Math 10 - Homework 10 answers

1. A clinical psychologist completed a study on hyperactivity in children using one-way ANOVA. The model was balanced with **5 replicates per treatment**. The factor was 3 types of school district (urban, rural and suburban). Unfortunately, hackers broke into the psychologist's computer and wiped out all the data. All that remained was a fragment of the ANOVA table:

Fill in the table and conduct the hypotheses test that compares mean level of hyperactivity in the 3 types of districts. Explain your results.

Ho: $\mu 1=\mu 2=\mu 3$ Ha: at least $\mu 1$ is different
Model: One factor ANOVA
k=3, n=3x5=15
Reject Ho if F>3.89

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F statistic	Critical Value of F for α= .05	Decision
Factor	7000	2	3500	21	3.89	Reject Ho
Error	2000	12	166.6667			
Total	9000	14				

Conclusion: There is a difference in hyperactivity due to type of school district. Without, the original data, there is no way to determine where this difference occurs.

2. A sociologist was interested in commute time for workers in the Bay Area. She categorized commuters by 4 regions (North Bay, South Bay, East Bay and Peninsula) and designed a balanced model with 8 replicates per region. Data is round trip commute time in minutes . The results and ANOVA output are shown on the next page:

   a. Test the Null Hypothesis that all regions have the same mean commute time at a significance level of 5%. State your decision in non-statistical language.

   Ho: $\mu 1=\mu 2=\mu 3=\mu 4$ Ha: at least $\mu 1$ is different
   Model: One factor ANOVA
   Reject Ho if p-value < .05
   Since p-value =.0010, reject Ho
   Conclusion: There is a difference in commute times due to region.

   b. Conduct **all** pairwise comparisons at an overall significance level of 5%.

   Ho: $\mu_i = \mu_j$ Ha: $\mu_i \neq \mu_j$ I, j represent all possible pairs (6 tests total)
   Model: Tukey HSD for simultaneous comparisons
   Reject Ho if HSD>2.73
   Comparisons where Ho is rejected: South Bay to North Bay, South Bay to Peninsula
   All other comparisons, fail to reject Ho

   c. Explain the results of this experiment as if you were addressing a transportation committee. What would you recommend?

   The South Bay has significantly longer commute times when compared to the North Bay and the Peninsula. There were no other significant differences reported. It seems the most serious problems with traffic are in the South Bay.

MINITAB OUTPUT

North	South	East	Pen
13	91	41	17
9	45	30	16
10	28	60	13
13	17	34	26
27	89	47	7
13	36	13	9
9	23	19	21
32	66	36	18

One-way ANOVA: North, South, East, Pen

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Source  DF     SS    MS     F      P
Factor   3   6392  2131  7.14  0.001
Error   28   8356   298
Total   31  14748

S = 17.28   R-Sq = 43.34%   R-Sq(adj) = 37.27%


                        Individual 95% CIs For Mean Based on
                        Pooled StDev
Level  N   Mean  StDev  --------+---------+---------+---------+-
North  8  15.75   8.76  (--------*-------)
South  8  49.38  29.22                          (-------*-------)
East   8  35.00  14.99               (-------*--------)
Pen    8  15.88   6.20  (--------*-------)
                        --------+---------+---------+---------+-
                               15        30        45        60

Pooled StDev = 17.28


Grouping Information Using Tukey Method

       N   Mean  Grouping
South  8  49.38  A
East   8  35.00  A B
Pen    8  15.88    B
North  8  15.75    B

Means that do not share a letter are significantly different.
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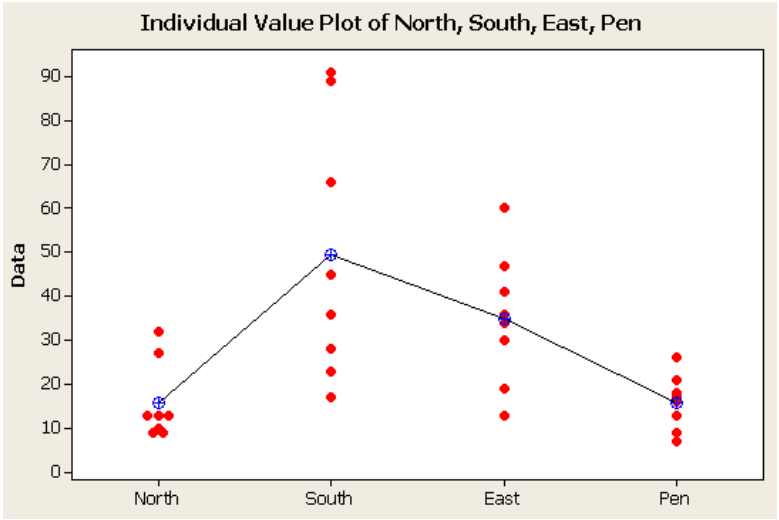


North South East Pen

MEGASTAT OUTPUT

13	91	41	17
9	45	30	16
10	28	60	13
13	17	34	26
27	89	47	7
13	36	13	9
9	23	19	21
32	66	36	18

Mean	*n*	*Std. Dev*	
15.8	8	8.76	North
49.4	8	29.22	South
35.0	8	14.99	East
15.9	8	6.20	Pen
29.0	32	21.81	Total

ANOVA table

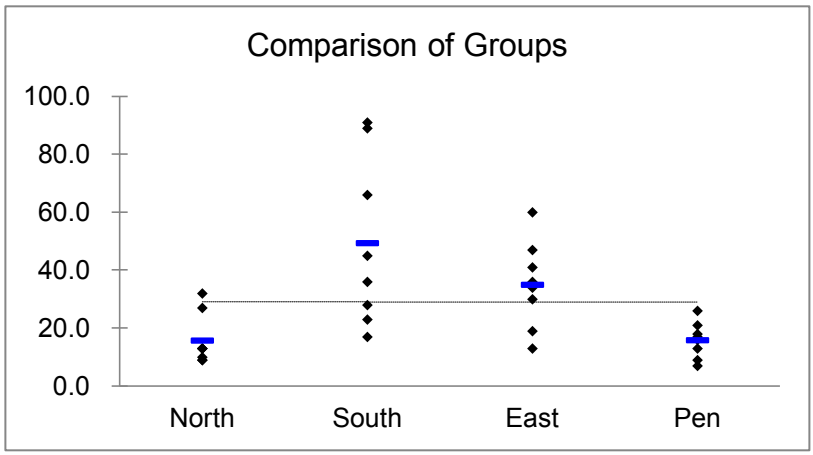
Source	*SS*	*df*	*MS*	*F*	*p-value*
Treatment	6,391.75	3	2,130.583	7.14	.0010
Error	8,356.25	28	298.438		
Total	14,748.00	31			

Tukey simultaneous comparison t-values (d.f. = 28)

		North	Pen	East	South
		15.8	15.9	35.0	49.4
North	15.8				
Pen	15.9	0.01			
East	35.0	2.23	2.21		
South	49.4	3.89	3.88	1.66	

critical values for experimentwise error rate:

0.05	2.73
0.01	3.42



3. People who are concerned about their health may prefer hot dogs that are low in salt and calories. The data contains data on the calories and sodium contained in each of 54 major hot dog brands. The hot dogs are classified by type: beef, poultry, and meat (mostly pork and beef, but up to 15% poultry meat). Minitab output is attached for two different hypothesis tests.
A test for a difference in **calories** due to hot dog type will be performed.

i. Design the test.

Ho: There is no difference in calories due to hot dog type.

Ha: There is a difference in calories due to hot dog type.

Ho: $\mu 1=\mu 2=\mu 3$ Ha: at least μ_i is different

Model: One factor ANOVA

Reject Ho if p-value < .05

ii. Fill in the missing information in the ANOVA table on the next page.'

Source	DF	SS	MS	F	P
Type	2	17692	8846	16.07	0.000
Error	51	28067	550		
Total	53	45759			

Conduct the test with an overall confidence level of 5%, including pairwise comparisons.

Since p-value =.000, reject Ho

Conclusion: There is a difference in calories due to hot dog type.

From the Tukey Test, we can conclude that poultry hot dogs have lower mean calories than Meat or Beef Hot Dogs. No other significant differences.