Grading Rubric: Homework 2

Total: 100 points

Problem 1: Hands-On OLS (35 pts)

1.1 Data Generation and Visualization (5 pts)

Correct data-generating process, fixed random seed, and scatter plot of (X_i, Y_i).

1.2 OLS Estimation (8 pts)

OLS fit with coefficient estimates, confidence intervals, p-values, and R^2 reported.

1.3 Interpretation (5 pts)

Correct comparison to true parameters and correct interpretation of confidence intervals and hypothesis tests.

1.4 Influential Point (7 pts)

Dataset correctly modified, OLS refit, and updated estimates, intervals, p-values, and R^2 reported.

1.5 Interpretation After Influence (4 pts)

Correct discussion of coefficient instability, loss of significance, and deterioration of fit.

1.6 Cook's Distance (3 pts)

Cook's distance computed correctly and plot produced with influential observation highlighted.

1.7 Leverage (3 pts)

Correct leverage formula stated and correct qualitative comparison of leverage between $(4, -5)$ and $(0, -5)$.

Problem 2: Central Limit Theorem (35 pts)

2.1 Setup (6 pts)

Correct specification of Bernoulli and Uniform noise distributions and histograms shown.

2.2 Empirical Verification (14 pts)

Fixed design points, correct response generation, OLS without intercept, and 1000 Monte Carlo repetitions for each setting.

2.3 Visualization and Normality Testing (15 pts)

Histograms of $\hat{\beta}_{\mathrm{OLS}}$ for all cases, Shapiro–Wilk tests reported, and correct interpretation of finite-sample non-normality and asymptotic normality.

Problem 3: Weighted Least Squares (30 pts)

3.1 Heteroskedastic Data Generation (6 pts)

Correct heteroskedastic variance specification and scatter plot illustrating heteroskedasticity.

3.2 Naive OLS (6 pts)

OLS fit reported with confidence interval.

3.3 Interpretation: OLS vs WLS (8 pts)

Correct statement of OLS inefficiency under heteroskedasticity, correct variance comparison with WLS, and correct discussion that confidence direction (over/under) is not universal.

3.4–3.6 Diagnostics and WLS (10 pts)

Q–Q plot for OLS residuals, WLS fit using correct weights, Q–Q plot for WLS residuals, and correct qualitative comparison.