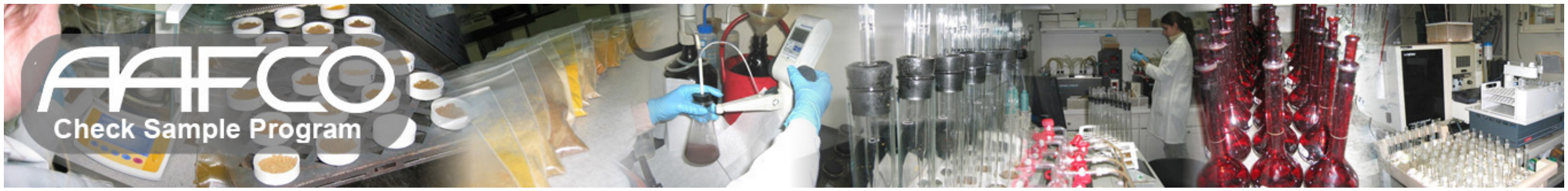
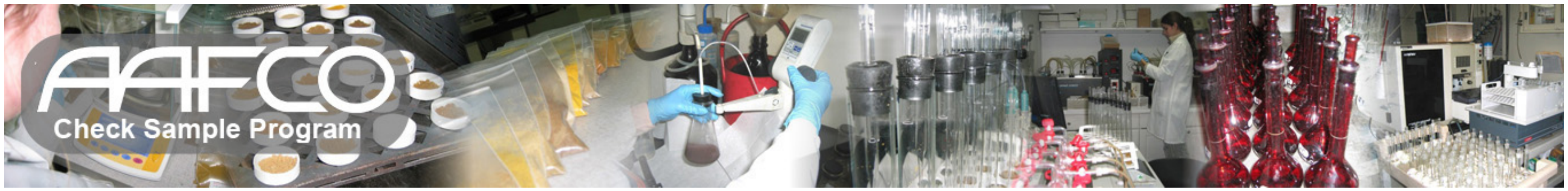


The AAFCO Check Sample Program Statistics and Reporting

Program Chair: Dr. Victoria Siegel
Statistics and Reports: Dr. Andrew Crawford

Contents **(Click Link to Jump)**



The AAFCO Check Sample Program

Program Model

Return To Contents

Program Model

Based Closely On:

"The International Harmonized Protocol for the Proficiency Testing of Analytical Laboratories", 2006 (IHP), **MICHAEL THOMPSON, STEPHEN L. R. ELLISON AND ROGER WOOD**

RSC | Advancing the Chemical Sciences

- AMC supported (Analytical Methods Committee of the RSC)
- Uses ISO statistical models - ISO 13528, 2005 and ISO 5725-2, 1994
- Robust statistics used as described in the IHP and ISO 13528
- Duplicate analysis supports method precision calculations.
- Proficiency testing often required for Laboratory Accreditation.
- Independent documentation on how it all works.
- Makes full use of Web based data transfer.

ISO International Organization for Standardization

To view a pdf version of the IHP click here.

AAFCO
Check Sample Program

Post Chemical Analysis Data Flow for One Sample

Collect Data

- Web server based collection of analytical data from Labs.
- Lab submits duplicate analysis and method used for each analyte run.
- Preliminary data review by Chair.
- Chair delivers raw data for statistical review.

Statistical Review

- ❑ Screen for poor duplicates, extreme outliers and data distribution shape.
- ❑ Perform Robust Stats calculations for individual methods and group analytes.
- ❑ Establish Consensus Values, Robust SD's and Uncertainties.
- ❑ Calculate Z scores and supporting Stats.
- ❑ Calculate method precision parameters.
- ❑ Expert review to handle anomalies.

Report to Labs

- Create report cards, general reports and Sample run reports. Report run observations and provide all reports to chair.
- Deliver Reports for Web based distribution to labs.

Proficiency Testing

From the IHP, 2006

1.1 Rationale for proficiency testing

- For a laboratory to produce consistently reliable data, it must implement an appropriate program of quality-assurance and performance-monitoring procedures. **Proficiency testing is one of these procedures**.

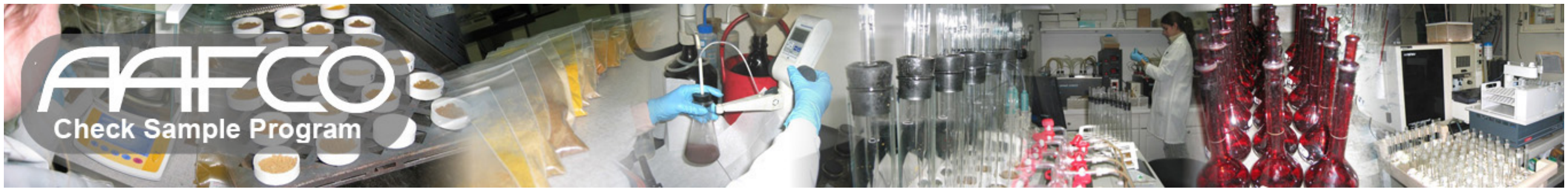
2.10 Choice of analytical method by participant

- Participants shall **normally use the analytical method of their choice**. In some instances, however, for example, where legislation so requires, participants may be instructed to use a specific documented method.

AAFCO Proficiency Testing Model

Data Analysis

- Use Robust Statistics to estimate Consensus Value and fit-for-purpose sigma (σ_{rob}) based on participants in the round.
- Mean of Lab duplicates used for Robust statistics.
- The different methods used for a single analyte can be grouped and used for true **Proficiency Testing**.
- Individual methods are still handled separately and called **Proficiency Testing for Individual Methods**.
- Duplicates are required to calculate individual method precision for each Sample run.



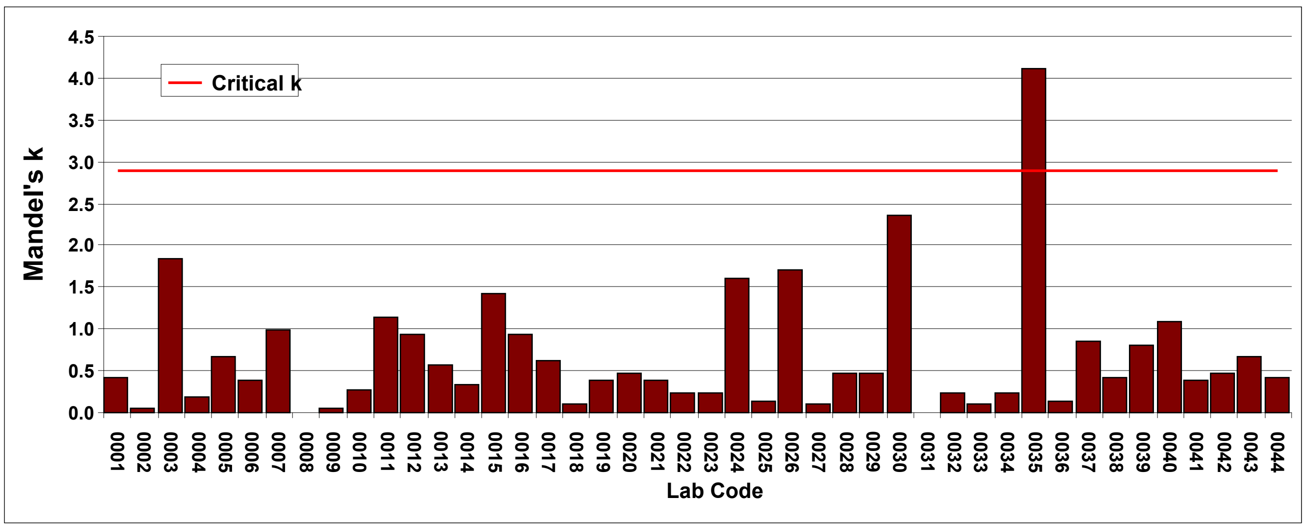
Data Pre-Screening and Just Looking at the Data

Tools to Identify and Remove the Clearly Bad Data

Return To Contents

Mandel's k to Flag for Duplicates Too Far Apart (k_{crit} set at $\alpha = 0.0025$)

$$k_i = \frac{S_i}{S_r}$$ ≡ A ratio of the i^{th} Lab SD to the within Lab SD

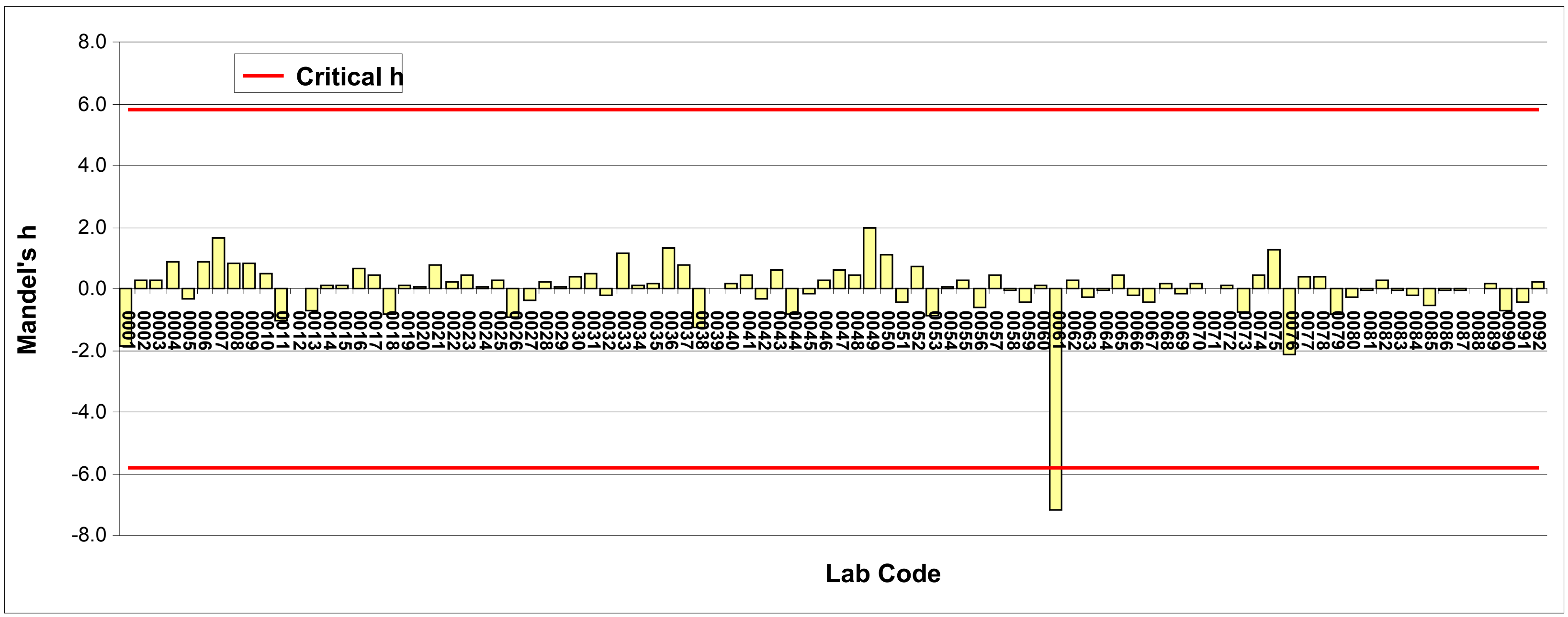


44 Labs perform Acid Detergent Fiber analysis in duplicate. The duplicates for Lab # 35 are too far apart. Data for this Lab may not be included in calculations.

Mandel's h to Flag for Extreme Outliers (h_{crit} set at α = 1.0E-10)

$$h_i = \frac{\overline{X}_i - \overline{\overline{X}}}{S_{\overline{X}}}$$

The difference between the i[th] Lab Mean and the Grand Mean as it relates to the SD of all the Lab means.



92 Labs perform Copper analysis. The value for Lab # 61 is extremely different from the other 91 values. A review of this data did exclude it from Robust calculations.

View Data Distribution Shape
Kernel Density Plots

$$f(X,h) = \frac{1}{nh}\sum_{i=1}^{n}\Phi\left(\frac{X - X_i}{h}\right)$$

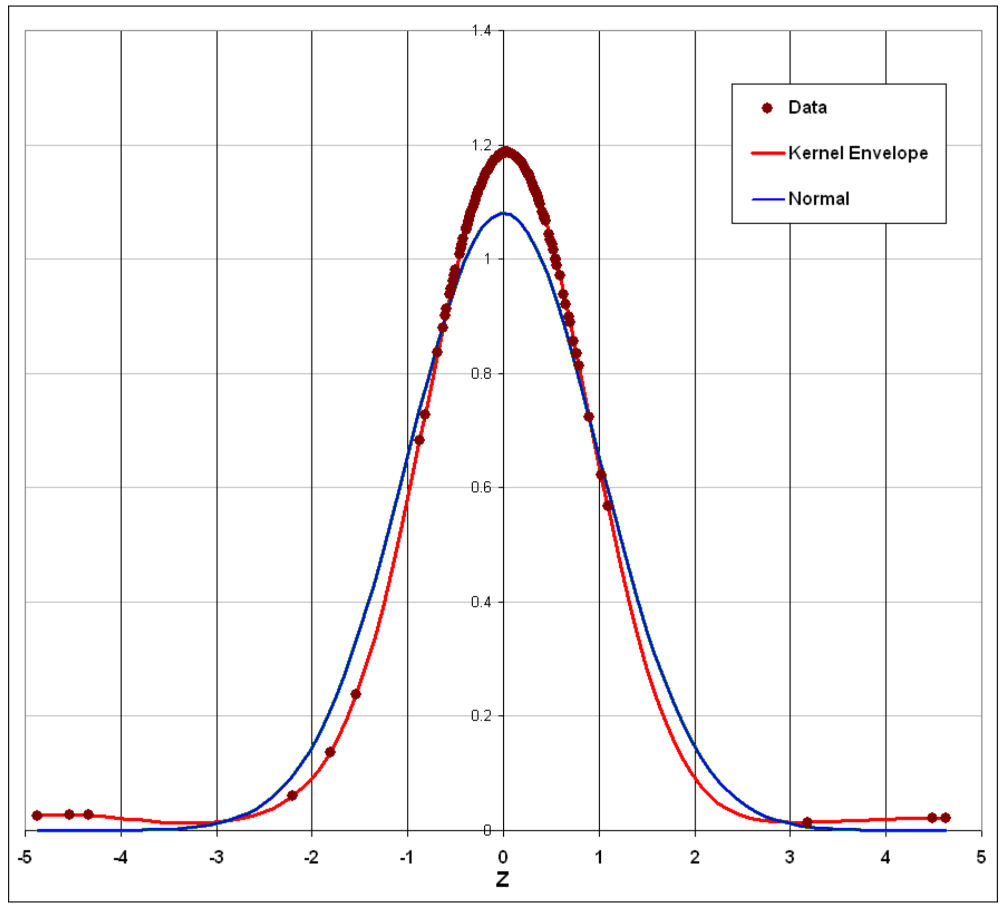
IHP recommended bandwidth, $h = 0.75 \times \sigma_n$

$\Phi =$ Standard Normal density function.

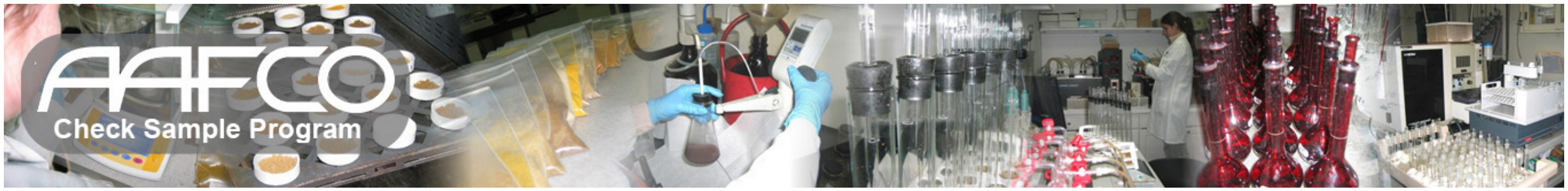
For a more complete description of how a Kernel Density Plot is formed from the summation of all the “Normal kernels” please click here.

150 Labs perform Crude Ash analysis. Here you can see the Lab means (**Brown**) distributed on a Kernel Density Plot (**Red**) compared with the Normal curve for this data (**Blue**).

This Kernel Density plot compares quite well with the shape of a Normal curve



Return To Contents



AAFCO Check Sample Program

Calculating Robust Statistics

"The International Harmonized Protocol For The Proficiency Testing Of Analytical Chemistry Laboratories", 2006

"ISO 13528 Statistical Methods for Use in Proficiency Testing by Interlaboratory Comparisons", 2005 – Algorithm A

Return To Contents

Why Robust Statistics?

- Most “real world” data distributions do not follow the Normal Gaussian Model, they are more like “contaminated” Normals.
- Distributions have “Fat Tails” and Outliers that skew the Mean and inflate the Standard Deviation (Normal estimators are very sensitive!).
- Even Outliers contain information.
- We need a Robust estimate of the Location of the data center.
- We need a Robust estimate of the data Dispersion.
- We need to identify and weight the “Reliable” data.

John Tukey, Peter Huber and Frank Hampel credited with founding the discipline.

All since Tukey’s landmark paper in 1960

Tukey, J. W. (1960). “A survey of sampling from contaminated distributions.”

Check Sample Program

Calculating Robust Statistics

Robust Mean = Median(LAB()) {Median value of All Lab X's}

Robust Std = 1.483 * MAD(LAB()) {MAD of Lab deviations}

The Median is a Robust measure of Location.

The Median Absolute Deviation (MAD) is a Robust measure of Dispersion.

Calculating Robust Statistics

Use Huber’s H15 method and Winsorize the Data.

Robust Mean = Median(LAB())

Robust Std = 1.483 * MAD(LAB())

```
For i = 1 To Number of Labs {Huber’s H15 Process}
    If LAB(i) > Robust Mean + 1.5 * Std Then
        LAB(i) = Robust Mean + 1.5 * Std
    If LAB(i) < Robust Mean - 1.5 * Std Then
        LAB(i) = Robust Mean - 1.5 * Std
Next i        {Now Winsorize all the Lab values}
```

AAFCO Check Sample Program

Calculating Robust Statistics

```
Robust Mean = Median(LAB())
Robust Std = 1.483 * MAD(LAB())
Do
    For i = 1 To Number of Labs
        If  LAB(i) > Robust Mean + 1.5 * Std Then
            LAB(i) = Robust Mean + 1.5 * Std
        If  LAB(i) < Robust Mean - 1.5 * Std Then
            LAB(i) = Robust Mean - 1.5 * Std
    Next i
    Old Mean = Robust Mean
    Robust Mean = Average(LAB())
    Robust Std = 1.134 * SD(LAB())
    Test = Abs (Old Mean – Robust Mean)
Loop While (Test > 0.0000001)   {Iterative process converges}
```

Use Huber's H15 method and Winsorize the Data.

Assigned Values

X_a = Robust Mean

σ_{rob} = Robust Std

```
Robust Mean = Median(LAB())
Robust Std = 1.483 * MAD(LAB())
Do
    For i = 1 To Number of Labs
        If  LAB(i) > Robust Mean + 1.5 * Std Then
            LAB(i) = Robust Mean + 1.5 * Std
        If  LAB(i) < Robust Mean - 1.5 * Std Then
            LAB(i) = Robust Mean - 1.5 * Std
    Next i
    Old Mean = Robust Mean
    Robust Mean = Average(LAB())
    Robust Std = 1.134 * SD(LAB())
    Test = Abs (Old Mean – Robust Mean)
Loop While (Test > 0.0000001)
```

Calculating Robust Statistics

Use Huber's H15 method and Winsorize the Data.

Assigned Value

X_a = Robust Mean

AAFCOCS Std

σ_{rob} = Robust Std

Uncertainty in X_a

$$U_a = \frac{\sigma_{rob}}{\sqrt{2n}}$$

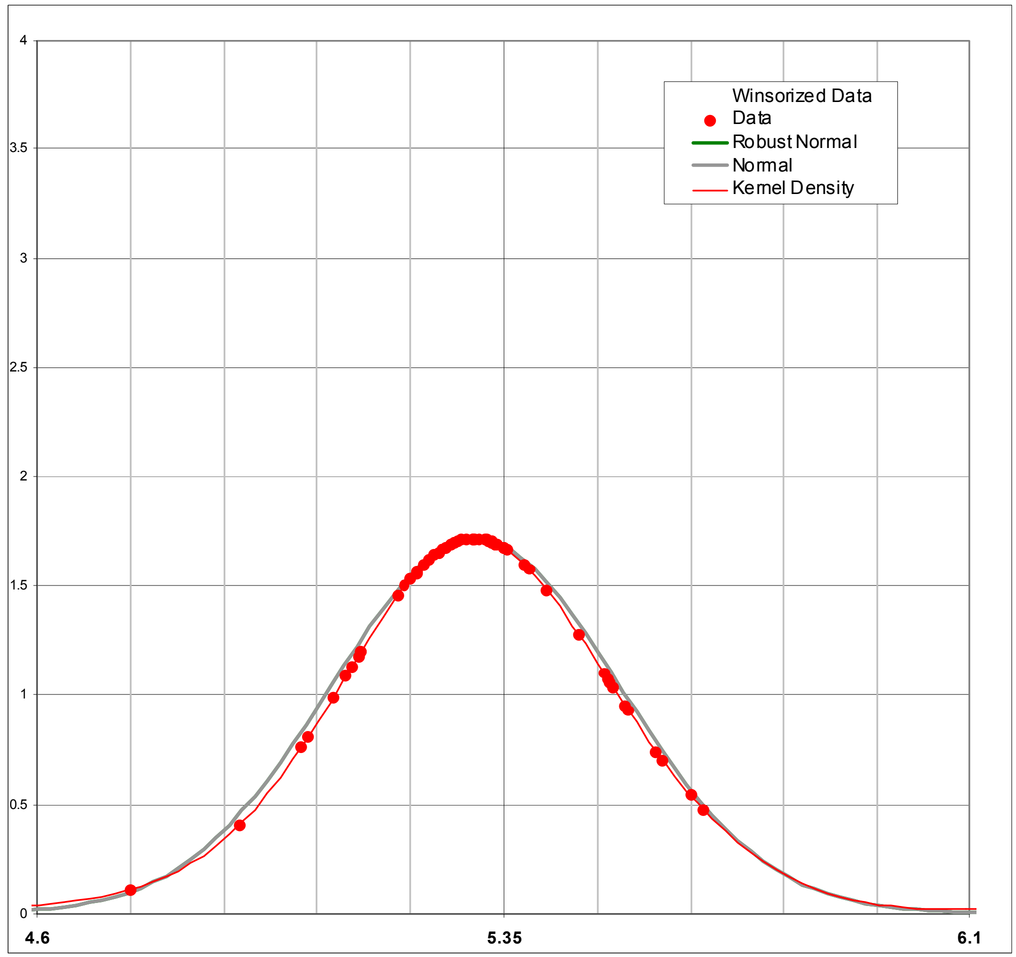
Check Sample Program

Graphical Analysis Review

Data points (**Red**) on Kernel Density Envelope.

Normal Curve (**Grey**)

Example 135 Labs run % Calcium Analysis



% Calcium

AAFCO Check Sample Program

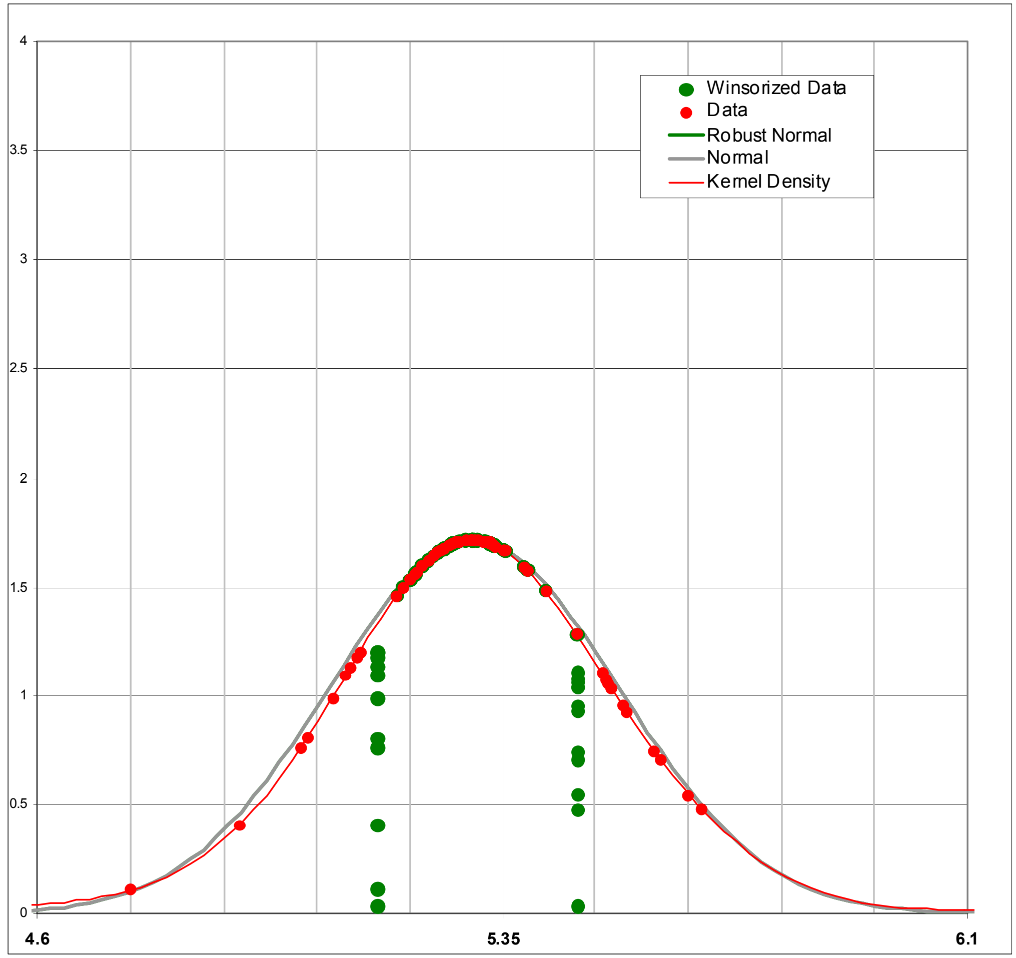
Example 135 Labs run % Calcium Analysis

Graphical Analysis Review

Data points (**Red**) on Kernel Density Envelope.

Normal Curve (**Grey**)

Winsorizing Squeezes outer Data Points In (**Green**)



% Calcium

Check Sample Program

Example 135 Labs run % Calcium Analysis

Graphical Analysis Review

Data points (**Red**) on Kernel Density Envelope.

Normal Curve (**Grey**)

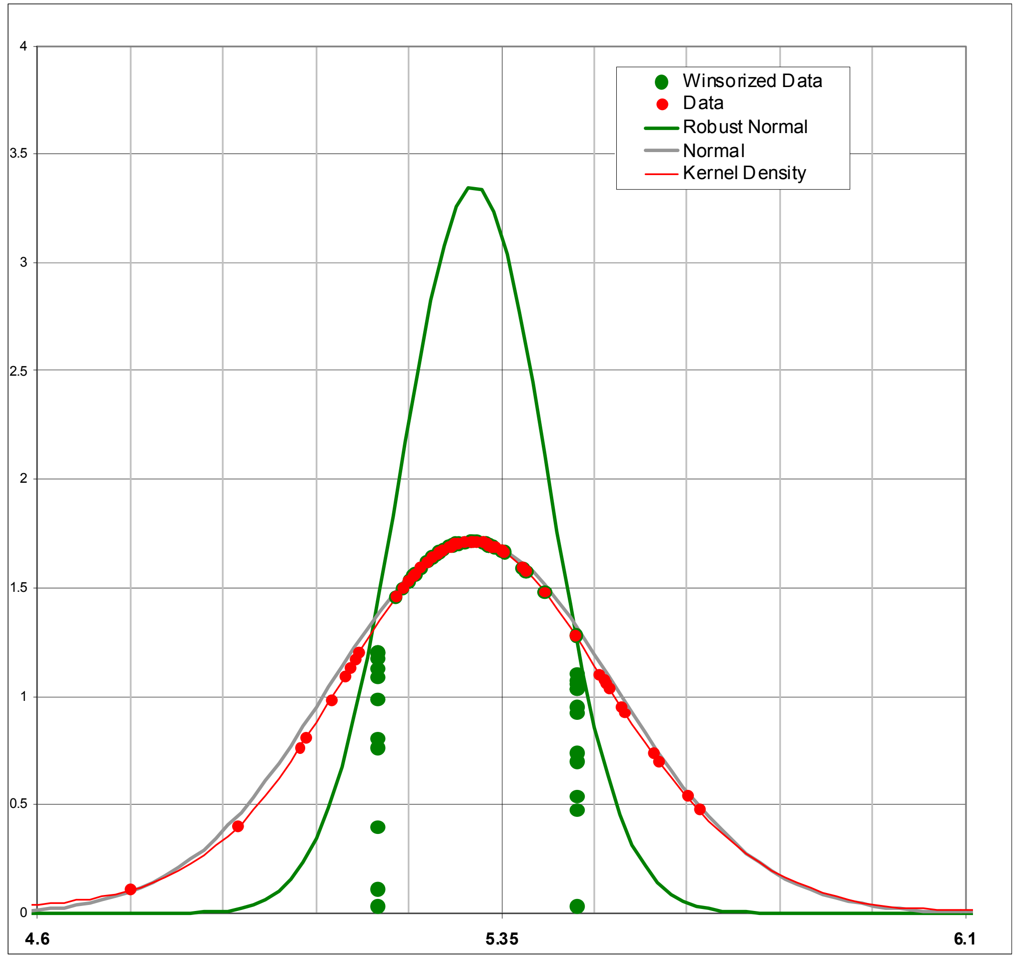
Winsorizing Squeezes outer Data Points In (**Green Points**)

A Robust Normal Is Calculated (**Green Curve**)

The Robust curve provides a better estimate of the location of the mean.

In this case the dispersion is reduced to better represent the “reliable” Normal data in the dataset.

σ_{rob} provides a more realistic fit-for-purpose measure of dispersion.



% Calcium

QQ Plots are created for each analyte method in a Sample run.

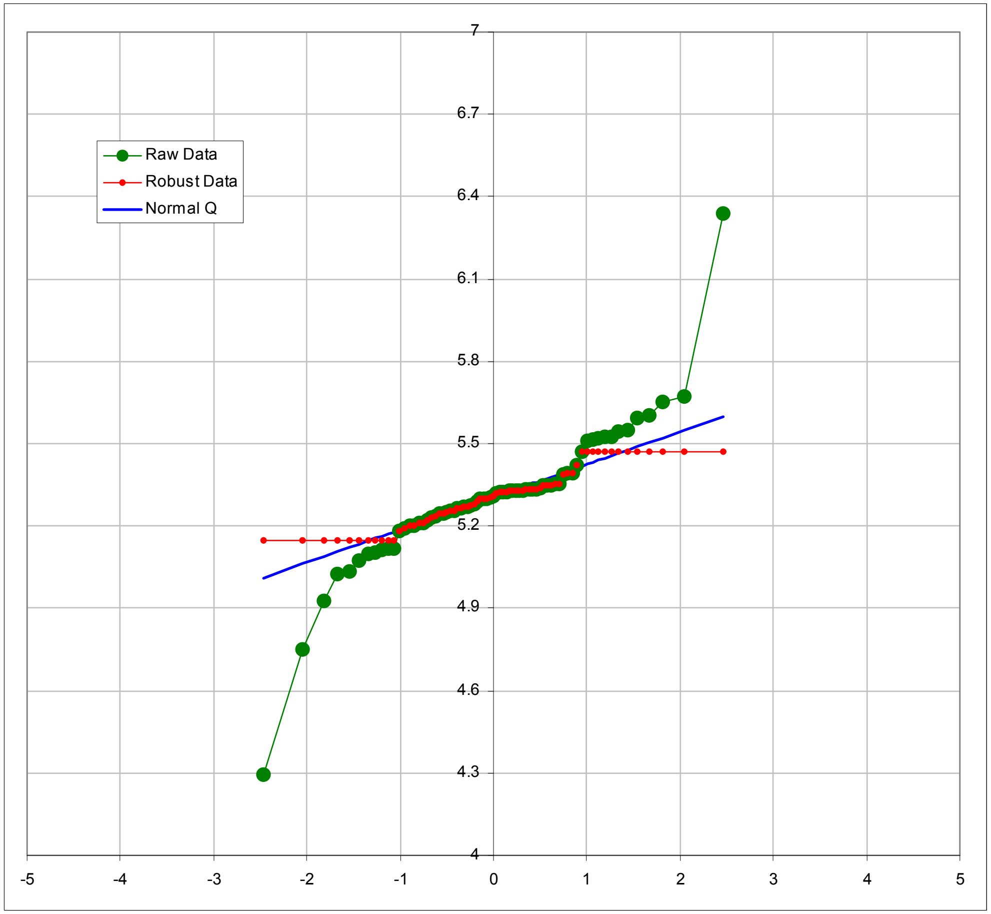
Graphical Analysis Review

% Calcium quantiles (y axis) are plotted against Normal scores (x axis) for the ordered data (**green**). The Winsorized data (**red**) and standard Normal (**blue**) are plotted on the same chart.

The "reliable" data for a Normal distribution exists where the 3 curves overlap.

The effect of Winsorizing clearly shows how the data in "fat tails" is drawn into the standard Normal.

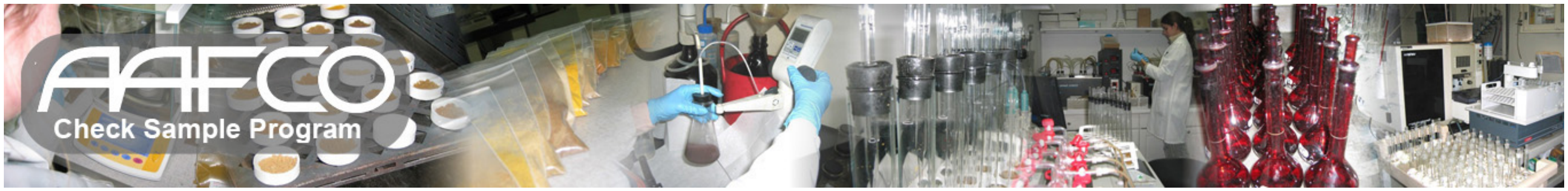
Example: 135 Labs run % Calcium Analysis



In summary:

from the Huber H15 Process we now have:

- An Assigned Value X_a (robust measure of location). This is a participant Consensus Value.
- A "fit for purpose" σ_{rob} standard deviation (robust measure of dispersion) based on participants in the round.
- An estimate of uncertainty in the assigned value U_a.
- Click here for a short description of the Huber process.



Check Sample Program

Z Statistics & Fitness for Purpose

Return To Contents

Calculating a Z Score

This is the classical Z score where we expect about 95% of the participants to fall between ± 2 and 99.7% to fall between ± 3.

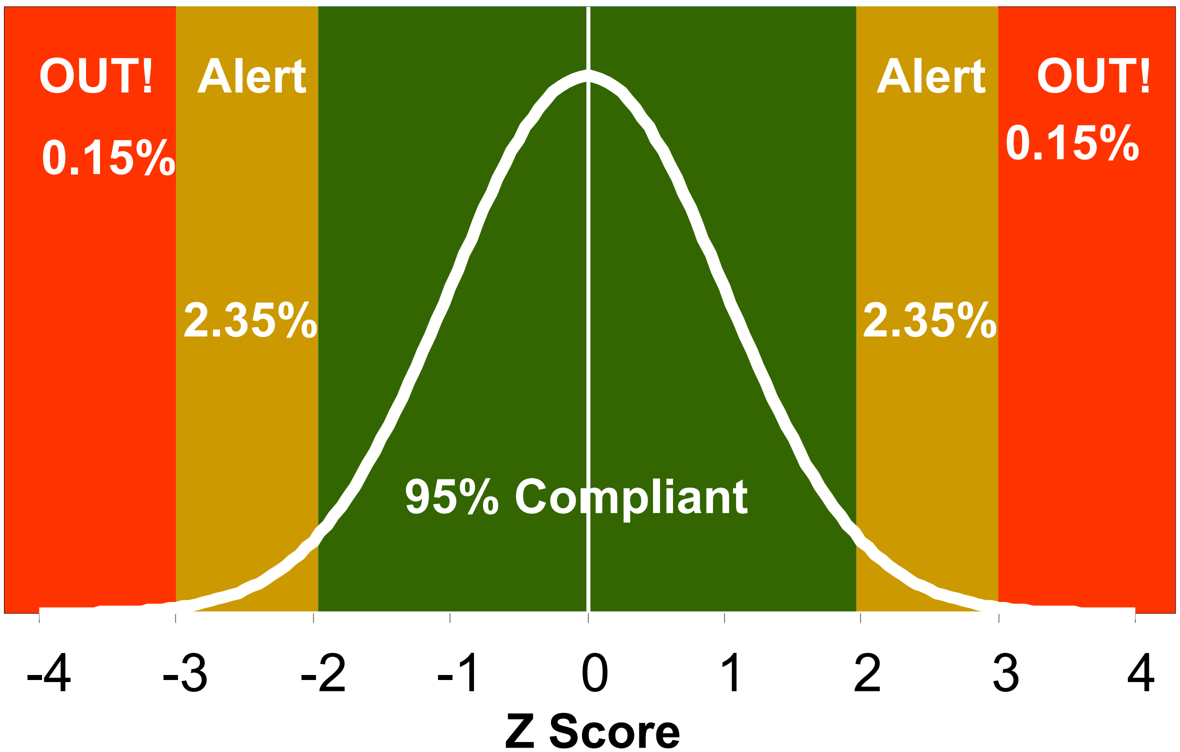
Robust statistics will usually cause slightly fewer labs to fall within accepted limits.

$$Z = \frac{X_{LAB} - X_a}{\sigma_{rob}}$$

This is fine if you want to score yourself against the other participants in that round.

Check Sample Program

Interpreting Z Scores for Proficiency Testing



Red indicates a normally distributed Z value >3 or <-3 and usually requires action. About 0.3 % fall in this range. **Orange** indicates a Z score between 2 and 3 or -2 and -3. This is a warning and roughly 4.7 % lie in this region. **Green** indicates a Z score < 2 and >-2 and is considered in compliance.

Calculating A Proficiency Z Score That is Fit-For-Purpose (σ_{ffp})

We can calculate a Normally distributed 0 centered Z score using the σ_{ffp} based on %RSD or other pertinent sigma rather than σ_{rob} derived from participants in that round.

$$Z = \frac{X_{LAB} - X_a}{\sigma_{ffp}}$$

If you wish you can substitute your own fit-for-purpose standard deviation (σ_{ffp}) to obtain an appropriate Z score.

Calculating A Proficiency Z Score Based on % RSD as Fitness For Purpose (σ_{ffp})

It may be more important to your client, a regulatory agency, a legal position or even to you that you are compliant to a predetermined level.

So we establish a "Fitness for Purpose" sigma to reflect this predetermined level (ie: %RSD).

$$\sigma_{ffp} = X_a \times \frac{\%RSD}{100}$$

Calculating a Threshold %RSD
Which is Independent of the variability in the run

$$Z = \frac{X_{LAB} - X_a}{\sigma_{ffp}}$$

Substituting for σ_{ffp}

$$Z = \frac{X_{LAB} - X_a}{\frac{\%RSD}{100} \times X_a}$$

Substituting Z = 2

$$\%RSD_{Z=2} = \frac{\left|X_{LAB} - X_a\right|}{2 \times X_a} \times 100$$

The %RSD is the relative standard deviation as a percent of the Assigned value and is a popular way to express variability. We cater to well over 300 labs in several different countries with different client, legal and regulatory requirements . Consequently there is no single fit-for-purpose sigma (σ_{ffp}) we can realistically report.

We offer the Threshold %RSD as a single fit-for-purpose parameter that can be compared with the individual requirements of your lab.

Fitness for Purpose Examples

AAFCO Check Sample Program

This Table demonstrates some of the dilemmas that can arise if you rely solely on Z scores derived from participant variation in the round and how the Threshold %RSD can alert you to the problem. The Table shows Z scores for five analytes at six different between lab %RSD's (1% to 50%), the corresponding AAFCO Z score using σ_{rob} and the Threshold %RSD at Z = 2 where n is the number of participating Labs.

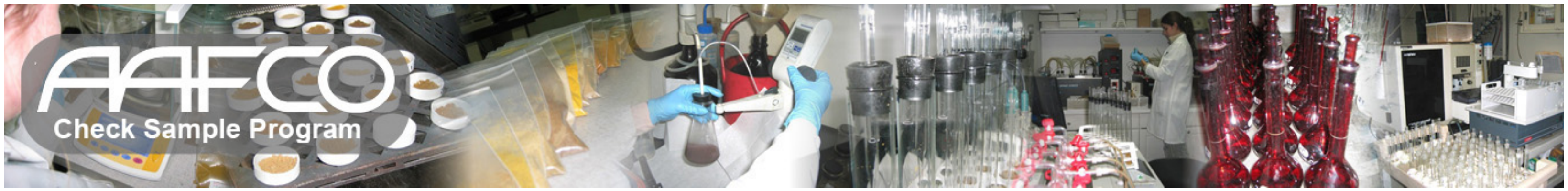
For example, 140 labs perform Protein analysis by N_2 combustion and you receive your Z score of **-3.02**. This is quite disturbing and could possibly trigger some action. The Table below indicates that you become Z compliant somewhere between 1% RSD and 2% RSD of the assigned value. This is acceptable to you and your client. So, just because 95% of the participants generated compliant Z scores does not necessarily mean your result is unacceptable.

Conversely, for a different sample 28 labs run Fiber analysis using the Fibertec system. This example shows that blindly accepting the compliant Z score of **-1.02** could actually represent a 33% discrepancy from the Assigned value.

AAFCO CS Z Score (σ_{rob})	Z Scores Based on % RSD Fitness for Purpose (σ_{ffp})							
	% RSD (σ_{ffp})	1%	2%	5%	10%	20%	50%	Threshold $\%RSD_{(Z=2)}$
-3.02	Protein (N_2 Comb. n = 140)	-3.08	-1.54	-0.62	-0.31	-0.14	-0.06	1.5%
-6.12	Crude Ash (n = 110)	-5.18	-2.59	-1.04	-0.52	-0.26	-0.10	2.6%
-1.64	Copper (ICP, n = 30)	-16.46	-8.23	-3.29	-1.65	-0.82	-0.33	8.2%
-1.42	Vitamin A (HPLC, n = 17)	-32.50	-16.25	-6.50	-3.25	-1.63	-0.65	16%
-1.02	Fiber (Fibertec, n = 28)	-65.75	-32.87	-13.15	-6.57	-3.29	-1.13	33%

In summary we now have:

- A Check Sample Z Score where Red indicates a normally distributed value >3 or <-3 and requires action. An Orange value between 2 and 3 or -2 and -3 provides a warning and a Green value < 2 and >-2 indicates compliance and is within 95% of the other Lab values.
- A Threshold %RSD which provides a personalized operating parameter for your Lab. This parameter is dependant only on your bias from the assigned value and not on the variability of the other labs and is designed to help address the “Fitness for Purpose” concerns of the IHP.
- For example, if your Threshold %RSD is 3% then you are in compliance with a minimum threshold of 3% RSD at Z = 2 (95%).
- Click here for a brief description of creating your own ffp criteria.



Method Precision Data from The AAFCO Check Sample Program

Statistical Model Based on ISO 5725-2 Accuracy (Trueness and Precision) of Measurement Methods and Results, 1994

For more information click on link - Methodology of Inter-comparison Tests and Statistical Analysis of Test results – Nordtest project No. 1483-99, 2000

Return To Contents

Outliers and Poor Duplicates

- Mandel's h for Outliers (h_{crit} set at $\alpha = 0.01$)
- Mandel's k for Duplicates Too Far Apart (k_{crit} set at $\alpha = 0.01$)

Precision

- The closeness of agreement between independent test results obtained under stipulated conditions.
- Dependent on the distribution of random errors.
- Repeatability and Reproducibility are 2 commonly defined stipulated conditions.
- We quantify precision by measuring:

Between Labs SD (s_L)
Repeatability SD (s_r) ≡ Within Labs SD
Reproducibility SD (s_R) ≡ Combined Variance

Computational formulas for calculating critical precision variances.

$$s_L = \sqrt{\left[\frac{n\left(\sum_{i=1}^{n} X_{LAB(i)}^{2}\right) - \left(\sum_{i=1}^{n} X_{LAB(i)}\right)^{2}}{n(n-1)}\right] - \frac{s_r^2}{2}}$$

Between Labs SD (s_L)
Repeatability SD (s_r) ≡ Within Labs SD
Reproducibility SD (s_R) ≡ Combined Variance

$$s_r = \sqrt{\frac{\sum_{i=1}^{n} (X_{i1} - X_{i2})^2}{2n}}$$

$$s_R = \sqrt{s_L^2 + s_r^2}$$

AAFCO Check Sample Program

Example Method Precision Report

Method # 019.00
Calcium, Ox-MnO_4 Vol.
Sample # 201321
Dry Dog Food

- The method precision report includes Robust parameters for comparison (**Green**).
- Here we see 3 labs removed from calculations after examining Mandel statistics.
- The Robust measure of location has shifted to 1.34 % from 1.32 % and the Robust measure of dispersion is substantially reduced (0.14 to 0.09).
- A Robust measure of the uncertainty in the assigned value is provided.
- The Between, Within and Reproducibility standard deviations and CV's are given (**Blue**).
- The S_R/S_r ratio of 5.9 is somewhat higher than the ~ 3 expected for ordinary lab bias.
- The average range is usually a very good estimate of S_r.
- The Horwitz %RSD for the Assigned value is given based on the 0.8495 exponent. Along with the assigned value this can be used to determine a σ_{ffp} if desired. For more on the Horwitz function and Horrat click here.
- Horwitz $\sigma_{ffp} = X_a * \%RSD_{Horwitz}/100$

Total # Labs Submitting	**26**
# Labs Included in Calculations	**23**
Mean	**1.316**
SD	**0.137**
Assigned Value - Robust Mean	**1.340**
AAFCO CS ffp - Robust sd	**0.089**
Uncertainty (U_a) - Robust	**0.013**
% RSD - Robust	**6.66%**
Between Labs s_L	**0.136**
Within Labs s_r	**0.023**
Reproducibility s_R	**0.138**
Between Labs %RSD	**10.34%**
Within Labs %rsd	**1.78%**
Reproducibility %RSD	**10.50%**
s_R/s_r	**5.907**
Average Range (R-bar)	**0.026**
Horwitz %RSD	**3.83%**

In summary we now have:

- A measure of the between labs variability (S_L)
- A measure of the within labs variability (S_r) called repeatability.
- A combined measure of the variability (S_R) called reproducibility.
- Using these standard deviations and the ordinary (non robust) mean of the dataset we can calculate the corresponding %rsd's which are very useful for comparing variability in samples with different analyte concentrations.
- If we look at S_R/S_r we create a new parameter which describes the between lab variability in terms of the within lab variability. Large ratios indicate possible lab generated method bias. Small values ~ 3 are indicative of the expected lab bias.
- The monthly Method report also includes other summary information as well as the average range for duplicates (R-Bar) and Horwitz considerations.

Return To Contents

AAFCO Check Sample Program

Many of these symbols denote quantities which are more fully defined in the document.

While every attempt is made to use these symbols consistently, for complete clarity it is important to review the meaning of the symbol in context.

Appendix A: Symbols Used in This Document

Symbol	Explanation
SD	Standard Deviation
Z	Ratio of the difference from the mean to a measure of dispersion (SD)
σ_{rob}	Robust standard deviation
$k_{(i) \text{ or crit}}$	Mandel's k, subscript denotes a Lab or a critical value
$h_{(i) \text{ or crit}}$	Mandel's h, subscript denotes a Lab or a critical value
h	Bandwidth in a kernel density calculation
n	Number of labs
Φ	Standard Normal density function.
X or X_{LAB}	Mean of lab duplicates. A subscript defines a mean or duplicate in context.
MAD	Median absolute deviation
X_a	Robust assigned value
U_a	Robust uncertainty of the assigned value
%rsd	% relative standard deviation of within lab duplicates, or repeatability SD
σ_{ffp}	Fit for purpose sigma
% RSD	% relative standard deviation of lab duplicate means, or reproducibility SD
Σ	Universal summation sign
S_L	Square root of the between labs variance
S_r	Square root of the within lab variance, or repeatability SD
S_R	Square root of the reproducibility variance
CV	Coefficient of Variation (SD/Mean)
R-bar	Average range of duplicates
α	Probability of a type I error. Often used in (1-α) significance level.

Return To Contents

AAFCO Check Sample Reports

Available to Clients On The Web

Return To Contents

Each Lab Receives a "Proficiency Testing For Individual Methods" Report Card for One Sample

AAFCO

Association of American Feed Control Officials

AAFCO Check Sample Program

Sample # 201321: Dry Dog Food

Report Card for Lab Code 0000

Notes:

Interpreting Z Scores: Red indicates a normally distributed Z value >3 or <-3 (requires action), Orange = Z between 2 and 3 or -2 and -3 (warning) and Green = Z < 2 and >-2 (OK at 95%). Flags indicate data usage: 0 = Used, 1 = Rejected for duplicates too far apart, 2 = Rejected as outlier and 8 = Analyst data exempt. Robust statistics not used if < 6 labs reporting, in this case the Z Scores are included for information only (Grey). Flag 9 indicates no statistics calculated for this dataset. To review the problem please see all submitted data for this test.

Proficiency For 14 Individual Methods

Method	Analyte	Lab 0000 Data		Method Values				AAFCO CS	Threshold	
Code	Name and Method (Units)	Value	range	Rob Mean	Rob SD	R-bar	# Labs	Z Score	%RSD	Flag
002.06	Protein, Combustion Nitrogen Analyzer (%)	19.205	0.47000	19.071	0.28820	0.13726	152	0.47	0%	0
004.07	Fiber, ANKOM (%)	2.7550	0.05000	3.0327	0.38301	0.13111	58	-0.73	5%	0
005.00	Ash, 2h @ 600°C (%)	7.1400	0.04000	7.2601	0.09347	0.05027	116	-1.29	1%	0
011.01	Loss on Drying, 135 °C 2hr (%)	7.6650	0.15000	7.6752	0.21982	0.10916	90	-0.05	0%	0
013.02	Fat, Mojonnier, Bak Ext (%)	9.0750	0.05000	9.8558	0.28608	0.14469	41	-2.73	4%	0
019.41	Calcium, ICP, Dry ash (%)	1.2950	0.03000	1.3540	0.06427	0.02858	36	-0.92	2%	0
022.41	Copper, ICP, Dry ash (ppm)	12.000	0.00000	12.780	1.2767	0.62082	28	-0.61	3%	0
025.41	Iron, ICP, Dry ash (ppm)	205.00	0.00000	238.64	18.649	6.8426	31	-1.80	7%	0
027.41	Magnesium, ICP, Dry ash (%)	0.25400	0.00400	0.27111	0.01838	0.00710	27	-0.93	3%	0
028.41	Manganese, ICP, Dry ash (ppm)	60.400	0.60000	68.289	3.9664	1.2448	28	-1.99	6%	0
031.41	Phosphorus, ICP, Dry ash (%)	0.98500	0.01000	1.0749	0.04436	0.02172	32	-2.03	4%	0
032.41	Potassium, ICP, Dry ash (%)	0.76500	0.00400	0.77684	0.03264	0.01648	27	-0.36	1%	0
033.01	Salt, Poten Cl (%)	0.70000	0.00000	0.62512	0.01521	0.00878	34	4.92	6%	0
037.41	Zinc, ICP, Dry ash (ppm)	167.50	1.0000	181.33	12.095	4.8023	30	-1.14	4%	0

This is an example of the report card that each lab receives for the individual methods that they ran. The mean and range of the reported lab duplicates is presented. This is a useful check on data entry accuracy.

The robust parameters determined for each method and used to calculate Z scores are presented with the average range and the number of participating labs. The color coded Z score and the Threshold %RSD are calculated.

Color coding and data flags are described in the Notes presented on each report card.

Each Lab Receives a "Proficiency Testing" Report Card for One Sample

Sample # 201321: Dry Dog Food

Report Card for Lab Code 0000

Association of American Feed Control Officials

AAFCO Check Sample Program

Notes:

Interpreting Z Scores: Red indicates a normally distributed Z value >3 or <-3 (requires action), Orange = Z between 2 and 3 or -2 and -3 (warning) and Green = Z < 2 and >-2 (OK at 95%). Flags indicate data usage: 0 = Used, 1 = Rejected for duplicates too far apart, 2 = Rejected as outlier and 8 = Analyst data exempt. Robust statistics not used if < 6 labs reporting, in this case the Z Scores are included for information only (Grey). Flag 9 indicates no statistics calculated for this dataset. To review the problem please see all submitted data for this test.

Proficiency Testing For 14 Analytes

Method	Analyte	Lab 0000 Data		Method Values				AAFCO CS	Lab 0000	
Group	Group (Units)	Value	range	Rob Mean	Rob SD	R-bar	# Labs	Z Score	Method	Flag
002	Protein (%)	19.205	0.47000	18.995	0.31203	0.12313	247	0.67	002.06	0
004	Fiber (%)	2.7550	0.05000	3.1126	0.40656	0.11497	141	-0.88	004.07	0
005	Ash (%)	7.1400	0.04000	7.2915	0.11195	0.04992	168	-1.35	005.00	0
011	Loss on Drying (%)	7.6650	0.15000	7.6574	0.22816	0.11171	96	0.03	011.01	0
013	Fat (%)	9.0750	0.05000	9.6576	0.41083	0.15723	96	-1.42	013.02	0
019	Calcium (%)	1.2950	0.03000	1.3621	0.06956	0.03195	152	-0.96	019.41	0
022	Copper (ppm)	12.000	0.00000	13.065	1.5268	0.64855	91	-0.70	022.41	0
025	Iron (ppm)	205.00	0.00000	238.74	24.134	6.9333	86	-1.40	025.41	0
027	Magnesium (%)	0.25400	0.00400	0.26562	0.01623	0.00861	81	-0.72	027.41	0
028	Manganese (ppm)	60.400	0.60000	69.082	5.1633	1.8437	94	-1.68	028.41	0
031	Phosphorus (%)	0.98500	0.01000	1.0542	0.04224	0.01912	135	-1.64	031.41	0
032	Potassium (%)	0.76500	0.00400	0.78267	0.04003	0.01655	87	-0.44	032.41	0
033	Salt (%)	0.70000	0.00000	0.60060	0.04084	0.01218	83	2.43	033.01	0
037	Zinc (ppm)	167.50	1.0000	180.84	11.025	4.6688	95	-1.21	037.41	0

This is an example of the report card that each lab receives for the grouped analyte methods that were run in the round. The mean and range of the reported lab duplicates are the same as the previous slide. The Z scores are now calculated with the grouped method robust values and the specific method code used by the lab is presented..

The number of participating labs generally increases and the σ_{rob} is expanded often resulting in increased compliance.

Master Lists Available on the Web

- All the tests from all the methods for one sample round are presented sorted by method and then by Z score. This list is provided separately for individual methods and grouped methods for true proficiency testing.
    - Click here for an example of an AAFCO Individual methods proficiency master list.
    - Click here for an example of a Proficiency master list
- A method performance table is provided listing all the method performance characteristics of the individual methods run in the round. These parameters are extensively described in the Statistics segment of this documentation.
    - Click here for an example of a method performance Table.

Return To 1st Slide
Jump To Statistics

AAFCO Check Sample Program

All Labs and All Methods Report
Sort by Method
Proficiency For Individual Methods
Sample # 201321
Dry Dog Food

Robust statistics not used if < 6 labs reporting, in this case the Z Scores are included for information only (Grey).

Method Code	Analyte Name and Method (Units)	Lab Code	Lab Data Value	Lab Data Range	Method Values Rob Mean	Method Values Rob SD	Method Values R-bar	Method Values # Labs	AAFCO CS Z Score	Threshold %RSD	Flag
000.99	Urea, Miscellaneous (%)	0920	0.00000	0.00000			0.00000	1			
001.00	Loss on Drying, Vac 95 °C 5 hr (%)	0596	5.4500	0.02000	7.0512	0.55454	0.07286	7	-2.89	11%	0
001.00	Loss on Drying, Vac 95 °C 5 hr (%)	0844	6.6050	0.03000	7.0512	0.55454	0.07286	7	-0.80	3%	0
001.00	Loss on Drying, Vac 95 °C 5 hr (%)	0309	6.8950	0.21000	7.0512	0.55454	0.07286	7	-0.28	1%	0
001.00	Loss on Drying, Vac 95 °C 5 hr (%)	0783	7.0950	0.03000	7.0512	0.55454	0.07286	7	0.08	0%	0
001.00	Loss on Drying, Vac 95 °C 5 hr (%)	0169	7.3850	0.05000	7.0512	0.55454	0.07286	7	0.60	2%	0
001.00	Loss on Drying, Vac 95 °C 5 hr (%)	0788	7.4600	0.02000	7.0512	0.55454	0.07286	7	0.74	3%	0
001.00	Loss on Drying, Vac 95 °C 5 hr (%)	0013	7.6350	0.15000	7.0512	0.55454	0.07286	7	1.05	4%	0
001.00	Loss on Drying, Vac 95 °C 5 hr (%)	0504	7.6100	0.68000	7.0512	0.55454	0.07286	7	1.01	4%	1
001.00	Loss on Drying, Vac 95 °C 5 hr (%)	1001	7.3600	0.00000	7.0512	0.55454	0.07286	7	0.56	2%	8
001.03	Loss on Drying, Low temp. methods (%)	0686	6.7250	0.03000	7.1874	0.09793	0.01760	20	-4.72	3%	0
001.03	Loss on Drying, Low temp. methods (%)	0907	6.9750	0.01000	7.1874	0.09793	0.01760	20	-2.17	1%	0
001.03	Loss on Drying, Low temp. methods (%)	2025	7.0100	0.02000	7.1874	0.09793	0.01760	20	-1.81	1%	0
001.03	Loss on Drying, Low temp. methods (%)	0891	7.0250	0.02200	7.1874	0.09793	0.01760	20	-1.66	1%	0
001.03	Loss on Drying, Low temp. methods (%)	0619	7.1200	0.02000	7.1874	0.09793	0.01760	20	-0.69	0%	0
001.03	Loss on Drying, Low temp. methods (%)	0895	7.1200	0.02000	7.1874	0.09793	0.01760	20	-0.69	0%	0
001.03	Loss on Drying, Low temp. methods (%)	0896	7.1400	0.02000	7.1874	0.09793	0.01760	20	-0.48	0%	0
001.03	Loss on Drying, Low temp. methods (%)	0868	7.1550	0.03000	7.1874	0.09793	0.01760	20	-0.33	0%	0
001.03	Loss on Drying, Low temp. methods (%)	0897	7.1850	0.03000	7.1874	0.09793	0.01760	20	-0.02	0%	0
001.03	Loss on Drying, Low temp. methods (%)	0950	7.1900	0.00000	7.1874	0.09793	0.01760	20	0.03	0%	0
001.03	Loss on Drying, Low temp. methods (%)	0878	7.2150	0.05000	7.1874	0.09793	0.01760	20	0.28	0%	0
001.03	Loss on Drying, Low temp. methods (%)	0893	7.2150	0.01000	7.1874	0.09793	0.01760	20	0.28	0%	0
001.03	Loss on Drying, Low temp. methods (%)	0903	7.2250	0.01000	7.1874	0.09793	0.01760	20	0.38	0%	0
001.03	Loss on Drying, Low temp. methods (%)	0899	7.2350	0.01000	7.1874	0.09793	0.01760	20	0.49	0%	0
001.03	Loss on Drying, Low temp. methods (%)	0938	7.2400	0.00000	7.1874	0.09793	0.01760	20	0.54	0%	0
001.03	Loss on Drying, Low temp. methods (%)	0894	7.2500	0.00000	7.1874	0.09793	0.01760	20	0.64	0%	0
001.03	Loss on Drying, Low temp. methods (%)	0911	7.2650	0.01000	7.1874	0.09793	0.01760	20	0.79	1%	0
001.03	Loss on Drying, Low temp. methods (%)	0886	7.2700	0.02000	7.1874	0.09793	0.01760	20	0.84	1%	0
001.03	Loss on Drying, Low temp. methods (%)	0937	7.3950	0.01000	7.1874	0.09793	0.01760	20	2.12	1%	0
001.03	Loss on Drying, Low temp. methods (%)	0882	7.5450	0.03000	7.1874	0.09793	0.01760	20	3.65	2%	0
001.05	Loss on Drying, LECO (%)	0610	7.0350	0.03000			0.03000	1			
001.07	Loss on Drying, 104°C 3 hr, in malt (%)	0618	5.3100	0.16000	7.0521	0.24446	0.10195	41	-7.13	12%	0
001.07	Loss on Drying, 104°C 3 hr, in malt (%)	0038	6.2450	0.07000	7.0521	0.24446	0.10195	41	-3.30	6%	0

AAFCO Check Sample Program
All Labs and All Methods Report
Sort by Method
Proficiency Testing
Sample # 201321
Dry Dog Food

CHECK SAMPLE PROGRAM

Robust statistics not used if < 6 labs reporting, in this case the Z Scores are included for information only (Grey).

Method Group	Analyte Group (Units)	Lab Code	Lab Data Value	Lab Data Range	Method Values Rob Mean	Rob SD	R-bar	# Labs	AAFCO CS Z Score	Your Method	Flag
000	Urea (%)	0920	0.00000	0.00000			0.00000	1			
001	Loss on Drying (%)	0618	5.2950	0.09000	7.1058	0.21509	0.07231	91	-8.42	001.99	0
001	Loss on Drying (%)	0618	5.3100	0.16000	7.1058	0.21509	0.07231	91	-8.35	001.07	0
001	Loss on Drying (%)	0596	5.4500	0.02000	7.1058	0.21509	0.07231	91	-7.70	001.00	0
001	Loss on Drying (%)	0720	6.1500	0.02000	7.1058	0.21509	0.07231	91	-4.44	001.99	0
001	Loss on Drying (%)	0628	6.2300	0.30000	7.1058	0.21509	0.07231	91	-4.07	001.99	0
001	Loss on Drying (%)	0038	6.2450	0.07000	7.1058	0.21509	0.07231	91	-4.00	001.07	0
001	Loss on Drying (%)	0536	6.4100	0.02000	7.1058	0.21509	0.07231	91	-3.24	001.99	0
001	Loss on Drying (%)	0676	6.4900	0.12000	7.1058	0.21509	0.07231	91	-2.86	001.99	0
001	Loss on Drying (%)	0510	6.6000	0.20000	7.1058	0.21509	0.07231	91	-2.35	001.99	0
001	Loss on Drying (%)	0844	6.6050	0.03000	7.1058	0.21509	0.07231	91	-2.33	001.00	0
001	Loss on Drying (%)	0083	6.6250	0.01000	7.1058	0.21509	0.07231	91	-2.24	001.07	0
001	Loss on Drying (%)	0413	6.6500	0.10000	7.1058	0.21509	0.07231	91	-2.12	001.07	0
001	Loss on Drying (%)	0940	6.6850	0.11000	7.1058	0.21509	0.07231	91	-1.96	001.07	0
001	Loss on Drying (%)	0297	6.7000	0.00000	7.1058	0.21509	0.07231	91	-1.89	001.07	0
001	Loss on Drying (%)	0686	6.7250	0.03000	7.1058	0.21509	0.07231	91	-1.77	001.03	0
001	Loss on Drying (%)	0278	6.7250	0.01000	7.1058	0.21509	0.07231	91	-1.77	001.07	0
001	Loss on Drying (%)	0845	6.7600	0.08000	7.1058	0.21509	0.07231	91	-1.61	001.07	0
001	Loss on Drying (%)	0683	6.7800	0.04000	7.1058	0.21509	0.07231	91	-1.51	001.07	0
001	Loss on Drying (%)	0307	6.8500	0.30000	7.1058	0.21509	0.07231	91	-1.19	001.07	0
001	Loss on Drying (%)	0948	6.8600	0.02000	7.1058	0.21509	0.07231	91	-1.14	001.99	0
001	Loss on Drying (%)	0309	6.8950	0.21000	7.1058	0.21509	0.07231	91	-0.98	001.00	0
001	Loss on Drying (%)	0015	6.9100	0.06000	7.1058	0.21509	0.07231	91	-0.91	001.07	0
001	Loss on Drying (%)	0843	6.9100	0.34000	7.1058	0.21509	0.07231	91	-0.91	001.07	0
001	Loss on Drying (%)	0630	6.9200	0.46000	7.1058	0.21509	0.07231	91	-0.86	001.99	0
001	Loss on Drying (%)	0907	6.9750	0.01000	7.1058	0.21509	0.07231	91	-0.61	001.03	0
001	Loss on Drying (%)	0590	6.9850	0.09000	7.1058	0.21509	0.07231	91	-0.56	001.08	0
001	Loss on Drying (%)	2025	7.0100	0.02000	7.1058	0.21509	0.07231	91	-0.45	001.03	0
001	Loss on Drying (%)	0353	7.0100	0.02000	7.1058	0.21509	0.07231	91	-0.45	001.07	0
001	Loss on Drying (%)	0891	7.0250	0.02200	7.1058	0.21509	0.07231	91	-0.38	001.03	0
001	Loss on Drying (%)	2009	7.0330	0.00590	7.1058	0.21509	0.07231	91	-0.34	001.07	0
001	Loss on Drying (%)	0610	7.0350	0.03000	7.1058	0.21509	0.07231	91	-0.33	001.05	0
001	Loss on Drying (%)	2011	7.0350	0.03000	7.1058	0.21509	0.07231	91	-0.33	001.07	0

AAFCO Check Sample Program

All Methods Report
Sort by Method
Proficiency For Individual Methods
Sample # 201321
Dry Dog Food

CHECK SAMPLE PROGRAM

Method Code	Total # Labs Submitting	# Labs Included in Calculations	Mean	SD	Assigned Value - Robust Mean	AAFCO CS ffp - Robust sd	Uncertainty (U)	% RSD	Between Labs sL	Within Labs sr	Reproducibility sR	Between Labs %RSD	Within Labs %rsd	Reproducibility %RSD	sR/sr	Average Range (R-bar)	Horwitz %RSD
000.99	1		0.00000														
001.00	9	7	6.9321	0.74267	7.0512	0.55454	0.14821	7.86%	0.38254	0.07708	0.39022	5.33%	1.07%	5.44%	5.0624	0.07286	2.98%
001.03	20	20	7.1750	0.16572	7.1874	0.09793	0.01548	1.36%	0.13053	0.01476	0.13136	1.81%	0.21%	1.82%	8.8969	0.01760	2.97%
001.05	1		7.0350														
001.07	42	41	7.0101	0.38104	7.0521	0.24446	0.02700	3.47%	0.26423	0.09359	0.28032	3.74%	1.33%	3.97%	2.9950	0.10195	2.98%
001.08	3	3	7.0550	0.06144	7.0550	0.06144	0.02508	0.87%	0.05538	0.03764	0.06696	0.78%	0.53%	0.95%	1.7790	0.03667	2.98%
001.99	22	20	6.9334	0.58543	7.0529	0.41479	0.06558	5.88%	0.46091	0.08703	0.46905	6.56%	1.24%	6.68%	5.3894	0.10041	2.98%
002.00	7	7	18.696	0.63830	18.813	0.43439	0.11610	2.31%	0.29457	0.09309	0.30893	1.56%	0.49%	1.63%	3.3185	0.12571	2.57%
002.01	13	13	18.824	0.26648	18.816	0.28452	0.05580	1.51%	0.25717	0.09876	0.27548	1.37%	0.52%	1.46%	2.7894	0.10047	2.57%
002.02	7	6	18.823	0.49275	18.944	0.26998	0.07794	1.43%	0.19189	0.01764	0.19270	1.01%	0.09%	1.01%	10.927	0.02553	2.57%
002.03	1		18.255														
002.04	6	5	18.746	0.45945	18.746	0.45945	0.14529	2.45%	0.45590	0.08062	0.46297	2.43%	0.43%	2.47%	5.7425	0.09600	2.57%
002.05	46	45	18.889	0.29826	18.878	0.26022	0.02743	1.38%	0.24379	0.07702	0.25566	1.29%	0.41%	1.35%	3.3193	0.07982	2.57%
002.06	239	152	19.061	0.37595	19.071	0.28820	0.01653	1.51%	0.28093	0.11672	0.30421	1.47%	0.61%	1.59%	2.6062	0.13726	2.57%
002.07	1		19.010														
002.08	3	3	19.506	0.91425	19.506	0.91425	0.37324	4.69%	0.90676	0.16513	0.92167	4.65%	0.85%	4.73%	5.5814	0.15457	2.56%
002.10	2	2	18.733	0.56957													
002.11	6	6	19.306	1.0431	19.306	1.1828	0.34145	6.13%	1.0384	0.13886	1.0477	5.38%	0.72%	5.43%	7.5448	0.16800	2.56%
002.99	5	5	18.945	0.48789	18.945	0.48789	0.15428	2.58%	0.39077	0.09500	0.40216	2.08%	0.51%	2.14%	4.2332	0.23800	2.57%
003.00	12	11	7.4779	1.7388	6.6171	0.33577	0.07159	5.07%	1.7300	0.24765	1.7476	23.13%	3.31%	23.37%	7.0567	0.22345	3.01%
003.01	3	3	7.2178	1.4669	7.2178	1.4669	0.59885	20.32%	1.4655	0.08967	1.4683	20.30%	1.24%	20.34%	16.373	0.10073	2.97%
003.06	18	18	6.3528	1.0423	6.3638	0.20918	0.03486	3.29%	0.19975	0.06186	0.20911	3.16%	0.98%	3.30%	3.3803	0.07667	3.03%
003.07	1		7.0650														
003.09	21	19	6.5252	0.58347	6.3985	0.14571	0.02364	2.28%	0.22392	0.05798	0.23131	3.51%	0.91%	3.62%	3.9895	0.07493	3.02%
003.10	32	29	6.2668	0.19227	6.2896	0.14416	0.01893	2.29%	0.12985	0.04692	0.13806	2.06%	0.75%	2.19%	2.9428	0.05780	3.03%
003.11	5	5	9.6550	1.3444	9.6550	1.3444	0.42515	13.92%	1.3443	0.02550	1.3446	13.92%	0.26%	13.93%	52.738	0.03000	2.84%
003.12	14	13	6.4431	0.16209	6.4021	0.10590	0.02077	1.65%	0.15948	0.04095	0.16466	2.48%	0.64%	2.56%	4.0209	0.04462	3.02%