

Quick Reference Summary

All Possible Question Variations

Complete Topic Variations - At a Glance

Use this table to check yourself: For each row, make sure you can handle BOTH sides. If she asked the left, could you answer the right?

Topic 1: β and Estimators

What She ASKED	What She COULD ASK
Definition of $\beta = [E(xx')]^{-1}E(xy)$	OLS estimator $\hat{\beta} = (X'X)^{-1}X'y$
Why estimate β ? (best linear approx)	Difference between β and $\hat{\beta}$
Calculate $\hat{\beta}$ from data	Calculate fitted values \hat{y} or residuals e
Dimensions of β , $E(xx')$, $E(xy)$	Verify first-order conditions $X'e = 0$
Unbiasedness of $\hat{\beta}$	Consistency of $\hat{\beta}$

Topic 2: Standard Errors

What She ASKED	What She COULD ASK
Expression for $se(\hat{\beta})$	Calculate $se(\hat{\beta})$ given MSE
What does SE measure?	How SE changes with n , σ^2 , VIF
Missing element in SE formula	Heteroskedasticity-robust SEs
Information SE provides	Factors affecting precision

Topic 3: t-tests

What She ASKED	What She COULD ASK
Test $H_0: \beta_2 = 0$ at $\alpha = 0.01$	Test $H_0: \beta_2 = 1$ or $H_0: \beta_2 = \beta_3$
Two-sided test	One-sided test ($H_1: \beta > 0$ or < 0)
Draw p-value for two-sided	Draw p-value for one-sided
At what α is variable significant?	Compare $\alpha = 0.01$ vs 0.05 vs 0.10
List assumptions for exact t-test	What changes without normality?
Calculate t-statistic	Interpret t-statistic value

Topic 4: F-tests

What She ASKED	What She COULD ASK
Test $H_0: \beta_3 = \beta_4 = \beta_5 = 0$	Test $H_0: \beta_2 = \beta_3$ (equality)
Exclusion restrictions	Linear restriction: $H_0: \beta_2 + \beta_3 = 1$
Write restricted model for RSSE	Calculate F from R ² formula
$F = (RSSE-SSE)/q \div SSE/(n-K)$	Overall significance F-test
Specify R and r matrices	Calculate q and degrees of freedom
Draw acceptance/rejection regions	Interpret F-value result
Intuition for acceptance region	Why F-test vs multiple t-tests?

Topic 5: Classical Assumptions

What She ASKED	What She COULD ASK
List all 6 assumptions	Which assumption violated in scenario?
Drop homoskedasticity - effects?	Drop normality - effects?
Drop strict exogeneity - effects?	Both heterosked. AND autocorrelation
Which statistics need adjustment?	Perfect collinearity - why can't estimate?
Statistical expression of assumptions	Difference between A4 and A5

Topic 6: R² and Model Fit

What She ASKED	What She COULD ASK
Why called in-sample predictive power?	Calculate R ² from ANOVA components
Regress residuals on X - what R ² ?	Difference between R ² and \bar{R}^2
How adding regressor affects R ²	When can R ² = 1? Can it be negative?
Properties of OLS residuals	What R ² does NOT tell you
R ² and causality relationship	R ² vs sample size relationship

Topic 7: Variance & Multicollinearity

What She ASKED	What She COULD ASK
Variance decomposition formula	Calculate VIF given R ²
What is VIF and what does it measure?	How multicollinearity affects SE, t, CI
Components: σ^2 , SST _j , R _j ²	What happens as R _j ² → 1?
Effect on histogram width in MC	Perfect vs imperfect collinearity
Does multicollinearity cause bias?	Effects on individual vs joint significance

Topic 8: Monte Carlo Simulations

What She ASKED	What She COULD ASK
Histogram centered at true β	Histogram width with different σ^2
What illustrates unbiasedness	What illustrates consistency (can't with fixed n)
Effect of changing σ_v^2 (collinearity)	Effect of changing sample size n
Fixed X vs random X	Conditional vs unconditional distribution
Shape of distribution (normality)	What happens when $\sigma^2 = 0$?
Confidence interval coverage	Perfect collinearity in simulation

Topic 9: Asymptotic Theory

What She ASKED	What She COULD ASK
Derive Wald test for $H_0: R\beta = r$	Derive LM (Lagrange Multiplier) test
$\sqrt{n}(\hat{\beta} - \beta) \rightarrow N(0, V)$	Derive LR (Likelihood Ratio) test
What changes without normality?	Equivalence of Wald, LM, LR tests
Exact vs asymptotic distributions	When to use t vs $N(0, 1)$
Chi-squared distribution in testing	Asymptotic variance estimation

Topic 10: ANOVA Components

What She ASKED	What She COULD ASK
Calculate SST from data	Relationship: $SST = SSR + SSE$
Calculate SSE from data	Calculate MSE and Root MSE
Calculate SSR from SST and SSE	Degrees of freedom for each component
How SSE relates to σ^2	Mean squares vs sum of squares

Topic 11: Regression Output Interpretation

What She ASKED	What She COULD ASK
What is coefficient estimate?	What is standard error column?
What is t-statistic column?	What is p-value column?
What is confidence interval?	Interpret specific coefficient value
Number of observations vs df	What does F-statistic test overall?
Root MSE interpretation	Difference between coef and std err

Formula Variations to Know

Important: She can ask for the SAME concept using DIFFERENT formulas!

F-statistic (4 different forms)	
$F = (RSSE-SSE)/q \div SSE/(n-K)$	From sum of squares
$F = (R^2_{ur} - R^2_r)/q \div (1-R^2_{ur})/(n-K)$	From R^2 comparison
$F = R^2/q \div (1-R^2)/(n-K)$	Overall significance ($q=K-1$)
$F = MSR / MSE$	From mean squares
R ² (2 different forms)	

F-statistic (4 different forms)	
$R^2 = \text{SSR} / \text{SST}$	Explained variation
$R^2 = 1 - \text{SSE} / \text{SST}$	Unexplained variation
Variance of β_j (2 forms)	
$\text{Var}(\beta_j X) = \sigma^2[(X'X)^{-1}]_{jj}$	Matrix form
$\text{Var}(\beta_j X) = \sigma^2/\text{SST}_j \times 1/(1-R^2_j)$	VIF form

How to Use This Table

Study Strategy:

1. Go through each row - make sure you can answer BOTH sides
2. If she asked the left, can you handle the right?
3. Practice writing out formulas from memory
4. For each topic, think of one MORE variation she could ask
5. The exam will likely have 2-3 variations from DIFFERENT topics

Master the variations, ace the exam!