"Comparison between Organic and Conventional Sweet Potato Prices from 2012 and 2013"

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Abstract

The United States Department of Agricultures' (USDA) Agricultural Market Service (AMS) database provides prices for sweet potatoes in the marketplace. Sweet potatoes are divided into two groups; conventional and organic. The purpose of this report is to compare the prices of sweet potatoes over a two year period between both groups; and determine whether there exists a relationship between these prices. If a relationship can be defined between conventional sweet potato prices and organic sweet potato prices, growers and distributors can quickly react to and adjust their produce market prices.

Comparison between Organic and Conventional Sweet Potato Prices from 2012 and 2013

The USDA lists historical prices of sweet potato crop across the United States. Prices of sweet potatoes have many factors which may affect their prices including weather or yield, or economic market variables such as supply & demand.

Abstractly-speaking, it would not be unreasonable to expect a positive correlation between the two groups; that if sweet potato prices fluctuate in one of the groups you would also see a tandem fluctuation in the same direction in the other group. Examining the USDA data, one will find that the prices react quite differently. Is this reaction due to the prices of other group or from a separate condition? That is what the goal of this research is intended to accomplish; to find whether or not the relationship these prices have to one another even exists. Accomplishing this will require inputting the data through a statistics software program and making sure specific conditions are met to explain the relationship.

It is hypothesized that after running the data through the software, it will be revealed that there does not exist a relationship between Organic and Conventional sweet potatoes. The reason for this hypothesis is a quick examination of the data. Particularly, the Organic 2013 sweet potato data—when compared to the other three groups—is not distributed the same. Organic 2013 has seven months of unchanged pricing and is the only group that has more than three identical prices within the same year.

Method

The first step to determining whether a relationship exists is to check to make sure the distributions of each sample group is normally distributed using Minitab's Anderson-Darling model. All distributions must be normal in order to proceed with relational testing in Minitab. If the groups check out as normal, then the experiment will move on to defining the relationship through parametric correlation and covariance. If one or more of the groups fail the normal test, then perform a Kolmogorov-Smirnov normal test as a means of redundancy. A failure within Kolmogorov-Smirnov will rule out the possibility of a linear relationship being established. For a failed parametric test, the last step will be to test variances for equality between the same group types over the two years. (I.e. Organic 2012 vs Organic 2013). Unequal variances indicate a pricing which is volatile from season to season.

Apparatus

Minitab v17.1.0

Results

Preface on data collection:

All data utilized in this report has been retrieved from the USDA (USDA Author, 2015) and their Agricultural Marketing Service division (AMS Author, 2015). The data used in this report contains monthly prices for sweet potatoes for the 2012 and 2013 season. Each year contains prices for organically grown crop and conventionally grown crop; and each price represents the cost of a 40 pound carton of sweet potatoes. The significance level of 0.05 will be utilized throughout the test. This alpha was chosen because of its popularity and its balance between capturing errors and assuming risk.

Anderson Darling Normality Test

The Anderson-Darling Normality Test is used to determine how well-modeled by a normal distribution the data set is. This test is important in that, depending on the results, it will dictate the subsequent methods used to establish a relationship. Every group must past this test by having a $p > 0.05$:

The average price of organic sweet potatoes in 2012 was \$38.93 (SD = \$5.749; $p = 0.036$). Organic 2012 data fails the Anderson-Darling normality test since its p-value < 0.05.

The average price of organic sweet potatoes in 2013 was \$34.01 (SD = \$2.452; $p < 0.005$). Organic 2013 data fails the Anderson-Darling normality test since its p-value < 0.05.

The average price of conventional sweet potatoes in 2012 was \$19.16 (SD = \$0.6056; $p = 0.436$). Conventional 2012 data passes the Anderson-Darling normality test since its p-value > 0.05.

The average price of conventional sweet potatoes in 2013 was $19.64 (SD = $0.8263; p = 0.052). Conventional 2013 data passes the Anderson-Darling normality test since its p-value > 0.05.

Both Organic groups failed the normal test; yet both Conventional groups passed. The interpretation of these results is that data from the Organic 2012 and Organic 2013 groups are not well-modeled enough to represent a normal distribution. The purpose of this report was to compare the Organic price points against the Conventional price points. Without an agreeable distribution, many of the tests that could have been used to test relationships between the two groups is statistically not allowed and thus must be abandoned.

See Appendix A for graphical results of the Normality Test under the Anderson-Darling model.

Kolmogorov-Smirnov Normality Test

The next appropriate step is the Kolmogorov-Smirnov test. The Kolmogorov test is a nonparametric goodness-of-fit test and is reserved specifically for use in continuous data where distributions are ambiguous. To pass, the threshold of p > 0.05 must be met for all groups. The results of the Kolmogorov-Smirnov test:

Organic 2012 data passes the Kolmogorov-Smirnov test because its p-value (p = 0.066) is > 0.05.

Organic 2013 data fails the Kolmogorov-Smirnov test because its p-value (p < 0.010) is < 0.05.

Conventional 2012 data passes the Kolmogorov-Smirnov test because its p-value (p > 0.150) is > 0.05.

Conventional 2013 data fails the Kolmogorov-Smirnov test because its p-value ($p = 0.048$) is < 0.05.

At this point we can conclude that there does not exist a means to find a linear relationship between Organic and Conventional sweet potato prices. The data has several failures for both types of normal test.

See Appendix B for graphical results of the Normality test under the Kolmogorov-Smirnov model.

Variance

Although the possibility of the existence of a linear relationship has been ruled out, comparing the variance of Organic 2012 against that of Organic 2013; as well as the variance of Conventional 2012 against Conventional 2013 might help to explain why the prices are set at their value. Minitab's 2-Variance test using the Bonett's testing model will help to compare the variance of two groups. In the appendix, there exists a second option of data called the Levene's Test. Levene's test is used in non-normal distributions of data that are heavily skewed or have distributions whose tails are over-represented. Because of the limitations of a non-normal distribution, we'll disregard this test.

H_0: $\theta_1^2 = \theta_2^2$ (The variances of one group is equivalent to the variance of another)

H_a: $\theta_1^2 \neq \theta_2^2$ (The variances of one group is not equivalent to the variance of another)

Using a 95% confidence interval and a significance level of 0.05 on both tests:

Organic 2012 versus Organic 2013: The P-value is 0.004. We will reject the null hypothesis and accept the alternative hypothesis. There exists significant statistical evidence to support the claim that the variance between Organic 2012 and Organic 2013 are not equivalent.

Conventional 2012 versus Conventional 2013: The P-value is 0.291. We will fail to reject the null hypothesis and reject the alternative hypothesis. There is not enough statistical evidence to support the claim that the variances between Conventional 2012 and Conventional 2013 are equivalent.

Discussion

In conclusion, there is no relationship between organic sweet potato prices and conventional sweet potato prices. Also, the variances among organic sweet potato prices are not equivalent. Although conclusive blanket statements about these results cannot be made; here are some proposals offered to help guide an explanation as to what has taken place during the 2012 and 2013 sweet potato growing season.

Drought/Surplus

What is well known about sweet potatoes is that this crop is sensitive to drought and sensitive to over-watering. Sweet Potatoes need annual water of approximately 33.0-40.0 inches of rainfall. (Albert, 2009) According to NOAA's climate data for Georgia; 2012 experienced below-average to near normal rainfall. Conversely, rainfall in 2013 was well above surplus with many areas receiving more than double the rainfall that sweet potatoes require. (FFC Webmaster, 2015) Christina DiMartino reports in her news column that southern sweet potato growers were experiencing delayed and smaller crops due to surplus rainfall toward the first half of the year. (DiMartino, 2013)

Delay

Sweet potatoes also cannot tolerate frost. The growing season lasts from after the last frost until their harvest before the first frost each year. After they are harvested, sweet potatoes are sometimes cured for several weeks to produce a sweeter sweet potato. (Bonnie Plants, 2015) The climate data from the southeastern states for 2012 indicate that the last frost occurred a month to a month and a half before the average last frost date. In 2013, the Last frost occurred

roughly on average. Now pivot to the prices of sweet potatoes. The mean price of organically grown sweet potatoes in

2012 was $39.83 and in 2013 the mean price was $34.01. Conventional mean prices for 2012 and 2013 were $19.16 and $19.64 respectively.

What are farmers planting?

North Carolina, having a significant market share of sweet potatoes, has a published report by the North Carolina Department of Agriculture and Consumer Services (Steve Troxler, Commissioner, 2015). According to this market analysis report of sweet potatoes production, the NCAGR has concluded that production has trended downward 6.4% between 2012 and 2013, nationwide. Harvested sweet potatoes across the country were down 13,400 acres in 2013 compared to 2012, resulting in 1,697,000 cwt. fewer sweet potatoes in the market in 2013 than in 2012. Although the second state with the largest sweet potato production—California—saw a relatively good year of growing, their production hardly offset the lower production from North Carolina.

References

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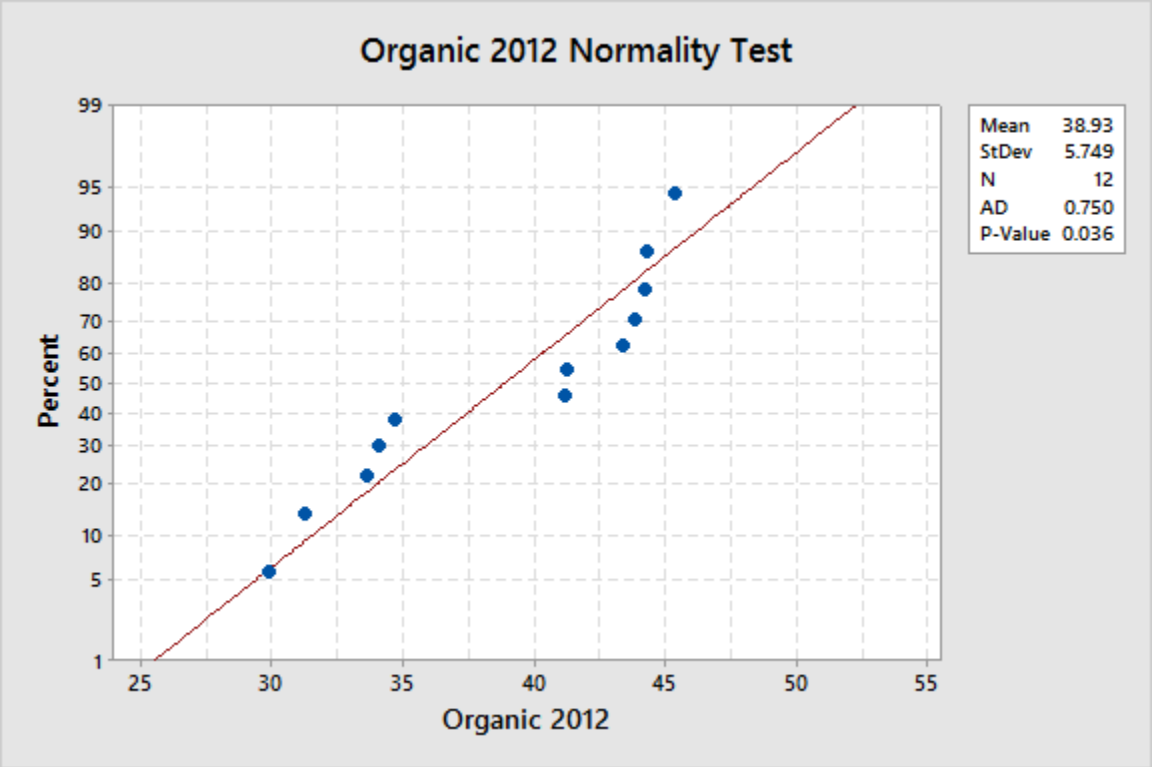
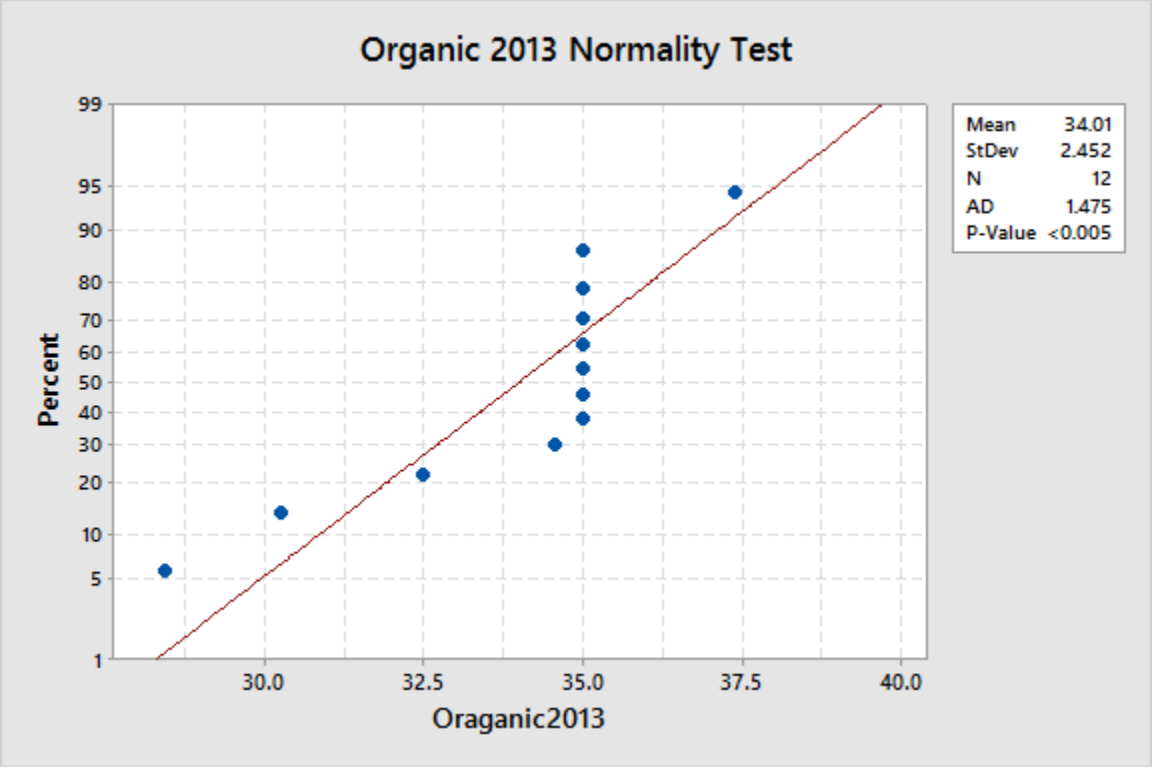
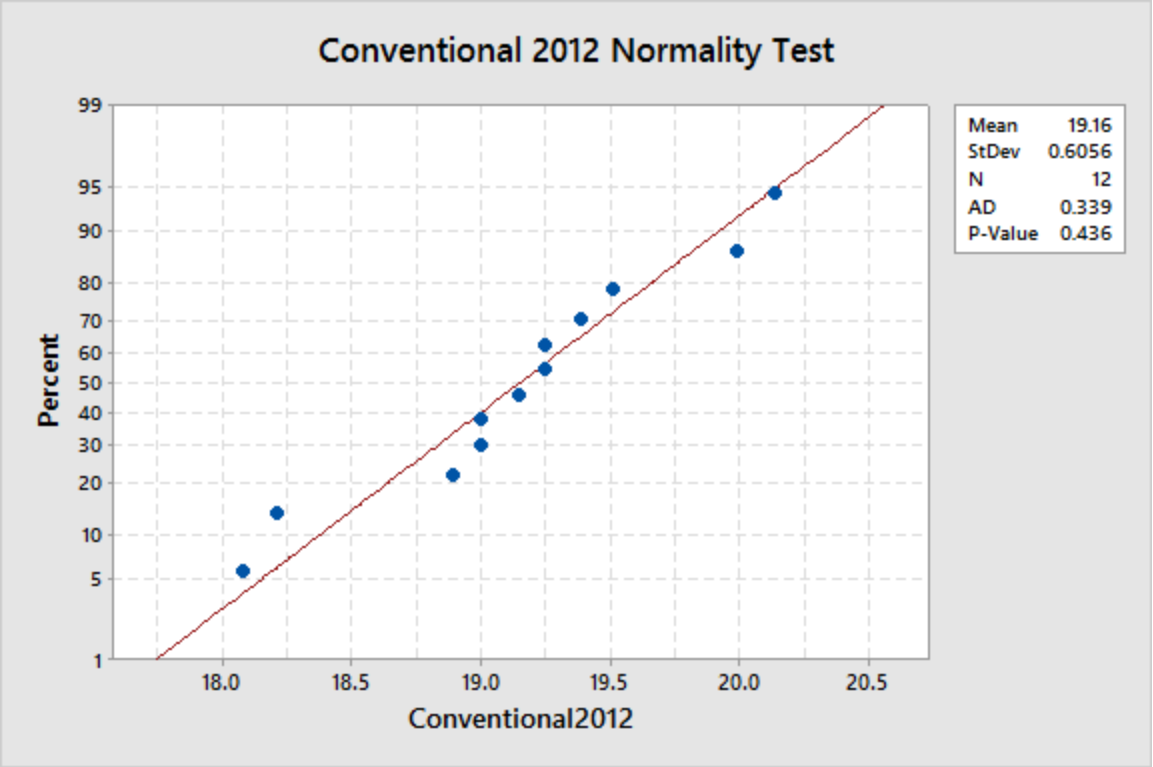
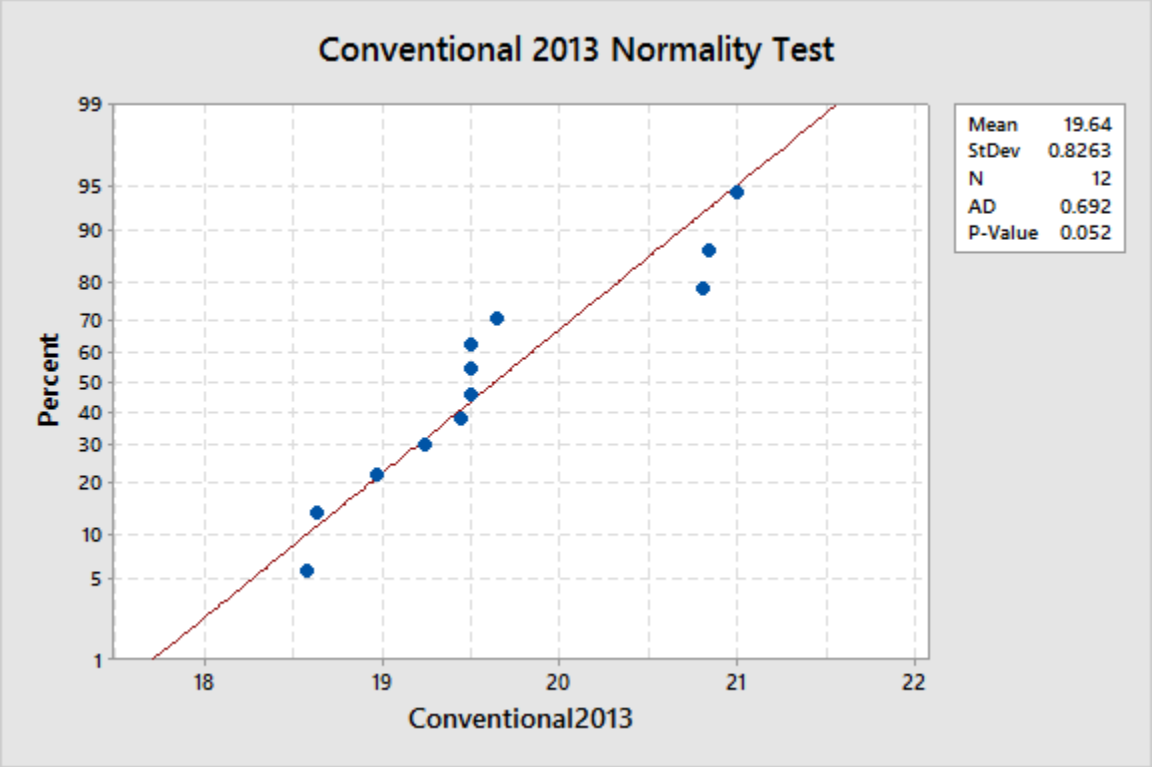
APPENDIX A – NOMALITY TEST DATA

Stat > Basic Statistics > Normality Test (Anderson-Darling Test)



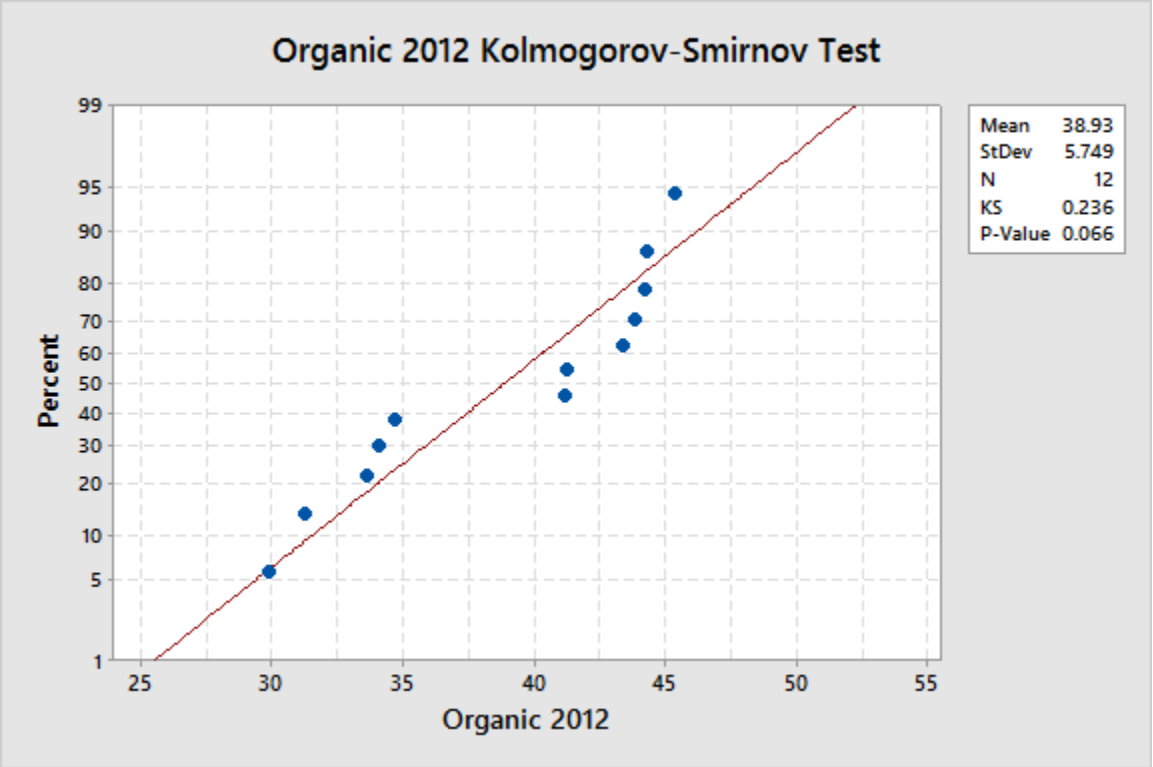


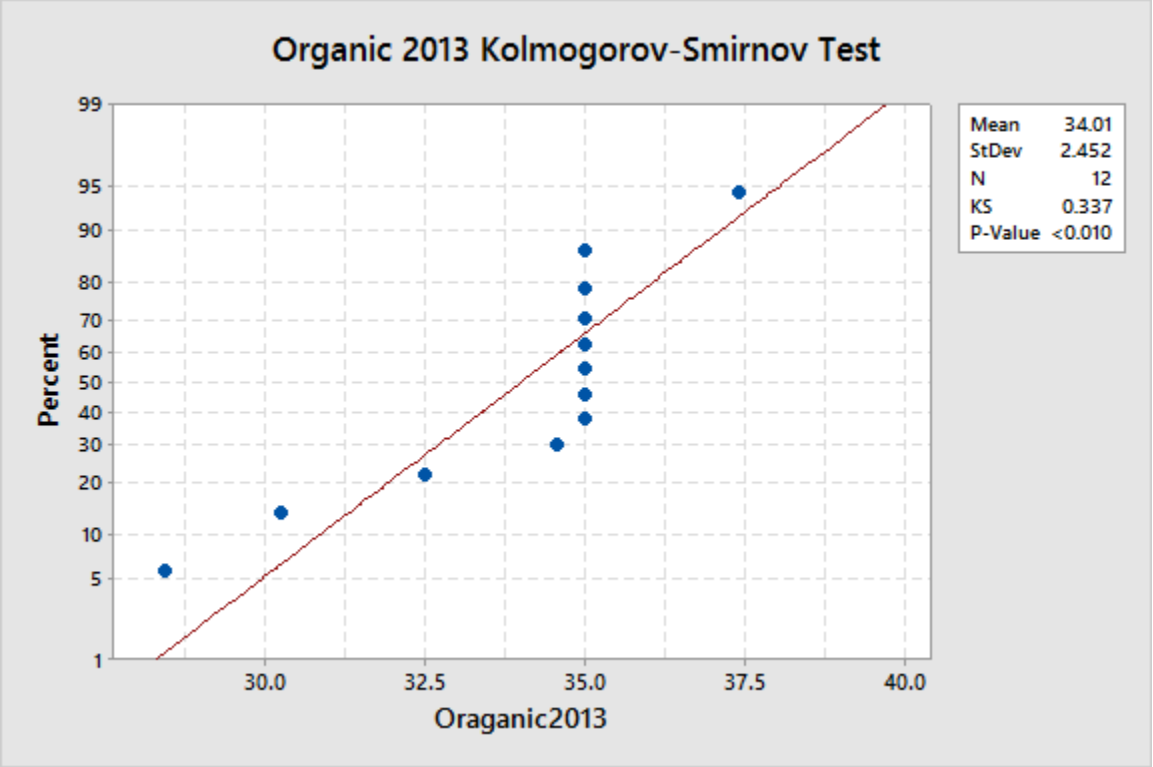

Conventional 2012 Normality Test
Percent
99
95
90
80
70
60
50
40
30
20
10
5
1
18.0
18.5
19.0
19.5
20.0
20.5
Conventional2012
Mean 19.16
StDev 0.6056
N 12
AD 0.339
P-Value 0.436

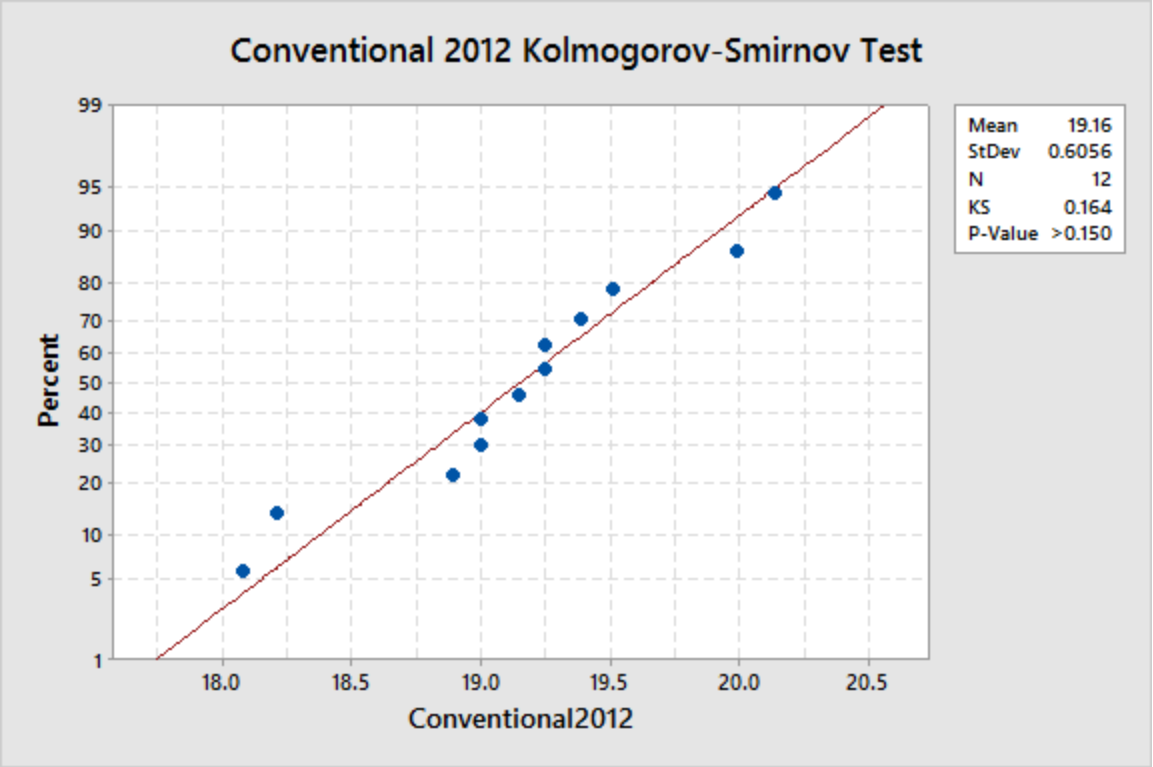

Conventional 2013 Normality Test
Percent
99
95
90
80
70
60
50
40
30
20
10
5
1
18
19
20
21
22
Conventional2013
Mean 19.64
StDev 0.8263
N 12
AD 0.692
P-Value 0.052

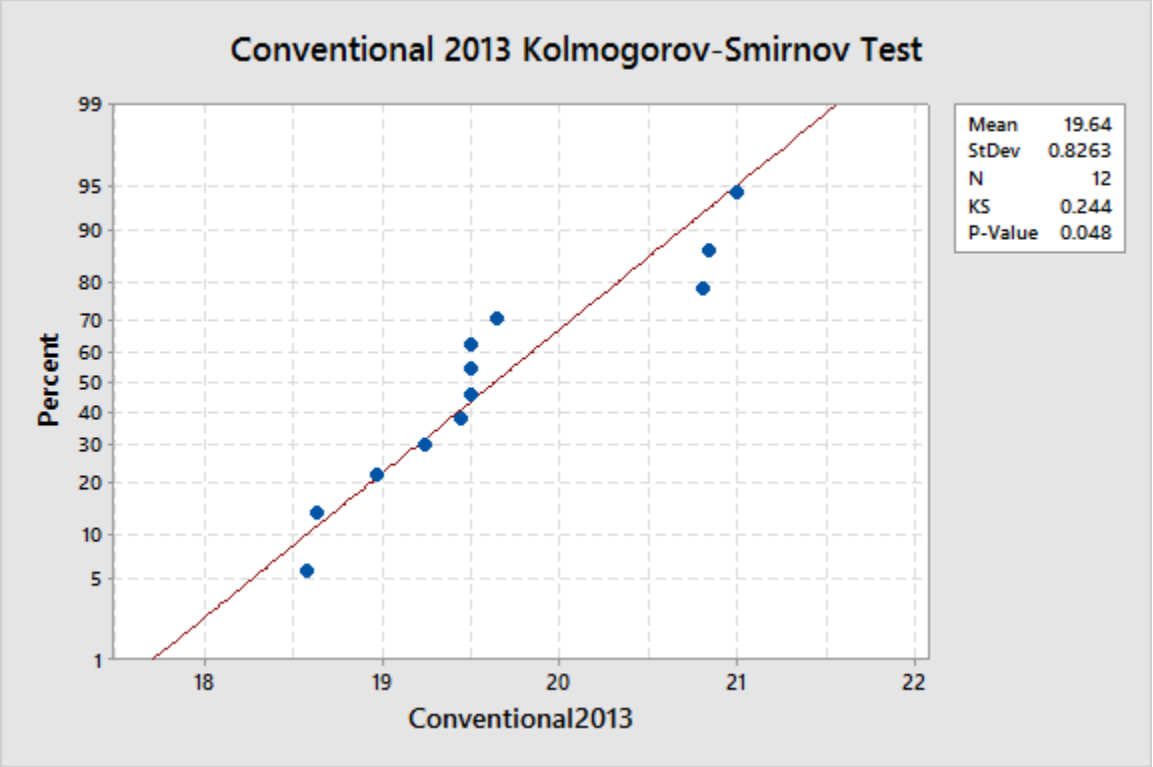
APPENDIX B – Kolmogorov-Smirnov Test

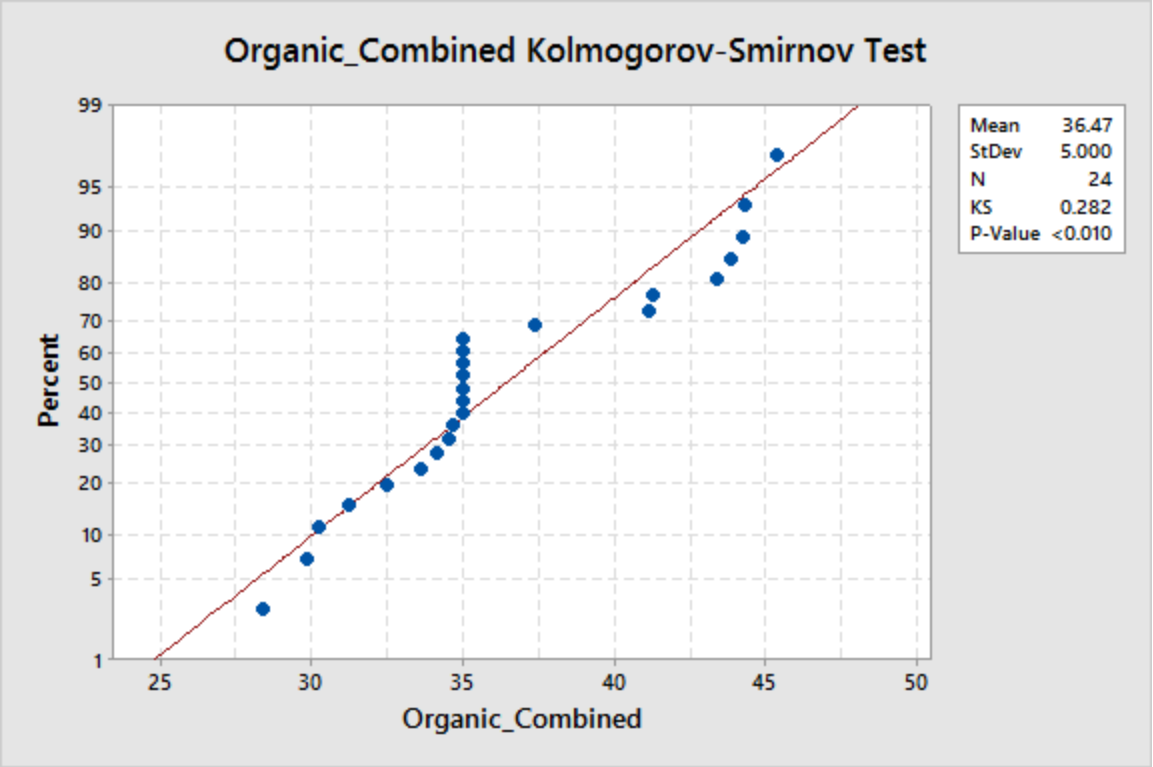
Stat > Basic Statistics > Normality Test (Kolmogorov-Smirnov Test)

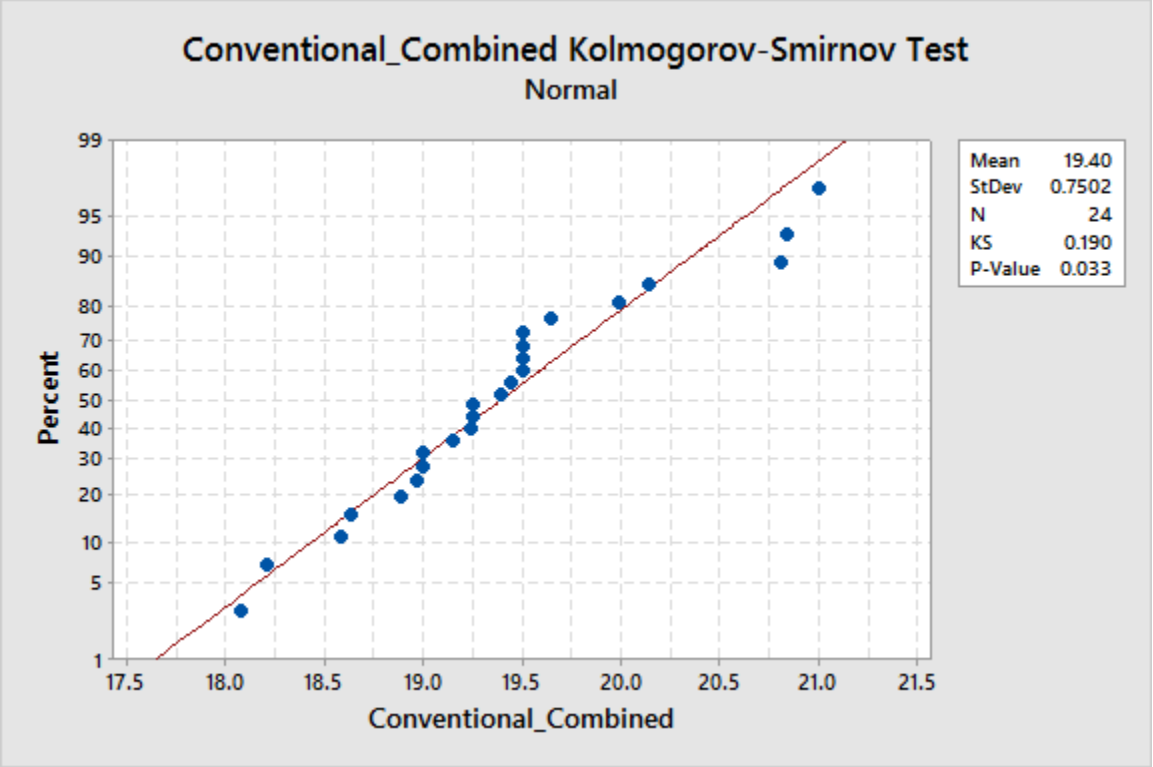





Conventional 2012 Kolmogorov-Smirnov Test
Percent
99
95
90
80
70
60
50
40
30
20
10
5
1
18.0
18.5
19.0
19.5
20.0
20.5
Conventional2012
Mean 19.16
StDev 0.6056
N 12
KS 0.164
P-Value >0.150


Conventional 2013 Kolmogorov-Smirnov Test
Percent
99
95
90
80
70
60
50
40
30
20
10
5
1
18
19
20
21
22
Conventional2013
Mean 19.64
StDev 0.8263
N 12
KS 0.244
P-Value 0.048


Organic_Combined Kolmogorov-Smirnov Test
Mean 36.47
StDev 5.000
N 24
KS 0.282
P-Value <0.010
Percent
99
95
90
80
70
60
50
40
30
20
10
5
1
25
30
35
40
45
50
Organic_Combined


Conventional_Combined Kolmogorov-Smirnov Test
Normal
Mean 19.40
StDev 0.7502
N 24
KS 0.190
P-Value 0.033
Percent
99
95
90
80
70
60
50
40
30
20
10
5
1
17.5
18.0
18.5
19.0
19.5
20.0
20.5
21.0
21.5
Conventional_Combined

APPENDIX C—Variance

Stat > Basic Statistics > 2 Variances