Math 257 Fall 2005
Quiz #3   Name:_____

You have 20 minutes to complete this quiz. Please answer all questions in the space provided.

A social worker from the Regina-Qu'appelle Health District is concerned about living conditions in the downtown area. She decides to compare the average number of rooms per dwelling to the average number of people living in that dwelling. She selects a simple random sample of 25 dwellings from among the 275 in the downtown area. Let x_i denote the number of people in dwelling i and let y_i denote the number of rooms in dwelling i. From a count of the number of rooms and number of people in each dwelling, the following data are collected:

$$\bar{x} = 9.2, \quad \bar{y} = 2.6, \quad \sum_{i=1}^{25} x_i^2 = 2240, \quad \sum_{i=1}^{25} y_i x_i = 522, \quad \sum_{i=1}^{25} y_i^2 = 169.$$

(a) Why might ratio estimation be appropriate for this situation?

(b) Construct an approximate 95% confidence interval for the ratio of average number of rooms per dwelling to average number of people per dwelling for this area.

$$\overline{Y} = R\overline{X}$$

$$r = \frac{\overline{y}}{\overline{x}}$$

$$s^2(r) = \frac{(1-f)}{n(n-1)\overline{x}^2} \sum_{i=1}^{n}(y_i - rx_i)^2$$

$$= \frac{(1-f)}{n(n-1)\overline{x}^2} \left(\sum_{i=1}^{n} y_i^2 - 2r \sum_{i=1}^{n} y_i x_i + r^2 \sum_{i=1}^{n} x_i^2 \right)$$

$$\overline{y}_R = r\overline{X} = \frac{\overline{y}}{\overline{x}}\overline{X}$$

$$s^2(\overline{y}_R) = \frac{(1-f)}{n(n-1)} \sum_{i=1}^{n}(y_i - rx_i)^2$$

$$= \frac{(1-f)}{n(n-1)} \left(\sum_{i=1}^{n} y_i^2 - 2r \sum_{i=1}^{n} y_i x_i + r^2 \sum_{i=1}^{n} x_i^2 \right)$$