

Name Jerry

Student Number \_\_\_\_\_

## STA 441s 2020 Quiz 3

These questions are all based on your analysis of the the Furnace data.

1. (2 points) How many houses have forced air furnaces? The answer is a number from your printout. Write the number in the space below. on the printout, circle the number and write "Question 1" beside it.

(76) not 75. If 75 check log file for notes about invalid data & deduct 5 more marks.

2. (4 points) We want to know whether amount of energy consumed is related to whether the vent damper is active or not.

One mark

- (a) Give the value of the test statistic ( $t$ , chi-square or  $F$ .) The answer is a number from your printout. Write the number in the space below. on the printout, circle the number and write "Question 2" beside it.

$t = 11.87$  (9.58 is a sign of reaching two data wrong.)

If these disagree, -2

- (b) Are the results statistically significant at the 0.05 level? Answer Yes or No.

Yes

- (c) Do you reject the null hypothesis at  $\alpha = 0.05$ ? Answer Yes or No.

Yes

-2 if this is wrong

- (d) In plain, non-statistical language, what do you conclude, if anything?

Houses tend to use less energy with vent damper in (or active).

No more than 4 marks off in total

3. (4 points) We want to know whether amount of energy consumed with vent damper active (in) is related to amount of energy consumed with vent damper inactive (out).

- (a) Give the value of the test statistic ( $r$ ,  $t$ , chi-square or  $F$ .) The answer is a number from your printout. Write the number in the space below. on the printout, circle the number and write "Question 3" beside it.

$r = 0.9811$ ,  $t = 47.57$  or  $F = 2262.95$

Any one is okay

- (b) Are the results statistically significant at the 0.05 level? Answer Yes or No.

Yes

- (c) Do you reject the null hypothesis at  $\alpha = 0.05$ ? Answer Yes or No.

Yes

- (d) In plain, non-statistical language, what do you conclude, if anything?

Houses that use more energy with the vent damper inactive also use more energy with the vent damper active.

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

Same markings rules as

Q2

```

1      OPTIONS NONOTES NOSTIMER NOSOURCE NOSYNTAXCHECK;
70
71      /* HW3Furnace.sas */
72      title 'STA441s20 Homework 3 Check: Descriptives and elementary tests on the
73      Furnace Data';
74
75      proc format;
76          value frnfmt 1= 'Forced air' 2= 'Gravity' 3= 'Forced water';
NOTE: Format FRNFMT is already on the library WORK.FORMATS.
NOTE: Format FRNFMT has been output.
77          value shfmt 1= 'Round' 2= 'Square' 3= 'Rectangular';
NOTE: Format SHFMT is already on the library WORK.FORMATS.
NOTE: Format SHFMT has been output.
78          value lnfmt 0= 'Unlined' 1= 'Tile' 2= 'Metal';
NOTE: Format LNFMT is already on the library WORK.FORMATS.
NOTE: Format LNFMT has been output.
79          value hfmt 1= 'Ranch' 2= 'Two-story' 3= 'tri-level'
80          4= 'Bi-level' 5= '1.5 stories';
NOTE: Format HFMT is already on the library WORK.FORMATS.
NOTE: Format HFMT has been output.
81          value catfmt 1= 'Ranch' 2= 'Two Story' 3= 'Other';
NOTE: Format CATFMT is already on the library WORK.FORMATS.
NOTE: Format CATFMT has been output.
82
83      /* Data issues:
84      There was no id.
85      Type of vent damper was last.
86      Chimney height must be in inches, not feet.
87      And of course there's the poem.
88      */
89
NOTE: PROCEDURE FORMAT used (Total process time):
      real time          0.00 seconds
      user cpu time      0.00 seconds
      system cpu time    0.00 seconds
      memory             300.65k
      OS Memory          33700.00k
      Timestamp          01/19/2020 08:58:38 PM
      Step Count          227   Switch Count   0
      Page Faults         0
      Page Reclaims       14
      Page Swaps          0
      Voluntary Context Switches 0
      Involuntary Context Switches 0
      Block Input Operations 0
      Block Output Operations 32

90      data warm;
91          infile '/home/brunner0/441s20/furnace.fixed.data.txt';
92          input typfurn area shape height liner house age
93          dampin dampout damper $;
94
95          label typfurn = 'Type of furnace'

```

```

96         area      = 'Chimney area'
97         shape      = 'Chimney shape'
98         height     = 'Chimney height in feet'
99         liner       = 'Type of Chimney liner'
100        house      = 'Type of house'
101        age         = 'House age in yrs (99=99+)'
102        damper      = 'Type of damper'
103        dampin      = 'Energy consumpt with damper active'
104        dampout     = 'Energy consumpt with damper inactive';
105
106        format typfurn frnfmt.;
107        format shape shfmt.;
108        format liner lnfmt.;
109        format house hfmt.;
110
111        /***** Creating New Variables *****/
112
113        consume = (dampin+dampout)/2;
114        label consume = 'Aver Energy Consumpt';
115
116        diff=dampout-dampin;
117        label diff = 'consumpt w/ damper out minus in';
118
119        if house=. then housecat=.;
120        else if house=1 then housecat=1;
121        else if house=2 then housecat=2;
122        else housecat=3;
123        label housecat = 'Recoded House Type';
124        format housecat catfmt.;
125

```

NOTE: The infile '/home/brunner0/441s20/furnace.fixed.data.txt' is:  
 Filename=/home/brunner0/441s20/furnace.fixed.data.txt,  
 Owner Name=brunner0,Group Name=oda,  
 Access Permission=-rw-r--r--,  
 Last Modified=19Jan2020:15:29:44,  
 File Size (bytes)=4050

NOTE: 90 records were read from the infile '/home/brunner0/441s20/furnace.fixed.data.txt'.  
 The minimum record length was 43.  
 The maximum record length was 43.

NOTE: The data set WORK.WARM has 90 observations and 13 variables.

NOTE: DATA statement used (Total process time):

real time	0.00 seconds
user cpu time	0.01 seconds
system cpu time	0.00 seconds
memory	808.15k
OS Memory	33960.00k
Timestamp	01/19/2020 08:58:38 PM
Step Count	228
Page Faults	0
Page Reclaims	93
Page Swaps	0
Voluntary Context Switches	20
Involuntary Context Switches	0
Block Input Operations	0
Block Output Operations	264

```

126      proc means n mean median stddev;
127          title2 'Q1: Describe Quantitative vars';
128          var area height age dampin dampout consume diff;
129

```

NOTE: There were 90 observations read from the data set WORK.WARM.

NOTE: PROCEDURE MEANS used (Total process time):

real time	0.04 seconds
user cpu time	0.04 seconds
system cpu time	0.01 seconds
memory	8504.78k
OS Memory	39100.00k
Timestamp	01/19/2020 08:58:38 PM
Step Count	229
Page Faults	0
Page Reclaims	1352
Page Swaps	0
Voluntary Context Switches	25
Involuntary Context Switches	0
Block Input Operations	0
Block Output Operations	8

```

130      proc freq;
131          title2 'Q1: Frequency Distributions of categorical variables';
132          tables typfurn shape liner house housecat damper;
133

```

NOTE: There were 90 observations read from the data set WORK.WARM.

NOTE: PROCEDURE FREQ used (Total process time):

real time	0.06 seconds
user cpu time	0.07 seconds
system cpu time	0.00 seconds
memory	1165.18k
OS Memory	34220.00k
Timestamp	01/19/2020 08:58:38 PM
Step Count	230
Page Faults	0
Page Reclaims	125
Page Swaps	0
Voluntary Context Switches	23
Involuntary Context Switches	0
Block Input Operations	0
Block Output Operations	288

```

134      proc means n mean stddev t probt;
135          title2 'Q2: Vent Damper In vs. Out';
136          var diff;
137

```

NOTE: There were 90 observations read from the data set WORK.WARM.

NOTE: PROCEDURE MEANS used (Total process time):

real time	0.01 seconds
user cpu time	0.02 seconds

```

system cpu time      0.01 seconds
memory              6860.34k
OS Memory           40140.00k
Timestamp            01/19/2020 08:58:38 PM
Step Count           231   Switch Count   2
Page Faults          0
Page Reclaims        1606
Page Swaps           0
Voluntary Context Switches 27
Involuntary Context Switches 0
Block Input Operations 0
Block Output Operations 0

```

```

138      proc freq;
139          title2 'Q3: Chimney shape and type of vent damper';
140          tables shape * damper / nocol nopercnt chisq;
141

```

NOTE: There were 90 observations read from the data set WORK.WARM.

NOTE: PROCEDURE FREQ used (Total process time):

```

real time           0.03 seconds
user cpu time        0.04 seconds
system cpu time      0.00 seconds
memory              1285.34k
OS Memory           34480.00k
Timestamp            01/19/2020 08:58:39 PM
Step Count           232   Switch Count   5
Page Faults          0
Page Reclaims        186
Page Swaps           0
Voluntary Context Switches 35
Involuntary Context Switches 0
Block Input Operations 0
Block Output Operations 552

```

```

142      proc corr;
143          title2 'Q4: Correlation of consumption, damper in with out ';
144          var dampin dampout;
145

```

NOTE: PROCEDURE CORR used (Total process time):

```

real time           0.03 seconds
user cpu time        0.03 seconds
system cpu time      0.00 seconds
memory              894.71k
OS Memory           33960.00k
Timestamp            01/19/2020 08:58:39 PM
Step Count           233   Switch Count   1
Page Faults          0
Page Reclaims        52
Page Swaps           0
Voluntary Context Switches 10
Involuntary Context Switches 0
Block Input Operations 0
Block Output Operations 0

```

```

146      proc reg plots = none;
147          title2 'Q4: Regression Predicting consumption with damper in from out';
148          model dampin = dampout;
149

```

```

NOTE: PROCEDURE REG used (Total process time):
      real time           0.04 seconds
      user cpu time       0.05 seconds
      system cpu time     0.00 seconds
      memory              2334.75k
      OS Memory           35776.00k
      Timestamp           01/19/2020 08:58:39 PM
      Step Count          234   Switch Count   2
      Page Faults         0
      Page Reclaims       293
      Page Swaps          0
      Voluntary Context Switches 21
      Involuntary Context Switches 0
      Block Input Operations 0
      Block Output Operations 72

```

```

150      proc glm;
151          title2 'Q5: Do energy savings depend on type of damper?';
152          class damper;
153          model diff = damper;
154          means damper;
155

```

```

NOTE: PROCEDURE GLM used (Total process time):
      real time           0.29 seconds
      user cpu time       0.17 seconds
      system cpu time     0.02 seconds
      memory              16551.25k
      OS Memory           48448.00k
      Timestamp           01/19/2020 08:58:39 PM
      Step Count          235   Switch Count   3
      Page Faults         0
      Page Reclaims       3857
      Page Swaps          0
      Voluntary Context Switches 725
      Involuntary Context Switches 0
      Block Input Operations 0
      Block Output Operations 1264

```

```

156      proc glm;
157          title2 'Q6: Average consumption and type of liner';
158          class liner;
159          model consume = liner;
160          lsmeans liner / tdiff pdiff adjust=bon;
161

```

```

NOTE: PROCEDURE GLM used (Total process time):
      real time           0.35 seconds

```

```
user cpu time      0.20 seconds
system cpu time    0.01 seconds
memory             5267.78k
OS Memory          49244.00k
Timestamp          01/19/2020 08:58:39 PM
Step Count         236   Switch Count   3
Page Faults        0
Page Reclaims      1217
Page Swaps         0
Voluntary Context Switches 1069
Involuntary Context Switches 0
Block Input Operations 0
Block Output Operations 1040
```

```
162      proc iml; /* Details about the last procedure do not appear on log file. */
NOTE: IML Ready
163          print "That's all, folks!";
164
165
166
167      OPTIONS NONOTES NOSTIMER NOSOURCE NOSYNTAXCHECK;
178
```



## STA441s20 Homework 3 Check: Descriptives and elementary tests on the Furnace Data

### Q1: Describe Quantitative vars

#### The MEANS Procedure

Variable	Label	N	Mean	Median	Std Dev
area	Chimney area	89	62.5617978	64.0000000	32.5307390
height	Chimney height in feet	90	21.9666667	20.0000000	5.9254735
age	House age in yrs (99=99+)	90	38.5666667	30.0000000	31.0932089
dampin	Energy consumpt with damper active	90	10.0384444	9.8350000	2.8679903
dampout	Energy consumpt with damper inactive	90	10.8131111	10.7400000	3.0884073
consume	Aver Energy Consumpt	90	10.4257778	10.2725000	2.9641170
diff	consumpt w/ damper out minus in	90	0.7746667	0.7100000	0.6191099

## STA441s20 Homework 3 Check: Descriptives and elementary tests on the Furnace Data

### Q1: Frequency Distributions of categorical variables

#### The FREQ Procedure

Question 1

Type of furnace				
typfurn	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Forced air	76	84.44	76	84.44
Gravity	7	7.78	83	92.22
Forced water	7	7.78	90	100.00

Chimney shape				
shape	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Round	39	43.82	39	43.82
Square	32	35.96	71	79.78
Rectangular	18	20.22	89	100.00
Frequency Missing = 1				

Type of Chimney liner				
liner	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Unlined	24	26.97	24	26.97
Tile	40	44.94	64	71.91
Metal	25	28.09	89	100.00
Frequency Missing = 1				

Type of house				
house	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Ranch	38	42.22	38	42.22
Two-story	40	44.44	78	86.67
tri-level	3	3.33	81	90.00



<b>Bi-level</b>	6	6.67	87	96.67
<b>1.5 stories</b>	3	3.33	90	100.00

Recoded House Type				
housecat	Frequency	Percent	Cumulative Frequency	Cumulative Percent
<b>Ranch</b>	38	42.22	38	42.22
<b>Two Story</b>	40	44.44	78	86.67
<b>Other</b>	12	13.33	90	100.00

Type of damper				
damper	Frequency	Percent	Cumulative Frequency	Cumulative Percent
<b>EVD</b>	40	44.44	40	44.44
<b>TVD</b>	50	55.56	90	100.00

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### STA441s20 Homework 3 Check: Descriptives and elementary tests on the Furnace Data Q2: Vent Damper In vs. Out

#### The MEANS Procedure

Analysis Variable : diff consumpt w/ damper out minus in				
N	Mean	Std Dev	t Value	Pr >  t
90	0.7746667	0.6191099	11.87	<.0001

Question 2

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### STA441s20 Homework 3 Check: Descriptives and elementary tests on the Furnace Data Q3: Chimney shape and type of vent damper

#### The FREQ Procedure

Frequency Row Pct	Table of shape by damper			
	shape(Chimney shape)	damper(Type of damper)		
		EVD	TVD	Total
	<b>Round</b>	15 38.46	24 61.54	39
	<b>Square</b>	14 43.75	18 56.25	32
	<b>Rectangular</b>	10 55.56	8 44.44	18
	<b>Total</b>	39	50	89
Frequency Missing = 1				

#### Statistics for Table of shape by damper

Statistic	DF	Value	Prob

Chi-Square	2	1.4619	0.4814
Likelihood Ratio Chi-Square	2	1.4567	0.4827
Mantel-Haenszel Chi-Square	1	1.3628	0.2431
Phi Coefficient		0.1282	
Contingency Coefficient		0.1271	
Cramer's V		0.1282	

Sample Size = 89  
Frequency Missing = 1

### STA441s20 Homework 3 Check: Descriptives and elementary tests on the Furnace Data Q4: Correlation of consumption, damper in with out

The CORR Procedure

2 Variables: dampin dampout

Simple Statistics							
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
dampin	90	10.03844	2.86799	903.46000	2.97000	18.26000	Energy consumpt with damper active
dampout	90	10.81311	3.08841	973.18000	3.20000	20.55000	Energy consumpt with damper inactive

Question 3

Pearson Correlation Coefficients, N = 90 Prob >  r  under H0: Rho=0		
	dampin	dampout
dampin Energy consumpt with damper active	1.00000	0.98111 <.0001
dampout Energy consumpt with damper inactive	0.98111 <.0001	1.00000

### STA441s20 Homework 3 Check: Descriptives and elementary tests on the Furnace Data Q4: Regression Predicting consumption with damper in from out

The REG Procedure

Model: MODEL1

Dependent Variable: dampin Energy consumpt with damper active

Number of Observations Read	90
Number of Observations Used	90

Question 3

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	704.65568	704.65568	2262.95	<.0001
Error	88	27.40210	0.31139		
Corrected Total	89	732.05778			

Root MSE	0.55802	R-Square	0.9626
----------	---------	----------	--------

<b>Dependent Mean</b>	10.03844	<b>Adj R-Sq</b>	0.9621
<b>Coeff Var</b>	5.55884		

Parameter Estimates						
Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr >  t
<b>Intercept</b>	Intercept	1	0.18678	0.21529	0.87	0.3880
<b>dampout</b>	Energy consumpt with damper inactive	1	0.91109	0.01915	47.57	<.0001

Question 3

### STA441s20 Homework 3 Check: Descriptives and elementary tests on the Furnace Data Q5: Do energy savings depend on type of damper?

#### The GLM Procedure

Class Level Information		
Class	Levels	Values
dampout	2	EVD TVD

<b>Number of Observations Read</b>	90
<b>Number of Observations Used</b>	90

### STA441s20 Homework 3 Check: Descriptives and elementary tests on the Furnace Data Q5: Do energy savings depend on type of damper?

#### The GLM Procedure

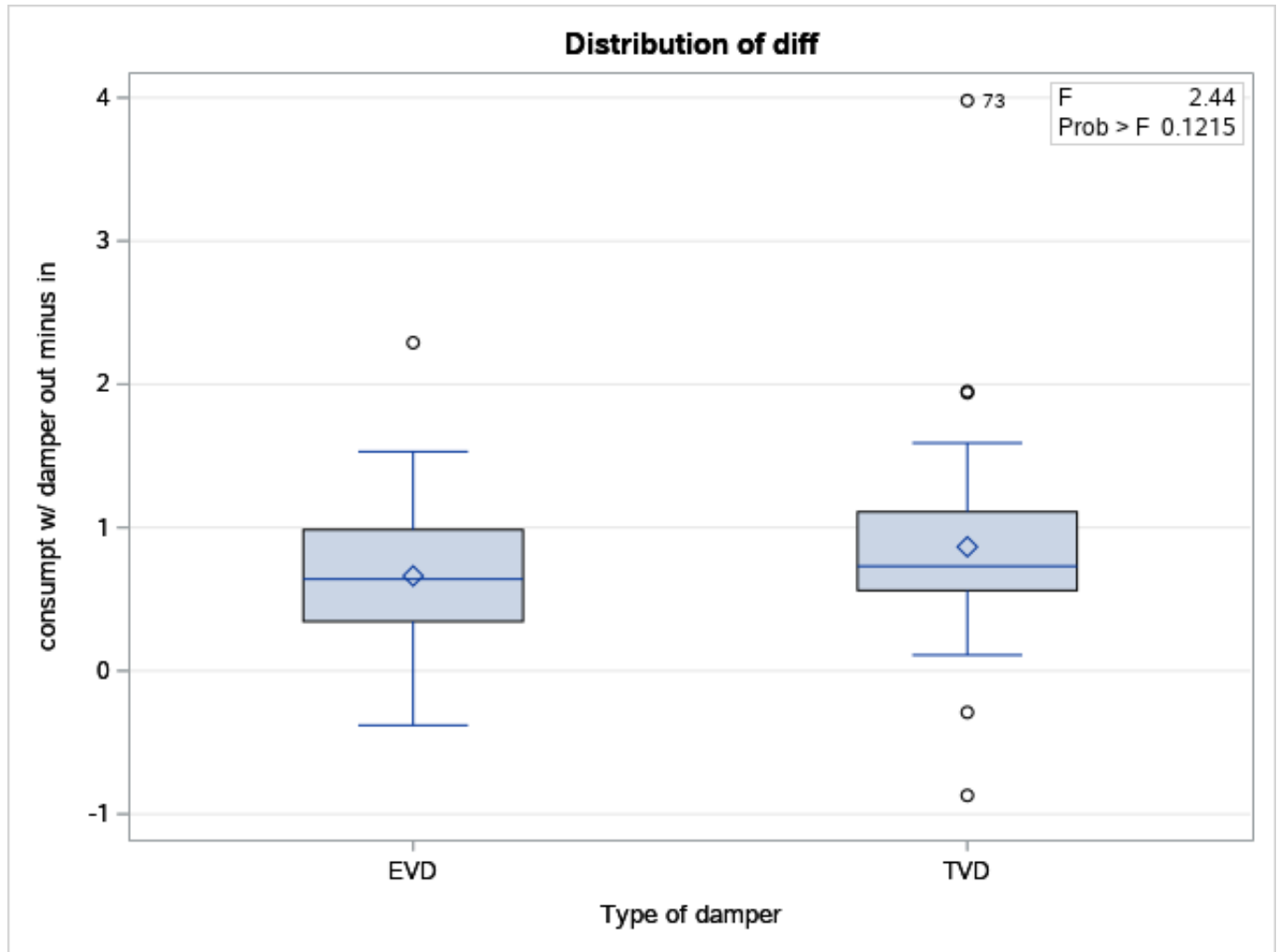
Dependent Variable: diff consumpt w/ damper out minus in

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
<b>Model</b>	1	0.92208200	0.92208200	2.44	0.1215
<b>Error</b>	88	33.19135800	0.37717452		
<b>Corrected Total</b>	89	34.11344000			

R-Square	Coeff Var	Root MSE	diff Mean
0.027030	79.27866	0.614145	0.774667

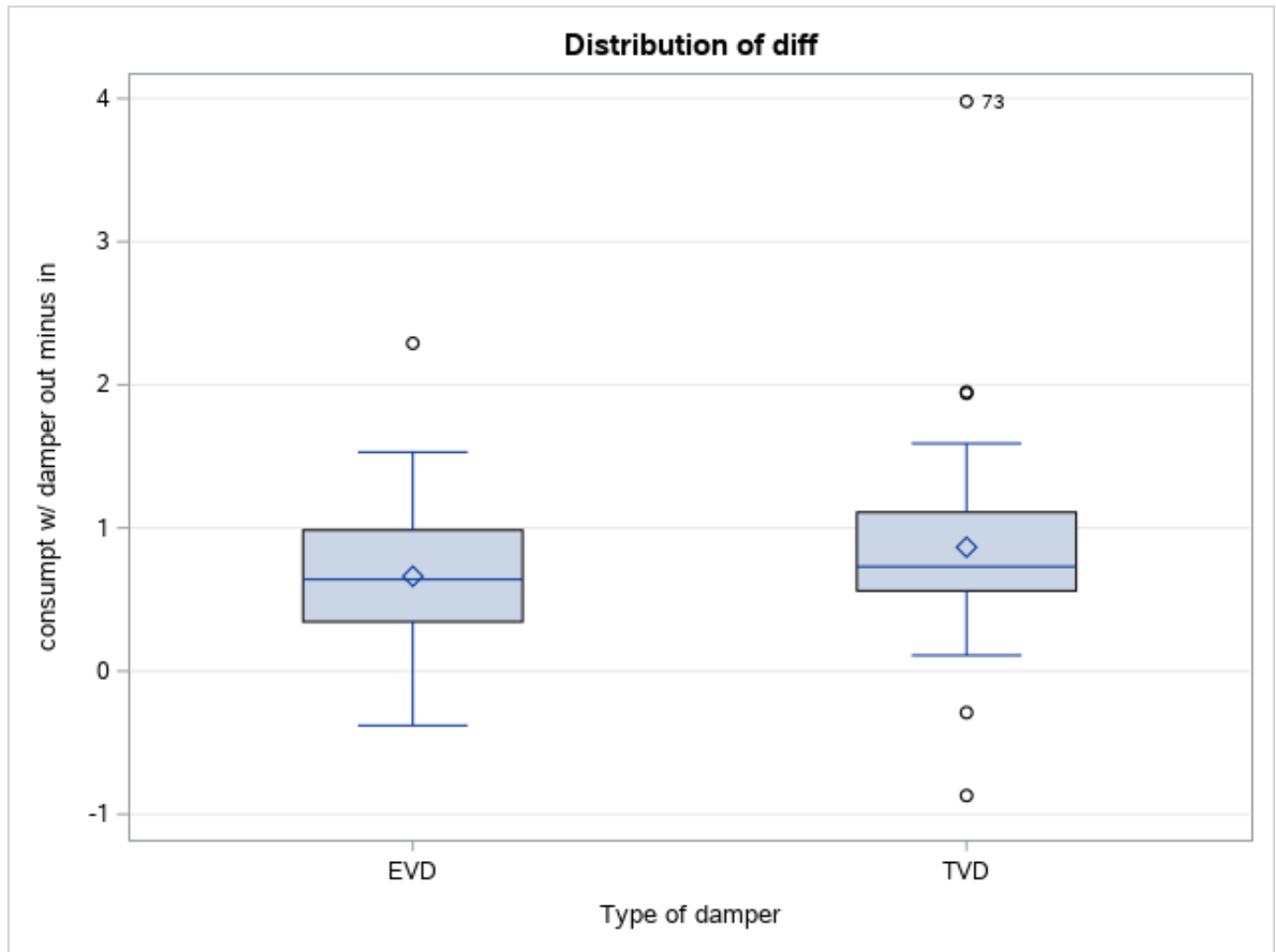
Source	DF	Type I SS	Mean Square	F Value	Pr > F
<b>dampout</b>	1	0.92208200	0.92208200	2.44	0.1215

Source	DF	Type III SS	Mean Square	F Value	Pr > F
<b>dampout</b>	1	0.92208200	0.92208200	2.44	0.1215



**STA441s20 Homework 3 Check: Descriptives and elementary tests on the Furnace Data**  
**Q5: Do energy savings depend on type of damper?**

The GLM Procedure



Level of damper	N	diff	
		Mean	Std Dev
EVD	40	0.66150000	0.51063334
TVD	50	0.86520000	0.68545007

### STA441s20 Homework 3 Check: Descriptives and elementary tests on the Furnace Data

#### Q6: Average consumption and type of liner

#### The GLM Procedure

Class Level Information		
Class	Levels	Values
liner	3	Metal Tile Unlined

Number of Observations Read	90
Number of Observations Used	89

## STA441s20 Homework 3 Check: Descriptives and elementary tests on the Furnace Data

### Q6: Average consumption and type of liner

#### The GLM Procedure

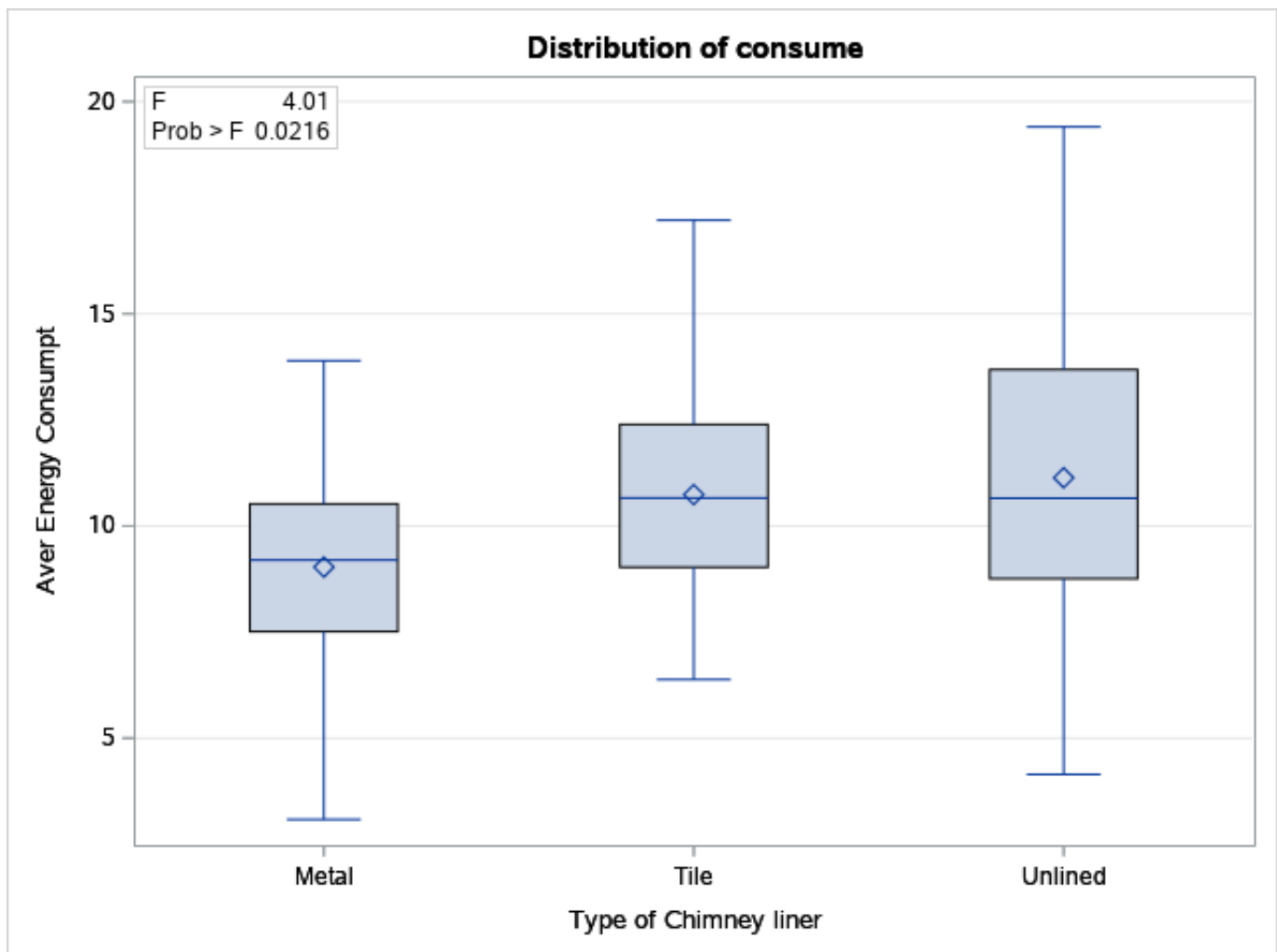
Dependent Variable: consume Aver Energy Consumpt

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	64.2868823	32.1434412	4.01	0.0216
Error	86	688.7845952	8.0091232		
Corrected Total	88	753.0714775			

R-Square	Coeff Var	Root MSE	consume Mean
0.085366	27.30188	2.830039	10.36573

Source	DF	Type I SS	Mean Square	F Value	Pr > F
liner	2	64.28688232	32.14344116	4.01	0.0216

Source	DF	Type III SS	Mean Square	F Value	Pr > F
liner	2	64.28688232	32.14344116	4.01	0.0216



## STA441s20 Homework 3 Check: Descriptives and elementary tests on the Furnace Data

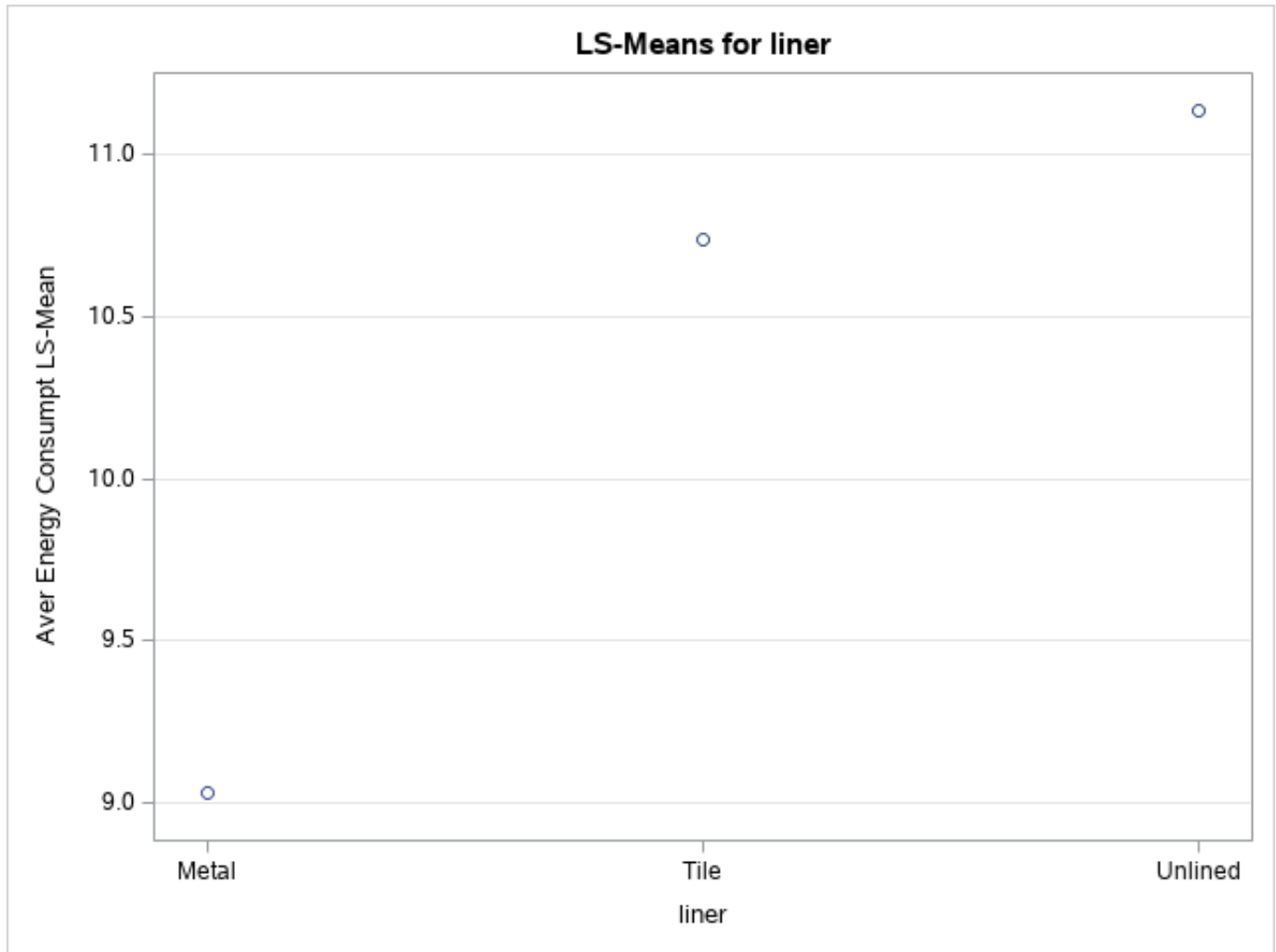
### Q6: Average consumption and type of liner

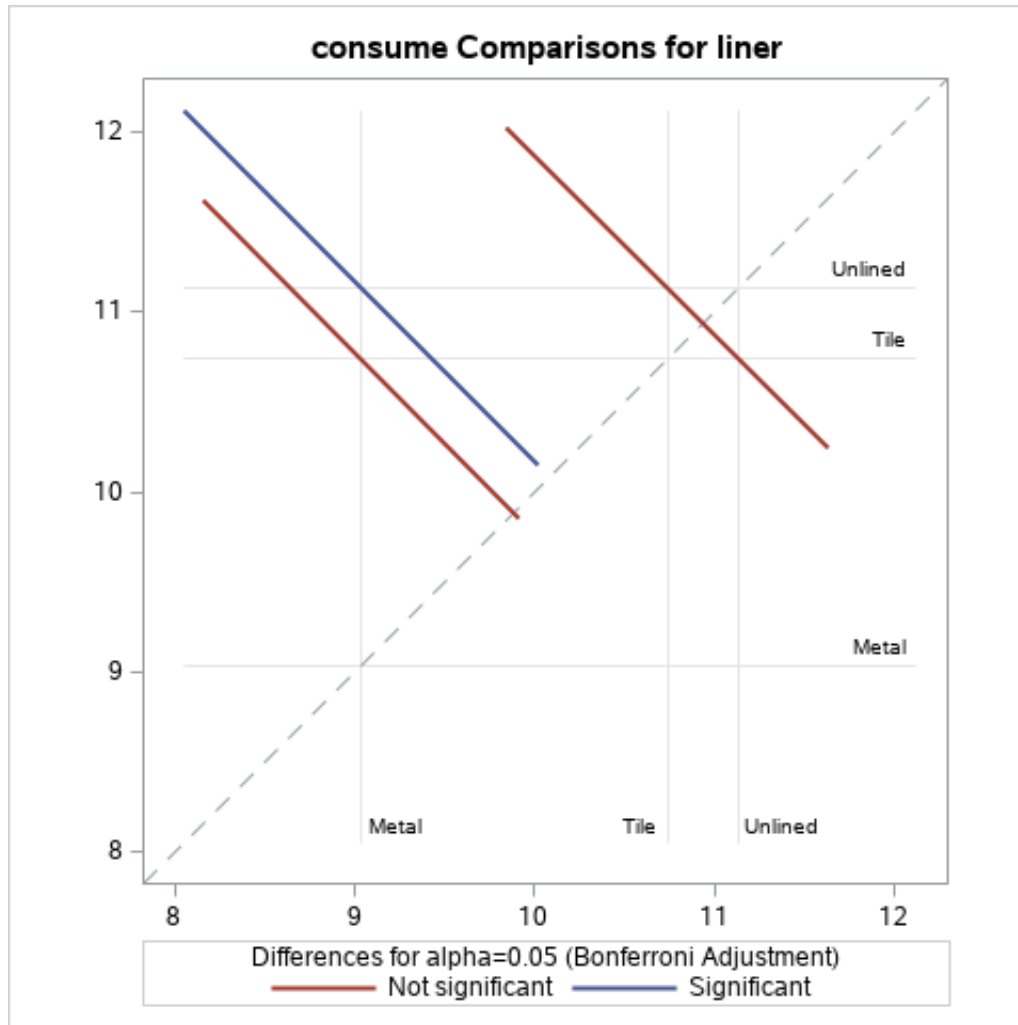
The GLM Procedure  
Least Squares Means  
Adjustment for Multiple Comparisons: Bonferroni

liner	consume LSMEAN	LSMEAN Number
Metal	9.0310000	1
Tile	10.7386250	2
Unlined	11.1345833	3

Least Squares Means for Effect liner t for H0: LSMean(i)=LSMean(j) / Pr >  t			
Dependent Variable: consume			
i/j	1	2	3
1		-2.3667 0.0606	-2.60103 0.0328
2	2.366701 0.0606		-0.54188 1.0000
3	2.601027 0.0328	0.541879 1.0000	







**STA441s20 Homework 3 Check: Descriptives and elementary tests on the Furnace Data**  
**Q6: Average consumption and type of liner**

That's all, folks!