PLSC 724 – EXAMINATION 1

October 9, 2024
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Name: Key

1. Given the data below for an experiment with treatments assigned to experimental units using a Completely Random Design with Sampling:

	A			B		
	Rep			Rep		
Sample	1	2	3	1	2	3
1	3	5	4	8	10	11
2	2	6	3	12	9	9
3	4	5		11	8	9
4	1			11	10	12
$\Sigma Y_{ij.}$	10	16	7	42	37	41
$\Sigma Y_{i..}$	33			120		

$Y_{...} = 153 \quad n = 21$

a. How many experimental units are there in this experiment (5)?

6

b. Calculate the Sum of Squares Among Experimental Units Total (20).

$$SS_{AEUT} = \left(\frac{10^2}{4} + \frac{16^2}{3} + \frac{7^2}{2} + \frac{42^2}{4} + \frac{37^2}{4} + \frac{41^2}{4}\right) - 153^2/21$$

$$= 25 + 85.3 + 24.5 + 441 + 342.25 + 420.25 - 1114.71$$

$$= 1338.30 - 1114.71$$

$$= 223.59$$

2. Given the JMP output in the accompanying document from the analysis of an experiment using a *t*-test, do you reject or fail to reject the null hypothesis that the two treatment variances are homogeneous at the 95% level of confidence? Please defend your answer (15)?

Testing $H_0: \sigma_1^2 = \sigma_2^2$

Use F-test 2-sided

P-value on output is 0.6496

Because the p-value > 0.05, we fail to reject $H_0: \sigma_1^2 = \sigma_2^2$ at the 95% level of confidence.

3. Given the ANOVA table and the treatment means below from the analysis of experiment conducted using a Completely Random Design with Sampling:

Sources of variation	Degrees of freedom	Sum of squares	Mean squares	*F*-value
Treatment	2	1149.69	574.85	62.62
Experimental error	3	27.53	9.18	
Sampling error	18	61.89	3.44	
Total	23	1239.11		

Treatment	Mean
A	4.10
B	10.36
C	20.88

$t-1=2$ $\quad (tr-1)-(t-1)=3$ $\quad trs-1=23$

$t=3$ $\quad 3r-1-2=3$ $\quad 3(2)s=24$

$3r=6$ $\quad 6s=24$

$r=2$ $\quad s=4$

a. Calculate the coefficient of variation for this experiment (15).

$$CV=\frac{\sqrt{\text{Expt Error}}}{\bar{Y}}\times 100 = \frac{\sqrt{9.18}}{\frac{(4.10+10.36+20.88)}{3}}\times 100 = \frac{\sqrt{9.18}}{\frac{35.31}{3}}\times 100$$

$$= \frac{\sqrt{9.18}}{11.78}\times 100 = 25.72\%$$

b. Calculate the standard error (15).

$$S_{\bar{Y}}=\sqrt{\frac{\text{Exp+Error}}{r.s}} = \sqrt{\frac{9.18}{2\times 4}} = \sqrt{\frac{9.18}{8}} = 1.07$$

c. Calculate the LSD value at the 95% level of confidence that can be used for mean separation (15).

$$t_{\frac{.05}{2}, Exp+Error\ df}\sqrt{\frac{2\,Exp+Error\ MS}{r \cdot s}} = 3.182\sqrt{\frac{2(9.18)}{2\times 4}} = 3.182 \times 1.515$$

$$= 4.82$$

d. Complete the mean separation of the treatment means using the least significant difference at the 95% level of confidence. Indicate what means are not significantly different using lower case letters (15).

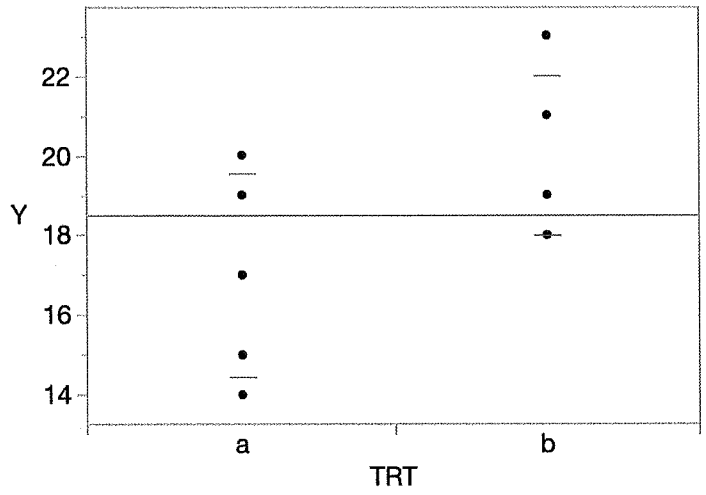
Trt	Mean	
A	4.10	a
B	10.36	b
C	20.88	c

"Upon my honor, I have neither given nor received aid in writing this exam."

Signed _____

PLSC 724 Exam #1 – Question 2 JMP Output

Oneway Analysis of Y By TRT

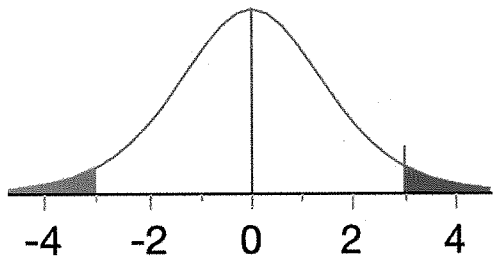


t Test

b-a

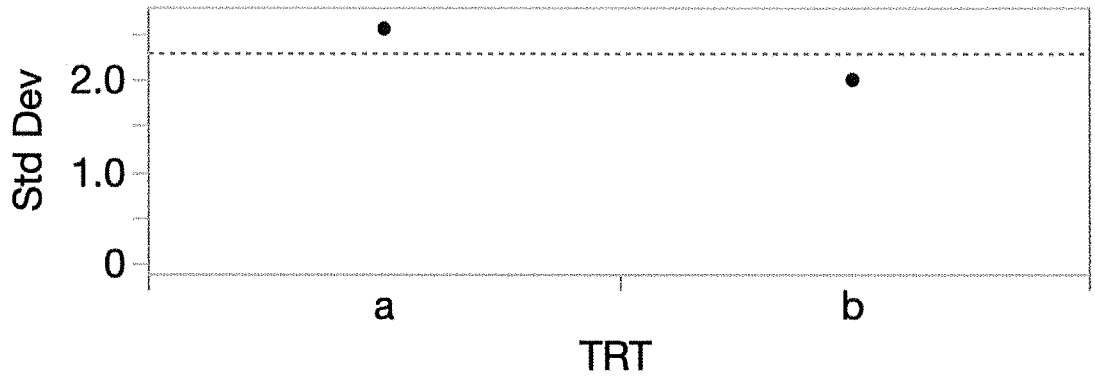
Assuming unequal variances

Difference	3.0000	t Ratio	2.070197
Std Err Dif	1.4491	DF	7.570815
Upper CL Dif	6.3750	Prob > |t|	0.0742
Lower CL Dif	-0.3750	Prob > t	0.0371*
Confidence	0.95	Prob < t	0.9629



PLSC 724 Exam #1 – Question 2 JMP Output

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
a	5	2.549510	2.000000	2.000000
b	5	2.000000	1.600000	1.400000

Test	F Ratio	DFNum	DFDen	p-Value
O'Brien[.5]	0.5462	1	8	0.4810
Brown-Forsythe	0.4186	1	8	0.5358
Levene	0.3478	1	8	0.5716
Bartlett	0.2075	1	.	0.6487
F Test 2-sided	1.6250	4	4	0.6496

Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
4.2857	1	7.5708	0.0742

t Test
2.0702

II. Percentage Points of the t Distribution[a]

ν \ α	.40	.25	.10	.05	.025	.01	.005	.0025	.001	.0005
1	.325	1.000	3.078	6.314	12.706	31.821	63.657	127.32	318.31	636.62
2	.289	.816	1.886	2.920	4.303	6.965	9.925	14.089	23.326	31.598
3	.277	.765	1.638	2.353	3.182	4.541	5.841	7.453	10.213	12.924
4	.271	.741	1.533	2.132	2.776	3.747	4.604	5.598	7.173	8.610
5	.267	.727	1.476	2.015	2.571	3.365	4.032	4.773	5.893	6.869
6	.265	.727	1.440	1.943	2.447	3.143	3.707	4.317	5.208	5.959
7	.263	.711	1.415	1.895	2.365	2.998	3.499	4.019	4.785	5.408
8	.262	.706	1.397	1.860	2.306	2.896	3.355	3.833	4.501	5.041
9	.261	.703	1.383	1.833	2.262	2.821	3.250	3.690	4.297	4.781
10	.260	.700	1.372	1.812	2.228	2.764	3.169	3.581	4.144	4.587
11	.260	.697	1.363	1.796	2.201	2.718	3.106	3.497	4.025	4.437
12	.259	.695	1.356	1.782	2.179	2.681	3.055	3.428	3.930	4.318
13	.259	.694	1.350	1.771	2.160	2.650	3.012	3.372	3.852	4.221
14	.258	.692	1.345	1.761	2.145	2.624	2.977	3.326	3.787	4.140
15	.258	.691	1.341	1.753	2.131	2.602	2.947	3.286	3.733	4.073
16	.258	.690	1.337	1.746	2.120	2.583	2.921	3.252	3.686	4.015
17	.257	.689	1.333	1.740	2.110	2.567	2.898	3.222	3.646	3.965
18	.257	.688	1.330	1.734	2.101	2.552	2.878	3.197	3.610	3.922
19	.257	.688	1.328	1.729	2.093	2.539	2.861	3.174	3.579	3.883
20	.257	.687	1.325	1.725	2.086	2.528	2.845	3.153	3.552	3.850
21	.257	.686	1.323	1.721	2.080	2.518	2.831	3.135	3.527	3.819
22	.256	.686	1.321	1.717	2.074	2.508	2.819	3.119	3.505	3.792
23	.256	.685	1.319	1.714	2.069	2.500	2.807	3.104	3.485	3.767
24	.256	.685	1.318	1.711	2.064	2.492	2.797	3.091	3.467	3.745
25	.256	.684	1.316	1.708	2.060	2.485	2.787	3.078	3.450	3.725
26	.256	.684	1.315	1.706	2.056	2.479	2.779	3.067	3.435	3.707
27	.256	.684	1.314	1.703	2.052	2.473	2.771	3.057	3.421	3.690
28	.256	.683	1.313	1.701	2.048	2.467	2.763	3.047	3.408	3.674
29	.256	.683	1.311	1.699	2.045	2.462	2.756	3.038	3.396	3.659
30	.256	.683	1.310	1.697	2.042	2.457	2.750	3.030	3.385	3.646
40	.255	.681	1.303	1.684	2.021	2.423	2.704	2.971	3.307	3.551
60	.254	.679	1.296	1.671	2.000	2.390	2.660	2.915	3.232	3.460
120	.254	.677	1.289	1.658	1.980	2.358	2.617	2.860	3.160	3.373
∞	.253	.674	1.282	1.645	1.960	2.326	2.576	2.807	3.090	3.291

ν = degrees of freedom.

[a]Adapted with permission from *Biometrika Tables for Statisticians*, Vol. 1, 3rd edition, by E. S. Pearson and H. O. Hartley, Cambridge University Press, Cambridge, 1966.