**Econ 102_A (Analysis of Economic Data): Cameron Winter 2019**
**Solutions to Second Midterm Exam**

**Version A**

**1.(a)** $r_{xy} = s_{xy}/\sqrt{s_{xx} \times s_{yy}} = 4/\sqrt{25 \times 16} = 4/20 = 0.2$.
**(b)** $R^2 = r_{xy}^2 = 0.2^2 = 0.04$.
**(c)** $\bar{x} = (1+2+3)/3 = 2$ and $\bar{y} = (4+1+1)/3 = 2$.

| $x_i$ | $y_i$ | $x_i - \bar{x}$ | $y_i - \bar{y}$ | $(x_i - \bar{x})(y_i - \bar{y})$ | $(x_i - \bar{x})^2$ |
|---|---|---|---|---|---|
| 1 | 4 | −1 | 2 | −2 | 1 |
| 2 | 1 | 0 | −1 | 0 | 0 |
| 3 | 1 | 1 | −1 | −1 | 1 |

$b = \sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y}) / \sum_{i=1}^n (x_i - \bar{x})^2 = (-3)/(2) = -1.5$.
**(d)** 1. Model $y_i = \beta_1 + \beta_2 x_i + u_i$
2. Zero conditional mean error. $\mathrm{E}[u_i|x_i] = 0$ for all $i$.
3. Constant conditional variance error. $\mathrm{Var}[u_i|x_i] = \sigma_u^2$ for all $i$.
4. Independent errors. $u_i$ independent of $u_j$ for all $i \neq j$.
**(e)** Assumptions 1 and 2 are necessary for unbiasedness.

**2.(a)** Higher Education spending falls by 0.753 percentage points.
**(b)** A 95% confidence interval for the population slope parameter is $(-0.887, -0.619)$ from the output.
**(c)** A 99% confidence interval for the population slope parameter is $b_2 \pm t_{.005;22} \times s_{b_2} = -0.753 \pm invttail(22, .005) \times 0.0648 = -0.753 \pm 2.819 \times 0.0648 = -0.753 \pm 0.183 = (-0.936, -0.570)$.
**(d)** $H_0 : \beta_2 = 0$ against $H_a : \beta_2 \neq 0$.
From the Stata output $p = 0.000 < 0.05$. So reject $H_0$ at level 0.05.
Conclude there is a statistically significant relationship at level 0.05.
**(e)** `display 2*tail(22,11.62)`
**(f)** $H_0 : \beta_2 = -1$ against $H_a : \beta_2 \neq -1$.
$t = (b_2 - (-1))/s_{b2} = (-0.753 - (-1))/0.0648 = 0.247/0.0648 = 3.810$.
Since $|t| = 3.810 > t_{.025;22} = invttail(22, .025) = 2.074$ we reject $H_0$.
Conclude that the slope coefficient is statistically different from $-1$ at level 0.05.

**3.(a)** No. The two are correlated, but one does not necessarily cause the other.
**(b)** 0.59541 from output.
**(c)** When $x = 12.68$ then $\widehat{y} = 20.067 - 0.753 \times 12.68 = 20.067 - 9.548 = 10.519$.
**(d)** `scatter HigherEd CrimJustice || lfit HigherEd CrimJustice`

**4.(a)** $t = (\widehat{\theta} - \theta^*)/se(\widehat{\theta}) = (19-10)/5 = 9/5 = 1.8$ so $|t| < 1.96$ and do not reject $H_0$.
**(b)** $H_0 : \theta \leq 10$ against $H_a : \theta > 10$. $t = 1.8$ again.
Now the critical value is $t_{.05;\infty}$. I did not give data on this but for large $n$ it will be less than 1.717 for 22 degrees of freedon given in the Stata output. Now reject $H_0$ as $t = 1.8 > 1.717$. (In fact $t_{.05;\infty} = 1.645$).
**(c)** TSS = ExplainedSS + ResidualSS = 100 + 50 = 150.
$R^2$ = ExplainedSS/TSS = 100/150 = 0.666. (or use $R^2 = 1-$ Residual/TSS$= 1 - 50/150 = 0.666$).

**Versions A and B: Multiple Choice**

| Question | **1.** | **2.** | **3.** | **4.** | **5.** |
|---|---|---|---|---|---|
| Answer Version A | *b* | *a* | *b* | *d* | *b* |
| Answer Version B | *d* | *c* | *a* | *b* | *a* |

The course grade is based on a curve from the combined scores of midterm 1 (22.5%), midterm 2 (22.5%), final (45%), quizes (5%) and assignments (5%). Suggested average GPA for this course is 2.7. **The curve for this exam is only a guide**. Curve below has average GPA 2.67.

| | |
|---|---|
| Scores out of | 35 |
| $75th$ percentile | 29 (83%) |
| Median | 24 (69%) |
| $25th$ percentile | 20.5 (59%) |

| | | | |
|---|---|---|---|
| A+ | 34 and above | C+ | 22 and above |
| A | 29 and above | C | 20.5and above |
| A- | 26.5 and above | C- | 19.5 and above |
| B+ | 25.5 and above | D+ | 18.5 and above |
| B | 24 and above | D | 17 and above |
| B- | 23 and above | D- | 16 and above |