Program Summary - FinalProject.sas

Execution Environment

Author:	u49579191
File:	/home/u49579191/STAT403/FinalProject.sas
SAS Platform:	Linux LIN X64 3.10.0-1062.9.1.el7.x86_64
SAS Host:	ODAWS02-USW2.ODA.SAS.COM
SAS Version:	9.04.01M6P11072018
SAS Locale:	en_US
Submission Time:	11/19/2020, 1:59:36 PM
Browser Host:	CPE-174-101-140-183.CINCI.RES.RR.COM
User Agent:	Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/86.0.4240.198 Safari/537.36
Application Server:	ODAMID02-USW2.ODA.SAS.COM

Code: FinalProject.sas

```
/*Coded by: Joelle Strom
            10/25/2020
            403 Project Final Analysis*/

/*Dataset is Medicare Drug Spending and Utilization, year 2018 extracted from the combined dataset for 2014-2018
obtained from Centers for Medicare and Medicaid Services at
https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Information-on-Prescription-Drugs/Medi

/*Methodology document: https://www.cms.gov/files/document/medicaid-drug-spending-methodology-2018.pdf*/

**Create macro to import each dataset, adding an identifier to each variable to distinguish the year, except
for brand, generic, and number of manufacturer variables, which do not change from year to year;
%Macro inputsort(dataset=,file=,year=);

Data &dataset;
Infile &file dlm='09'x firstobs=2;
Length Brand$ 50. Generic$ 50.;
Input Brand$ Generic$ NumManufac Spending&year Dose&year Claims&year AvgSpendDose&year AvgSpendClaims&year Outlier&year;
If Spending&year=. then Spending&year=0;
If Dose&year=. then Dose&year=0;
If Claims&year=. then Claims&year=0;
If AvgSpendDose&year=. then AvgSpendDose&year=0;
If AvgSpendClaims&year=. then AvgSpendClaims&year=0;
Run;

Proc Sort Data=&dataset;
By Brand;
Run;

%Mend inputsort;

*Input the datasets;
%inputsort(dataset=meds2014,file="/home/u49579191/STAT403/med2014.txt",year=14);
%inputsort(dataset=meds2015,file="/home/u49579191/STAT403/med2015.txt",year=15);
%inputsort(dataset=meds2016,file="/home/u49579191/STAT403/med2016.txt",year=16);
%inputsort(dataset=meds2017,file="/home/u49579191/STAT403/med2017.txt",year=17);
%inputsort(dataset=meds2018,file="/home/u49579191/STAT403/med2018.txt",year=18);

*Create formatting to bin number of manufacturers;
Proc Format;
Value nummanufacft  Low-1 = "1 manufacturer"
                    2-6 = "2-6 manufacturers"
                    7-High = "7 or more manufacturers";

*Merge by drug brand name;
Data meds;
Merge meds2014 meds2015 meds2016 meds2017 meds2018;
By Brand;
Run;

*Separate the spending variable and number of manufacturers into new datasets by year in preparation for data formatting for
Data spending2014;
Set meds;
Drop Brand Generic Spending14--Claims14 AvgSpendClaims14--Outlier18;
Rename AvgSpendDose14=AvgSpend;
Year=2014;
```

```
Run;

Data spending2015;
Set meds;
Drop Brand Generic Spending14--Claims15 AvgSpendClaims15--Outlier18;
Rename AvgSpendDose15=AvgSpend;
Year=2015;
Run;

Data spending2016;
Set meds;
Drop Brand Generic Spending14--Claims16 AvgSpendClaims16--Outlier18;
Rename AvgSpendDose16=AvgSpend;
Year=2016;
Run;

Data spending2017;
Set meds;
Drop Brand Generic Spending14--Claims17 AvgSpendClaims17--Outlier18;
Rename AvgSpendDose17=AvgSpend;
Year=2017;
Run;

Data spending2018;
Set meds;
Drop Brand Generic Spending14--Claims18 AvgSpendClaims18--Outlier18;
Rename AvgSpendDose18=AvgSpend;
Year=2018;
Run;

*Combine the above datasets, we now have a variable to label the year, the spending variable, and manufacturers;
Data differences;
Set spending2014 spending2015 spending2016 spending2017 spending2018;
If NOT AvgSpend=0 then LogSpend = log(AvgSpend);
Label NumManufac="Number of Manufacturers" AvgSpend="Average Spending per Dose" LogSpend="ln(Average Spending per Dose)";
Run;

*Check for normality of transformed data;
Proc Univariate Data=differences plots;
Title "Descriptive Statistics and Distribution of Transformed Average Spending";
Var LogSpend;
Run;

*Create new dataset with formatting applied to turn number of manufacturers into categorical variable for ANOVA;
Data differencebin;
Set differences;
Format NumManufac nummanufacft.;
Run;

*Two-way ANOVA to compare spending across manufacturers and year;
Proc GLM Data=differencebin plots(maxpoints=21600);
Title "Two-Way ANOVA Comparing ln(Average Spending per Dose) Across Year and Number of Manufacturers";
Class Year NumManufac;
Model LogSpend=Year|NumManufac;
Means Year|NumManufac/Tukey;
Run;

*Sort and find means for each category, then create separate dataset for means broken down by categories;
Proc Sort Data=differencebin;
By NumManufac Year;

Proc Means Data=differencebin;
Class NumManufac Year;
Var LogSpend;
Output Out=Means Mean=MeanLog;
Run;

Data m3;
Set Means;
If _TYPE_=3;

*Create interaction plot;
symbol1 Value=dot I=Join;
axis1 Label= (Angle=90 'Mean of Average Spending Per Dose');
Proc Gplot Data=m3;
Title "Interaction Plot of ln(Average Spending per Dose) across Year and Number of Manufacturers";
Plot MeanLog*Year=NumManufac/vaxis=axis1;
```

```
Run;

*Sort and find means of average spending by year and number of manufacturers, put in new dataset mnb3;
Proc Sort Data=differences;
By NumManufac Year;

Proc Means Data=differences;
Class NumManufac Year;
Var AvgSpend;
Output Out=meannonbin Mean=MeanSpend;
Run;

Data mnb3;
Set meannonbin;
If _TYPE_=3;

*Plot output of generated grid to visualize the model;
Proc G3d Data=mnb3;
Title "Plot of Mean Average Spending per Dose by Year and Number of Manufacturers";
Plot Year*NumManufac=MeanSpend/rotate=290 tilt=60 yticknum=5 xticknum=6;
Run;
```

Log: FinalProject.sas

Warnings (3)

Notes (99)

```
1          OPTIONS NONOTES NOSTIMER NOSOURCE NOSYNTAXCHECK;
72
73         /*Coded by: Joelle Strom
74         10/25/2020
75         403 Project Final Analysis*/
76
77         /*Dataset is Medicare Drug Spending and Utilization, year 2018 extracted from the combined dataset for 2014-2018
78         obtained from Centers for Medicare and Medicaid Services at
79         https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Information-on-Prescription-Drugs/
79       ! Medicaid*/
80
81         /*Methodology document: https://www.cms.gov/files/document/medicaid-drug-spending-methodology-2018.pdf*/
82
83         **Create macro to import each dataset, adding an identifier to each variable to distinguish the year, except
84         for brand, generic, and number of manufacturer variables, which do not change from year to year;
85         %Macro inputsort(dataset=,file=,year=);
86
87         Data &dataset;
88         Infile &file dlm='09'x firstobs=2;
89         Length Brand$ 50. Generic$ 50.;
90         Input Brand$ Generic$ NumManufac Spending&year Dose&year Claims&year AvgSpendDose&year AvgSpendClaims&year Outlier&year;
91         If Spending&year=. then Spending&year=0;
92         If Dose&year=. then Dose&year=0;
93         If Claims&year=. then Claims&year=0;
94         If AvgSpendDose&year=. then AvgSpendDose&year=0;
95         If AvgSpendClaims&year=. then AvgSpendClaims&year=0;
96         Run;
97
98         Proc Sort Data=&dataset;
99         By Brand;
100        Run;
101
102        %Mend inputsort;
103
104        *Input the datasets;
105        %inputsort(dataset=meds2014,file="/home/u49579191/STAT403/med2014.txt",year=14);

NOTE: The infile "/home/u49579191/STAT403/med2014.txt" is:
      Filename=/home/u49579191/STAT403/med2014.txt,
      Owner Name=u49579191,Group Name=oda,
      Access Permission=-rw-r--r--,
      Last Modified=18Oct2020:11:35:02,
      File Size (bytes)=335219

NOTE: 4306 records were read from the infile "/home/u49579191/STAT403/med2014.txt".
      The minimum record length was 25.
      The maximum record length was 122.
NOTE: The data set WORK.MEDS2014 has 4306 observations and 9 variables.
NOTE: DATA statement used (Total process time):
      real time           0.09 seconds
      user cpu time       0.00 seconds
```

```
      system cpu time     0.00 seconds
      memory              1516.18k
      OS Memory           40104.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                        156  Switch Count  2
      Page Faults                       0
      Page Reclaims                     64
      Page Swaps                        0
      Voluntary Context Switches        19
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           1544



NOTE: There were 4306 observations read from the data set WORK.MEDS2014.
NOTE: The data set WORK.MEDS2014 has 4306 observations and 9 variables.
NOTE: PROCEDURE SORT used (Total process time):
      real time           0.00 seconds
      user cpu time       0.00 seconds
      system cpu time     0.01 seconds
      memory              3733.40k
      OS Memory           42428.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                        157  Switch Count  2
      Page Faults                       0
      Page Reclaims                     424
      Page Swaps                        0
      Voluntary Context Switches        11
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           1544


106        %inputsort(dataset=meds2015,file="/home/u49579191/STAT403/med2015.txt",year=15);

NOTE: The infile "/home/u49579191/STAT403/med2015.txt" is:
      Filename=/home/u49579191/STAT403/med2015.txt,
      Owner Name=u49579191,Group Name=oda,
      Access Permission=-rw-r--r--,
      Last Modified=18Oct2020:11:41:10,
      File Size (bytes)=341951

NOTE: 4310 records were read from the infile "/home/u49579191/STAT403/med2015.txt".
      The minimum record length was 8.
      The maximum record length was 121.
NOTE: SAS went to a new line when INPUT statement reached past the end of a line.
NOTE: The data set WORK.MEDS2015 has 4306 observations and 9 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              1589.28k
      OS Memory           39336.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                        158  Switch Count  2
      Page Faults                       0
      Page Reclaims                     68
      Page Swaps                        0
      Voluntary Context Switches        15
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           1544



NOTE: There were 4306 observations read from the data set WORK.MEDS2015.
NOTE: The data set WORK.MEDS2015 has 4306 observations and 9 variables.
NOTE: PROCEDURE SORT used (Total process time):
      real time           0.00 seconds
      user cpu time       0.00 seconds
      system cpu time     0.00 seconds
      memory              3735.37k
      OS Memory           42172.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                        159  Switch Count  2
      Page Faults                       0
      Page Reclaims                     422
      Page Swaps                        0
      Voluntary Context Switches        11
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           1544


107        %inputsort(dataset=meds2016,file="/home/u49579191/STAT403/med2016.txt",year=16);
```

```
NOTE: The infile "/home/u49579191/STAT403/med2016.txt" is:
      Filename=/home/u49579191/STAT403/med2016.txt,
      Owner Name=u49579191,Group Name=oda,
      Access Permission=-rw-r--r--,
      Last Modified=18Oct2020:11:41:10,
      File Size (bytes)=348108

NOTE: 4310 records were read from the infile "/home/u49579191/STAT403/med2016.txt".
      The minimum record length was 8.
      The maximum record length was 119.
NOTE: SAS went to a new line when INPUT statement reached past the end of a line.
NOTE: The data set WORK.MEDS2016 has 4306 observations and 9 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              1572.43k
      OS Memory           39336.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                        160  Switch Count  2
      Page Faults                       0
      Page Reclaims                     64
      Page Swaps                        0
      Voluntary Context Switches        15
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           1544



NOTE: There were 4306 observations read from the data set WORK.MEDS2016.
NOTE: The data set WORK.MEDS2016 has 4306 observations and 9 variables.
NOTE: PROCEDURE SORT used (Total process time):
      real time           0.00 seconds
      user cpu time       0.00 seconds
      system cpu time     0.01 seconds
      memory              3677.28k
      OS Memory           42172.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                        161  Switch Count  2
      Page Faults                       0
      Page Reclaims                     422
      Page Swaps                        0
      Voluntary Context Switches        9
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           1544


108        %inputsort(dataset=meds2017,file="/home/u49579191/STAT403/med2017.txt",year=17);

NOTE: The infile "/home/u49579191/STAT403/med2017.txt" is:
      Filename=/home/u49579191/STAT403/med2017.txt,
      Owner Name=u49579191,Group Name=oda,
      Access Permission=-rw-r--r--,
      Last Modified=18Oct2020:11:41:10,
      File Size (bytes)=354923

NOTE: 4310 records were read from the infile "/home/u49579191/STAT403/med2017.txt".
      The minimum record length was 8.
      The maximum record length was 120.
NOTE: SAS went to a new line when INPUT statement reached past the end of a line.
NOTE: The data set WORK.MEDS2017 has 4306 observations and 9 variables.
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              1572.43k
      OS Memory           39336.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                        162  Switch Count  2
      Page Faults                       0
      Page Reclaims                     62
      Page Swaps                        0
      Voluntary Context Switches        15
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           1544



NOTE: There were 4306 observations read from the data set WORK.MEDS2017.
NOTE: The data set WORK.MEDS2017 has 4306 observations and 9 variables.
NOTE: PROCEDURE SORT used (Total process time):
      real time           0.00 seconds
```

```
      user cpu time       0.00 seconds
      system cpu time     0.01 seconds
      memory              3677.28k
      OS Memory           42172.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                        163  Switch Count  2
      Page Faults                       0
      Page Reclaims                     420
      Page Swaps                        0
      Voluntary Context Switches        9
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           1544


109        %inputsort(dataset=meds2018,file="/home/u49579191/STAT403/med2018.txt",year=18);

NOTE: The infile "/home/u49579191/STAT403/med2018.txt" is:
      Filename=/home/u49579191/STAT403/med2018.txt,
      Owner Name=u49579191,Group Name=oda,
      Access Permission=-rw-r--r--,
      Last Modified=18Oct2020:11:41:10,
      File Size (bytes)=363863

NOTE: 4310 records were read from the infile "/home/u49579191/STAT403/med2018.txt".
      The minimum record length was 8.
      The maximum record length was 120.
NOTE: SAS went to a new line when INPUT statement reached past the end of a line.
NOTE: The data set WORK.MEDS2018 has 4306 observations and 9 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              1649.15k
      OS Memory           39336.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                        164  Switch Count  2
      Page Faults                       0
      Page Reclaims                     60
      Page Swaps                        0
      Voluntary Context Switches        15
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           1544



NOTE: There were 4306 observations read from the data set WORK.MEDS2018.
NOTE: The data set WORK.MEDS2018 has 4306 observations and 9 variables.
NOTE: PROCEDURE SORT used (Total process time):
      real time           0.00 seconds
      user cpu time       0.00 seconds
      system cpu time     0.00 seconds
      memory              3621.28k
      OS Memory           42172.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                        165  Switch Count  2
      Page Faults                       0
      Page Reclaims                     420
      Page Swaps                        0
      Voluntary Context Switches        9
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           1544


110
111        *Create formatting to bin number of manufacturers;
112        Proc Format;
113        Value nummanufacftLow-1 = "1 manufacturer"
114        2-6 = "2-6 manufacturers"
115        7-High = "7 or more manufacturers";
NOTE: Format NUMMANUFACFT is already on the library WORK.FORMATS.
NOTE: Format NUMMANUFACFT has been output.
116
117        *Merge by drug brand name;

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              386.09k
      OS Memory           39076.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                        166  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


118       Data meds;
119       Merge meds2014 meds2015 meds2016 meds2017 meds2018;
120       By Brand;
121       Run;

NOTE: MERGE statement has more than one data set with repeats of BY values.
NOTE: There were 4306 observations read from the data set WORK.MEDS2014.
NOTE: There were 4306 observations read from the data set WORK.MEDS2015.
NOTE: There were 4306 observations read from the data set WORK.MEDS2016.
NOTE: There were 4306 observations read from the data set WORK.MEDS2017.
NOTE: There were 4306 observations read from the data set WORK.MEDS2018.
NOTE: The data set WORK.MEDS has 4306 observations and 33 variables.
NOTE: DATA statement used (Total process time):
      real time           0.01 seconds
      user cpu time       0.01 seconds
      system cpu time     0.01 seconds
      memory              7106.34k
      OS Memory           45244.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                       167  Switch Count  2
      Page Faults                      0
      Page Reclaims                    1165
      Page Swaps                       0
      Voluntary Context Switches       11
      Involuntary Context Switches     0
      Block Input Operations           0
      Block Output Operations          3080


122
123       *Separate the spending variable and number of manufacturers into new datasets by year in preparation for data formatting
123     ! for ANOVA;
124       Data spending2014;
125       Set meds;
126       Drop Brand Generic Spending14--Claims14 AvgSpendClaims14--Outlier18;
127       Rename AvgSpendDose14=AvgSpend;
128       Year=2014;
129       Run;

NOTE: There were 4306 observations read from the data set WORK.MEDS.
NOTE: The data set WORK.SPENDING2014 has 4306 observations and 3 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              2332.46k
      OS Memory           40364.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                       168  Switch Count  2
      Page Faults                      0
      Page Reclaims                    293
      Page Swaps                       0
      Voluntary Context Switches       9
      Involuntary Context Switches     0
      Block Input Operations           0
      Block Output Operations          264


130
131       Data spending2015;
132       Set meds;
133       Drop Brand Generic Spending14--Claims15 AvgSpendClaims15--Outlier18;
134       Rename AvgSpendDose15=AvgSpend;
135       Year=2015;
136       Run;

NOTE: There were 4306 observations read from the data set WORK.MEDS.
NOTE: The data set WORK.SPENDING2015 has 4306 observations and 3 variables.
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              2440.65k
      OS Memory           40364.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                       169  Switch Count  2
      Page Faults                      0
      Page Reclaims                    292
```

```
      Page Swaps                       0
      Voluntary Context Switches       11
      Involuntary Context Switches     0
      Block Input Operations           0
      Block Output Operations          264


137
138        Data spending2016;
139        Set meds;
140        Drop Brand Generic Spending14--Claims16 AvgSpendClaims16--Outlier18;
141        Rename AvgSpendDose16=AvgSpend;
142        Year=2016;
143        Run;

NOTE: There were 4306 observations read from the data set WORK.MEDS.
NOTE: The data set WORK.SPENDING2016 has 4306 observations and 3 variables.
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              2496.87k
      OS Memory           40364.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                       170  Switch Count  2
      Page Faults                      0
      Page Reclaims                    291
      Page Swaps                       0
      Voluntary Context Switches       10
      Involuntary Context Switches     0
      Block Input Operations           0
      Block Output Operations          264


144
145        Data spending2017;
146        Set meds;
147        Drop Brand Generic Spending14--Claims17 AvgSpendClaims17--Outlier18;
148        Rename AvgSpendDose17=AvgSpend;
149        Year=2017;
150        Run;

NOTE: There were 4306 observations read from the data set WORK.MEDS.
NOTE: The data set WORK.SPENDING2017 has 4306 observations and 3 variables.
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              2441.00k
      OS Memory           40364.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                       171  Switch Count  2
      Page Faults                      0
      Page Reclaims                    289
      Page Swaps                       0
      Voluntary Context Switches       9
      Involuntary Context Switches     0
      Block Input Operations           0
      Block Output Operations          264


151
152        Data spending2018;
153        Set meds;
154        Drop Brand Generic Spending14--Claims18 AvgSpendClaims18--Outlier18;
155        Rename AvgSpendDose18=AvgSpend;
156        Year=2018;
157        Run;

NOTE: There were 4306 observations read from the data set WORK.MEDS.
NOTE: The data set WORK.SPENDING2018 has 4306 observations and 3 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              2440.65k
      OS Memory           40364.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                       172  Switch Count  2
      Page Faults                      0
      Page Reclaims                    289
      Page Swaps                       0
      Voluntary Context Switches       11
      Involuntary Context Switches     0
      Block Input Operations           0
      Block Output Operations          272
```

```
158
159         *Combine the above datasets, we now have a variable to label the year, the spending variable, and manufacturers;
160         Data differences;
161         Set spending2014 spending2015 spending2016 spending2017 spending2018;
162         If NOT AvgSpend=0 then LogSpend = log(AvgSpend);
163         Label NumManufac="Number of Manufacturers" AvgSpend="Average Spending per Dose" LogSpend="ln(Average Spending per Dose)";
164         Run;

NOTE: There were 4306 observations read from the data set WORK.SPENDING2014.
NOTE: There were 4306 observations read from the data set WORK.SPENDING2015.
NOTE: There were 4306 observations read from the data set WORK.SPENDING2016.
NOTE: There were 4306 observations read from the data set WORK.SPENDING2017.
NOTE: There were 4306 observations read from the data set WORK.SPENDING2018.
NOTE: The data set WORK.DIFFERENCES has 21530 observations and 4 variables.
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              2983.68k
      OS Memory           40636.00k
      Timestamp           11/19/2020 06:59:25 PM
      Step Count                        173  Switch Count  2
      Page Faults                       0
      Page Reclaims                     235
      Page Swaps                        0
      Voluntary Context Switches        14
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           1544


165
166         *Check for normality of transformed data;
167         Proc Univariate Data=differences plots;
168         Title "Descriptive Statistics and Distribution of Transformed Average Spending";
169         Var LogSpend;
170         Run;


Output Added:
-------------
Name:       Moments
Label:      Moments
Template:   base.univariate.Moments
Path:       Univariate.LogSpend.Moments
-------------

Output Added:
-------------
Name:       BasicMeasures
Label:      Basic Measures of Location and Variability
Template:   base.univariate.Measures
Path:       Univariate.LogSpend.BasicMeasures
-------------

Output Added:
-------------
Name:       TestsForLocation
Label:      Tests For Location
Template:   base.univariate.Location
Path:       Univariate.LogSpend.TestsForLocation
-------------

Output Added:
-------------
Name:       Quantiles
Label:      Quantiles
Template:   base.univariate.Quantiles
Path:       Univariate.LogSpend.Quantiles
-------------

Output Added:
-------------
Name:       ExtremeObs
Label:      Extreme Observations
Template:   base.univariate.ExtObs
Path:       Univariate.LogSpend.ExtremeObs
-------------

Output Added:
-------------
Name:       MissingValues
Label:      Missing Values
Template:   base.univariate.Missings
```

```
Path:       Univariate.LogSpend.MissingValues
-------------

Output Added:
-------------
Name:       Plots
Label:      Plots for LogSpend
Template:   base.univariate.Graphics.Plots
Path:       Univariate.LogSpend.Plots
-------------
NOTE: PROCEDURE UNIVARIATE used (Total process time):
      real time           2.02 seconds
      user cpu time       1.42 seconds
      system cpu time     0.07 seconds
      memory              40076.93k
      OS Memory           73388.00k
      Timestamp           11/19/2020 06:59:27 PM
      Step Count                        174  Switch Count  17
      Page Faults                       0
      Page Reclaims                     22083
      Page Swaps                        0
      Voluntary Context Switches        996
      Involuntary Context Switches      7
      Block Input Operations            0
      Block Output Operations           35760


171
172        *Create new dataset with formatting applied to turn number of manufacturers into categorical variable for ANOVA;
173        Data differencebin;
174        Set differences;
175        Format NumManufac nummanufacft.;
176        Run;

NOTE: There were 21530 observations read from the data set WORK.DIFFERENCES.
NOTE: The data set WORK.DIFFERENCEBIN has 21530 observations and 4 variables.
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              2295.09k
      OS Memory           66988.00k
      Timestamp           11/19/2020 06:59:27 PM
      Step Count                        175  Switch Count  2
      Page Faults                       0
      Page Reclaims                     238
      Page Swaps                        0
      Voluntary Context Switches        14
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           1544


177
178        *Two-way ANOVA to compare spending across manufacturers and year;
179        Proc GLM Data=differencebin plots(maxpoints=21600);
180        Title "Two-Way ANOVA Comparing ln(Average Spending per Dose) Across Year and Number of Manufacturers";
181        Class Year NumManufac;
182        Model LogSpend=Year|NumManufac;
183        Means Year|NumManufac/Tukey;
184        Run;


Output Added:
-------------
Name:       ClassLevels
Label:      Class Levels
Template:   STAT.GLM.ClassLevels
Path:       GLM.Data.ClassLevels
-------------

Output Added:
-------------
Name:       NObs
Label:      Number of Observations
Template:   STAT.GLM.NObsNotitle
Path:       GLM.Data.NObs
-------------

Output Added:
-------------
Name:       OverallANOVA
Label:      Overall ANOVA
Template:   stat.GLM.OverallANOVA
Path:       GLM.ANOVA.LogSpend.OverallANOVA
-------------
```

```
Output Added:
-------------
Name:       FitStatistics
Label:      Fit Statistics
Template:   stat.GLM.FitStatistics
Path:       GLM.ANOVA.LogSpend.FitStatistics
-------------

Output Added:
-------------
Name:       ModelANOVA
Label:      Type I Model ANOVA
Template:   stat.GLM.Tests
Path:       GLM.ANOVA.LogSpend.ModelANOVA
-------------

Output Added:
-------------
Name:       ModelANOVA
Label:      Type III Model ANOVA
Template:   stat.GLM.Tests
Path:       GLM.ANOVA.LogSpend.ModelANOVA
-------------

Output Added:
-------------
Name:       IntPlot
Label:      Interaction Plot
Template:   Stat.GLM.Graphics.IntPlot
Path:       GLM.ANOVA.LogSpend.IntPlot
-------------
NOTE: Means from the MEANS statement are not adjusted for other terms in the model.  For adjusted means, use the LSMEANS statement.

Output Added:
-------------
Name:       BoxPlot
Label:      Distribution of LogSpend by Year
Template:   Stat.GLM.Graphics.MeansBoxPlot
Path:       GLM.Means.Year.LogSpend.BoxPlot
-------------

Output Added:
-------------
Name:       CLDiffsInfo
Label:      Information
Template:   stat.GLM.SquashFact
Path:       GLM.Means.Year.LogSpend.CLDiffs.Tukey.CLDiffsInfo
-------------

Output Added:
-------------
Name:       CLDiffs
Label:      Pairs
Template:   stat.GLM.MCPairs
Path:       GLM.Means.Year.LogSpend.CLDiffs.Tukey.CLDiffs
-------------

Output Added:
-------------
Name:       BoxPlot
Label:      Distribution of LogSpend by NumManufac
Template:   Stat.GLM.Graphics.MeansBoxPlot
Path:       GLM.Means.NumManufac.LogSpend.BoxPlot
-------------

Output Added:
-------------
Name:       CLDiffsInfo
Label:      Information
Template:   stat.GLM.SquashFact
Path:       GLM.Means.NumManufac.LogSpend.CLDiffs.Tukey.CLDiffsInfo
-------------

Output Added:
-------------
Name:       CLDiffs
Label:      Pairs
Template:   stat.GLM.MCPairs
Path:       GLM.Means.NumManufac.LogSpend.CLDiffs.Tukey.CLDiffs
-------------

Output Added:
-------------
Name:       BoxPlot
Label:      Distribution of LogSpend by Year*NumManufac
```

```
Template:   Stat.GLM.Graphics.MeansBoxPlot
Path:       GLM.Means.'Year*NumManufac'n.LogSpend.BoxPlot
-------------

Output Added:
-------------
Name:       Means
Label:      Means
Template:   stat.GLM.Means
Path:       GLM.Means.'Year*NumManufac'n.Means
-------------
185
186        *Sort and find means for each category, then create separate dataset for means broken down by categories;

NOTE: PROCEDURE GLM used (Total process time):
      real time           6.95 seconds
      user cpu time       4.43 seconds
      system cpu time     0.39 seconds
      memory              20539.28k
      OS Memory           84416.00k
      Timestamp           11/19/2020 06:59:34 PM
      Step Count                        176  Switch Count  47
      Page Faults                       0
      Page Reclaims                     24071
      Page Swaps                        0
      Voluntary Context Switches        119130
      Involuntary Context Switches      5
      Block Input Operations            0
      Block Output Operations           76952


187        Proc Sort Data=differencebin;
188        By NumManufac Year;
189

NOTE: There were 21530 observations read from the data set WORK.DIFFERENCEBIN.
NOTE: The data set WORK.DIFFERENCEBIN has 21530 observations and 4 variables.
NOTE: PROCEDURE SORT used (Total process time):
      real time           0.01 seconds
      user cpu time       0.01 seconds
      system cpu time     0.00 seconds
      memory              3915.90k
      OS Memory           72892.00k
      Timestamp           11/19/2020 06:59:34 PM
      Step Count                        177  Switch Count  2
      Page Faults                       0
      Page Reclaims                     519
      Page Swaps                        0
      Voluntary Context Switches        16
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           1544


190        Proc Means Data=differencebin;
191        Class NumManufac Year;
192        Var LogSpend;
193        Output Out=Means Mean=MeanLog;
194        Run;


Output Added:
-------------
Name:       Summary
Label:      Summary statistics
Template:   base.summary
Path:       Means.Summary
-------------
NOTE: There were 21530 observations read from the data set WORK.DIFFERENCEBIN.
NOTE: The data set WORK.MEANS has 24 observations and 5 variables.
NOTE: PROCEDURE MEANS used (Total process time):
      real time           0.05 seconds
      user cpu time       0.05 seconds
      system cpu time     0.00 seconds
      memory              10029.46k
      OS Memory           80832.00k
      Timestamp           11/19/2020 06:59:34 PM
      Step Count                        178  Switch Count  3
      Page Faults                       1
      Page Reclaims                     2331
      Page Swaps                        0
      Voluntary Context Switches        46
      Involuntary Context Switches      0
      Block Input Operations            152
      Block Output Operations           280
```

```
195
196         Data m3;
197         Set Means;
198         If _TYPE_=3;
199
200         *Create interaction plot;
201         symbol1 Value=dot I=Join;
202         axis1 Label= (Angle=90 'Mean of Average Spending Per Dose');

NOTE: There were 24 observations read from the data set WORK.MEANS.
NOTE: The data set WORK.M3 has 15 observations and 5 variables.
NOTE: DATA statement used (Total process time):
      real time           0.00 seconds
      user cpu time       0.00 seconds
      system cpu time     0.01 seconds
      memory              949.18k
      OS Memory           70572.00k
      Timestamp           11/19/2020 06:59:34 PM
      Step Count                        179  Switch Count  4
      Page Faults                       0
      Page Reclaims                     239
      Page Swaps                        0
      Voluntary Context Switches        33
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           264


203         Proc Gplot Data=m3;
204         Title "Interaction Plot of ln(Average Spending per Dose) across Year and Number of Manufacturers";
205         Plot MeanLog*Year=NumManufac/vaxis=axis1;
206         Run;

WARNING: TITLE1 is too long. Height has been reduced to 93.46 pct of specified or default size.
WARNING: TITLE1 is too long. Height has been reduced to 95.24 pct of specified or default size.
WARNING: TITLE1 is too long. Height has been reduced to 89.89 pct of specified or default size.

Output Added:
-------------
Name:       GPLOT2
Label:      Plot of MeanLog by Year identified by NumManufac
Data Name:  GRSEG
Path:       GPlot.GPLOT2
-------------
207
208         *Sort and find means of average spending by year and number of manufacturers, put in new dataset mnb3;

NOTE: There were 15 observations read from the data set WORK.M3.
NOTE: PROCEDURE GPLOT used (Total process time):
      real time           0.33 seconds
      user cpu time       0.29 seconds
      system cpu time     0.04 seconds
      memory              10054.62k
      OS Memory           77592.00k
      Timestamp           11/19/2020 06:59:35 PM
      Step Count                        180  Switch Count  1
      Page Faults                       0
      Page Reclaims                     2045
      Page Swaps                        0
      Voluntary Context Switches        16
      Involuntary Context Switches      2
      Block Input Operations            24
      Block Output Operations           576


209         Proc Sort Data=differences;
210         By NumManufac Year;
211

NOTE: There were 21530 observations read from the data set WORK.DIFFERENCES.
NOTE: The data set WORK.DIFFERENCES has 21530 observations and 4 variables.
NOTE: PROCEDURE SORT used (Total process time):
      real time           0.01 seconds
      user cpu time       0.01 seconds
      system cpu time     0.00 seconds
      memory              3913.43k
      OS Memory           77500.00k
      Timestamp           11/19/2020 06:59:35 PM
      Step Count                        181  Switch Count  2
      Page Faults                       0
      Page Reclaims                     479
      Page Swaps                        0
      Voluntary Context Switches        15
      Involuntary Context Switches      0
      Block Input Operations            0
```

```
      Block Output Operations           1544


212        Proc Means Data=differences;
213        Class NumManufac Year;
214        Var AvgSpend;
215        Output Out=meannonbin Mean=MeanSpend;
216        Run;


Output Added:
-------------
Name:        Summary
Label:       Summary statistics
Template:    base.summary
Path:        Means.Summary
-------------
NOTE: There were 21530 observations read from the data set WORK.DIFFERENCES.
NOTE: The data set WORK.MEANNONBIN has 198 observations and 5 variables.
NOTE: PROCEDURE MEANS used (Total process time):
      real time           0.27 seconds
      user cpu time       0.27 seconds
      system cpu time     0.00 seconds
      memory              12045.31k
      OS Memory           84416.00k
      Timestamp           11/19/2020 06:59:35 PM
      Step Count                        182  Switch Count  3
      Page Faults                       0
      Page Reclaims                     2386
      Page Swaps                        0
      Voluntary Context Switches        44
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           480


217
218        Data mnb3;
219        Set meannonbin;
220        If _TYPE_=3;
221
222        *Plot output of generated grid to visualize the model;

NOTE: There were 198 observations read from the data set WORK.MEANNONBIN.
NOTE: The data set WORK.MNB3 has 160 observations and 5 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              838.00k
      OS Memory           75436.00k
      Timestamp           11/19/2020 06:59:35 PM
      Step Count                        183  Switch Count  2
      Page Faults                       0
      Page Reclaims                     122
      Page Swaps                        0
      Voluntary Context Switches        12
      Involuntary Context Switches      0
      Block Input Operations            0
      Block Output Operations           264


223        Proc G3d Data=mnb3;
224        Title "Plot of Mean Average Spending per Dose by Year and Number of Manufacturers";
225        Plot Year*NumManufac=MeanSpend/rotate=290 tilt=60 yticknum=5 xticknum=6;
226        Run;


Output Added:
-------------
Name:        G3D10
Label:       3-D surface plot of Average Spending per Dose by Number of Manufacturers and Year
Data Name:   GRSEG
Path:        G3d.G3D10
-------------
NOTE: PROCEDURE G3D used (Total process time):
      real time           0.26 seconds
      user cpu time       0.23 seconds
      system cpu time     0.02 seconds
      memory              8612.18k
      OS Memory           79788.00k
      Timestamp           11/19/2020 06:59:35 PM
      Step Count                        184  Switch Count  1
      Page Faults                       0
      Page Reclaims                     1791
      Page Swaps                        0
```

```
Voluntary Context Switches        12
Involuntary Context Switches      0
Block Input Operations            0
Block Output Operations           728


227
228        OPTIONS NONOTES NOSTIMER NOSOURCE NOSYNTAXCHECK;
240
```

Results: FinalProject.sas

Descriptive Statistics and Distribution of Transformed Average Spending

The UNIVARIATE Procedure
Variable: LogSpend (ln(Average Spending per Dose))

Moments			
N	18879	Sum Weights	18879
Mean	1.50529085	Sum Observations	28418.386
Std Deviation	2.61255572	Variance	6.8254474
Skewness	0.38358495	Kurtosis	0.04240422
Uncorrected SS	171628.732	Corrected SS	128850.796
Coeff Variation	173.558201	Std Error Mean	0.01901411

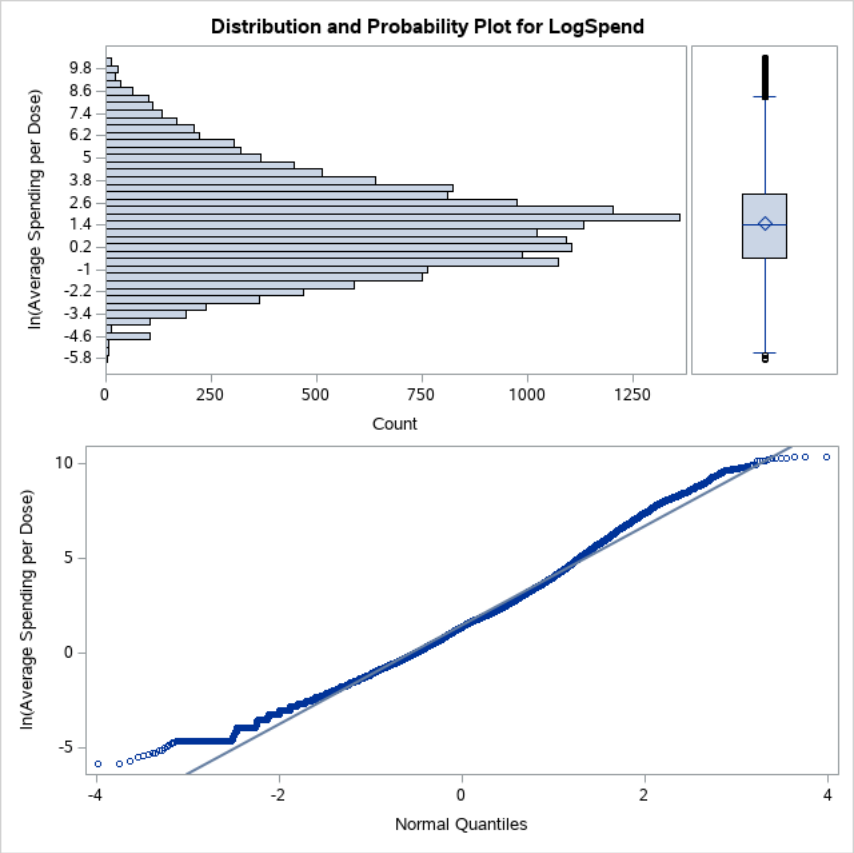
Basic Statistical Measures			
Location		Variability	
Mean	1.50529	Std Deviation	2.61256
Median	1.40118	Variance	6.82545
Mode	-2.99573	Range	16.21270
		Interquartile Range	3.46438

Tests for Location: Mu0=0				
Test	Statistic		p Value	
Student's t	t	79.16703	Pr > |t|	<.0001
Sign	M	3770	Pr >= |M|	<.0001
Signed Rank	S	51238829	Pr >= |S|	<.0001

Quantiles (Definition 5)	
Level	Quantile
100% Max	10.377285
99%	8.268162
95%	6.289052
90%	5.046675
75% Q3	3.093313
50% Median	1.401183
25% Q1	-0.371064
10%	-1.714798
5%	-2.407946
1%	-3.912023
0% Min	-5.835420

Extreme Observations			
Lowest		Highest	
Value	Obs	Value	Obs
-5.83542	2879	10.3072	10008
-5.79898	986	10.3249	20839
-5.65208	2881	10.3594	1396
-5.47998	2810	10.3669	17801
-5.40738	2882	10.3773	14314

Missing Values			
Missing Value	Count	Percent Of	
		All Obs	Missing Obs
.	2651	12.31	100.00



Two-Way ANOVA Comparing ln(Average Spending per Dose) Across Year and Number of Manufacturers

The GLM Procedure

Class Level Information		
Class	**Levels**	**Values**
Year	5	2014 2015 2016 2017 2018
NumManufac	3	1 manufacturer 2-6 manufacturers 7 or more manufacturers

Number of Observations Read	21530
Number of Observations Used	18879

Two-Way ANOVA Comparing ln(Average Spending per Dose) Across Year and Number of Manufacturers

The GLM Procedure

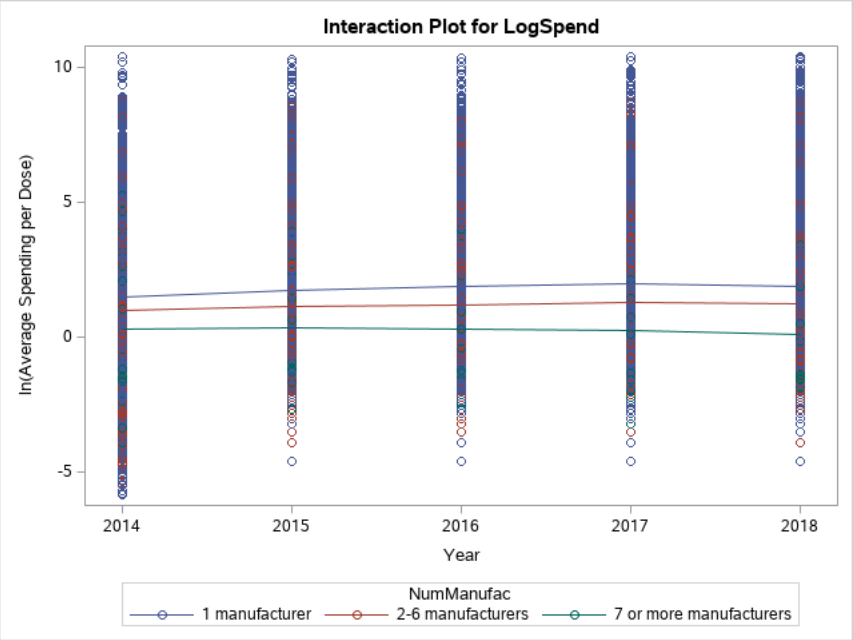
Dependent Variable: LogSpend ln(Average Spending per Dose)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	5304.4737	378.8910	57.85	<.0001
Error	18864	123546.3224	6.5493		
Corrected Total	18878	128850.7960			

R-Square	Coeff Var	Root MSE	LogSpend Mean
0.041168	170.0112	2.559163	1.505291

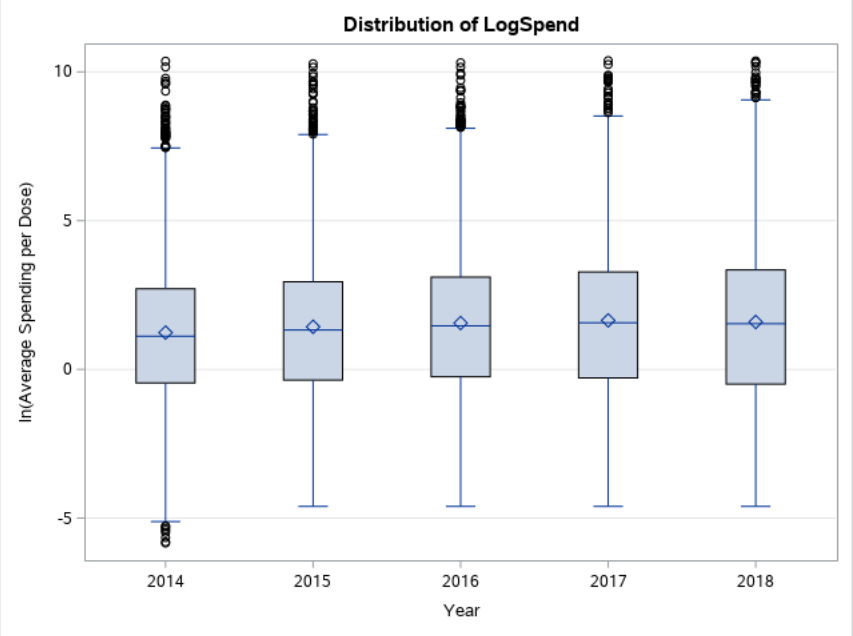
Source	DF	Type I SS	Mean Square	F Value	Pr > F
Year	4	379.722740	94.930685	14.49	<.0001
NumManufac	2	4835.810232	2417.905116	369.18	<.0001
Year*NumManufac	8	88.940684	11.117585	1.70	0.0935

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Year	4	73.915273	18.478818	2.82	0.0236
NumManufac	2	4779.004972	2389.502486	364.85	<.0001
Year*NumManufac	8	88.940684	11.117585	1.70	0.0935



Two-Way ANOVA Comparing ln(Average Spending per Dose) Across Year and Number of Manufacturers

The GLM Procedure



Two-Way ANOVA Comparing ln(Average Spending per Dose) Across Year and Number of Manufacturers

The GLM Procedure

Tukey's Studentized Range (HSD) Test for LogSpend

Note: This test controls the Type I experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	18864
Error Mean Square	6.549317
Critical Value of Studentized Range	3.85803

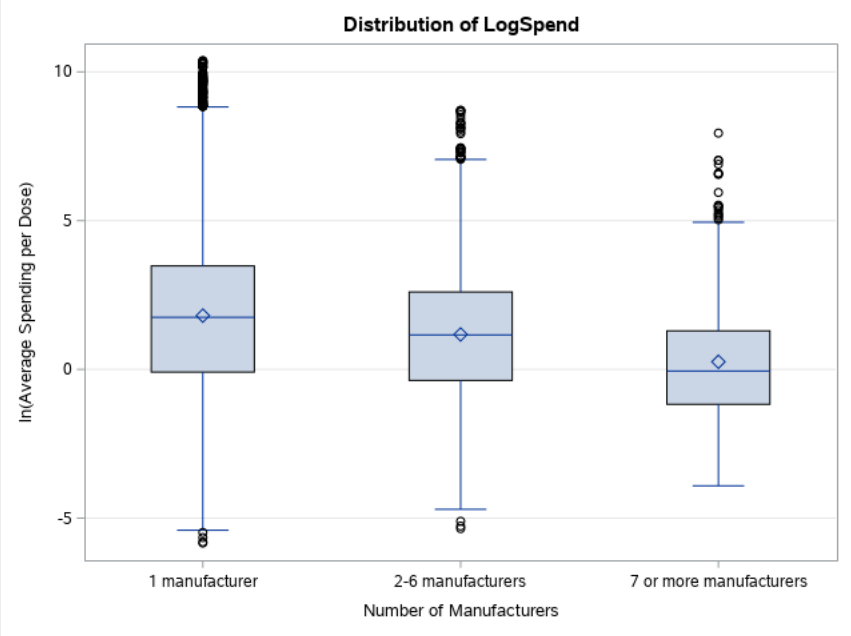
Comparisons significant at the 0.05 level are indicated by *.**

Year Comparison	Difference Between Means	Simultaneous 95% Confidence Limits		
2017 - 2018	0.05404	-0.09981	0.20789	
2017 - 2016	0.09229	-0.06675	0.25133	
2017 - 2015	0.21657	0.05546	0.37768	***
2017 - 2014	0.40974	0.24542	0.57406	***
2018 - 2017	-0.05404	-0.20789	0.09981	
2018 - 2016	0.03825	-0.11788	0.19439	

Comparisons significant at the 0.05 level are indicated by ***.				
Year Comparison	Difference Between Means	Simultaneous 95% Confidence Limits		
2018 - 2015	0.16253	0.00428	0.32078	***
2018 - 2014	0.35570	0.19419	0.51721	***
2016 - 2017	-0.09229	-0.25133	0.06675	
2016 - 2018	-0.03825	-0.19439	0.11788	
2016 - 2015	0.12428	-0.03902	0.28757	
2016 - 2014	0.31745	0.15099	0.48391	***
2015 - 2017	-0.21657	-0.37768	-0.05546	***
2015 - 2018	-0.16253	-0.32078	-0.00428	***
2015 - 2016	-0.12428	-0.28757	0.03902	
2015 - 2014	0.19317	0.02473	0.36161	***
2014 - 2017	-0.40974	-0.57406	-0.24542	***
2014 - 2018	-0.35570	-0.51721	-0.19419	***
2014 - 2016	-0.31745	-0.48391	-0.15099	***
2014 - 2015	-0.19317	-0.36161	-0.02473	***

Two-Way ANOVA Comparing ln(Average Spending per Dose) Across Year and Number of Manufacturers

The GLM Procedure



Two-Way ANOVA Comparing ln(Average Spending per Dose) Across Year and Number of Manufacturers

The GLM Procedure

Tukey's Studentized Range (HSD) Test for LogSpend

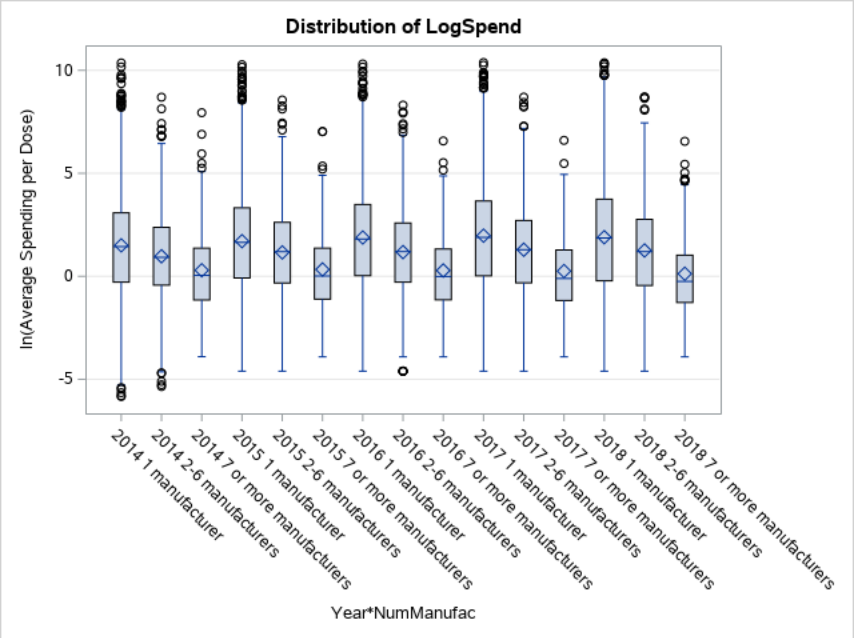
Note: This test controls the Type I experimentwise error rate.

Alpha	0.05
Error Degrees of Freedom	18864
Error Mean Square	6.549317
Critical Value of Studentized Range	3.31476

Comparisons significant at the 0.05 level are indicated by ***.				
NumManufac Comparison	Difference Between Means	Simultaneous 95% Confidence Limits		
1 manufacturer - 2-6 manufacturers	0.63261	0.52242	0.74281	***
1 manufacturer - 7 or more manufacturers	1.55228	1.41161	1.69296	***
2-6 manufacturers - 1 manufacturer	-0.63261	-0.74281	-0.52242	***
2-6 manufacturers - 7 or more manufacturers	0.91967	0.75730	1.08203	***
7 or more manufacturers - 1 manufacturer	-1.55228	-1.69296	-1.41161	***
7 or more manufacturers - 2-6 manufacturers	-0.91967	-1.08203	-0.75730	***

Two-Way ANOVA Comparing ln(Average Spending per Dose) Across Year and Number of Manufacturers

The GLM Procedure

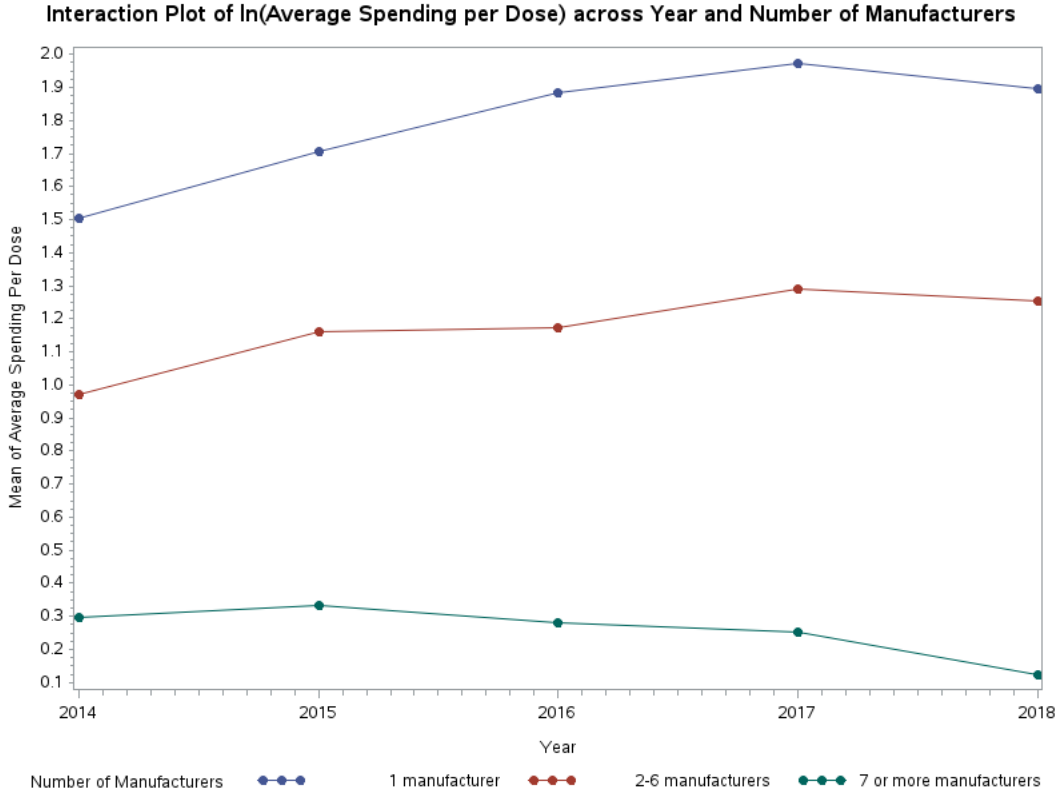


Level of Year	Level of NumManufac	N	LogSpend	
			Mean	Std Dev
2014	1 manufacturer	2194	1.50234049	2.64355230
2014	2-6 manufacturers	709	0.97111667	2.21462890
2014	7 or more manufacturers	411	0.29521215	1.83114281
2015	1 manufacturer	2405	1.70755707	2.65980255
2015	2-6 manufacturers	744	1.16048448	2.24557129
2015	7 or more manufacturers	418	0.33115443	1.83621841
2016	1 manufacturer	2553	1.88513337	2.68018256
2016	2-6 manufacturers	769	1.17313099	2.27444720
2016	7 or more manufacturers	427	0.28146386	1.78310385
2017	1 manufacturer	2737	1.97190707	2.73440402
2017	2-6 manufacturers	799	1.29113385	2.29010125
2017	7 or more manufacturers	429	0.25283723	1.79322900
2018	1 manufacturer	3029	1.89652328	2.90083868
2018	2-6 manufacturers	824	1.25501252	2.38705747
2018	7 or more manufacturers	431	0.12282812	1.78249528

Two-Way ANOVA Comparing ln(Average Spending per Dose) Across Year and Number of Manufacturers

The MEANS Procedure

Analysis Variable : LogSpend ln(Average Spending per Dose)							
Number of Manufacturers	Year	N Obs	N	Mean	Std Dev	Minimum	Maximum
1 manufacturer	2014	3049	2194	1.5023405	2.6435523	-5.8354195	10.3593717
	2015	3049	2405	1.7075571	2.6598025	-4.6051702	10.2737834
	2016	3049	2553	1.8851334	2.6801826	-4.6051702	10.3072439
	2017	3049	2737	1.9719071	2.7344040	-4.6051702	10.3772846
	2018	3049	3029	1.8965233	2.9008387	-4.6051702	10.3668715
2-6 manufacturers	2014	826	709	0.9711167	2.2146289	-5.3497686	8.6944061
	2015	826	744	1.1604845	2.2455713	-4.6051702	8.5588072
	2016	826	769	1.1731310	2.2744472	-4.6051702	8.3095095
	2017	826	799	1.2911339	2.2901012	-4.6051702	8.6989829
	2018	826	824	1.2550125	2.3870575	-4.6051702	8.7122302
7 or more manufacturers	2014	431	411	0.2952121	1.8311428	-3.9039719	7.9428949
	2015	431	418	0.3311544	1.8362184	-3.9120230	7.0286978
	2016	431	427	0.2814639	1.7831039	-3.9120230	6.5712050
	2017	431	429	0.2528372	1.7932290	-3.9120230	6.5998977
	2018	431	431	0.1228281	1.7824953	-3.9120230	6.5535772



Interaction Plot of ln(Average Spending per Dose) across Year and Number of Manufacturers

The MEANS Procedure

Analysis Variable : AvgSpend Average Spending per Dose							
Number of Manufacturers	Year	N Obs	N	Mean	Std Dev	Minimum	Maximum
1	2014	3049	3049	129.6452573	1062.40	0	31551.35
	2015	3049	3049	174.0851558	1211.17	0	28963.26
	2016	3049	3049	191.8004952	1196.84	0	29948.78
	2017	3049	3049	251.3673696	1480.68	0	32121.62
	2018	3049	3049	307.7163267	1697.60	0	31788.87
2	2014	395	395	60.2652463	375.5459950	0	5969.43
	2015	395	395	73.3587595	398.9768004	0	5212.46
	2016	395	395	72.8604051	332.0477172	0	4062.32
	2017	395	395	102.0526835	496.0603575	0	5996.81
	2018	395	395	126.7717468	588.7444010	0	6076.78
3	2014	174	174	12.6647515	50.5265023	0	589.4453334
	2015	174	174	17.1958621	58.8493456	0	674.7200000
	2016	174	174	19.6008046	68.1335866	0	791.9300000
	2017	174	174	20.1678736	69.2776035	0	799.3800000
	2018	174	174	22.5567816	74.2436165	0.0100000	835.1200000
4	2014	99	99	10.2283445	29.8684921	0	189.6824447
	2015	99	99	16.3929293	49.8238486	0	363.2700000
	2016	99	99	18.4766667	59.1206720	0	389.7100000
	2017	99	99	24.7189899	80.0950128	0	570.6900000
	2018	99	99	21.1966667	66.1072154	0.0300000	419.0600000
5	2014	87	87	14.5846228	56.1512079	0	504.7105786
	2015	87	87	14.3201149	53.2590136	0	481.9700000
	2016	87	87	9.4883908	17.5563702	0	94.9700000
	2017	87	87	12.2802299	23.2734196	0	112.5900000
	2018	87	87	10.1185057	18.4431987	0.0600000	108.5900000
6	2014	71	71	6.7563231	20.4051841	0	112.8443167
	2015	71	71	12.3884507	33.3110345	0	152.3400000
	2016	71	71	13.5829577	37.9912138	0	246.1700000
	2017	71	71	19.2788732	56.3653613	0.0400000	365.5800000
	2018	71	71	17.7688732	60.1181072	0.0400000	446.9200000
7	2014	76	76	6.6082162	15.0214043	0	88.3298821
	2015	76	76	6.8240789	15.1631477	0	92.5200000
	2016	76	76	6.7475000	16.8880576	0.0600000	130.6100000
	2017	76	76	7.3959211	17.0832283	0.0400000	103.8400000
	2018	76	76	8.2076316	28.5327271	0.0900000	229.6000000
8	2014	57	57	66.9940936	372.9732732	0	2815.50
	2015	57	57	33.1970175	149.0215503	0	1123.49
	2016	57	57	12.7640351	23.5085579	0	127.3300000
	2017	57	57	11.9615789	20.0196700	0	94.8400000
	2018	57	57	11.7489474	21.8616787	0.0200000	100.9600000
9	2014	58	58	21.2640303	129.4086884	0	986.5054899

Analysis Variable : AvgSpend Average Spending per Dose							
Number of Manufacturers	Year	N Obs	N	Mean	Std Dev	Minimum	Maximum
	2015	58	58	23.5234483	147.8712068	0	1128.56
	2016	58	58	15.6401724	93.5219353	0.1100000	714.2300000
	2017	58	58	15.8534483	96.2622340	0.1100000	735.0200000
	2018	58	58	14.6425862	91.9481973	0.0900000	701.7500000
10	2014	44	44	8.5292954	28.9448135	0	191.0021927
	2015	44	44	9.7456818	28.3382807	0	181.8100000
	2016	44	44	10.5195455	27.4931097	0.0700000	172.9900000
	2017	44	44	10.5656818	23.8340382	0.0700000	136.2400000
	2018	44	44	9.7134091	20.7723977	0.0700000	107.1000000
11	2014	25	25	22.5866234	76.5015461	0	382.4860368
	2015	25	25	15.6996000	42.9977842	0	211.4200000
	2016	25	25	16.0740000	49.4033634	0.1100000	249.4000000
	2017	25	25	17.2124000	48.4913167	0.1200000	239.4900000
	2018	25	25	11.2812000	30.9855944	0.1300000	152.8700000
12	2014	23	23	1.4807005	2.1453950	0.1022364	8.0606777
	2015	23	23	2.0860870	4.1526101	0.1000000	19.2400000
	2016	23	23	1.8613043	3.5474796	0.0900000	16.1000000
	2017	23	23	2.6586957	6.1224878	0.1000000	26.7300000
	2018	23	23	2.9147826	7.0179788	0.1100000	30.6300000
13	2014	16	16	1.5502552	2.4495037	0	8.4122321
	2015	16	16	10.0593750	33.3869083	0	134.6100000
	2016	16	16	4.6868750	12.5012206	0	49.4300000
	2017	16	16	2.6943750	5.7693257	0	17.9300000
	2018	16	16	6.3162500	16.1547247	0.1300000	62.7000000
14	2014	27	27	4.2700494	10.3075117	0	50.4346755
	2015	27	27	4.8840741	14.4711206	0	74.6000000
	2016	27	27	7.0537037	24.9930369	0.1000000	130.3100000
	2017	27	27	7.5914815	27.1982174	0.1000000	140.5000000
	2018	27	27	6.2333333	22.0375210	0.1200000	113.6700000
15	2014	8	8	1.8406048	2.8486931	0.0508514	7.9596128
	2015	8	8	1.5437500	2.1855626	0.0500000	5.7900000
	2016	8	8	1.2362500	1.7903546	0.0500000	5.1400000
	2017	8	8	0.9512500	1.2693805	0.0800000	3.6400000
	2018	8	8	4.3887500	10.6894132	0.0500000	30.7500000
16	2014	20	20	3.2384443	7.3243707	0.1262519	32.6143652
	2015	20	20	4.3145000	9.8042748	0.1100000	33.9500000
	2016	20	20	4.1000000	10.1478315	0.1000000	42.2900000
	2017	20	20	5.3280000	15.4984898	0.1000000	67.9000000
	2018	20	20	3.7910000	9.5756264	0.1000000	38.2400000
17	2014	13	13	13.4478650	28.6750630	0.1097362	99.7033669
	2015	13	13	13.4469231	28.9950451	0.0900000	103.8200000
	2016	13	13	12.2338462	26.2976731	0.0900000	93.0600000
	2017	13	13	15.7892308	34.1906424	0.0900000	119.1900000
	2018	13	13	17.6707692	35.6998551	0.0900000	106.2600000
18	2014	12	12	3.6438962	6.7705533	0.1174096	23.7684406
	2015	12	12	3.0633333	5.9658259	0.1300000	20.5400000
	2016	12	12	2.5225000	4.9134752	0.1200000	16.3800000
	2017	12	12	2.1675000	4.0875134	0.1100000	12.7500000
	2018	12	12	2.1116667	4.1039002	0.1100000	11.5100000
19	2014	11	11	2.8348961	7.1282938	0	24.2623134
	2015	11	11	6.3500000	12.0222477	0	37.5400000
	2016	11	11	5.1463636	9.1776514	0.1400000	31.1900000
	2017	11	11	4.3136364	9.4233383	0.1300000	32.4600000
	2018	11	11	4.4881818	11.6822222	0.1200000	39.6300000
20	2014	9	9	5.0950806	10.0822575	0	30.9240827
	2015	9	9	4.9200000	10.6372529	0.1200000	32.5600000
	2016	9	9	3.4877778	7.8163959	0.1100000	24.0100000
	2017	9	9	3.9933333	8.8004418	0.1200000	26.8100000
	2018	9	9	3.5144444	6.7367131	0.1300000	19.3200000
21	2014	4	4	0.6613021	0.6209251	0.1270136	1.3962689
	2015	4	4	0.6525000	0.6195899	0.1200000	1.3700000
	2016	4	4	0.6050000	0.5935487	0.1000000	1.3300000
	2017	4	4	0.5700000	0.5541961	0.1100000	1.3000000
	2018	4	4	0.4850000	0.4415503	0.1100000	1.0700000
22	2014	3	3	2.3646836	2.0981669	0.6947551	4.7197822
	2015	3	3	1.3700000	0.7562407	0.5400000	2.0200000
	2016	3	3	1.0033333	0.5310681	0.4000000	1.4000000
	2017	3	3	0.9000000	0.5100000	0.3900000	1.4100000
	2018	3	3	0.8000000	0.5766281	0.3500000	1.4500000
23	2014	3	3	0.7554678	0.7805217	0.1403230	1.6334889
	2015	3	3	1.0466667	1.3057310	0.1200000	2.5400000
	2016	3	3	0.9266667	1.1328872	0.1100000	2.2200000
	2017	3	3	0.9900000	1.2480785	0.1200000	2.4200000
	2018	3	3	1.2066667	1.7029484	0.1300000	3.1700000
24	2014	3	3	0.4078777	0.1588371	0.2307589	0.5376792
	2015	3	3	0.3866667	0.1607275	0.2700000	0.5700000
	2016	3	3	0.3600000	0.1479865	0.2600000	0.5300000
	2017	3	3	0.3466667	0.0907377	0.2800000	0.4500000
	2018	3	3	0.2833333	0.0251661	0.2600000	0.3100000

Analysis Variable : AvgSpend Average Spending per Dose							
Number of Manufacturers	Year	N Obs	N	Mean	Std Dev	Minimum	Maximum
25	2014	4	4	0.3017335	0.2319323	0.0997037	0.6257531
	2015	4	4	0.3425000	0.2590206	0.1000000	0.6900000
	2016	4	4	0.3925000	0.2842974	0.0800000	0.7700000
	2017	4	4	0.3475000	0.2784930	0.0900000	0.7400000
	2018	4	4	0.3075000	0.2354251	0.0900000	0.6400000
26	2014	4	4	0.2605748	0.0812641	0.1700551	0.3518259
	2015	4	4	0.2150000	0.0624500	0.1400000	0.2900000
	2016	4	4	0.1950000	0.0574456	0.1200000	0.2400000
	2017	4	4	0.2350000	0.0974679	0.1400000	0.3500000
	2018	4	4	0.2225000	0.0797392	0.1500000	0.3100000
28	2014	4	4	4.2876858	6.5921329	0.7355261	14.1718808
	2015	4	4	6.7400000	11.0431276	0.5600000	23.2800000
	2016	4	4	5.4975000	8.8676655	0.5000000	18.7800000
	2017	4	4	6.0725000	10.2834799	0.4200000	21.4800000
	2018	4	4	7.8425000	13.9767411	0.3500000	28.7900000
29	2014	1	1	2.5868873	.	2.5868873	2.5868873
	2015	1	1	2.0700000	.	2.0700000	2.0700000
	2016	1	1	1.5600000	.	1.5600000	1.5600000
	2017	1	1	1.2300000	.	1.2300000	1.2300000
	2018	1	1	0.8300000	.	0.8300000	0.8300000
30	2014	3	3	0.3545466	0.2248471	0.0952521	0.4956377
	2015	3	3	0.3333333	0.2214347	0.0800000	0.4900000
	2016	3	3	0.3066667	0.2218859	0.0700000	0.5100000
	2017	3	3	0.3066667	0.2411086	0.0800000	0.5600000
	2018	3	3	0.2800000	0.2227106	0.0800000	0.5200000
34	2014	1	1	0.2088518	.	0.2088518	0.2088518
	2015	1	1	0.2100000	.	0.2100000	0.2100000
	2016	1	1	0.1700000	.	0.1700000	0.1700000
	2017	1	1	0.1600000	.	0.1600000	0.1600000
	2018	1	1	0.1400000	.	0.1400000	0.1400000
35	2014	1	1	0.9797673	.	0.9797673	0.9797673
	2015	1	1	0.9900000	.	0.9900000	0.9900000
	2016	1	1	0.8900000	.	0.8900000	0.8900000
	2017	1	1	1.5300000	.	1.5300000	1.5300000
	2018	1	1	1.6500000	.	1.6500000	1.6500000
42	2014	1	1	0.3147577	.	0.3147577	0.3147577
	2015	1	1	0.2900000	.	0.2900000	0.2900000
	2016	1	1	0.2600000	.	0.2600000	0.2600000
	2017	1	1	0.2400000	.	0.2400000	0.2400000
	2018	1	1	0.2100000	.	0.2100000	0.2100000

Plot of Mean Average Spending per Dose by Year and Number of Manufacturers