Pledge: I pledge my honor that I have abided by the Stevens Honor System. -Eric Altenburg

12.31: Page 682-683

(a)

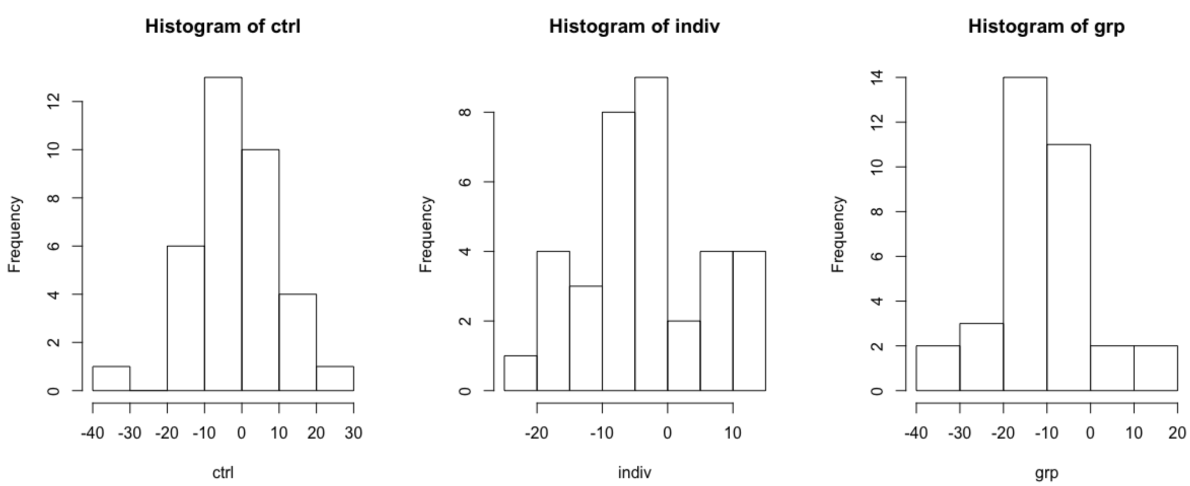
Groups	Sample Size	Mean	Std. Deviation
Control	35	-1.0086	11.5007
Individual	35	-3.7086	9.0784
Group	34	-10.7853	11.1392

(b)

Yes it is reasonable to pool the variances because the following holds true:

$2 * 9.0784 = 18.1568 > 11.5007$

(c)



From these histograms, one can draw the conclusion that the sample means are approximately normal because although the control seems to be more of a symmetric distribution and the individual is right-skewed, the sample sizes are around 34, therefore, if the samples do not exactly represent a normal distribution, it is acceptable.

12.32: Page 683

(a)

We define $H_0 : \mu_1 = \mu_2 = \mu_3$ versus H_a : they are not all equal.

$$\begin{aligned}
\overline{X}_{.,.} &= \frac{(35(-1.0086) + 35(-3.7086) + 34(-10.7853)}{104} \\
&= -5.1135 \\
SSB &= \Sigma_{i=1}^{3} n_i(\overline{X}_{i,.} - \overline{X}_{.,.})^2 \\
&= 1752.5945 \\
SSE &= \Sigma_{i=1}^{3}(n_i - 1)S_i^2 \\
&= 11393.9358 \\
f &= \frac{\frac{SSB}{k-1}}{\frac{SSE}{n-k}} \\
&= 7.7678 \\
df &= 2 \\
P(F > 7.7678) &= 1 - pf(7.7678, 2, 101) = 0.0007278958 << 0.05 = \alpha
\end{aligned}$$

Source	df	SS	MS	F statistic	p-value
Group	2	1752.5945	876.2973	7.7678	0.0007278958
Error	101	11393.9358	112.8112		
Total	103	13146.5303			

Since the p-value is less than the significance level of 0.05, we reject H_0 which states that μ_1, μ_2, μ_3 are not all equal.

(b)

From Professor Li's announcement via Canvas:

> regarding 12.32 b
> Hi, there,
> Please forget the residual analysis in Question 12.32 (b), which is not considered in our slides.
> Regards,
> Xiaohu Li

(c)

$$\begin{aligned}
T_{i,j} &= \frac{\overline{X}_{i,.} - \overline{X}_{j,.}}{\sqrt{S_p^2(\frac{1}{n_i} + \frac{1}{n_j})}} \\
S_p^2 &= \frac{SSE}{n-k} = 112.8019 \\
Individual - Control &= |-1.0634| \\
Individual - Group &= |-2.7671| \\
Control - Group &= |-3.8228|
\end{aligned}$$

$$P(|T_{i,j}| > |t_{i,j}|) = 2[1 - pt(|t_{i,j}|, n-k)] < \alpha$$
$$n - k = 104 - 3 = 101$$
$$Individual - Control = 0.2901365$$
$$Individual - Group = 0.006727696$$
$$Control - Group = 0.0002283676$$

Based on the LSD method:

Individual-Control, $0.2901365 > 0.05$, therefore, we fail to reject H_0 saying that $\mu_{individual} = \mu_{control}$.

Individual-Group, $0.0067276965 < 0.05$, therefore, we reject H_0 saying that $\mu_{individual} \neq \mu_{group}$.

Control-Group, $0.0002283676 < 0.05$, therefore, we reject H_0 saying that $\mu_{control} \neq \mu_{group}$.

(d)

Based on the ANOVA test in part (a), it is clear that the means are different among each group. Using the LSD method from part (c) shows that the outlier causing the means to be different in part (a) was the group-incentive program as individual and control both had equal means, but in both of the group-incentive pairings, it rejected the H_0 stating that the two means are not equal.

12.33: Page 683

(a)

The new means and standard deviations for each of the groups would still remain the same, however, they would just be divided by 2.2:

Groups	Sample Size	Mean	Std. Deviation
Control	35	-0.4585	5.2276
Individual	35	-1.6857	4.1265
Group	34	-4.9024	5.0632

(b)

Source	df	SS	MS	F statistic	p-value
Group	2	362.1000	181.0500	7.7678	0.0007278958
Error	101	2354.0851	23.3077		
Total	103	2716.1851			

Based on these findings, dividing by 2.2 did not change the normality of the data, therefore, the values are the same as the previous problem and so are the findings in regards to the hypotheses.

12.41: Page 685

μ_1 = Blue Eyes

$\mu_2 =$ Brown Eyes

$\mu_3 =$ Down Eyes

$\mu_4 =$ Green Eyes

(a)

Compare the average of brown eyes to the average of another color eye:
$\psi_1 = \mu_2 - \frac{(\mu_1+\mu_4)}{2}$

(b)

Compare down eyes to the rest of the eyes:
$\psi_2 = \frac{(\mu_1+\mu_2+\mu_4)}{3} - \mu_3$

12.42: Page 685

(a)

$\Psi_1, H_0 : \Psi_1 = 0$

$\Psi_1, H_a : \Psi_1 \neq 0$

$\Psi_2, H_0 : \Psi_2 = 0$

$\Psi_2, H_a : \Psi_2 \neq 0$

(b)

$c_1 = 3.72 - \frac{7.05}{2} = 0.195$
$c_2 = \frac{3.19+3.72+3.86}{3} - 3.11 = 0.48$

(c)

$$S_p = \sqrt{\frac{(67-1)(1.65)(2) + ...}{(67-1) + ...}} = 1.68$$

$$SE_{c_1} = 1.68 * \sqrt{\frac{1}{37} + \frac{\frac{-1}{4}}{67} + \frac{\frac{-1}{4}}{77}} = 0.3098$$

$$SE_{c_2} = 1.68 * \sqrt{\frac{\frac{1}{9}}{67} + \frac{\frac{1}{9}}{37} + \frac{\frac{1}{9}}{77} + \frac{1}{41}} = 0.2933$$

(d)

$$\begin{aligned} t_1 &= \frac{c_1}{SE_{c_1}} = \frac{0.195}{0.3098} = 0.631 \\ df &= n - k = 218 \\ P(|T| > |t|) &= 2[1 - pt(|t|, n-k)] < \alpha \\ p - value &= 0.5228446 > 0.05 = \alpha \end{aligned}$$

Based on this p-value, since it is not less than the significance level of 0.05, we fail to reject H_0.

$$\begin{aligned} t_2 &= \frac{0.48}{0.2933} = 1.64 \\ df &= 218 \\ P(|T| > |t|) &= 2[1 - pt(|t|, n-k)] < \alpha \\ p - value &= 0.1024473 > 0.5 = \alpha \end{aligned}$$

Based on this p-value, since it is not less than the significance level of 0.05, we fail to reject H_0.

(e)

For c_1:

$0.195 \pm 1.96 * 0.309 = 0.195 \pm 0.6564 = (-0.41064, 0.80064)$

For c_2:

$0.48 \pm 1.96 * 0.293 = 0.48 \pm 0.57428 = (-0.09428, 1.05428)$