ECON306 – Quiz 3

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There are five problems worth 20 points each. You have 40min to solve all of them. Don't forget to write your name and PSU ID (e.g. bxs5142).

1. Consider the following output of a linear regression

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------------------------------------------------------------------------------
       y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------+--------------------------------------------------------------------
      x1 |  -2.681508   1.393991            0.055    -5.424424    .0614073
      x2 |  -3.702419               -24.04  0.000    -4.005491   -3.399348
      x3 |   .1086104    .090719     1.20   0.232    -.0698947    .2871154
   _cons |   906.7392   28.26505    32.08   0.000     851.1228    962.3555
------------------------------------------------------------------------------
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(a) Fill in the missing values.

The t-statistic for x_1 is:

$$t_1 = \frac{\hat{\beta}_1}{\text{SE}(\hat{\beta}_1)} = \frac{-2.68}{1.39} \approx 1.93$$

The standard error for $\hat{\beta}_2$ is:

$$\text{SE}(\hat{\beta}_2) = \frac{\hat{\beta}_2}{t_2} = \frac{-3.70}{-24.04} \approx 0.15$$

(b) Write down the estimated model.

$$\hat{y}_i = 906.74 - 2.68x_{1i} - 3.70x_{2i} + 0.11x_{3i}$$

(c) Given $x_1 = 2.5$, $x_2 = 24$ and $x_3 = -5$, what would be the expected effect of decreasing x_2 to 18?

$$\Delta y_i = \hat{\beta}_2 \Delta x_2 = (-3.30)(-6) \approx -19.8$$

(d) Is x_1 significant at the 95% confidence level?

No, the p-value is 0.055, which means that it is significant at the 94.5% $(1 - 0.055)$ level, but not at any higher level of significance. Alternatively, notice that 0 is in the 95% confidence interval in the table.

(e) Write down the t-statistic that you would use to verify whether $\beta_2 < -3$, i.e. to test:

$$\mathscr{H}_0\colon\ \beta_2 \leq -3 \quad \text{vs} \qquad \mathscr{H}_1\colon\ \beta_2 > -3$$

$$t = \frac{\hat{\beta}_2 - b}{\text{SE}(\hat{\beta}_2)} = \frac{-3.7 - (-3)}{0.15} \approx -4.67$$

(f) (Bonus) Would you be able to reject the hypothesis $\mathscr{H}_0$: $\beta_2 \leq -3$ with 95% confidence?

No. In fact, since $\hat{\beta}_2 < -3$, we could not reject $\hat{\beta}_2 \leq -3$ at any significance level!

2. Fill in the blanks. The sampling variance of $\hat{\beta}_1$:

(a) Increases when the variance of ___ε___ increases.

(b) Decreases when the variance of ___x___ increases.

(c) ___Decreases___ when the sample size increases.

(d) ___Remains unchanged___ when the value of β_1 increases.

3. Which of the following assumptions are important to have unbiased estimates for β_1? (mark all that apply)

(a) Homoskedasticity $\mathbb{V}[\varepsilon_i] = \sigma_\varepsilon^2$

(b) Orthogonality $\mathbb{E}[x_i \varepsilon_i] = 0$

(c) No multicolinearity $\mathbb{V}[x_i] > 0$

(d) Normal errors $\varepsilon_i \sim N(0, \sigma_i^2)$

4. Which of the following assumptions are important to have unbiased estimates for the variance of β_1? (mark all that apply)

(a) Homoskedasticity $\mathbb{V}[\varepsilon_i] = \sigma_\varepsilon^2$

(b) Orthogonality $\mathbb{E}[x_i \varepsilon_i] = 0$

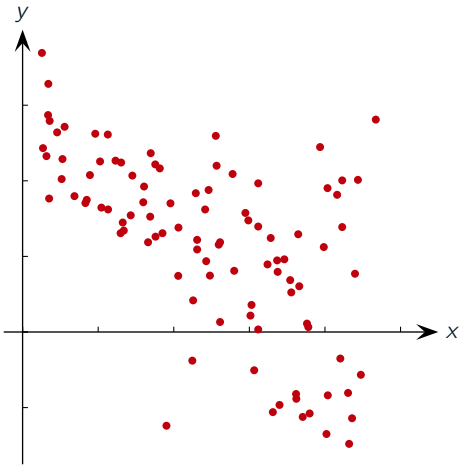
(c) No serial correlation $\mathbb{E}[\varepsilon_i \varepsilon_j] = 0$

(d) Unbiased errors $\mathbb{E}[\varepsilon_i] = 0$

5. For the following scatterplots:

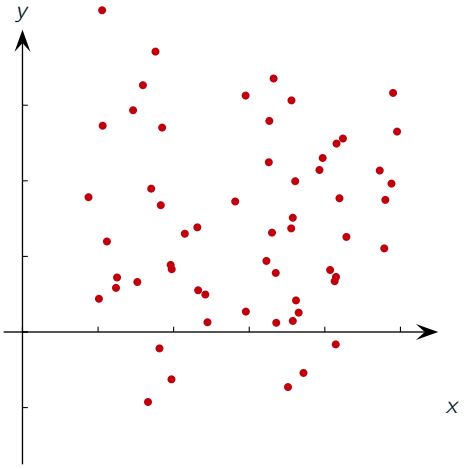
(a) Determine whether the relationship between x and y appears to be positive and significant, negative and significant, or insignificant.

(b) Determine whether some of the 7 classical assumptions appear to be violated (write at most two).



Relationship: Negative and significant

Assumptions: Homoskedasticity



Relationship: Insignificant

Assumptions: None