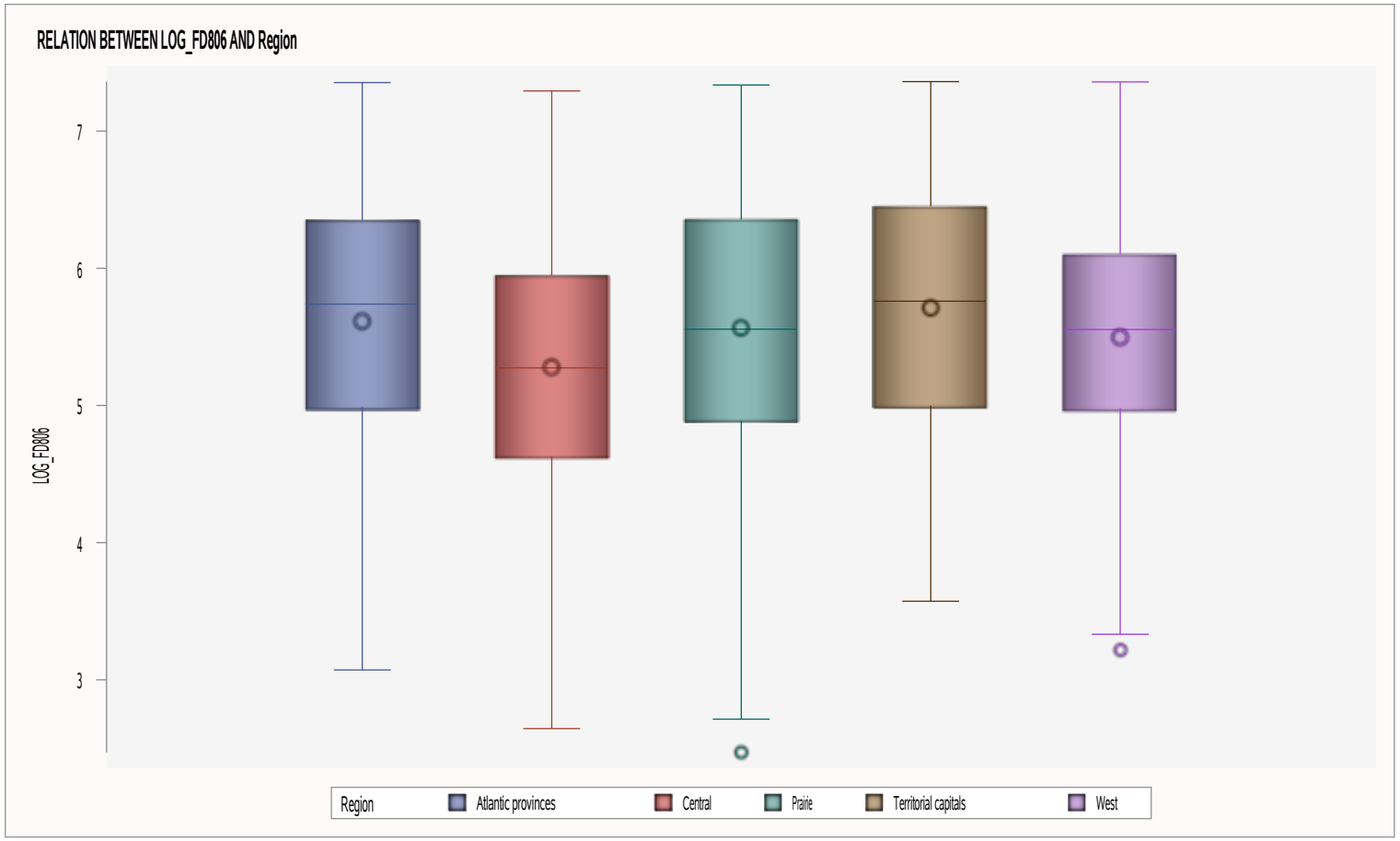
# BIVARIATE ANALYSIS OF Region AND LOG_FD806 FOR ANA.MODEL2
# RELATION BETWEEN LOG_FD806 AND Region

## The MEANS Procedure

| Analysis Variable : LOG_FD806 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Region | N Obs | N | N Miss | Minimum | Lower Quartile | Median | Mean | Upper Quartile | Maximum | Quartile Range | Coeff of Variation | Lower 95% CL for Mean | Upper 95% CL for Mean | Skewness |
| Atlantic provinces | 629768 | 629768 | 0 | 3.07 | 4.97 | 5.74 | 5.62 | 6.35 | 7.35 | 1.38 | 16.90 | 5.61 | 5.62 | -0.41 |
| Central | 4987062 | 4987062 | 0 | 2.64 | 4.62 | 5.27 | 5.27 | 5.95 | 7.29 | 1.33 | 17.70 | 5.27 | 5.28 | -0.07 |
| Prairie | 1530428 | 1530428 | 0 | 2.47 | 4.88 | 5.56 | 5.56 | 6.36 | 7.34 | 1.48 | 16.94 | 5.56 | 5.57 | -0.28 |
| Territorial capitals | 11711 | 11711 | 0 | 3.57 | 4.99 | 5.76 | 5.71 | 6.45 | 7.36 | 1.47 | 16.60 | 5.70 | 5.73 | -0.28 |
| West | 969907 | 969907 | 0 | 3.22 | 4.97 | 5.55 | 5.49 | 6.10 | 7.36 | 1.14 | 16.17 | 5.49 | 5.49 | -0.29 |



| One-way ANOVA Assumptions |
|---|
| In order to run a one-way ANOVA the following assumptions must be met: |
| |
| 1.The response of interest is continuous and normally distributed for each treatment group: |
| Normality test: PROC UNIVARIATE NORMAL and QQPlot for each group. |
| 2.Treatment groups are independent of one another. Experimental units only receive one treatment,and they do not overlap. |
| 3.There are no major outliers. |
| 4.A check for unequal variances will help determine which version of a one-way ANOVA is most appropriate |
| (Levene's test, Null hypothesis: variances are equal between groups): |
| A .If variances are equal, then the assumptions of a standard one-way ANOVA are met. |
| B. If variances are unequal, then a Welch's one-way ANOVA is appropriate. |

| Normal Distribution? |
|---|
| Null hypothesis: sample has a normal distribution |
| CLT : |
| a.If it looks normal and each group have more than 30 observations |
| b.If moderately skewed, each group must have more than 100 observations |
| *rule of thumb: If skewness is between -1 and -0.5 or between 0.5 and 1, the distribution is moderately skewed. |
| *if the sample size is over 2000, the Kolmgorov test should be used. If the sample size is less than 2000, the Shapiro test is better. |

## The UNIVARIATE Procedure
## Variable: LOG_FD806

## Freq: WeightD

**Region=Atlantic provinces**

| Moments | | | |
|---|---|---|---|
| **N** | 629768 | **Sum Weights** | 629768 |
| **Mean** | 5.61588116 | **Sum Observations** | 3536702.25 |
| **Std Deviation** | 0.94909276 | **Variance** | 0.90077707 |
| **Skewness** | -0.4111892 | **Kurtosis** | -0.3415584 |

# The UNIVARIATE Procedure
## Variable: LOG_FD806

## Freq: WeightD

**Region=Atlantic provinces**

| Moments | | | |
|---|---|---|---|
| **Uncorrected SS** | 20428979.2 | **Corrected SS** | 567279.674 |
| **Coeff Variation** | 16.9001575 | **Std Error Mean** | 0.00119596 |

| Basic Statistical Measures | | | |
|---|---|---|---|
| **Location** | | **Variability** | |
| **Mean** | 5.615881 | **Std Deviation** | 0.94909 |
| **Median** | 5.738828 | **Variance** | 0.90078 |
| **Mode** | 4.333099 | **Range** | 4.28184 |
| | | **Interquartile Range** | 1.37771 |

| Tests for Location: Mu0=0 | | | | |
|---|---|---|---|---|
| **Test** | **Statistic** | | **p Value** | |
| **Student's t** | **t** | 4695.691 | **Pr > \|t\|** | <.0001 |
| **Sign** | **M** | 314884 | **Pr >= \|M\|** | <.0001 |
| **Signed Rank** | **S** | 9.915E10 | **Pr >= \|S\|** | <.0001 |

| Tests for Normality | | | | |
|---|---|---|---|---|
| **Test** | **Statistic** | | **p Value** | |
| **Kolmogorov-Smirnov** | **D** | 0.052851 | **Pr > D** | <0.0100 |
| **Cramer-von Mises** | **W-Sq** | 365.0699 | **Pr > W-Sq** | <0.0050 |
| **Anderson-Darling** | **A-Sq** | 2531.387 | **Pr > A-Sq** | <0.0050 |

# The UNIVARIATE Procedure
# Variable: LOG_FD806

## Freq: WeightD

**Region=Atlantic provinces**

| Quantiles (Definition 5) | |
|---|---|
| **Level** | **Quantile** |
| **100% Max** | 7.35361 |
| **99%** | 7.32214 |
| **95%** | 7.03277 |
| **90%** | 6.73863 |
| **75% Q3** | 6.35141 |
| **50% Median** | 5.73883 |
| **25% Q1** | 4.97369 |
| **10%** | 4.32665 |
| **5%** | 3.89182 |
| **1%** | 3.25810 |
| **0% Min** | 3.07177 |

| Extreme Observations | | | | | |
|---|---|---|---|---|---|
| **Lowest** | | | **Highest** | | |
| **Value** | **Freq** | **Obs** | **Value** | **Freq** | **Obs** |
| 3.07177 | 840 | 331 | 7.34003 | 776 | 205 |
| 3.07177 | 347 | 241 | 7.34357 | 669 | 35 |
| 3.15274 | 132 | 176 | 7.35014 | 1360 | 634 |
| 3.21165 | 209 | 688 | 7.35109 | 759 | 717 |
| 3.21727 | 186 | 527 | 7.35361 | 491 | 226 |

# The UNIVARIATE Procedure
## Variable: LOG_FD806

## Freq: WeightD

**Region=Central**

| Moments | | | |
|---|---|---|---|
| **N** | 4987062 | **Sum Weights** | 4987062 |
| **Mean** | 5.27439207 | **Sum Observations** | 26303720.3 |
| **Std Deviation** | 0.93379405 | **Variance** | 0.87197133 |
| **Skewness** | -0.0677122 | **Kurtosis** | -0.5844914 |
| **Uncorrected SS** | 143084708 | **Corrected SS** | 4348574.21 |
| **Coeff Variation** | 17.7042973 | **Std Error Mean** | 0.00041815 |

| Basic Statistical Measures | | | |
|---|---|---|---|
| **Location** | | **Variability** | |
| **Mean** | 5.274392 | **Std Deviation** | 0.93379 |
| **Median** | 5.273820 | **Variance** | 0.87197 |
| **Mode** | 4.276944 | **Range** | 4.64785 |
| | | **Interquartile Range** | 1.33043 |

| Tests for Location: Mu0=0 | | | | |
|---|---|---|---|---|
| **Test** | **Statistic** | | **p Value** | |
| **Student's t** | **t** | 12613.73 | **Pr > \|t\|** | <.0001 |
| **Sign** | **M** | 2493531 | **Pr >= \|M\|** | <.0001 |
| **Signed Rank** | **S** | 6.218E12 | **Pr >= \|S\|** | <.0001 |

## The UNIVARIATE Procedure
## Variable: LOG_FD806

### Freq: WeightD

**Region=Central**

| Tests for Normality | | | | |
|---|---|---|---|---|
| **Test** | **Statistic** | | **p Value** | |
| **Kolmogorov-Smirnov** | **D** | 0.039316 | **Pr > D** | <0.0100 |
| **Cramer-von Mises** | **W-Sq** | 1237.889 | **Pr > W-Sq** | <0.0050 |
| **Anderson-Darling** | **A-Sq** | 9225.814 | **Pr > A-Sq** | <0.0050 |

| Quantiles (Definition 5) | |
|---|---|
| **Level** | **Quantile** |
| **100% Max** | 7.29261 |
| **99%** | 7.17749 |
| **95%** | 6.80870 |
| **90%** | 6.51514 |
| **75% Q3** | 5.94694 |
| **50% Median** | 5.27382 |
| **25% Q1** | 4.61651 |
| **10%** | 3.99046 |
| **5%** | 3.87287 |
| **1%** | 3.27790 |
| **0% Min** | 2.64476 |

## The UNIVARIATE Procedure
## Variable: LOG_FD806

### Freq: WeightD

**Region=Central**

| Extreme Observations | | | | | |
|---|---|---|---|---|---|
| Lowest | | | Highest | | |
| Value | Freq | Obs | Value | Freq | Obs |
| 2.64476 | 15313 | 1259 | 7.23335 | 5785 | 1060 |
| 3.02237 | 4062 | 1240 | 7.24642 | 6213 | 1146 |
| 3.03495 | 8060 | 1283 | 7.25157 | 2957 | 888 |
| 3.05777 | 7665 | 1297 | 7.28909 | 12702 | 903 |
| 3.27790 | 16121 | 1013 | 7.29261 | 12196 | 792 |

## The UNIVARIATE Procedure
## Variable: LOG_FD806

### Freq: WeightD

**Region=Prairie**

| Moments | | | |
|---|---|---|---|
| N | 1530428 | Sum Weights | 1530428 |
| Mean | 5.56479741 | Sum Observations | 8516521.77 |
| Std Deviation | 0.94258654 | Variance | 0.88846939 |
| Skewness | -0.2784877 | Kurtosis | -0.4230712 |
| Uncorrected SS | 48752455.8 | Corrected SS | 1359737.54 |
| Coeff Variation | 16.9383802 | Std Error Mean | 0.00076193 |

## The UNIVARIATE Procedure
## Variable: LOG_FD806

## Freq: WeightD

**Region=Prairie**

| Basic Statistical Measures | | | |
|---|---|---|---|
| **Location** | | **Variability** | |
| **Mean** | 5.564797 | **Std Deviation** | 0.94259 |
| **Median** | 5.555901 | **Variance** | 0.88847 |
| **Mode** | 6.439478 | **Range** | 4.86516 |
| | | **Interquartile Range** | 1.47808 |

| Tests for Location: Mu0=0 | | | | |
|---|---|---|---|---|
| **Test** | **Statistic** | | **p Value** | |
| **Student's t** | **t** | 7303.56 | **Pr > \|t\|** | <.0001 |
| **Sign** | **M** | 765214 | **Pr >= \|M\|** | <.0001 |
| **Signed Rank** | **S** | 5.856E11 | **Pr >= \|S\|** | <.0001 |

| Tests for Normality | | | | |
|---|---|---|---|---|
| **Test** | **Statistic** | | **p Value** | |
| **Kolmogorov-Smirnov** | **D** | 0.053018 | **Pr > D** | <0.0100 |
| **Cramer-von Mises** | **W-Sq** | 637.2333 | **Pr > W-Sq** | <0.0050 |
| **Anderson-Darling** | **A-Sq** | 4755.851 | **Pr > A-Sq** | <0.0050 |

| Quantiles (Definition 5) | |
|---|---|
| **Level** | **Quantile** |
| **100% Max** | 7.33580 |
| **99%** | 7.30953 |
| **95%** | 7.06397 |
| **90%** | 6.73285 |

## The UNIVARIATE Procedure
## Variable: LOG_FD806

### Freq: WeightD

**Region=Prairie**

| Quantiles (Definition 5) | |
|---|---|
| **Level** | **Quantile** |
| **75% Q3** | 6.35580 |
| **50% Median** | 5.55590 |
| **25% Q1** | 4.87771 |
| **10%** | 4.32968 |
| **5%** | 4.01241 |
| **1%** | 3.38608 |
| **0% Min** | 2.47064 |

| Extreme Observations | | | | | |
|---|---|---|---|---|---|
| **Lowest** | | | **Highest** | | |
| **Value** | **Freq** | **Obs** | **Value** | **Freq** | **Obs** |
| 2.47064 | 3940 | 1853 | 7.27891 | 505 | 1585 |
| 2.71337 | 1520 | 1916 | 7.30361 | 5912 | 1353 |
| 3.08374 | 1372 | 1347 | 7.30953 | 8411 | 1436 |
| 3.08374 | 3250 | 1321 | 7.32095 | 5649 | 1694 |
| 3.10727 | 381 | 1617 | 7.33580 | 1566 | 1781 |

## The UNIVARIATE Procedure
## Variable: LOG_FD806

## Freq: WeightD

**Region=Territorial capitals**

| Moments | | | |
|---|---|---|---|
| **N** | 11711 | **Sum Weights** | 11711 |
| **Mean** | 5.71392282 | **Sum Observations** | 66915.7502 |
| **Std Deviation** | 0.94859878 | **Variance** | 0.89983964 |
| **Skewness** | -0.2810241 | **Kurtosis** | -0.9449775 |
| **Uncorrected SS** | 392888.554 | **Corrected SS** | 10537.1222 |
| **Coeff Variation** | 16.6015329 | **Std Error Mean** | 0.00876568 |

| Basic Statistical Measures | | | |
|---|---|---|---|
| **Location** | | **Variability** | |
| **Mean** | 5.713923 | **Std Deviation** | 0.94860 |
| **Median** | 5.759879 | **Variance** | 0.89984 |
| **Mode** | 4.574092 | **Range** | 3.78783 |
| | | **Interquartile Range** | 1.46558 |

| Tests for Location: Mu0=0 | | | | |
|---|---|---|---|---|
| **Test** | **Statistic** | | **p Value** | |
| **Student's t** | **t** | 651.8517 | **Pr > \|t\|** | <.0001 |
| **Sign** | **M** | 5855.5 | **Pr >= \|M\|** | <.0001 |
| **Signed Rank** | **S** | 34289808 | **Pr >= \|S\|** | <.0001 |

## The UNIVARIATE Procedure
## Variable: LOG_FD806

### Freq: WeightD

**Region=Territorial capitals**

| Tests for Normality | | | | |
|---|---|---|---|---|
| **Test** | **Statistic** | | **p Value** | |
| **Kolmogorov-Smirnov** | **D** | 0.082104 | **Pr > D** | <0.0100 |
| **Cramer-von Mises** | **W-Sq** | 16.42393 | **Pr > W-Sq** | <0.0050 |
| **Anderson-Darling** | **A-Sq** | 115.1312 | **Pr > A-Sq** | <0.0050 |

| Quantiles (Definition 5) | |
|---|---|
| **Level** | **Quantile** |
| **100% Max** | 7.36074 |
| **99%** | 7.30971 |
| **95%** | 7.08256 |
| **90%** | 6.93674 |
| **75% Q3** | 6.45063 |
| **50% Median** | 5.75988 |
| **25% Q1** | 4.98504 |
| **10%** | 4.25135 |
| **5%** | 4.13772 |
| **1%** | 3.78328 |
| **0% Min** | 3.57291 |

## The UNIVARIATE Procedure
## Variable: LOG_FD806

## Freq: WeightD

**Region=Territorial capitals**

| Extreme Observations | | | | | |
|---|---|---|---|---|---|
| Lowest | | | Highest | | |
| Value | Freq | Obs | Value | Freq | Obs |
| 3.57291 | 18 | 2074 | 7.27783 | 46 | 2131 |
| 3.78328 | 115 | 2058 | 7.28773 | 45 | 2096 |
| 3.85757 | 157 | 2064 | 7.30971 | 58 | 2104 |
| 3.91562 | 58 | 2130 | 7.32818 | 59 | 1964 |
| 3.94119 | 33 | 2065 | 7.36074 | 43 | 2084 |

## The UNIVARIATE Procedure
## Variable: LOG_FD806

## Freq: WeightD

**Region=West**

| Moments | | | |
|---|---|---|---|
| **N** | 969907 | **Sum Weights** | 969907 |
| **Mean** | 5.49258536 | **Sum Observations** | 5327296.99 |
| **Std Deviation** | 0.88839624 | **Variance** | 0.78924789 |
| **Skewness** | -0.2858383 | **Kurtosis** | -0.3704013 |
| **Uncorrected SS** | 30026129.7 | **Corrected SS** | 765496.26 |
| **Coeff Variation** | 16.174464 | **Std Error Mean** | 0.00090207 |

## The UNIVARIATE Procedure
## Variable: LOG_FD806

## Freq: WeightD

**Region=West**

| Basic Statistical Measures | | | |
|---|---|---|---|
| **Location** | | **Variability** | |
| **Mean** | 5.492585 | **Std Deviation** | 0.88840 |
| **Median** | 5.553541 | **Variance** | 0.78925 |
| **Mode** | 6.246301 | **Range** | 4.14116 |
| | | **Interquartile Range** | 1.13596 |

| Tests for Location: Mu0=0 | | | | |
|---|---|---|---|---|
| **Test** | **Statistic** | | **p Value** | |
| **Student's t** | **t** | 6088.848 | **Pr > \|t\|** | <.0001 |
| **Sign** | **M** | 484953.5 | **Pr >= \|M\|** | <.0001 |
| **Signed Rank** | **S** | 2.352E11 | **Pr >= \|S\|** | <.0001 |

| Tests for Normality | | | | |
|---|---|---|---|---|
| **Test** | **Statistic** | | **p Value** | |
| **Kolmogorov-Smirnov** | **D** | 0.051237 | **Pr > D** | <0.0100 |
| **Cramer-von Mises** | **W-Sq** | 491.1901 | **Pr > W-Sq** | <0.0050 |
| **Anderson-Darling** | **A-Sq** | 3618.11 | **Pr > A-Sq** | <0.0050 |

| Quantiles (Definition 5) | |
|---|---|
| **Level** | **Quantile** |
| **100% Max** | 7.35843 |
| **99%** | 7.20510 |
| **95%** | 7.04319 |
| **90%** | 6.60932 |

## The UNIVARIATE Procedure
## Variable: LOG_FD806

### Freq: WeightD

**Region=West**

| Quantiles (Definition 5) | |
|---|---|
| **Level** | **Quantile** |
| **75% Q3** | 6.10216 |
| **50% Median** | 5.55354 |
| **25% Q1** | 4.96620 |
| **10%** | 4.14804 |
| **5%** | 3.87867 |
| **1%** | 3.36246 |
| **0% Min** | 3.21727 |

| Extreme Observations | | | | | |
|---|---|---|---|---|---|
| **Lowest** | | | **Highest** | | |
| **Value** | **Freq** | **Obs** | **Value** | **Freq** | **Obs** |
| 3.21727 | 1553 | 2301 | 7.10462 | 9539 | 2207 |
| 3.33220 | 6907 | 2300 | 7.19090 | 3791 | 2255 |
| 3.36246 | 3183 | 2272 | 7.20510 | 5467 | 2235 |
| 3.44042 | 4303 | 2210 | 7.21127 | 1683 | 2307 |
| 3.63627 | 3779 | 2260 | 7.35843 | 4907 | 2170 |

| |
|---|
| Null hypothesis: equal variances |
| a.If variances are equal, then a pooled t-test is appropriate |
| b.If variances are unequal, then a Satterthwaite (also known as Welch's) test is appropriate |

## The GLM Procedure

| Class Level Information | | |
|---|---|---|
| **Class** | **Levels** | **Values** |
| **Region** | 5 | Atlantic provinces Central Prairie Territorial capitals West |

| | |
|---|---|
| **Number of Observations Read** | 2327 |
| **Number of Observations Used** | 2327 |
| **Sum of Frequencies Read** | 8128876 |
| **Sum of Frequencies Used** | 8128876 |

## The GLM Procedure

## Dependent Variable: LOG_FD806

## Frequency: WeightD

| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| **Model** | 4 | 156486.214 | 39121.553 | 45098.0 | <.0001 |
| **Error** | 8.13E6 | 7051624.800 | 0.867 | | |
| **Corrected Total** | 8.13E6 | 7208111.014 | | | |

| R-Square | Coeff Var | Root MSE | LOG_FD806 Mean |
|---|---|---|---|
| 0.021710 | 17.30495 | 0.931386 | 5.382190 |

| Source | DF | Type I SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| **Region** | 4 | 156486.2138 | 39121.5534 | 45098.0 | <.0001 |

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| **Region** | 4 | 156486.2138 | 39121.5534 | 45098.0 | <.0001 |

## The GLM Procedure

| Levene's Test for Homogeneity of LOG_FD806 Variance ANOVA of Absolute Deviations from Group Means | | | | | |
|---|---|---|---|---|---|
| Source | DF | Sum of Squares | Mean Square | F Value | Pr > F |
| Region | 4 | 3169.5 | 792.4 | 2785.20 | <.0001 |
| Error | 8.13E6 | 2312645 | 0.2845 | | |

| Welch's ANOVA for LOG_FD806 | | | |
|---|---|---|---|
| Source | DF | F Value | Pr > F |
| Region | 4.0000 | 44621.4 | <.0001 |
| Error | 91152.3 | | |

## The GLM Procedure

| Level of Region | N | LOG_FD806 | |
|---|---|---|---|
| | | Mean | Std Dev |
| Atlantic provinces | 629768 | 5.61588116 | 0.94909276 |
| Central | 4987062 | 5.27439207 | 0.93379405 |
| Prairie | 1530428 | 5.56479741 | 0.94258654 |
| Territorial capitals | 11711 | 5.71392282 | 0.94859878 |
| West | 969907 | 5.49258536 | 0.88839624 |

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

| Region | LOG_FD806 LSMEAN | LSMEAN Number |
|---|---|---|
| Atlantic provinces | 5.61588116 | 1 |
| Central | 5.27439207 | 2 |
| Prairie | 5.56479741 | 3 |

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

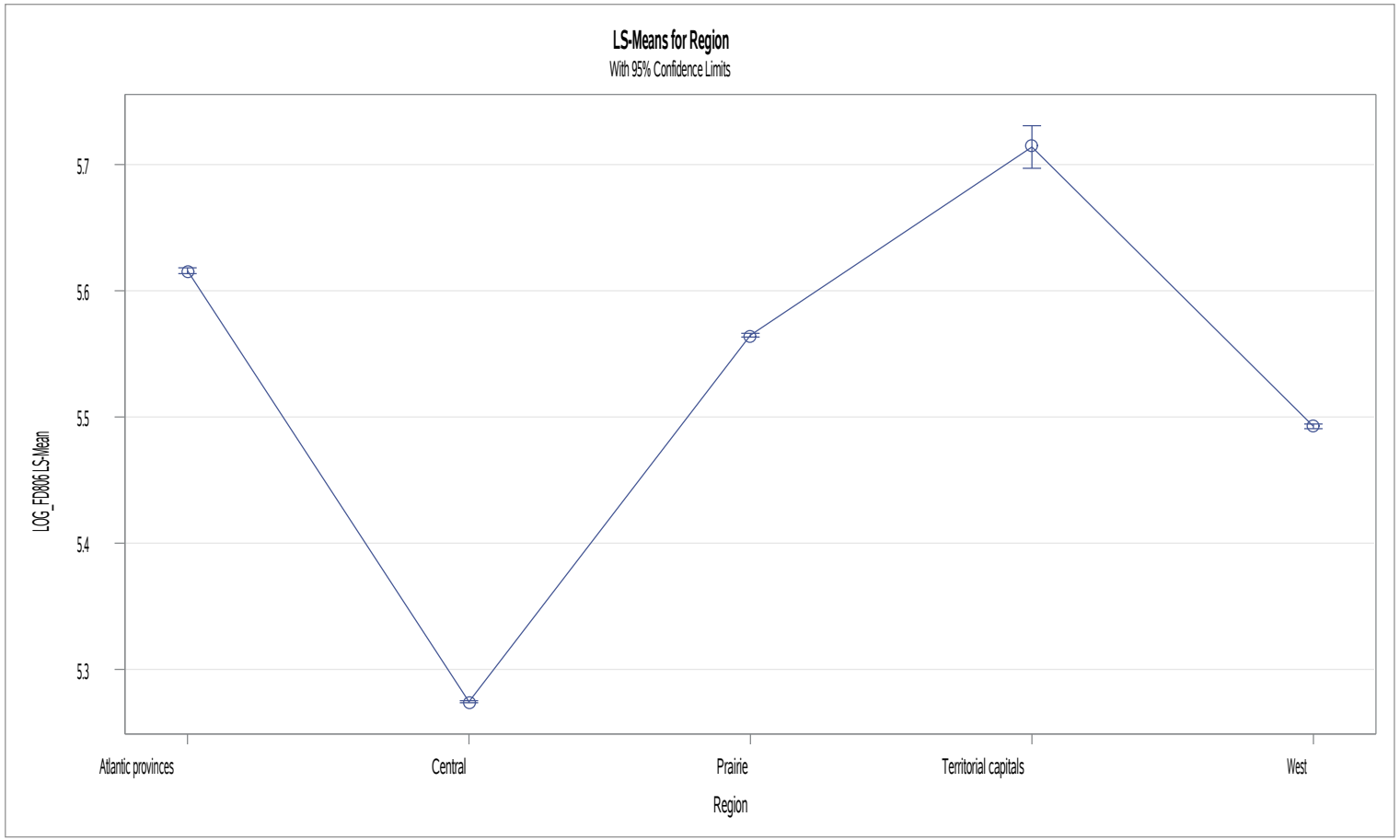
| Region | LOG_FD806 LSMEAN | LSMEAN Number |
|---|---|---|
| Territorial capitals | 5.71392282 | 4 |
| West | 5.49258536 | 5 |

**Least Squares Means for effect Region**
**Pr > |t| for H0: LSMean(i)=LSMean(j)**

**Dependent Variable: LOG_FD806**

| i/j | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | | <.0001 | <.0001 | <.0001 | <.0001 |
| 2 | <.0001 | | <.0001 | <.0001 | <.0001 |
| 3 | <.0001 | <.0001 | | <.0001 | <.0001 |
| 4 | <.0001 | <.0001 | <.0001 | | <.0001 |
| 5 | <.0001 | <.0001 | <.0001 | <.0001 | |

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



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