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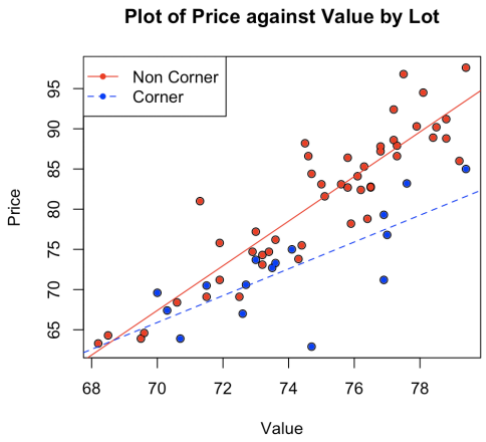
STAT 5120
Homework 6

1. (a) For both Corner and Non-Corner, there seems to be a positive linear relationship between Price and Value. Since two slopes are not the same, a possible interaction should exist.



$$Price\ (non\ Corner) = -126.9052 + 2.7759 * Value$$
$$Price\ (Corner) = = -50.8873 + 1.6684 * Value$$

(b)

$$Price = -126.9052 + 2.7759 * Value + 76.0215 * Lot - 1.1075 * Value * Lot$$

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Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -126.9052    14.7225  -8.620 4.33e-12 ***
Value          2.7759     0.1963  14.142  < 2e-16 ***
Lot           76.0215    30.1314   2.523  0.01430 *
Value:Lot     -1.1075     0.4055  -2.731  0.00828 **
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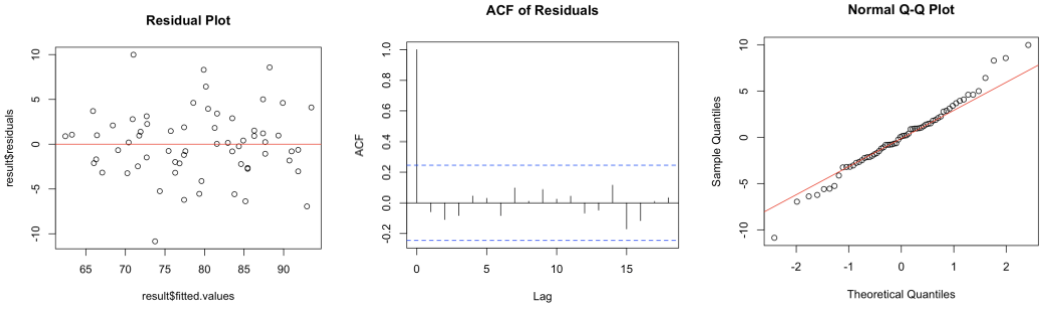
(c) The residuals fall in a horizontal band around 0, with no apparent pattern. The variance is constant. Errors are uncorrelated, and normality of error term assumption is met.



(d) Test Statistic = 2.6385, p-value = 0.1094. We fail to reject null, so we say that we have equal vairances across classes of Lot.

(e) t-statistic is -2.731 and p-value is 0.00828. The interaction term is statistically significant.

(f)
For Corner

$$Price = -126.9052 + 2.7759 * Value + 76.0215 * 1 - 1.1075 * Value * 1$$
$$= -50.8873 + 1.6684 * Value$$

For Non-Corner

$$Price = -126.9052 + 2.7759 * Value + 76.0215 * 0 - 1.1075 * Value * 0$$
$$= -126.9052 + 2.7759 * Value$$

(g) When assessed value is 70, price of Corner = -50.8873+1.6684*70 = 65.9043 and price for non-Corner = -126.9052 + 2.7759*70 = 67.4078. The difference is 1.5035.
When assessed value is 80, price of Corner = -50.8873+1.6684*80 = 82.5883 and price for non-Corner = -126.9052 + 2.7759*80 = 95.1668. The difference is 12.5785.

(h) As the valuation changes, the difference in price of Corner and non-Corner changes. This means the interaction exists.

2. (a) ptsd is higher for women who reported childhood sexual abuse than those who did not.

(b) There appears to be a positive correlation between ptsd and cpa.

(c) The interaction term is insignificant, so we fit the model with additive effects.

$$\hat{ptsd} = 10.2480 + 0.5506 \cdot cpa - 6.2728\, csa$$

(d) For any given value of cpa, the ptsd of women who reported childhood sexual abuse has higher mean level than those who did not. To be more specific, the mean level of ptsd of reported women is 6.2728 unit higher than those who did not report, for any given value of cpa.

3. (a) H_0: $\beta_4 = \beta_5 = 0$; H_a: at least one of β_4 and β_5 is non-zero.

$$F = \frac{9720281}{2} \div 5166633 = 0.9407$$

$F_{0.95,2,45}$ is 3.204317, so we fail to reject null hypothesis. We can drop interaction terms.

(b) Reference class is NE/NC.

(c) $\beta_2 = 529.4$.

The mean response (annual pay) for teachers in South is 529.4 dollars higher than those in NE/NC area, for any given of spend.

(d) $B = t_{1-\alpha/2g,\, n-k-1}$. Now $g=3$ and $n-k-1 = 47$, so $B = qt(1-0.05/6, 47) = 2.482694$

i) $\hat{\beta}_2 \pm SE(\hat{\beta}_2) \cdot 2.482694 = 529.4 \pm 2.482694 \cdot 766.9 = (-1374.578,\ 2433.378)$

ii) $\hat{\beta}_3 \pm SE(\hat{\beta}_3) \cdot 2.482694 = 1674 \pm 2.482694 \cdot 801.2 = (-315.1384,\ 3663.1384)$

iii) $s\{\hat{\beta}_2 - \hat{\beta}_3\} = \sqrt{s^2\{\beta_2\} + s^2\{\beta_3\} - 2s\{\beta_2, \beta_3\}}$

$= \sqrt{588126.71689 + 641873.8 - 2 \cdot (744238.02959)}$

$= \sqrt{741524.5}$

$(\hat{\beta}_2 - \hat{\beta}_3) \pm s\{\hat{\beta}_2 - \hat{\beta}_3\} \cdot 2.482694 = (529.4 - 1674) \pm 2.482694 \cdot \sqrt{741524.5}$

$= (-3282.4933, 993.2933)$

e) All three intervals contain 0, so we may say that geographic region has no significant effect on mean annual salary for teachers, after taking spend per student into consideration.