28th January

STAT 5023
HW #2

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(1) An ANOVA table for a one-way experiment gives the following.

Source	df	SS
Between	2	810
Within	8	720

Answer true or false and explain for the following six statements.

Solution:

Source	df	SS	MS	F
Between	2	810	405	4.500
Within	8	720	90	
Total	10	1530		

The Mean Square of each row is Calculated by dividing the Sum of Squares

F- Statistic

Test Statistic : $F_{max} = \frac{S^2_{max}}{S^2_{min}} = \frac{405}{9} = 4.500$

a. The null hypothesis is that all four means are Equal.

- Since the degree of freedom between factors is Equal to 2.
- The total no. of factors = 2+1 = 3
- Only 3 means are Equal.

Hence, the statement is FALSE

b. The Calculated Value of F is 4.500

TRUE.

$$F_{max} = \frac{S^2_{max}}{S^2_{min}} = \frac{405}{9} = 4.500$$

c. The Critical Value for F for 5% Significance is 6.06

- As this is a One-tail distribution. from, F-distribution, the Critical Value of F, $\alpha = 0.05$, degrees of freedom (2, 8), is 4.46.
- Since, F = 4.500 is greater the Critical Value the above Statement is FALSE

d. The null hypothesis Cannot be Reject at 5% Significance.

- From c., Critical Value of f is less than F Statistic. Therefore we reject the NULL HYPOTHESIS. The Statement is FALSE

e. The null hypothesis Cannot be rejected at 1% Significance.

From the F distribution table,

Critical Value of F at $\alpha = 0.01$ and df (2, 8) $\Rightarrow$ 8.65

Hence we do not reject the null hypothesis at 1% Significance

Therefore, the above Statement is TRUE

f. There are 10 Observations in the Experiment

degree of freedom = 2 + 8 = 10

$\Rightarrow$ No. of Observations = 10 + 1

= 11

Therefore, the above Statement is FALSE

2. Q-9, page 315

The data shown in Table 6.35 relate to the effectiveness of several insecticides. One hundred insects of a particular species were put into a chamber and exposed to an insecticide for 15 s. The procedure was applied in random order six times for each of four insecticides. The response is the number of dead insects. Perform the appropriate analysis to see the effectiveness of insecticides and make a recommendation? Compute a 99% confidence interval for each of the four groups means using SAS, and write the values in the remarks/conclusions for this assignment. Check assumptions!

Table 6.35 Data for Exercise 9

Insecticide			
A	B	C	D
85	90	93	98
82	92	94	98
83	90	96	100
88	91	95	97
89	93	96	97
92	81	94	99

Solution:

Code:

```
TITLE 'TEST for Insecticide';
DATA Insecticide;
INPUT GROUP $ NFDead @@;
DATALINES;
A 85 A 82 A 83 A 88 A 89 A 92
B 90 B 92 B 90 B 91 B 93 B 81
C 93 C 94 C 96 C 95 C 96 C 94
D 98 D 98 D 100 D 97 D 97 D 99
;

PROC GLM data=Insecticide alpha=0.01 plot=diagnostics;
CLASS GROUP;
MODEL NFDead=GROUP;
LSMEANS GROUP/CL;
run;
```

TEST for Insecticide

The GLM Procedure

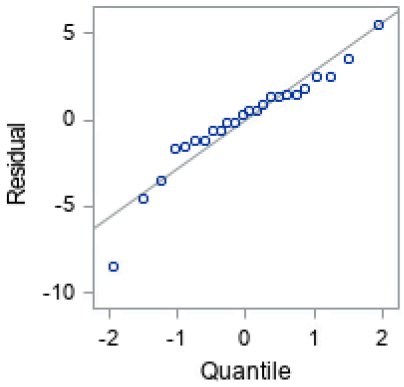
Dependent Variable: NFDead

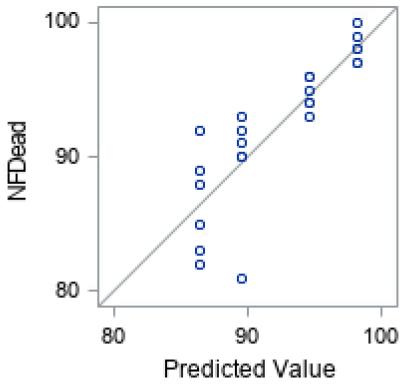
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	488.7916667	162.9305556	17.99	<.0001
Error	20	181.1666667	9.0583333		
Corrected Total	23	669.9583333			

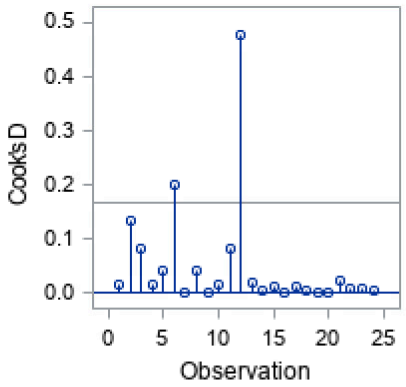
R-Square	Coeff Var	Root MSE	NFDead Mean
0.729585	3.264029	3.009707	92.20833

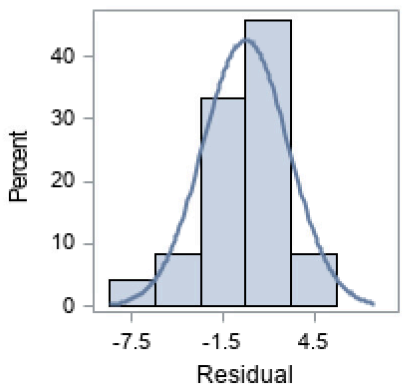
Source	DF	Type I SS	Mean Square	F Value	Pr > F
GROUP	3	488.7916667	162.9305556	17.99	<.0001

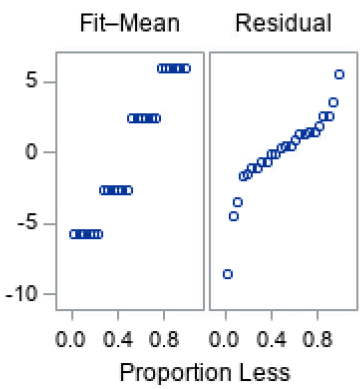
Source	DF	Type III SS	Mean Square	F Value	Pr > F
GROUP	3	488.7916667	162.9305556	17.99	<.0001



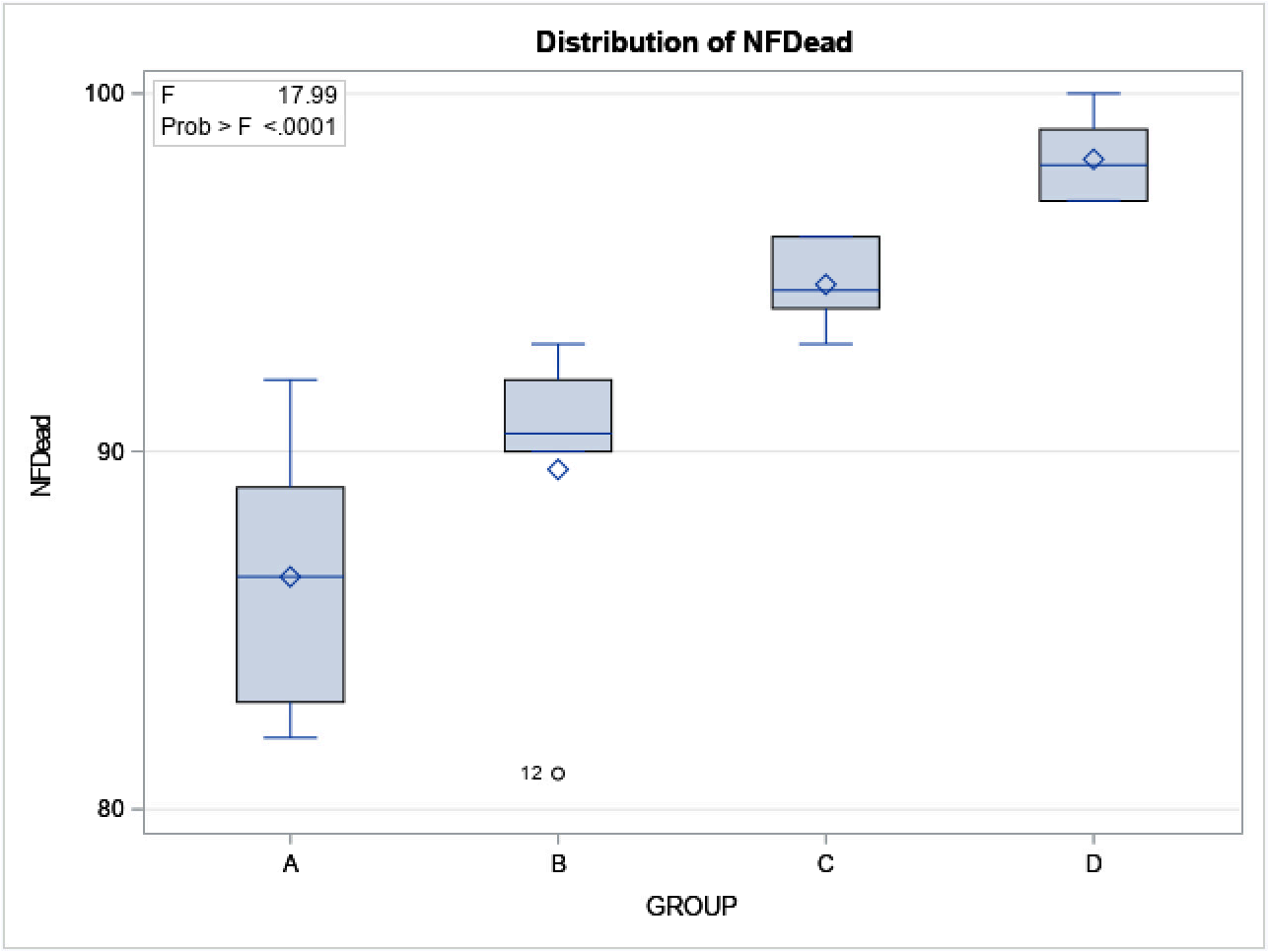








Observations	24
Parameters	4
Error DF	20
MSE	9.0583
R-Square	0.7296
Adj R-Square	0.689



TEST for Insecticide

The GLM Procedure
Least Squares Means

GROUP	NFDead LSMEAN
A	86.5000000
B	89.5000000
C	94.6666667
D	98.1666667

GROUP	NFDead LSMEAN	99% Confidence Limits	
A	86.500000	83.003910	89.996090
B	89.500000	86.003910	92.996090
C	94.666667	91.170576	98.162757
D	98.166667	94.670576	101.662757

. The Quantile and Normality were generated and Screenshots are placed above
. Initially we assume that

Null Hypothesis	H0 : mu1=mu2=mu3=mu4
Alternative Hypothesis	H1: At least one Means is not equal to other Means

We have considered alpha as 0.01 as it is given to check for the confidence 91%

From the Quantile and Normality graphs we can say that it is Normally Distributed.
We can see that there is no common means between from box-plot.
We got F as 17.99.
As we can see that P value is less than 0.001.

Therefore, P Value is less than alpha. We reject NULL Hypothesis

From the above statements, We can say that At least one of the Insecticide has a different effect on Insects

3. A Small Cooperation makes insulation Shields for Electrical Wires Using three different types of machines. The Corporation wants to evaluate the Variation in the inside diameter dimension of the Shields produced by the machines. A quality engineer at the Coorporation randomly selects Shields produced by each of the machines and records the inside diameters of each Shield (in mm). She wants to determine Whether the means and Standard deviation of the three machines differ

Machine A	Machine B	Machine C
18.1	8.7	29.7
2.4	56.8	18.7
2.7	4.4	16.5
7.5	8.3	63.7
11.0	5.8	18.9
		107.2
		19.7
		93.4
		21.6
		17.8

a. Conduct a test for the homogeneity of the population Variances. Use $\alpha = 0.05$

I would Choose Hartleys F-Max test for Homogeneity of Variance

$H_0 : \sigma_1 = \sigma_2 = \sigma_3$

H_1 : Atleast one of them is different

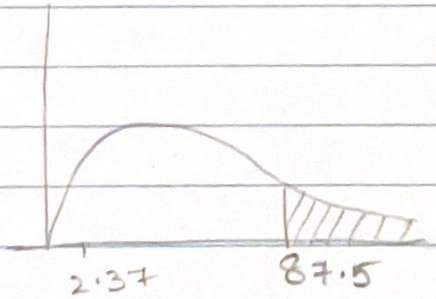
$S_1^2 = 6.52^2 = 42.5104$ $\quad S_2^2 = 22.4^2 = 501.76$ $\quad S_3^2 = 34.5^2 = 1190.25$

$$F_{Max} = \frac{S^2_{Max}}{S^2_{Min}} = \frac{1190.25}{501.76} = 2.3722$$

$$F_{Max} = 2.3722$$

Now, $t = 3$ $\quad df = T - 1 = 2$ $\quad \alpha = 0.05$

from Fmax table
87.5



∴ We dont Reject H_0.

b. Would it be appropriate to proceed with an analysis of Variance based on the results of this test Explain

No, Because We are not sure about Equality of Variance.

So, it is not profitable to proceed with ANOVA based on the results of the test

c. If the Variances of the diameters are different, Suggest a transformation that may alleviate their differences and then Conduct

Now, $\frac{S_1^2}{\bar{y}_1^2} = \frac{6.52^2}{8.34^2}$ $\frac{S_2^2}{\bar{y}_2^2} = \frac{22.4^2}{16.8^2}$ $\frac{S_3^2}{\bar{y}_3^2} = \frac{34.5^2}{40.7^2}$

$= 0.611$ $= 1.78$ $= 0.72$

From Excel,

$P = 0.066$

$P < 0.05$

∴ We Can say that there is a difference in ~~means~~ Variances even after alleviating.

d. Compare the results of your analysis in c to the Computer Output given in the following page which was an analysis of Variance on the Original diameters

In the Computer Output P-Value of test is ($0.094 > 0.05$) Large enough to say that all the machine mean diameters are Equal

But from the Obtained results of transformed data the mean diameters are not appeared to be Equal.