beta_1 + \beta_2 HOURS + \beta_3 EDUC + \beta_4 EXPER + \beta_5 EXPER^2 + e_1$$

where *WAGE* is the hourly wage, *HOURS* is number of hours worked per week, *EDUC* is years of education, and *EXPER* is years of experience.

Your classmate observes that there may be an auxiliary relationship:

$$HOURS = \alpha_1 + \alpha_2 \log(WAGE) + \alpha_3 KIDS + \alpha_4 \log(HWAGE) + e_2$$

where *KIDS* is the number of children under age six and *HWAGE* is the husband's wage rate.

Problem 11.12 (a): OLS Estimation

(a) Can the wage equation be estimated satisfactorily using the OLS estimator? If not, why not?

Problem 11.12 (a): OLS Estimation

(a) Can the wage equation be estimated satisfactorily using the OLS estimator? If not, why not?

Solution:
The wage equation **cannot** be satisfactorily estimated with OLS.

Problem 11.12 (a): OLS Estimation

(a) Can the wage equation be estimated satisfactorily using the OLS estimator? If not, why not?

Solution:
The wage equation **cannot** be satisfactorily estimated with OLS.

Why? If the auxiliary relationship is true:

- $HOURS$ depends on $\log(WAGE)$
- But in the wage equation, $HOURS$ is a regressor
- This creates **endogeneity bias** on $\hat{\beta}_2$

Problem 11.12 (a): OLS Estimation

(a) Can the wage equation be estimated satisfactorily using the OLS estimator? If not, why not?

Solution:
The wage equation **cannot** be satisfactorily estimated with OLS.

Why? If the auxiliary relationship is true:

- $HOURS$ depends on $\log(WAGE)$
- But in the wage equation, $HOURS$ is a regressor
- This creates **endogeneity bias** on $\hat{\beta}_2$

The problem: $\text{Cov}(HOURS, e_1) \neq 0$ because wages affect hours, which means the error term is correlated with the regressor.

Problem 11.12 (b): Identification

(b) Is the wage equation "identified"? What does the term identification mean in this context?

Problem 11.12 (b): Identification

(b) Is the wage equation "identified"? What does the term identification mean in this context?

Solution:
The wage equation **is identified**.

Problem 11.12 (b): Identification

(b) Is the wage equation "identified"? What does the term identification mean in this context?

Solution:

The wage equation **is identified**.

What does "identification" mean?

- We need at least one instrument that shifts *HOURS* without directly affecting *WAGE*
- The instrument must be correlated with *HOURS* (relevance)
- The instrument must be uncorrelated with e_1 (exogeneity)

Problem 11.12 (b): Identification

(b) Is the wage equation "identified"? What does the term identification mean in this context?

Solution:

The wage equation **is identified**.

What does "identification" mean?

- We need at least one instrument that shifts *HOURS* without directly affecting *WAGE*
- The instrument must be correlated with *HOURS* (relevance)
- The instrument must be uncorrelated with e_1 (exogeneity)

Our instruments:

- *KIDS* – affects hours worked (childcare) but not hourly wage directly
- $\log(HWAGE)$ – husband's wage affects wife's labor supply but not her wage rate

Problem 11.12 (c): Alternative Estimation Procedure

- If you seek an alternative to least squares estimation, suggest an estimation procedure and how it is carried out step by step.

Problem 11.12 (c): Alternative Estimation Procedure

- (c) If you seek an alternative to least squares estimation, suggest an estimation procedure and how it is carried out step by step.

Solution: Two-Stage Least Squares (2SLS)

Problem 11.12 (c): Alternative Estimation Procedure

- (c) If you seek an alternative to least squares estimation, suggest an estimation procedure and how it is carried out step by step.

Solution: Two-Stage Least Squares (2SLS)
Step 1: Estimate the reduced-form equation for *HOURS*:

$$HOURS = \theta_1 + \theta_2 EDUC + \theta_3 EXPER + \theta_4 EXPER^2 + \theta_5 KIDS + \theta_6 \log(HWAGE) + u$$

Problem 11.12 (c): Alternative Estimation Procedure

(c) If you seek an alternative to least squares estimation, suggest an estimation procedure and how it is carried out step by step.

Solution: Two-Stage Least Squares (2SLS)
Step 1: Estimate the reduced-form equation for $HOURS$:

$$HOURS = \theta_1 + \theta_2 EDUC + \theta_3 EXPER + \theta_4 EXPER^2 + \theta_5 KIDS + \theta_6 \log(HWAGE) + u$$

Step 2: Obtain fitted values $\widehat{HOURS}$ from this regression

Problem 11.12 (c): Alternative Estimation Procedure

- If you seek an alternative to least squares estimation, suggest an estimation procedure and how it is carried out step by step.

Solution: Two-Stage Least Squares (2SLS)
Step 1: Estimate the reduced-form equation for *HOURS*:

$$HOURS = \theta_1 + \theta_2 EDUC + \theta_3 EXPER + \theta_4 EXPER^2 + \theta_5 KIDS + \theta_6 \log(HWAGE) + u$$

Step 2: Obtain fitted values $\widehat{HOURS}$ from this regression
Step 3: Estimate the wage equation replacing *HOURS* with $\widehat{HOURS}$:

$$\log(WAGE) = \beta_1 + \beta_2 \widehat{HOURS} + \beta_3 EDUC + \beta_4 EXPER + \beta_5 EXPER^2 + e_1$$

Problem 11.12 (d): Additional Conditions

(d) Other than the identification condition, are there any other conditions that must be met to confidently use the 2SLS procedure?

Problem 11.12 (d): Additional Conditions

(d) Other than the identification condition, are there any other conditions that must be met to confidently use the 2SLS procedure?

Solution:
The instruments must be **strong** (not weak).

Problem 11.12 (d): Additional Conditions

(d) Other than the identification condition, are there any other conditions that must be met to confidently use the 2SLS procedure?

Solution:
The instruments must be **strong** (not weak).

How to check:

- Test whether θ_5 and θ_6 are **jointly significant** in the first-stage regression
- Compute the F-statistic for joint significance
- Rule of thumb: $F > 10$ for strong instruments

Problem 11.12 (d): Additional Conditions

(d) Other than the identification condition, are there any other conditions that must be met to confidently use the 2SLS procedure?

Solution:
The instruments must be **strong** (not weak).

How to check:

- Test whether θ_5 and θ_6 are **jointly significant** in the first-stage regression
- Compute the F-statistic for joint significance
- Rule of thumb: $F > 10$ for strong instruments

Why does this matter?

- If instruments are weak, they don't shift *HOURS* enough
- 2SLS estimates will be biased toward OLS
- Standard errors and test statistics will be unreliable

Outline

Problem 11.20: Chicken (Broiler) Demand

This exercise examines a supply and demand model for edible chicken ("broilers").

Demand equation:

$$\log(Q_t) = \alpha_1 + \alpha_2 \log(P_t) + \alpha_3 \log(Y_t) + \alpha_4 \log(PB_t) + \alpha_5 POPGRO_t + e_t^d$$

where:

- Q = per capita consumption of chicken (pounds)
- P = real price of chicken
- Y = real per capita income
- PB = real price of beef
- $POPGRO$ = rate of population growth

Problem 11.20 (a): Endogenous vs Exogenous

(a) What are the endogenous variables? What are the exogenous variables?

Problem 11.20 (a): Endogenous vs Exogenous

(a) What are the endogenous variables? What are the exogenous variables?

Solution:
Endogenous variables (determined within the system):

- Price P – determined by supply and demand interaction
- Quantity Q – determined by supply and demand interaction

Problem 11.20 (a): Endogenous vs Exogenous

(a) What are the endogenous variables? What are the exogenous variables?

Solution:
Endogenous variables (determined within the system):

- Price P – determined by supply and demand interaction
- Quantity Q – determined by supply and demand interaction

Exogenous variables (determined outside the system):

- Real per capita income Y
- Real price of beef PB
- Population growth $POPGRO$

Problem 11.20 (a): Endogenous vs Exogenous

(a) What are the endogenous variables? What are the exogenous variables?

Solution:
Endogenous variables (determined within the system):

- Price P – determined by supply and demand interaction
- Quantity Q – determined by supply and demand interaction

Exogenous variables (determined outside the system):

- Real per capita income Y
- Real price of beef PB
- Population growth $POPGRO$

Key insight: P and Q are jointly determined – this is why OLS will be biased.

Problem 11.20 (b): OLS Estimation

- (b) Using data from 1960 to 1999, estimate the demand equation by OLS. Comment on the signs and significance.

Problem 11.20 (b): OLS Estimation

(b) Using data from 1960 to 1999, estimate the demand equation by OLS. Comment on the signs and significance.

Solution:
OLS Results:

- $\log(P)$: coefficient is **negative** but **not significant**
- $\log(Y)$: coefficient is **positive** and **significant** (income elasticity)
- $\log(PB)$: coefficient is **negative** but **not significant**
- $POPGRO$: coefficient is **positive** and **significant**

Problem 11.20 (b): OLS Estimation

- (b) Using data from 1960 to 1999, estimate the demand equation by OLS. Comment on the signs and significance.

Solution:
OLS Results:

- $\log(P)$: coefficient is **negative** but **not significant**
- $\log(Y)$: coefficient is **positive** and **significant** (income elasticity)
- $\log(PB)$: coefficient is **negative** but **not significant**
- $POPGRO$: coefficient is **positive** and **significant**

Problem: The price coefficient should be negative and significant for demand. The insignificance suggests endogeneity bias is masking the true relationship.

Problem 11.20 (c): Testing for Serial Correlation

- Test the OLS residuals for serial correlation using a correlogram and the $T \times R^2$ test.

Problem 11.20 (c): Testing for Serial Correlation

(c) Test the OLS residuals for serial correlation using a correlogram and the $T \times R^2$ test.

Solution:
Correlogram: Shows significant autocorrelation at lags 1 and 2.

Problem 11.20 (c): Testing for Serial Correlation

(c) Test the OLS residuals for serial correlation using a correlogram and the $T \times R^2$ test.

Solution:
Correlogram: Shows significant autocorrelation at lags 1 and 2.

Breusch-Godfrey $T \times R^2$ test:

- Regress $\hat{e}_t$ on $\hat{e}_{t-1}$, $\hat{e}_{t-2}$, and original regressors
- Test statistic: $N \times R^2$ is much greater than $\chi^2_{0.95,2} = 5.99$

Problem 11.20 (c): Testing for Serial Correlation

(c) Test the OLS residuals for serial correlation using a correlogram and the $T \times R^2$ test.

Solution:
Correlogram: Shows significant autocorrelation at lags 1 and 2.

Breusch-Godfrey $T \times R^2$ test:

- Regress $\hat{e}_t$ on $\hat{e}_{t-1}$, $\hat{e}_{t-2}$, and original regressors
- Test statistic: $N \times R^2$ is much greater than $\chi^2_{0.95,2} = 5.99$

Conclusion: Reject the null hypothesis of no serial correlation. The residuals are autocorrelated.

Problem 11.20 (d): 2SLS Estimation

(d) Estimate the demand equation by 2SLS using instruments: $\log(PF_t)$, $TIME_t$, $\log(QPROD_{t-1})$, and $\log(EXPTS_{t-1})$.

Problem 11.20 (d): 2SLS Estimation

(d) Estimate the demand equation by 2SLS using instruments: $\log(PF_t)$, $TIME_t$, $\log(QPROD_{t-1})$, and $\log(EXPTS_{t-1})$.

Solution:
2SLS Results:

- $\log(P)$: now **negative and significant** at 10% level
- Other coefficients largely unchanged

Problem 11.20 (d): 2SLS Estimation

(d) Estimate the demand equation by 2SLS using instruments: $\log(PF_t)$, $TIME_t$, $\log(QPROD_{t-1})$, and $\log(EXPTS_{t-1})$.

Solution:
2SLS Results:

- $\log(P)$: now **negative and significant** at 10% level
- Other coefficients largely unchanged

Key improvement: The price elasticity (α_2) now has the expected negative sign and is statistically significant.

Problem 11.20 (d): 2SLS Estimation

(d) Estimate the demand equation by 2SLS using instruments: $\log(PF_t)$, $TIME_t$, $\log(QPROD_{t-1})$, and $\log(EXPTS_{t-1})$.

Solution:
2SLS Results:

- $\log(P)$: now **negative and significant** at 10% level
- Other coefficients largely unchanged

Key improvement: The price elasticity (α_2) now has the expected negative sign and is statistically significant.

Why did this help? The instruments shift the supply curve, allowing us to trace out the demand curve and identify the true price-quantity relationship.

Problem 11.20 (e): First-Stage and Instrument Strength

- (e) Estimate the first-stage equation and test the joint significance of the instruments. Can we conclude that at least one instrument is strong?

Problem 11.20 (e): First-Stage and Instrument Strength

- (e) Estimate the first-stage equation and test the joint significance of the instruments. Can we conclude that at least one instrument is strong?

Solution:

First-stage regression: regress $\log(P)$ on all instruments and exogenous variables.

Problem 11.20 (e): First-Stage and Instrument Strength

(e) Estimate the first-stage equation and test the joint significance of the instruments. Can we conclude that at least one instrument is strong?

Solution:

First-stage regression: regress $\log(P)$ on all instruments and exogenous variables.

F-test for joint significance:

- F-statistic $>$ critical value $\Rightarrow$ instruments are jointly significant
- However, $F < 10$ (rule of thumb threshold)

Problem 11.20 (e): First-Stage and Instrument Strength

(e) Estimate the first-stage equation and test the joint significance of the instruments. Can we conclude that at least one instrument is strong?

Solution:
First-stage regression: regress $\log(P)$ on all instruments and exogenous variables.

F-test for joint significance:

- F-statistic $>$ critical value $\Rightarrow$ instruments are jointly significant
- However, $F < 10$ (rule of thumb threshold)

Conclusion: The instruments are **weak**. While statistically significant, they may not shift price enough to produce reliable 2SLS estimates.

Problem 11.20 (f)–(g): Serial Correlation in First Stage

(f) Test the reduced-form equation for serial correlation.

Problem 11.20 (f)–(g): Serial Correlation in First Stage

(f) Test the reduced-form equation for serial correlation.

Solution: The $T \times R^2$ test rejects the null – serial correlation is present in the first stage as well.

Problem 11.20 (f)–(g): Serial Correlation in First Stage

(f) Test the reduced-form equation for serial correlation.

Solution: The $T \times R^2$ test rejects the null – serial correlation is present in the first stage as well.

(g) Estimate the first-stage with HAC standard errors.

Problem 11.20 (f)–(g): Serial Correlation in First Stage

(f) Test the reduced-form equation for serial correlation.

Solution: The $T \times R^2$ test rejects the null – serial correlation is present in the first stage as well.

(g) Estimate the first-stage with HAC standard errors.

Solution:

- HAC (Newey-West) standard errors are larger than OLS SEs
- Some coefficients lose significance
- The F-test for instrument strength is unchanged (based on coefficients, not SEs)

Problem 11.20 (h): 2SLS Residuals and HAC

(h) Obtain 2SLS residuals, construct a correlogram. Obtain 2SLS estimates with HAC standard errors.

Problem 11.20 (h): 2SLS Residuals and HAC

(h) Obtain 2SLS residuals, construct a correlogram. Obtain 2SLS estimates with HAC standard errors.

Solution:
Correlogram: Shows significant autocorrelation at lag 1, with lags 2–3 potentially significant.

Problem 11.20 (h): 2SLS Residuals and HAC

(h) Obtain 2SLS residuals, construct a correlogram. Obtain 2SLS estimates with HAC standard errors.

Solution:
Correlogram: Shows significant autocorrelation at lag 1, with lags 2–3 potentially significant.

2SLS with HAC standard errors:

- All standard errors increase (as expected with autocorrelation)
- Price coefficient is **no longer significant** at 10% level
- Other coefficients' significance unchanged

Problem 11.20 (h): 2SLS Residuals and HAC

(h) Obtain 2SLS residuals, construct a correlogram. Obtain 2SLS estimates with HAC standard errors.

Solution:

Correlogram: Shows significant autocorrelation at lag 1, with lags 2–3 potentially significant.

2SLS with HAC standard errors:

- All standard errors increase (as expected with autocorrelation)
- Price coefficient is **no longer significant** at 10% level
- Other coefficients' significance unchanged

Implication: After properly accounting for serial correlation, the price elasticity estimate becomes more uncertain.

Problem 11.20 (i): Sargan Test

(i) Test the validity of the surplus instruments using the Sargan test.

Problem 11.20 (i): Sargan Test

(i) Test the validity of the surplus instruments using the Sargan test.

Solution:
Sargan test statistic: 22.41 with p-value ≈ 0

Problem 11.20 (i): Sargan Test

(i) Test the validity of the surplus instruments using the Sargan test.

Solution:

Sargan test statistic: 22.41 with p-value ≈ 0

Conclusion: **Reject** the null hypothesis that all instruments are valid.

Problem 11.20 (i): Sargan Test

(i) Test the validity of the surplus instruments using the Sargan test.

Solution:
Sargan test statistic: 22.41 with p-value ≈ 0

Conclusion: Reject the null hypothesis that all instruments are valid.

What does this mean?

- One or more instruments may be correlated with the error term
- The instruments may not be truly exogenous
- This potentially invalidates all the 2SLS results

Problem 11.20 (i): Sargan Test

(i) Test the validity of the surplus instruments using the Sargan test.

Solution:
Sargan test statistic: 22.41 with p-value ≈ 0

Conclusion: **Reject** the null hypothesis that all instruments are valid.

What does this mean?

- One or more instruments may be correlated with the error term
- The instruments may not be truly exogenous
- This potentially invalidates all the 2SLS results

Warning: Even though 2SLS gave "better" results than OLS, we should be cautious about their validity.

Outline

Problem 11.28: Truffle Supply and Demand

Supply and demand curves traditionally have price (P) on the vertical axis and quantity (Q) on the horizontal axis.

Problem 11.28: Truffle Supply and Demand

Supply and demand curves traditionally have price (P) on the vertical axis and quantity (Q) on the horizontal axis.

Rewritten equations with P on LHS:
Demand:

$$P_i = \alpha_1 + \alpha_2 Q_i + \alpha_3 PS_i + \alpha_4 DI_i + e_{di}$$

Supply:

$$P_i = \beta_1 + \beta_2 Q_i + \beta_3 PF_i + e_{si}$$

where PS = price of substitute, DI = disposable income, PF = price of truffle-pigs.

Problem 11.28 (a): Anticipated Signs

(a) What are the anticipated signs of the parameters?

Problem 11.28 (a): Anticipated Signs

(a) What are the anticipated signs of the parameters?

Solution:
Demand equation:

- $\alpha_2 < 0$: Higher quantity $\Rightarrow$ lower price (demand curve slopes down)
- $\alpha_3 > 0$: Higher substitute price $\Rightarrow$ willing to pay more for truffles
- $\alpha_4 > 0$: Higher income $\Rightarrow$ willing to pay more

Problem 11.28 (a): Anticipated Signs

(a) What are the anticipated signs of the parameters?

Solution:
Demand equation:

- $\alpha_2 < 0$: Higher quantity $\Rightarrow$ lower price (demand curve slopes down)
- $\alpha_3 > 0$: Higher substitute price $\Rightarrow$ willing to pay more for truffles
- $\alpha_4 > 0$: Higher income $\Rightarrow$ willing to pay more

Supply equation:

- $\beta_2 > 0$: Higher quantity $\Rightarrow$ higher price needed (supply curve slopes up)
- $\beta_3 > 0$: Higher input costs $\Rightarrow$ higher output price

Problem 11.28 (b): 2SLS Estimation

- (b) Estimate the supply and demand equations using 2SLS. Are the signs correct? Are the coefficients significant?

Problem 11.28 (b): 2SLS Estimation

(b) Estimate the supply and demand equations using 2SLS. Are the signs correct? Are the coefficients significant?

Solution:
Demand equation (instrument: PF):

- All signs are **correct**
- All coefficients are **significant**

Problem 11.28 (b): 2SLS Estimation

(b) Estimate the supply and demand equations using 2SLS. Are the signs correct? Are the coefficients significant?

Solution:
Demand equation (instrument: PF):

- All signs are **correct**
- All coefficients are **significant**

Supply equation (instruments: PS, DI):

- All signs are **correct**
- All coefficients are **significant**

Problem 11.28 (b): 2SLS Estimation

(b) Estimate the supply and demand equations using 2SLS. Are the signs correct? Are the coefficients significant?

Solution:
Demand equation (instrument: PF):

- All signs are **correct**
- All coefficients are **significant**

Supply equation (instruments: PS, DI):

- All signs are **correct**
- All coefficients are **significant**

Key insight: 2SLS successfully identifies both curves by using variables that shift one curve to trace out the other.

Problem 11.28 (c): Price Elasticity of Demand

- (c) Estimate the price elasticity of demand "at the means."

Problem 11.28 (c): Price Elasticity of Demand

(c) Estimate the price elasticity of demand "at the means."

Solution:

The price elasticity of demand is:

$$e_p = \frac{\Delta Q}{\Delta P} \cdot \frac{\bar{P}}{\bar{Q}} = \frac{1}{\alpha_2} \cdot \frac{\bar{P}}{\bar{Q}}$$

Problem 11.28 (c): Price Elasticity of Demand

(c) Estimate the price elasticity of demand "at the means."

Solution:
The price elasticity of demand is:

$$e_p = \frac{\Delta Q}{\Delta P} \cdot \frac{\bar{P}}{\bar{Q}} = \frac{1}{\alpha_2} \cdot \frac{\bar{P}}{\bar{Q}}$$

Why $1/\alpha_2$?

- Our demand equation has P on the LHS
- So $\alpha_2 = \Delta P / \Delta Q$
- Elasticity needs $\Delta Q / \Delta P = 1/\alpha_2$

Problem 11.28 (c): Price Elasticity of Demand

(c) Estimate the price elasticity of demand "at the means."

Solution:
The price elasticity of demand is:

$$e_p = \frac{\Delta Q}{\Delta P} \cdot \frac{\bar{P}}{\bar{Q}} = \frac{1}{\alpha_2} \cdot \frac{\bar{P}}{\bar{Q}}$$

Why $1/\alpha_2$?

- Our demand equation has P on the LHS
- So $\alpha_2 = \Delta P / \Delta Q$
- Elasticity needs $\Delta Q / \Delta P = 1/\alpha_2$

Substituting the estimates and sample means gives the elasticity.

Problem 11.28 (d): Graphing Supply and Demand

(d) Sketch the supply and demand equations with P on vertical axis, using $DI^* = 3.5$, $PF^* = 23$, $PS^* = 22$.

Problem 11.28 (d): Graphing Supply and Demand

(d) Sketch the supply and demand equations with P on vertical axis, using $DI^* = 3.5$, $PF^* = 23$, $PS^* = 22$.

Solution:
Substitute the fixed exogenous values into the estimated equations:
Demand: $P = \hat{\alpha}_1 + \hat{\alpha}_2 Q + \hat{\alpha}_3(22) + \hat{\alpha}_4(3.5)$
Supply: $P = \hat{\beta}_1 + \hat{\beta}_2 Q + \hat{\beta}_3(23)$

Problem 11.28 (d): Graphing Supply and Demand

(d) Sketch the supply and demand equations with P on vertical axis, using $DI^* = 3.5$, $PF^* = 23$, $PS^* = 22$.

Solution:
Substitute the fixed exogenous values into the estimated equations:
Demand: $P = \hat{\alpha}_1 + \hat{\alpha}_2 Q + \hat{\alpha}_3(22) + \hat{\alpha}_4(3.5)$
Supply: $P = \hat{\beta}_1 + \hat{\beta}_2 Q + \hat{\beta}_3(23)$

Graph characteristics:

- Demand curve slopes downward ($\alpha_2 < 0$)
- Supply curve slopes upward ($\beta_2 > 0$)
- Intersection gives equilibrium (Q^*, P^*)

Problem 11.28 (e): Equilibrium Values

- What are the equilibrium values? Compare to reduced-form predictions.

Problem 11.28 (e): Equilibrium Values

(e) What are the equilibrium values? Compare to reduced-form predictions.

Solution:

From structural equations: Set demand = supply and solve:

$$111.58 - 2.67Q = 9.25 + 2.94Q$$

$$Q_{EQM} = 18.25, \quad P_{EQM} = 62.84$$

Problem 11.28 (e): Equilibrium Values

(e) What are the equilibrium values? Compare to reduced-form predictions.

Solution:

From structural equations: Set demand = supply and solve:

$$111.58 - 2.67Q = 9.25 + 2.94Q$$

$$Q_{EQM} = 18.25, \quad P_{EQM} = 62.84$$

From reduced-form equations:

$$Q_{RF} = 18.26, \quad P_{RF} = 62.82$$

Problem 11.28 (e): Equilibrium Values

- (e) What are the equilibrium values? Compare to reduced-form predictions.

Solution:

From structural equations: Set demand = supply and solve:

$$111.58 - 2.67Q = 9.25 + 2.94Q$$

$$Q_{EQM} = 18.25, \quad P_{EQM} = 62.84$$

From reduced-form equations:

$$Q_{RF} = 18.26, \quad P_{RF} = 62.82$$

Conclusion: The results are **nearly identical**, confirming internal consistency of the model.

Problem 11.28 (f): OLS vs 2SLS Comparison

(f) Estimate supply and demand using OLS. Compare to 2SLS results.

Problem 11.28 (f): OLS vs 2SLS Comparison

(f) Estimate supply and demand using OLS. Compare to 2SLS results.

Solution:
Demand equation (OLS):

- $\hat{\alpha}_2$ is now **positive** (wrong sign!)
- Coefficient is **not significant**
- Magnitude of $\hat{\alpha}_3$ drops

Problem 11.28 (f): OLS vs 2SLS Comparison

(f) Estimate supply and demand using OLS. Compare to 2SLS results.

Solution:
Demand equation (OLS):

- $\hat{\alpha}_2$ is now **positive** (wrong sign!)
- Coefficient is **not significant**
- Magnitude of $\hat{\alpha}_3$ drops

Supply equation (OLS):

- Results are similar to 2SLS
- All coefficients significant with correct signs

Problem 11.28 (f): OLS vs 2SLS Comparison

(f) Estimate supply and demand using OLS. Compare to 2SLS results.

Solution:
Demand equation (OLS):

- $\hat{\alpha}_2$ is now **positive** (wrong sign!)
- Coefficient is **not significant**
- Magnitude of $\hat{\alpha}_3$ drops

Supply equation (OLS):

- Results are similar to 2SLS
- All coefficients significant with correct signs

Key takeaway: OLS fails badly for demand (simultaneity bias flips the sign), but works reasonably for supply in this case.

Thank you!

jakeanderson@g.ucla.edu