

Name Jenny

Student Number _____

STA 441s 2020 Quiz 2

1. (4 points) In a study comparing the effectiveness of different exercise programmes, volunteers were randomly assigned to one of three exercise programmes (A, B, C) or put on a waiting list and told to work out on their own. Thus, there were four experimental treatments. Denote the true treatment means by μ_a, μ_b, μ_c and μ_w .

Aerobic capacity is the body's ability to process oxygen. Using a standard treadmill test, aerobic capacity was measured before and after 6 months of participation in the program (or 6 months of being on the waiting list). The response variable was improvement in aerobic capacity.

- (a) What null hypothesis would you test to determine whether experimental treatment had any effect on average aerobic capacity? State the null hypothesis in symbols.

$$H_0: \mu_a = \mu_b = \mu_c = \mu_w$$

- (b) For the test of whether experimental treatment had any effect on average aerobic capacity, give the contrast or contrasts you would test. Make a table. There is one column in your table for each treatment mean, and one row for each contrast.

μ_a	μ_b	μ_c	μ_w	
1	-1	0	0	
0	1	-1	0	
0	0	1	-1	

as are okay
Anything equivalent to this.

- (c) What null hypothesis would you test to determine whether the average improvement from the three exercise programs was greater than improvement from the wait list control? State the null hypothesis in symbols.

$$H_0: \frac{1}{3}(\mu_a + \mu_b + \mu_c) = \mu_w \text{ or } \mu_a + \mu_b + \mu_c = 3\mu_w$$

- (d) For the test of whether average improvement from the three exercise programs was greater than improvement from the wait list control, give the contrast or contrasts you would test. Make a table. There is one column in your table for each treatment mean, and one row for each contrast.

μ_a	μ_b	μ_c	μ_w
1	1	1	-3

2. Please refer to your analysis of the Chick Weights data.

- (a) (1 point) What proportion of the variation in the chicks' weight is explained by type of feed? The answer is a number on your printout. Write the number in the space below. on the printout, circle the number and write "Question 2a" beside it.

$$R^2 = 0.54$$

- (b) (5 points) In your analysis of the Chick Weights data, you used Tukey multiple comparisons to test for all pairwise differences between means, at joint significance level 0.05. Based on this, answer each of the questions below "Yes" or "No." *To get any marks for this question, you can get no more than one wrong.*

- Is there sufficient evidence to conclude that sunflower is better than casin?

No

- Is there sufficient evidence to conclude that casin is better than meatmeal?

No

- Is there sufficient evidence to conclude that meatmeal is better than soybean?

No

- Is there sufficient evidence to conclude that soybean is better than linseed?

No

- Is there sufficient evidence to conclude that linseed is better than horsebean?

No

- Is there sufficient evidence to conclude that sunflower is better than horsebean?

Yes

- Is there sufficient evidence to conclude that casin is better than soybean?

Yes

Attach your log file and your output (results) file to the quiz paper. Make sure your name and student number are written clearly on both printouts.

```

1      OPTIONS NONOTES NOSTIMER NOSOURCE NOSYNTAXCHECK;
70
71      /* HW2chickwts.sas */
72      options linesize=79 pagesize=100 noovp formdlm=' ';
73      title 'STA441 HW2 Check: Chickwts';
74
75      data cluck;
76          infile '/home/brunner0/441s20/ChickWeight.data.txt';
77          length feed $ 9;
78          input id weight feed $;
79          label weight = 'Weight in grams at 6 weeks';
80

```

NOTE: The infile '/home/brunner0/441s20/ChickWeight.data.txt' is:
 Filename=/home/brunner0/441s20/ChickWeight.data.txt,
 Owner Name=brunner0, Group Name=oda,
 Access Permission=-rw-r--r--,
 Last Modified=08Jan2020:17:41:46,
 File Size (bytes)=1493

NOTE: 72 records were read from the infile
 '/home/brunner0/441s20/ChickWeight.data.txt'.
 The minimum record length was 0.
 The maximum record length was 19.

NOTE: SAS went to a new line when INPUT statement reached past the end of a line.

NOTE: The data set WORK.CLUCK has 71 observations and 3 variables.

NOTE: DATA statement used (Total process time):

real time	0.01 seconds
user cpu time	0.00 seconds
system cpu time	0.00 seconds
memory	756.34k
OS Memory	27560.00k
Timestamp	01/08/2020 10:44:25 PM
Step Count	24
Page Faults	0
Page Reclaims	188
Page Swaps	0
Voluntary Context Switches	22
Involuntary Context Switches	0
Block Input Operations	8
Block Output Operations	264

```

81      proc means;
82          class feed;
83          var weight;
84

```

NOTE: There were 71 observations read from the data set WORK.CLUCK.

NOTE: PROCEDURE MEANS used (Total process time):

real time	0.04 seconds
user cpu time	0.03 seconds
system cpu time	0.01 seconds
memory	10238.96k

```

OS Memory          36796.00k
Timestamp          01/08/2020 10:44:25 PM
Step Count         25   Switch Count   1
Page Faults        0
Page Reclaims      2897
Page Swaps         0
Voluntary Context Switches 15
Involuntary Context Switches 0
Block Input Operations 0
Block Output Operations 8

```

```

85      proc glm;
86          title2 'F-test for difference among 6 feed types';
87          class feed;
88          model weight=feed;
89          contrast 'All But Horsebean' feed 1 0 -1 0 0 0,
90                  feed 1 0 0 -1 0 0,
91                  feed 1 0 0 0 -1 0,
92                  feed 1 0 0 0 0 -1;
93          means feed; /* Redundant with proc means */
94          lsmeans feed / pdiff adjust=tukey;
95
96      /* Commented out: This is sort of reasonable too. Do you really want
96      ! to
97          estimate the common variance using horsebean? Also,
97      ! non-parametric.
98
99      proc glm;
100          title2 'F-test for difference among 5 excluding horsebean';
101          class feed;
102          where feed ne 'horsebean';
103          model weight=feed;
104
105      proc npar1way Wilcoxon;
106          title2 'Kruskal-Wallis for difference among 5 excluding
106      ! horsebean';
107          class feed;
108          where feed ne 'horsebean';
109          var weight;
110
111
112
113
114      OPTIONS NONOTES NOSTIMER NOSOURCE NOSYNTAXCHECK;
115      ODS HTML CLOSE;
116      &GRAPHTERM; ;*';*";*"/;RUN;
117
117      !                               QUIT;

```

NOTE: PROCEDURE GLM used (Total process time):

```

real time          3.07 seconds
user cpu time      0.36 seconds
system cpu time    0.03 seconds
memory            18311.60k
OS Memory          48220.00k

```

Timestamp	01/08/2020 10:44:28 PM
Step Count	26 Switch Count 3
Page Faults	0
Page Reclaims	6228
Page Swaps	0
Voluntary Context Switches	2361
Involuntary Context Switches	1
Block Input Operations	0
Block Output Operations	1816

```

118      QUIT;RUN;
119      ODS HTML5 (ID=WEB) CLOSE;
120
121      ODS PDF (ID=WEB) CLOSE;
NOTE: ODS PDF(WEB) printed 8 pages to
      /saswork/SAS_work2A17000052F6_odaws04-usw2/#LN00034.
122      FILENAME _GSFNAME;
NOTE: Fileref _GSFNAME has been deassigned.
123      DATA _NULL_;
124      RUN;

```

```

NOTE: DATA statement used (Total process time):
      real time          0.00 seconds
      user cpu time      0.00 seconds
      system cpu time    0.00 seconds
      memory             460.84k
      OS Memory          27816.00k
      Timestamp          01/08/2020 10:44:28 PM
      Step Count         27 Switch Count 0
      Page Faults        0
      Page Reclaims      27
      Page Swaps         0
      Voluntary Context Switches 0
      Involuntary Context Switches 0
      Block Input Operations 0
      Block Output Operations 0

```

```

125      OPTIONS NOTES STIMER SOURCE SYNTAXCHECK;
126

```

STA441 HW2 Check: Chickwts**The MEANS Procedure**

Analysis Variable : weight Weight in grams at 6 weeks						
feed	N Obs	N	Mean	Std Dev	Minimum	Maximum
casein	12	12	323.5833333	64.4338397	216.0000000	404.0000000
horsebean	10	10	160.2000000	38.6258405	108.0000000	227.0000000
linseed	12	12	218.7500000	52.2356983	141.0000000	309.0000000
meatmeal	11	11	276.9090909	64.9006233	153.0000000	380.0000000
soybean	14	14	246.4285714	54.1290684	158.0000000	329.0000000
sunflower	12	12	328.9166667	48.8363842	226.0000000	423.0000000

STA441 HW2 Check: Chickwts
F-test for difference among 6 feed types

The GLM Procedure

Class Level Information		
Class	Levels	Values
feed	6	casein horsebean linseed meatmeal soybean sunflower

Number of Observations Read	71
Number of Observations Used	71

STA441 HW2 Check: Chickwts
F-test for difference among 6 feed types

The GLM Procedure

Dependent Variable: weight Weight in grams at 6 weeks

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	231129.1621	46225.8324	15.36	<.0001
Error	65	195556.0210	3008.5542		
Corrected Total	70	426685.1831			

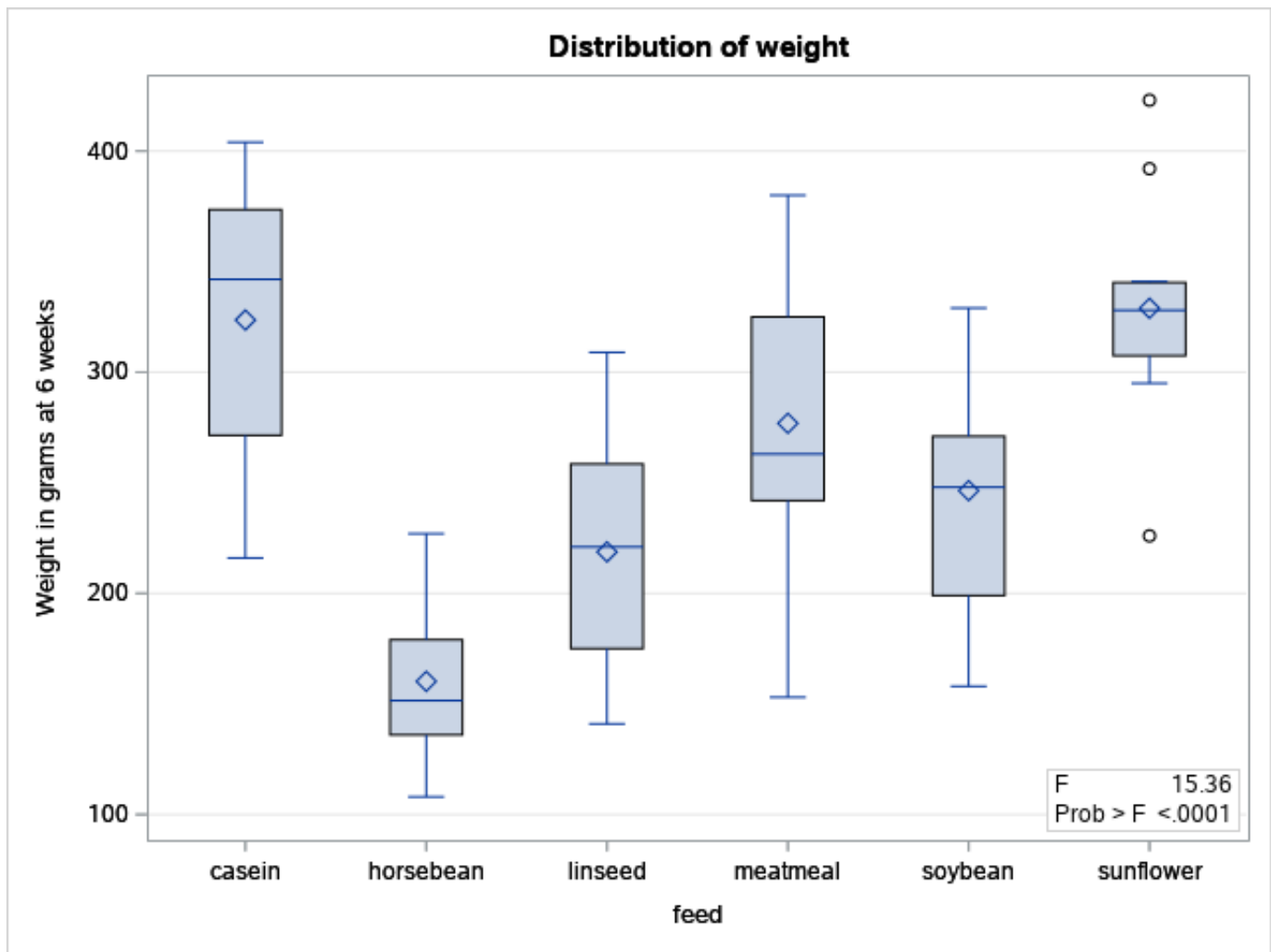
Question 2a

R-Square	Coeff Var	Root MSE	weight Mean
0.541685	20.99052	54.85029	261.3099

Source	DF	Type I SS	Mean Square	F Value	Pr > F
feed	5	231129.1621	46225.8324	15.36	<.0001

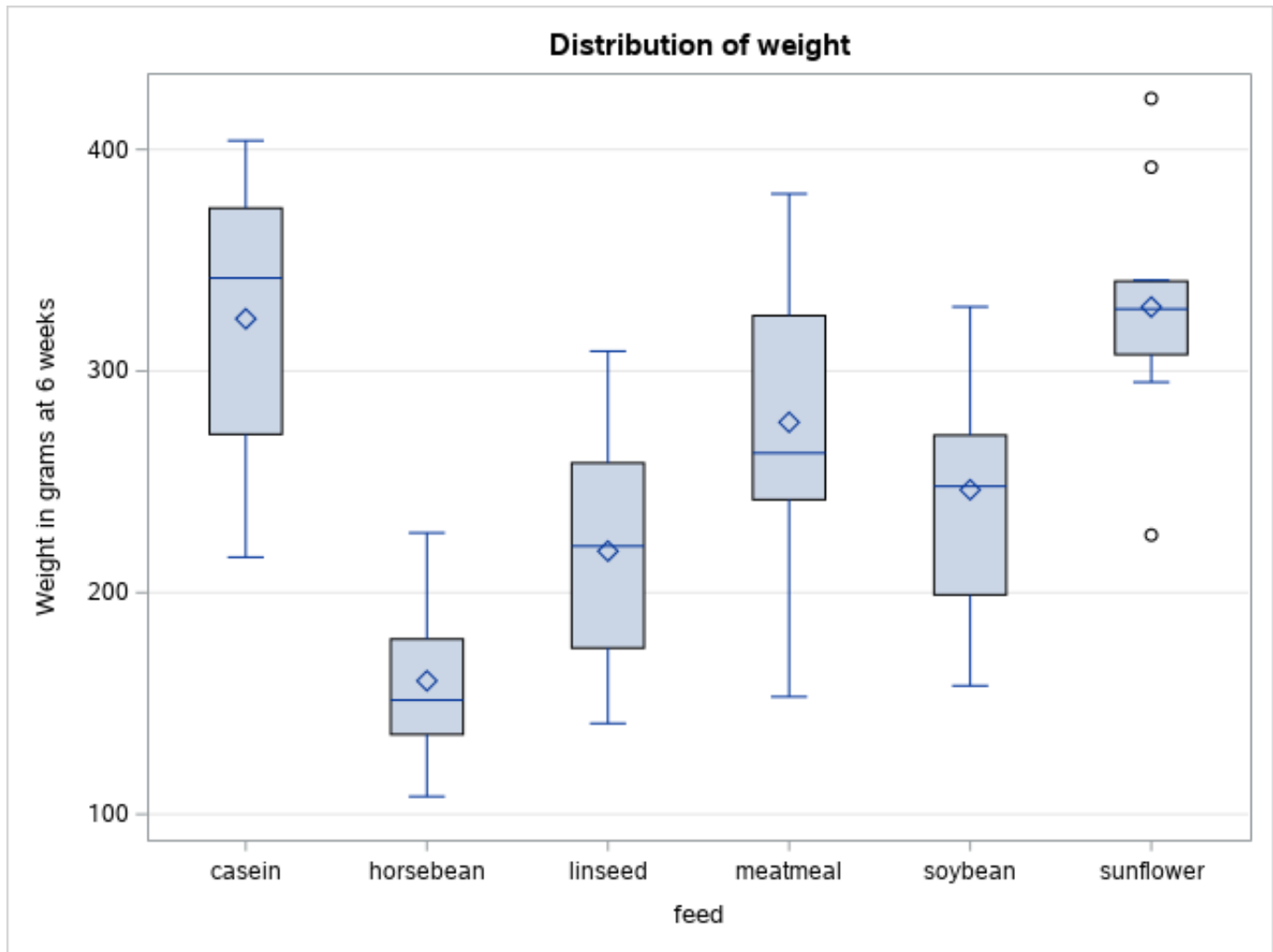
Source	DF	Type III SS	Mean Square	F Value	Pr > F
feed	5	231129.1621	46225.8324	15.36	<.0001

Contrast	DF	Contrast SS	Mean Square	F Value	Pr > F
All But Horsebean	4	112137.7757	28034.4439	9.32	<.0001



STA441 HW2 Check: Chickwts
F-test for difference among 6 feed types

The GLM Procedure



Level of feed	N	weight	
		Mean	Std Dev
casein	12	323.583333	64.4338397
horsebean	10	160.200000	38.6258405
linseed	12	218.750000	52.2356983
meatmeal	11	276.909091	64.9006233
soybean	14	246.428571	54.1290684
sunflower	12	328.916667	48.8363842

STA441 HW2 Check: Chickwts
F-test for difference among 6 feed types

The GLM Procedure
Least Squares Means
Adjustment for Multiple Comparisons: Tukey-Kramer

feed	weight LSMEAN	LSMEAN Number
casein	323.583333	1
horsebean	160.200000	2

linseed	218.750000	3
meatmeal	276.909091	4
soybean	246.428571	5
sunflower	328.916667	6

Least Squares Means for effect feed Pr > t for H0: LSMean(i)=LSMean(j)						
Dependent Variable: weight						
i/j	1	2	3	4	5	6
1		<.0001	0.0002	0.3325	0.0084	0.9999
2	<.0001		0.1413	0.0001	0.0042	<.0001
3	0.0002	0.1413		0.1277	0.7933	<.0001
4	0.3325	0.0001	0.1277		0.7391	0.2207
5	0.0084	0.0042	0.7933	0.7391		0.0039
6	0.9999	<.0001	<.0001	0.2207	0.0039	

