8.16 $N = 48,\ n = 10$

$$\sum y_i = 736$$
$$\sum m_i = 365$$

$$\bar{y}_t = \frac{\sum y_i}{n} = \frac{736}{10} = 73.6$$
$$\hat{\tau} = N\bar{y}_t = 48(73.6) = 3532.8$$
$$\hat{V}(\hat{\tau}) = N^2\left(\frac{N-n}{Nn}\right)s_t^2$$
$$= 48^2\left(\frac{48-10}{48(10)}\right)(398.93)$$
$$B = 2\sqrt{\hat{V}(\hat{\tau})} = 539.50$$

8.17 $N = 175,\ n = 25$

m_i = number of elements in cluster i = 4 tires per cab

$\bar{M}$ = average cluster size = 4

$$\sum a_i = 40$$
$$\sum m_i = 100$$
$$\hat{p} = \frac{\sum a_i}{\sum m_i} = \frac{40}{100} = .4$$
$$\hat{V}(\hat{p}) = \left(\frac{N-n}{Nn\bar{M}^2}\right)s_p^2$$
$$= \left(\frac{175-25}{175(25)4^2}\right)(1.583)$$
$$B = 2\sqrt{\hat{V}(\hat{p})} = .116$$

8.20 $N = 386, n = 20$

$y_i =$ total height of all trees in plot i.

$y_1 = m_1 \bar{y}_1$

$$\sum y_i = 6180.8$$

$$\sum m_i = 1046$$

$$\bar{y} = \frac{\sum y_i}{\sum m_i} = \frac{6180.8}{1046} = 5.91$$

$$\overline{M} = \frac{\sum m_i}{n} = \frac{1046}{20} = 52.3$$

$$\hat{V}(\bar{y}) = \left(\frac{1}{n\overline{M}^2}\right) s_p^2$$

$$= \left(\frac{386 - 20}{386(20)(52.3)^2}\right)(1499.55)$$

(Use $\overline{m}$ to estimate $\overline{M}$)

$$B = 2\sqrt{\hat{V}(\bar{y})} = .322$$

8.21 a_i = number of defective microchips on board i

m_i = number of microchips on board i (12 per board)

$n = 10, \quad \overline{M} = 12$

$$\sum a_i = 16$$

$$\sum m_i = 120$$

$$\hat{p} = \frac{\sum a_i}{\sum m_i} = \frac{16}{120} = .1333$$

By Equation (8.17), ignoring the fpc,

$$\hat{V}(\hat{p}) = \left(\frac{1}{n\overline{M}^2}\right) s_p^2$$

$$= \frac{1}{10(12^2)}(2.046)$$

$$B = 2\sqrt{\hat{V}(\hat{p})} = .075$$

8.22 $N = 50, \quad n = 10$

$$\hat{\tau} = N\frac{\sum a_i}{n} = 50\frac{16}{10} = 80$$

$$\hat{V}(\hat{\tau}) = N^2\left(\frac{N-n}{nN}\right)s_p^2$$

$$= (50)^2\left(\frac{50-10}{10(50)}\right)(2.046)$$

$$B = 2\sqrt{\hat{V}(\hat{\tau})} = 40.46$$

8.23 m_i = number of equipment items
a_i = number of items not properly identified

$N = 15, \quad n = 5$

$$\sum a_i = 9$$

$$\sum m_i = 98$$

$$\hat{p} = \frac{\sum a_i}{\sum m_i} = \frac{9}{98} = .0918 \quad \overline{m} = \frac{\sum m_i}{n} = \frac{98}{5} = 19.6$$

$$\hat{V}(\hat{p}) = \left(\frac{N-n}{Nn\overline{M}^2}\right)s_P^2$$

$$= \left(\frac{15-5}{15(5)(19.6)^2}\right)(1.095)$$

($\overline{M}$ is estimated by $\overline{m}$)

$$B = 2\sqrt{\hat{V}(\hat{p})} = .039$$