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.