

Section 0

- 1 Computer output for analysis of a random sample of data is shown below. Some of the quantities are missing. Compute the values of the missing quantities:

Variable	N	Mean	SE of mean	Std. Dev.	Variance	Minimum	Maximum
Y	9	19.96	1.04	3.12	9.734	15.94	27.16

- 2 Consider the computer output shown below.

One-Sample T: Y

Test of mu=91 vs. \neq 91

Variable	N	Mean	Std. Dev	SE of mean	95% CI	T	P
Y	25	92.5805	2.3366	0.4673	(91.6160, 93.545)	3.38	0.002

- (a) Fill in the missing values in the output. Can the null hypothesis be rejected at the 0.05 level? Why?
Yes, the p-value is less than .05, providing sufficient evidence for $H_1 : \mu \neq 90$
- (b) Is this a one-sided or a two-sided test? *Two-sided. Hypothesis is that $\mu = 91$*
- (c) If the hypotheses had been $H_0 : \mu = 90$ versus $H_1 : \mu \neq 90$ would you reject the null hypothesis at the 0.05 level? *Yes, the mean 92.5805 is even further from 90, ensuring that the p-value for that test would be even more significant.*
- (d) Use the output and the t table (or R) to find a 99 percent two-sided CI on the mean.
(91.2735, 93.8875)
- (e) What is the P-value if the alternative hypothesis $H_1 : \mu > 91$?
p-value for the two-sided test is .002, so the one-sided p-value will be half as much. $p=0.001$
- 3 (a) $H_0 : \mu_{M1} = \mu_{M2}, H_1 : \mu_{M1} \neq \mu_{M2}$
 (b) $z=1.349627, p\text{-value} = 0.177$
 (c) $CI(95) = .01 \pm .014; (-.004, .024)$
 (d) $t = 0.79894, df = 18, p\text{-value} = 0.4347$
- 4 *The test statistic of 2.675 (with p-value 0.009059) exceeds the critical value of 1.76 for $\alpha = .05$. This difference in wafer thickness between the two temperatures is significant.*
- 5 (a) *test statistic $z= 4, p=.0000317$. Reject H_0 .*

- (b) *Test statistic = 1.714, $p=.086$ which is less than critical two-tailed value of 1.96*
- (c) $t = 0.66544$, $df = 15$, $p\text{-value} = 0.2579$
- 6 (a) $t=0.6438566$, $df=12.833$, $p=0.531$
- (b) $(-2.2607, 4.1767)$. *This interval contains both positive and negative values, which says that the true difference could be positive or negative and zero (equality of means) is plausible.*
- 7 (a) *Test stat= 3.154, $p=.0046$*
- (b) $(1.72, 6.28)$
- 8 Standardize each score
- 9 (a) *No.*
- (b) We must assume x is distributed normally.
 0.158655
- (c) *No.*
- (d) We must again assume x is distributed normally.
 0.000782
- (e) *Yes!*
- (f) We do not have to assume anything. We can use the Central Limit Theorem (CLT) to assume normality of z .
There is a 0% chance of the group scoring higher than 60 points.
- 11 (a) 15
- (b) 23
- 12 (a) 29
- (b) 64
- 13 $t = 6.0819$, $df = 8$, $p\text{-value} = 0.0002953$;
 $(0.1700423, 0.3777355)$
- 14 (a) $t = 2.8823$, $df = 9$, $p\text{-value} = 0.01811$
- (b) $t = 1.0588$, $df = 18$, $p\text{-value} = 0.3037$
- (c) CI for paired comp. $(0.2581889, 2.1418111)$
CI for two-sample $(-1.181045, 3.581045)$
Centers of the CI's are identical. The spread, however, is far greater for the two-sample T . The two intervals are different because with the paired comparison test you are removing the person to person variability, which variability shows up in the two-sample T .

- (d) Stick with paired comparison test because the sample is composed of people who demonstrate various levels of violence. People composing the sample have different starting levels of aggression.

Section 1.1

- 15 #1.3 (6 pts.–2 pts. each)
- (a) chance error
- 18 (a) Larger fish are more likely to be caught because they will not slip through the net. Fish smaller than one inch are less likely to be caught because they can slip through the net.
- 19 #1.8 (2 pts.) (1) Randomizing protects against bias. (2) Allows us to use probability and sampling distributions when analyzing the data.

Chapter 4

- 20 #A3 on p.109. *Dependent/Response* - Number of words of each word type recalled. *Independent/Condition* Word type concrete and abstract. *Material/Unit of analysis* Each subject.
- 22 #A6 on p.109. A reasonable response could be; *Dependent/Response* - Performance on memory recall test *Independent/Conditions* - Exposure to varying intensities of anxiety provoking situations. *Material* - Each participant.
- 25 (#B1 p. 116) For seeds of wild grasses:
- (a) Weight–**Ratio**
- (b) Species–**Nominal**
- (c) Percent (out of 10) that germinate–**Ratio**
- (d) Size category: small, medium, or large–**Ordinal**
- 27 (#B8 p. 117)
- Purpose: To judge the value of dairy cows
- Response 1: Weight of the cow
- Response 2: Average milk yeild, in pounds per weeks**

Sections 1.2-1.3

- 35 (b) Blocks: Each individual student is a block
 Units: The student at the times of each test—e.g., Bobby at the 9:00 am test time and Bobby at the 10:00 am test time
- 36 We know that the women did better after being complimented, so only 72% and 87% are possibilities. We know that the gender \times feedback type interaction is significant, so 72% must not be correct—72% would be the expected result for the women/compliment group IF there were no interaction. The only plausible answer is 87%.
- 37 (a) One possibility is below, but the difference between stat and non-stat in the morning has to be equal to the stat versus non-stat difference for the afternoon. Also, average for morning must be at least 5 units higher than average for afternoon and average for stat must be at least 5 units higher than the average for non-stat.

		Major		
		stat	non-stat	overall
Lecture Time	morning	83	78	80.5
	afternoon	78	73	75.5
overall		80.5	75.5	

Chapter 3

38 Complete Decomposition:

	Observed			Benchmark			Day length			Residuals	
Long	1.490	1.525	=	1.47	1.47	+	0.12	0.12	+	-0.100	-0.065
	1.555	1.790		1.47	1.47		0.12	0.12		-0.035	0.200
Short	1.375	1.485		1.47	1.47		-0.12	-0.12		0.025	0.135
	1.255	1.285		1.47	1.47		-0.12	-0.12		-0.095	-0.065

40 The anova table is:

Table 1: Anova table for problem #8

Source	SS	df	MS	F	p-value
Grand ave	17.2872	1	17.2872		
Day length	0.1152	1	0.1152	7.8949	0.0308
Residuals	0.0876	6	0.0146		
Total	17.4900	8			

42 SD= 0.1208

47 (a) $\mu_{highsalt} - \mu_{lowsalt}$. $74 - 38.25 \pm 2.77 \times \sqrt{.5 \times 84.625} \rightarrow (17.73169, 53.76831)$

(b) $\mu_{butteryoil} - \mu_{canolaoil}$. $5.75 \pm 2.77 \times \sqrt{.5 \times 84.625} \rightarrow (-12.26831, 23.76831)$

(c) $\mu_{highsaltwithbuttery} - \mu_{lowsaltwithcanola}$ $41.5 \pm 2.77 \times \sqrt{84.625} \rightarrow (16.01826, 66.98174)$

Chapter 5

48 0.698%

49 (a) Boxplot:

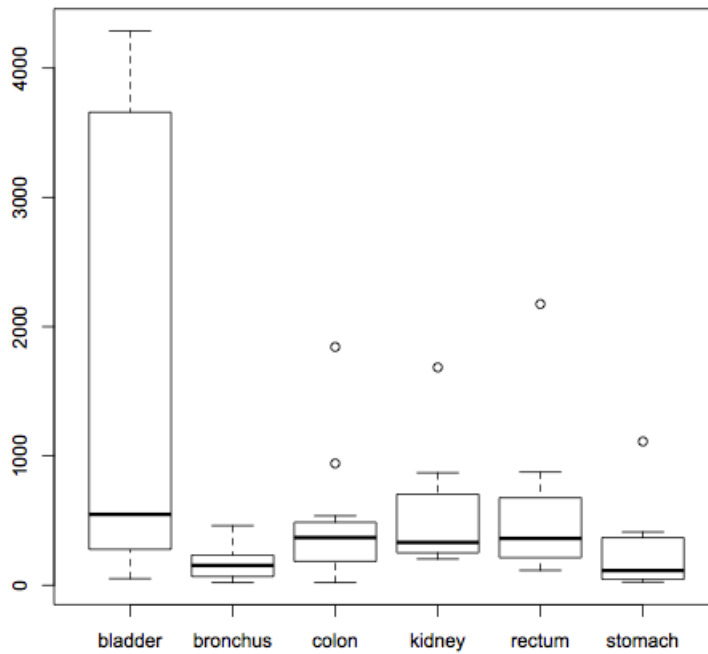


Table of means and sds:

	bladder	bronchus	colon	kidney	rectum	stomach
Mean	1764.6000	171.1250	437.5000	589.7143	633.1429	236.8333
Std.Dev	2035.8678	131.4817	432.9531	537.2212	725.2789	310.7258

(b) Boxplot:

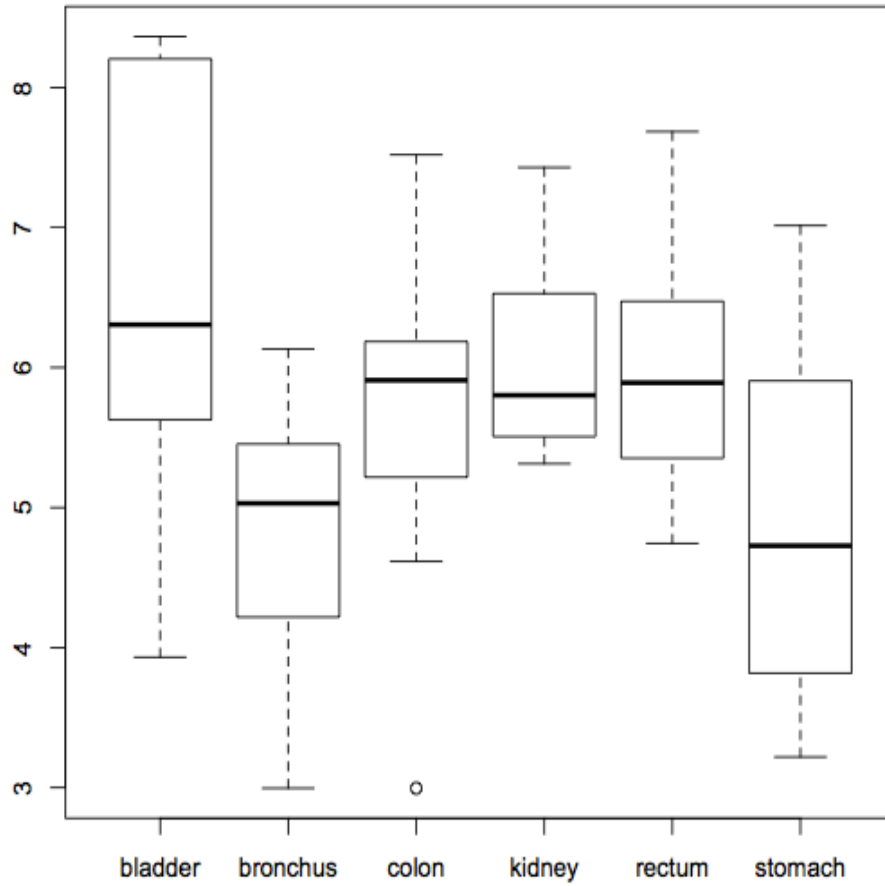


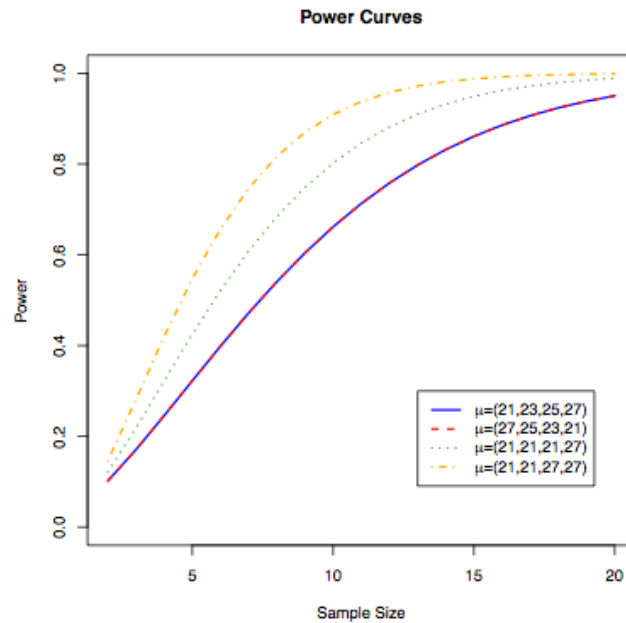
Table of means and sds for log transform:

	bladder	bronchus	colon	kidney	rectum	stomach
Mean	6.4868	4.8405	5.6926	6.0878	5.9960	4.8173
Std.Dev	1.8555	0.8599	1.0016	0.7883	0.9939	1.17623

$$\begin{array}{c}
 \text{Grand Avg.} \\
 \begin{array}{|c|c|c|}
 \hline
 20 & 20 & 20 \\
 \hline
 20 & 20 & 20 \\
 \hline
 20 & 20 & 20 \\
 \hline
 20 & 20 & 20 \\
 \hline
 20 & 20 & 20 \\
 \hline
 \end{array}
 \end{array}
 +
 \begin{array}{c}
 \text{Diet} \\
 \begin{array}{|c|c|c|}
 \hline
 \text{Cheetos} & \text{Steak} & \text{Tofu} \\
 \hline
 7 & 2 & -9 \\
 \hline
 7 & 2 & -9 \\
 \hline
 7 & 2 & -9 \\
 \hline
 7 & 2 & -9 \\
 \hline
 7 & 2 & -9 \\
 \hline
 \end{array}
 \end{array}
 +
 \begin{array}{c}
 \text{Residual} \\
 \begin{array}{|c|c|c|}
 \hline
 ? & ? & ? \\
 \hline
 ? & ? & ? \\
 \hline
 ? & ? & ? \\
 \hline
 ? & ? & ? \\
 \hline
 ? & ? & ? \\
 \hline
 \end{array}
 \end{array}$$

Degrees of freedom for Grand Avg. = 1, Diet = 2, and Residual = 12.

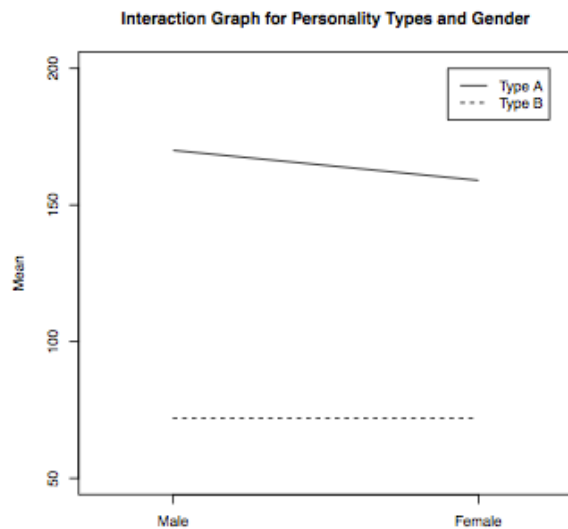
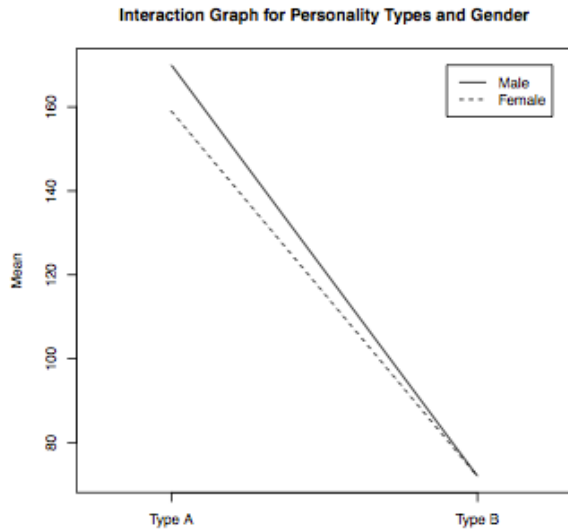
- 56 F statistic for testing conditions is 2.07525. Make sure to calculate your p-value.
- 57 The R command for the SD of the numbers 2, 3, 9, and 10 is: “`sd(c(2,3,9,10))`”
- 58 F statistic for testing conditions is 6.90061. Make sure to calculate your p-value.
- 59 (b) F statistic for testing cancer types is 3.87.
- 60 (b) F statistic for testing cancer types is 3.87.
- 60 (c) (0.2552, 2.2858)
- 61 (a) Plot of all four power curves:



- (b) The smallest group size (n) that gives 85% power is **15**.

Chapter 6

- 63 (a) Interaction Plots:



The interaction graph that is easier to understand is entirely a matter of opinion.

- (b) Factor #1: Gender, two levels (male and female)
- Factor #2: Personality type, two levels (type A and type B)
- Response: Time (seconds) spent attending to negative information.
- Interaction: The time spent attending to negative information due to personality type is not different depending on gender.

66 Analysis of Variance Table

Response: Yield

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
sowdate	3	747.78	249.259	876.130	< 2.2e-16 ***
variety	2	8.40	4.201	14.767	1.005e-05 ***
sowdate:variety	6	5.87	0.978	3.437	0.006645 **
Residuals	48	13.66	0.284		

 Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

67 The GLM Procedure

Dependent Variable: TimePredictionError

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	100458.0000	20091.6000	208.80	<.0001
Error	18	1732.0000	96.2222		
Corrected Total	23	102190.0000			

Source	DF	Type I SS	Mean Square	F Value	Pr > F
LargeSystemExp	1	34504.16667	34504.16667	358.59	<.0001

YearsOfExp	2	41719.75000	20859.87500	216.79	<.0001
LargeSyst*YearsOfExp	2	24234.08333	12117.04167	125.93	<.0001

68 (a) Writing model with gender first, then part, then the interaction:

<i>Source</i>	<i>df</i>	Type I SS	<i>MS</i>	<i>F</i>	<i>p-value</i>
gender	1	1018.8553	1018.8553	161.13	< .0001
part	1	33.08937	33.08937	5.23	0.0238
part*gender	1	6.5843	6.5843	1.04	0.3095

or, writing model with part first, then gender, then the interaction:

<i>Source</i>	<i>df</i>	Type I SS	<i>MS</i>	<i>F</i>	<i>p-value</i>
part	1	122.39	122.39	19.36	< 0.0001
gender	1	929.554	929.554	147	< .0001
part*gender	1	6.5843	6.5843	1.04	0.3095

(b) Anova table from SAS (Type III):

<i>Source</i>	<i>df</i>	Type III SS	<i>MS</i>	<i>F</i>	<i>p-value</i>
gender	1	872.647	872.64	138	< .0001
part	1	36.7916	36.7916	5.82	0.0173
part*gender	1	6.5843	6.5843	1.04	0.3095

Section 7.1

70 (a) nuisance factor is the block of farmland.

(b) the unit is a plot of land within a block of farmland.

(c) there are five plots in each block of farmland. That is, each block of farmland is broken into five plots.

73 /* Results for CB[1] */

Source	DF	Type I SS	Mean Square	F Value	Pr > F
block	4	6138.560000	1534.640000	0.20	0.9361
height	4	8852.160000	2213.040000	0.28	0.8836

Source	DF	Type III SS	Mean Square	F Value	Pr > F
block	4	6138.560000	1534.640000	0.20	0.9361
height	4	8852.160000	2213.040000	0.28	0.8836

/* Results for BF[1] */

Source	DF	Type I SS	Mean Square	F Value	Pr > F
height	4	8852.160000	2213.040000	0.34	0.8484

Source	DF	Type III SS	Mean Square	F Value	Pr > F
height	4	8852.160000	2213.040000	0.34	0.8484

Section 7.3

75 ANOVA table for auxin data.

Source	df	SS	MS	F-ratio	p-value
mean	1	14450	14450		
auxin	3	927.25	309.083	7.667183	.004000129
plant(auxin)	12	483.75	40.3125		
deblading	1	24.5	24.5	6.87719	.02228439
auxin*deblading	3	265.75	88.583	24.8654	.0000195
residual	12	42.75	3.5625		
total	32	16194	506.0625		

Section 7.2

77

Source	DF	Type I SS	Mean Square	F Value	Pr > F
cow	2	46674.0000	23337.0000	9.81	0.0925
period	2	5850.0000	2925.0000	1.23	0.4485
diet	2	103416.0000	51708.0000	21.74	0.0440

Source	DF	Type III SS	Mean Square	F Value	Pr > F
cow	2	46674.0000	23337.0000	9.81	0.0925
period	2	5850.0000	2925.0000	1.23	0.4485
diet	2	103416.0000	51708.0000	21.74	0.0440

Section 7.4

81 #D4 on pages 278-9

Grand Avg.	Between	Block	Within	Inter.	Residual
40 40	20 20	3 3	10 -10	5 -5	2 -2
40 40	20 20	-3 -3	10 -10	5 -5	-2 2
40 40	-15 -15	-2 -2	10 -10	-2 2	-1 1
40 40	-15 -15	2 2	10 -10	-2 2	1 -1
40 40	-5 -5	4 4	10 -10	-3 3	0 0
40 40	-5 -5	-4 -4	10 -10	-3 3	0 0
df=1	df=2	df=3	df=1	df=2	df=3

Chapter 11

84 (c) We reject the null hypothesis (p-value = 0.0056). At least one α_i is different.

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	2708060.29	451343.38	3.41	0.0056
Error	63	8338789.50	132361.74		
Corrected Total	69	11046849.79			

- (d) The proper approach for pairwise comparisons is **Tukey**.
Vans are significantly different from medium and heavy cars.
- (e) **Tukey** is best approach since it has the smallest interval width.
width of Tukey is 991. Width of Scheffe is 1194.6. Width of Bonferroni is 1030.2.
- | | | | | |
|-------------------|---------------|--------|--------|-------|
| (i) Tukey: | compact - van | -357.7 | -853.2 | 137.8 |
| (ii) Scheffe: | compact - van | -357.7 | -955.0 | 239.6 |
| (iii) Bonferroni: | compact - van | -357.7 | -872.8 | 157.4 |
- (f) **Bonferroni** is the best approach.
- (i) mean of the trucks&vans&minivans minus the mean of the other 4 car types is significant, so there is a difference between those cars.
 - (ii) mean of the heavy&medium cars minus the mean of the light&compact cars is not significant, so there is not a difference between those cars.
 - (iii) mean of minivans minus mean of compact cars is not significant, so there is not a difference between those cars.

85 **Bonferroni** is the best approach.

```
proc glm data=wear;
  class filler prop;
  model wear1 = filler prop filler*prop / alpha=.025 clparm;
  /* The alpha=.025 option above is for a Bonferroni correction (2 contrasts).
     Using this option gives a 97.5% confidence level for the confidence interval
     associated with each of the two contrasts. */
  contrast 'mu12 - mu2.' filler 1 -1 prop -.333333 .666666 -.333333
    filler*prop 0 1 0 -.33333333 -.33333333 -.333333/e;
```

```

contrast 'mu11 - mu12' prop 1 -1 0 filler*prop 1 -1 0 0 0 0 /e;
/* The contrast and estimate statements are doing the same thing here, so you
only need the two contrast statements OR the two estimate statements.
The estimate statement also gives CI's */
estimate 'mu12 - mu2.' filler 1 -1 prop -.333333 .666666 -.333333
filler*prop 0 1 0 -.33333333 -.33333333 -.333333/e;
estimate 'mu11 - mu12' prop 1 -1 0 filler*prop 1 -1 0 0 0 0 /e;
run;

```

Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
mu12 - mu2.	1	4108.170068	4108.170068	17.48	0.0058
mu11 - mu12	1	552.250000	552.250000	2.35	0.1762

Parameter	Estimate	Standard Error	t Value	Pr > t	97.5% Confidence Limits	
mu12 - mu2.	52.3333550	12.5166556	4.18	0.0058	15.1753263	89.4913837
mu11 - mu12	-23.5000000	15.3297097	-1.53	0.1762	-69.0091051	22.0091051

- Because .0058 is less than $\alpha/2 = .025$, (mean of fabric wear values in filler level 1 (cotton) and proportion level 2 (50% filled)) is significantly different from (mean of fabric wear values in filler level 2 (polyester)).
- Because .1762 is greater than $\alpha/2 = .025$, (mean of fabric wear values in filler level 1 and proportion level 1) is not significantly different from (mean of fabric wear values in filler level 1 and proportion level 2).