1 (a) $\hat{\mu}_1 = \bar{y}_{1.} = 145$

$\hat{\mu}_2 = \bar{y}_{2.} = 145.25$

$\hat{\mu}_3 = \bar{y}_{3.} = 132.25$

$\hat{\mu}_4 = \bar{y}_{4.} = 129.25$

$\bar{y}_{..} = 137.9375$

$TSS = 1080.9375$

$FSS = 844.6875$

$RSS = 236.25$

$y_{ij} = \mu_i + \varepsilon_{ij}$

$y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$

$$\begin{cases} H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 \\ H_a: \text{not all } \mu_i \text{ equal} \end{cases}$$

$$F\ stat = \frac{FSS/3}{RSS/12} \doteq 14.3015873 > F_{3,12}\ 0.05$$

$\Rightarrow$ reject H_0 $\Rightarrow$ there is a difference.

(b). $S^2_{\bar{y}_4} = \frac{1}{4} \cdot \frac{RSS}{12} = 4.921875$

$\mu_4 \in \hat{\mu}_4 \pm T_{12}(0.025)\, S_{\bar{y}_4}$

$\mu_4 \in 129.25 \pm T_{12}(0.025)\sqrt{4.921875}$

(c) $D = \mu_1 - \mu_4$

$\hat{D} = \hat{\mu}_1 - \hat{\mu}_4 = 15.75$

$S^2_{\hat{D}} = \frac{RSS}{12}\left(\frac{1}{4} + \frac{1}{4}\right) = 9.84375$

$D \in \hat{D} \pm T_{12}(0.005)\, S_{\hat{D}}$

$D \in 15.75 \pm T_{12}(0.005)\sqrt{9.84375}$

(d) I would use Scheffe

$$S^2_{\hat{L}_i} = \frac{RSS}{12} \cdot \frac{1}{2} = 9.84375$$

$i = 1, 2, 3, 4, 5$

$L_1 = \mu_1 - \mu_2 \quad \hat{L}_1 = -0.25 \quad L_1 \in -0.25 \pm F_{3,12}(0.1) \cdot \sqrt{9.84375}$

$L_2 = \mu_2 - \mu_3 \quad \hat{L}_2 = 13 \quad L_2 \in 13 \pm F_{3,12}(0.1) \cdot \sqrt{9.84375}$

$L_3 = \mu_3 - \mu_4 \quad \hat{L}_3 = 3 \quad L_3 \in 3 \pm F_{3,12}(0.1) \cdot \sqrt{9.84375}$

$L_4 = \mu_4 - \mu_1 \quad \hat{L}_4 = -15.75 \quad L_4 \in -15.75 \pm F_{3,12}(0.1) \cdot \sqrt{9.84375}$

$L_5 = \mu_1 - \mu_3 \quad \hat{L}_5 = 12.75 \quad L_5 \in 12.75 \pm F_{3,12}(0.1) \cdot \sqrt{9.84375}$

$L_6 = \mu_2 - \mu_4 \quad \hat{L}_6 = 16 \quad L_6 \in 16 \pm F_{3,12}(0.1) \cdot \sqrt{9.84375}$

Type 2. produces highest.

(e) No need to change type.