1) a) $SS_T = SS_{trt} + SS_E$

$$\sum_{i=1}^{a}\sum_{j=1}^{n}(y_{ij}-\bar{y}_{..})^2 = n\sum_{i=1}^{a}(\bar{y}_{i.}-\bar{y}_{..})^2 + \sum_{i=1}^{a}\sum_{j=1}^{n}(y_{ij}-\hat{y}_{ij})^2$$

$$\bar{y}_{..} = \frac{3.25 + 0.75}{2} = 2$$

$SS_T = 92$

$SS_{trt} = 25$

$SS_E = 67$

Sources of Variations	Sums of Squares	degrees of freedom	Mean Squares	F_0
Diet (A, B)	$SS_{trt} = 25$	$a-1 = 1$	$MS_{trt} = 25$	$\frac{MS_{trt}}{MS_E} = \frac{25}{4.786} = 5.224$
Weight Loss (pounds)	$SS_E = 67$	$N-a = 14$	$MS_E = 4.786$	
Total	$SS_T = 92$	$N-1 = 15$	$MS_T = 29.786$	

$H_0 : \mu_1 = \mu_2$, μ_i is the average weight loss in the i^{th} group.

$H_a : \mu_1 \neq \mu_2$

$\therefore$ Given the fact that $F_{0.05,1,14} = 4.46$, we can reject the null hypothesis. There appears to be difference in weight loss depending on the diet.

b)

$SS_T = SS_{trt} + SS_{block} + SS_E$

$SS_T = 92$

$SS_{trt} = 25$

$SS_{block} = 25$

$SS_E = 42$

Sources of Variations	Sums of Squares	degrees of freedom	Mean Squares	F_0
Diet (A, B)	$SS_{trt} = 25$	$a-1 = 1$	$MS_{trt} = 25$	$\frac{MS_{trt}}{MS_E} = \frac{25}{6} = 4.167$
Sex	$SS_{block} = 25$	$b-1 = 7$	$MS_{block} = 3.571$	
Weight Loss (pounds)	$SS_E = 42$	$(a-1)(b-1) = 7$	$MS_E = 6$	
Total	$SS_T = 92$	$N-1 = 15$	$MS_T = 34.571$	

$H_0 : \mu_{male} = \mu_{female}$

$H_a : \mu_{male} \neq \mu_{female}$

$\therefore$ Given the critical value $F_{0.05,1,7} = 5.59$, we cannot reject the null hypothesis. There appears to be no difference in the average weight loss between male and female

c) The first student's report is better because the p-value of Diet in the second student's report is over 1, which makes the report unreliable since a p-value can never exceed 1.

2) $MS_A = \sum_{i=1}^{4} (\bar{y}_{i..} - \bar{y}_{...})^2$

$MS_B =$

3) a) $\sum_{i=1}^{a} \tau_i = 0$, $\sum_{j=1}^{b} \beta_j = 0$, $\varepsilon_{ij} \sim NID(0, \sigma^2)$

$\sim iid, \sigma_\tau^2$ $\sim iid, \sigma_\beta^2$

1. Each block contains the same number of units

2. Each treatment occur the same number of times in total

3. Each pair of treatments occurs together the same number of times in total

b) $H_0 : \tau_i = 0$

$H_A : \tau_i \neq 0$

4) a) $\mu - 50.2 = 69.8 - \mu$ because 50.2 and 69.8 are 95% confidence interval.

$\Rightarrow \mu = 60$

$\Rightarrow$ The length $|\mu - 50.2| = |69.8 - \mu| = t_{0.025, gn-1} \sqrt{\frac{MS_E}{gn}} = 9.8$

$\sigma_\tau^2 = \frac{E(MS_{trt}) - E(MS_E)}{n}$

$\sigma^2 = E(MS_E)$

b) $E(\bar{Y}_{..}) = E\left(\frac{1}{gn}\sum_{i=1}^{g}\sum_{j=1}^{n} Y_{ij}\right) = \frac{1}{gn} E\left(\sum_{i=1}^{g}\sum_{j=1}^{n} \mu + \tau_i + \varepsilon_{ij}\right)$, since $\sum_{i=1}^{g} \tau_i = \sum_{i=1}^{g}\sum_{j=1}^{n} \varepsilon_{ij} = 0$

$$= \frac{1}{gn}(gn\mu)$$

$$= \mu = 60$$

$$Var(\bar{Y}_{..}) = Var\left(\frac{1}{gn}\sum_{i=1}^{g}\sum_{j=1}^{n} \mu + \tau_i + \varepsilon_{ij}\right)$$

$$= \frac{1}{gn}\left(n\sigma_\tau^2 + \sigma^2\right)$$

$$= \frac{1}{gn}\left[E(MS_{trt}) - E(MS_E) + E(MS_E)\right]$$

$$= \frac{1}{gn} E(MS_{trt})$$