Econ 102 (Analysis of Economic Data): Cameron Spring 2016
Solutions to Second Midterm Exam

Version A

1.(a) 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 $i \neq j$.
(b) Assumption 3.
(c) "Best" means smallest variance.
(d) The correlation between x and y is 0.6, or $R^2 = 0.6^2 = 0.36$ or a one standard deviation increase in x is associated with a 0.6 standard deviation change in y.
(e) Type 1 error is rejecting H_0 when H_0 is true.

2.(a) $b_2 = 54.69$ so a \$1,000 increase in newspaper advertising is associated with 54.69 more units solds.
(b) A 95% confidence interval for β_2 is (22.005, 87.381) from the regression output.
(c) A 90% confidence interval for β_2 is $b_2 \pm t_{.05,.198} \times s_{b_2}$
$= 54.6931 \pm invttail(198, .05) \times 16.575 = 54.6931 \pm 1.6526 \times 16.575 = 54.6931 \pm 27.3918 = (27.301, 82.085)$.
(d) $H_0 : \beta_2 = 0$ against $H_a : \beta_2 \neq 0$.
Simplest is using p-value approach: $p = 0.001 < 0.05$. So reject H_0 at level 0.05.
Alternatively and equivalently $|t| = 3.30 > t_{.025,198} = invttail(198, .025) = 1.972$. So reject H_0.
Conclude there is a statistically significant relationship at level 0.05.
(e) $H_0 : \beta_2 \leq 30$ against $H_a : \beta_2 > 30$. (Make the claim the alternative)
$t = (b_2 - 30)/s_{b2} = (54.6931 - 30)/16.575 = 24.6931/16.575 = 1.490$.
Since $t = 1.490 < t_{.05,198} = invttail(198, .05) = 1.652$ we do not reject H_0.
Conclude that sales do not rise by more than 30 units for each \$1,000 increase in newpaper advertising.
(f) $\widehat{y} = b_1 + b_2 x = 12351.41 + 54.6931 \times 100 = \$17{,}821$.

3.(a) $\mathrm{Var}[\bar{y}] = \frac{1}{n-1}\sum_{i=1}^n (y_i - \bar{y})^2 = \frac{1}{9} \times 90 = 10$.
(b) $b_2 = \sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y}) / \sum_{i=1}^n (x_i - \bar{x})^2 = 20/10 = 2$.
$b_1 = \bar{y} - b_2 \bar{x} = 20 - 2 \times 1 = 18$.
(c) $s_e^2 = \sum_{i=1}^n (y_i - \widehat{y}_i)^2/(n-2) = 50/8 = 6.25$. $s_e = \sqrt{6.25} = 2.5$.
(d) $R^2 = 1 - ResidSS/TotalSS = 1 - \sum_{i=1}^n (y_i - \widehat{y}_i)^2 / \sum_{i=1}^n (y_i - \bar{y})^2 = 1 - 50/90 = 4/9 = 0.4444$.
(e) $r_{xy} = \sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y}) / \sqrt{\sum_{i=1}^n (x_i - \bar{x})^2 \sum_{i=1}^n (y_i - \bar{y})^2} = 20/\sqrt{10 \times 90} = 20/30 = 2/3$.
(Or use $r_{xy}^2 = R^2 = 4/9$ so $r_{xy} = \sqrt{4/9} = 2/3$).
(f) We expect b_2 on average equals β_2 which from the code is $\beta_2 = 3$.

Multiple Choice for Versions A and B

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

Version B

1.(a) 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 $i \neq j$.
(b) Assumption 3.
(c) "Best" means smallest variance.
(d) The correlation between x and y is 0.4, or $R^2 = 0.4^2 = 0.16$ or a one standard deviation increase in x is associated with a 0.4 standard deviation change in y.
(e) Type 2 error is failing to reject H_0 when H_0 is false.

2.(a) $b_2 = 48.01$ so a \$1,000 increase in newspaper advertising is associated with 48.01 more units solds.
(b) A 95% confidence interval for β_2 is (13.908, 82.114) from the regression output.
(c) A 99% confidence interval for β_2 is $b_2 \pm t_{.005,.198} \times s_{b_2}$
$= 48.0108 \pm invttail(178, .005) \times 17.281 = 48.0108 \pm 2.6037 \times 17.281 = 48.0108 \pm 44.9945 = (3.016, 93.005)$.
(d) $H_0 : \beta_2 = 0$ against $H_a : \beta_2 \neq 0$.
Simplest is using p-value approach: $p = 0.006 < 0.05$. So reject H_0 at level 0.05.
Alternatively and equivalently $|t| = 2.78 > t_{.025,178} = invttail(178, .025) = 1.973$. So reject H_0.
Conclude there is a statistically significant relationship at level 0.05.
(e) $H_0 : \beta_2 \leq 10$ against $H_a : \beta_2 > 10$. (Make the claim the alternative)
$t = (b_2 - 10)/s_{b2} = (48.0108 - 10)/17.281 = 38.0108/17.281 = 2.199$.
Since $t = 2.199 > t_{.05,178} = invttail(178, .05) = 1.653$ we reject H_0.
Conclude that sales rise by more than 10 units for each \$1,000 increase in newpaper advertising.
(f) $\widehat{y} = b_1 + b_2 x = 12502.97 + 48.0108 \times 200 = \$22{,}105$.

3.(a) $\mathrm{Var}[\bar{y}] = \frac{1}{n-1}\sum_{i=1}^n (y_i - \bar{y})^2 = \frac{1}{9} \times 360 = 40$.
(b) $b_2 = \sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y}) / \sum_{i=1}^n (x_i - \bar{x})^2 = 80/40 = 2$.
$b_1 = \bar{y} - b_2\bar{x} = 20 - 2 \times 2 = 16$.
(c) $s_e^2 = \sum_{i=1}^n (y_i - \widehat{y}_i)^2/(n-2) = 200/8 = 25$. $s_e = \sqrt{25} = 5$.
(d) $R^2 = 1 - ResidSS/TotalSS = 1 - \sum_{i=1}^n (y_i - \widehat{y}_i)^2 / \sum_{i=1}^n (y_i - \bar{y})^2 = 1 - 200/360 = 4/9 = 0.4444$.
(e) $r_{xy} = \sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y}) / \sqrt{\sum_{i=1}^n (x_i - \bar{x})^2 \sum_{i=1}^n (y_i - \bar{y})^2} = 80/\sqrt{40 \times 360} = 80/120 = 2/3$.
(Or use $r_{xy}^2 = R^2 = 4/9$ so $r_{xy} = \sqrt{4/9} = 2/3$).
(f) We expect b_2 on average equals β_2 which from the code is $\beta_2 = 1$.

The course grade will be based on a curve from the combined scores of midterm 1 (22.5%), midterm 2 (22.5%), final (45%) and assignments (10%). **The curve for this exam is only a guide**. Suggested average GPA for this course is 2.7. Curve below has average GPA 2.72 for this exam.

Scores out of	30	
75*th* percentile	26.5	(88.3%)
Median	24.5	(82%)
25*th* percentile	23	(77%)

A+	29.5 and above	C+	23 and above
A	27.5 and above	C	22.5 and above
A-	26.5 and above	C-	21.5 and above
B+	25.5 and above	D+	20.5 and above
B	25 and above	D	20 and above
B-	24 and above	D-	19 and above