

Test Group Summary Report

C40A Petroleum Hydrocarbons in Water

June 2021 PT Round

Issued: October 13, 2021

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1.0 The Proficiency Testing Report

The Proficiency Testing Report consists of two parts.

- *PTC Proficiency Testing Report*: This report contains participant-specific data and other confidential information. This report is emailed to participants at the end of the PT round.
- *Test Group Summary Report*: A Test Group Summary Report is created for each quantified test group at the end of the PT round. These reports contain more detailed information on the round than are found in the participant-specific PTC Proficiency Testing Report. These reports do not contain any confidential information and are made available on the PTC web site.

2.0 Definitions

The participant-specific PTC Proficiency Testing Report contains some terms that new participants may not be familiar with.

<i>Code:</i>	The registration code that is unique to each analyte that a participant is registered for.
<i>App:</i>	If a participant is accredited by CALA, this three-digit number is the appendix number that the accredited method is assigned to.
<i>N:</i>	The number of participants results that were used to calculate the summary statistics. This excludes qualified data (e.g., <) and any results that were flagged as outliers.
<i>Assigned:</i>	The Assigned Value is the robust mean of the reported results, outliers excluded. This is often referred to as the “target” value.
<i>$\pm U$:</i>	The uncertainty of the assigned value.
<i>Reported:</i>	The result reported by the participant.
<i>s:</i>	The Standard Deviation of Proficiency Assessment (SDPA). This value is used to determine the acceptance limits for the PT evaluation.
<i>z-Score:</i>	A value assigned to each reported result that is a measure of the degree to which it deviates from the Assigned Value.
<i>Score:</i>	The composite score of the four results reported for each analyte. It is normalized to a score out of 100.
<i>Bias:</i>	A flag assigned if bias is detected using the re-scaled z-score procedure.

3.0 Scoring System

Participant performance is evaluated for each proficiency testing sample by a quantitative method that is consistent with ISO/IEC 17043:2010 *Conformity assessment – General requirements for proficiency testing*, the *International Harmonized Protocol for Proficiency Testing of (Chemical) Analytical Laboratories* (2006), and ISO 13528:2015 *Statistical methods for use in proficiency testing by interlaboratory comparisons*.

The following is a brief description of the evaluation procedure used by PTC. The detailed evaluation procedure is described in PROC09 – PT Evaluation *Procedure*, which is available on the PTC website www.PTCanada.org).

3.1 HOMOGENEITY AND STABILITY ASSESSMENT

Homogeneity and stability are assessed using participant data. Regression analysis is performed on reported result against order of sample production (Homogeneity) and reported result against date of analysis (Stability). If the slope is significantly different than zero for either then the Standard Deviation of Proficiency Assessment (s) is increased to minimize the impact.

3.2 THE Z SCORE

A "z-score" is calculated for each reported result as follows:

$$z - Score = \frac{(x - \bar{X})}{SDPA} \quad \text{where: } \begin{array}{l} x = \text{participant result;} \\ \bar{X} = \text{the Assigned Value;} \\ SDPA = \text{the Standard Deviation for Proficiency Assessment.} \end{array}$$

The assigned value \bar{X} is generally estimated from the inter-laboratory Robust mean after outliers due to obvious gross errors (e.g., reported in wrong units) have been removed.

The Standard Deviation for Proficiency Assessment, s, is determined as follows:

- The inter-laboratory Robust standard deviation ($Stdev_{rob}$) is calculated using reported results, obvious outliers removed;
- The regression equation standard deviation ($Stdev_{reg}$) is estimated from regression equations derived from previous studies (see PROC11- *PT Regression Equations* for details);
- The SDPA is the higher of $Stdev_{rob}$ and $Stdev_{reg}$;
- When a laboratory reports its detection limit, s will be estimated using a pooled variance procedure that uses both the inter-laboratory data and the reported detection limit.

3.2 COMPOSITE (PT) SCORE

Since each PT round involves four or two separate samples of distinct concentration for each test, it is necessary to calculate a composite PT score for each test to determine overall performance. The composite score is calculated by first averaging the absolute z-scores for the four results and then calculating a final score as $100 + (-15 \times \text{avg } |z|)$.

Acceptable PT Scores equal or exceed 70.

3.3 IDENTIFYING BIAS

The proficiency testing report provides flags for bias. These are determined using the re-scaled z-score procedure.

$$RSZ = \frac{\sum z}{\sqrt{N}}$$

where z = the z -score
 N = the number of samples

Flags are assigned for each test group/parameter combination as follows:

$RSZ \geq -2$ and ≤ 2	no flag assigned
$RSZ > 2$	H (High)
$RSZ > 3$	VH (Very High)
$RSZ < -2$	L (LOW)
$RSZ < -3$	VL (Very Low)

3.4 DEVIATIONS FROM EVALUATION PROCEDURE

Other than changes to the Standard Deviation of Proficiency Assessment due to homogeneity or stability flags, any deviation from the published evaluation procedure is described on the cover page(s) of the final *PTC Proficiency Testing Report*.

4.0 PT Round Specific Data Summary

The following pages provide more detailed information about the PT round indicated in the cover page of this report than is found in the participant-specific PTC Proficiency Testing Report. The graphical representations and the statistical summaries are based upon the data after outliers have been removed.

4.1 SUMMARY STATISTICS

In addition to some of the statistics found in the customer reports, this table includes additional summary statistics such as Median, different measures of dispersion, the number of outliers removed, the number of results in the Questionable range ($|z|$ between 2 and 3) and the Unacceptable range ($z > 3$), and whether a data set was flagged for Homogeneity or Stability. This section also includes sorted scatter plots of the data for each sample.

4.2 z - SCORE PLOTS

The z -scores for each sample are ranked in increasing order and plotted. When the data is normally distributed, the plot should show a slight sigmoidal curve, with an equal number of points above zero as below. Each bar in these plots is colour-coded to indicate the analytical method used by the participant.

4.3 KERNEL DENSITY PLOTS

Kernel density plots are generated for each data set. These plots are a graphical way to represent the overall data distribution and are used to visualize possible deviations from normality and unimodality.

4.4 STABILITY AND HOMOGENEITY PLOTS

Plots of reported result against analysis date, and reported result against order of bottling are displayed, along with the regression line. These regression analyses are used to determine if the SDPA should be adjusted due to homogeneity or stability.

BENZENE

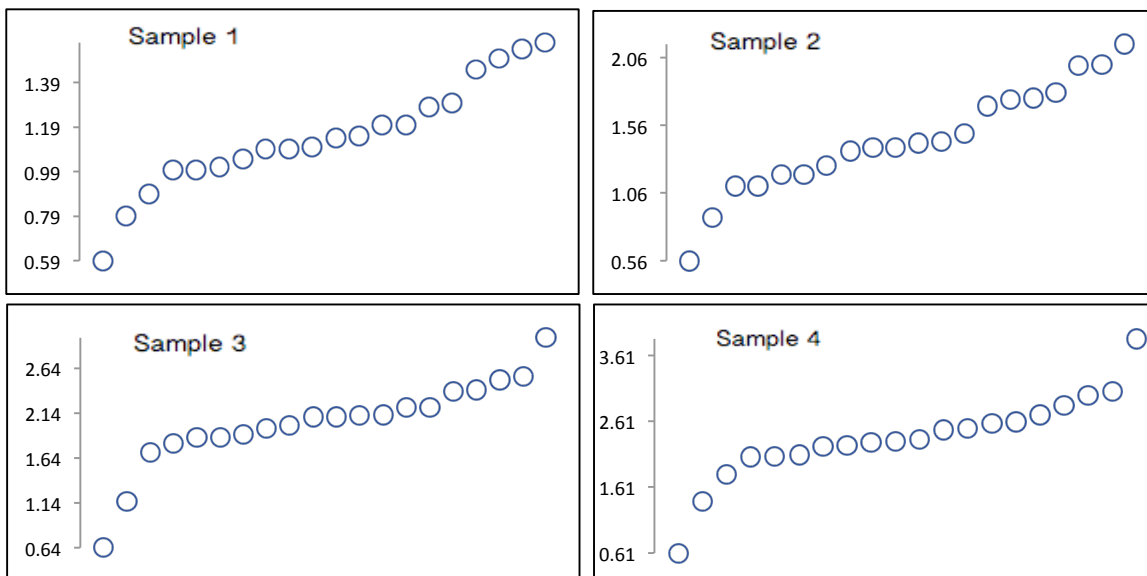
Summary Statistics

Statistic	C40A-1	C40A-2	C40A-3	C40A-4
N	20	20	20	20
Median	1.12	1.42	2.10	2.32
Robust Mean	1.15	1.46	2.07	2.38
U	0.072	0.114	0.099	0.138
Robust Standard Deviation	0.259	0.409	0.353	0.494
Regression Standard Deviation	0.173	0.219	0.311	0.357
Stability Flag				
Homogeneity Flag	Homogeneity			
Standard Deviation Used (SDPA)	0.259	0.714	0.353	0.494
Outliers	0	0	0	0
$ z > 3.0$	0	0	1	1
$2 < z < 3$	1	0	2	1

Methods Used

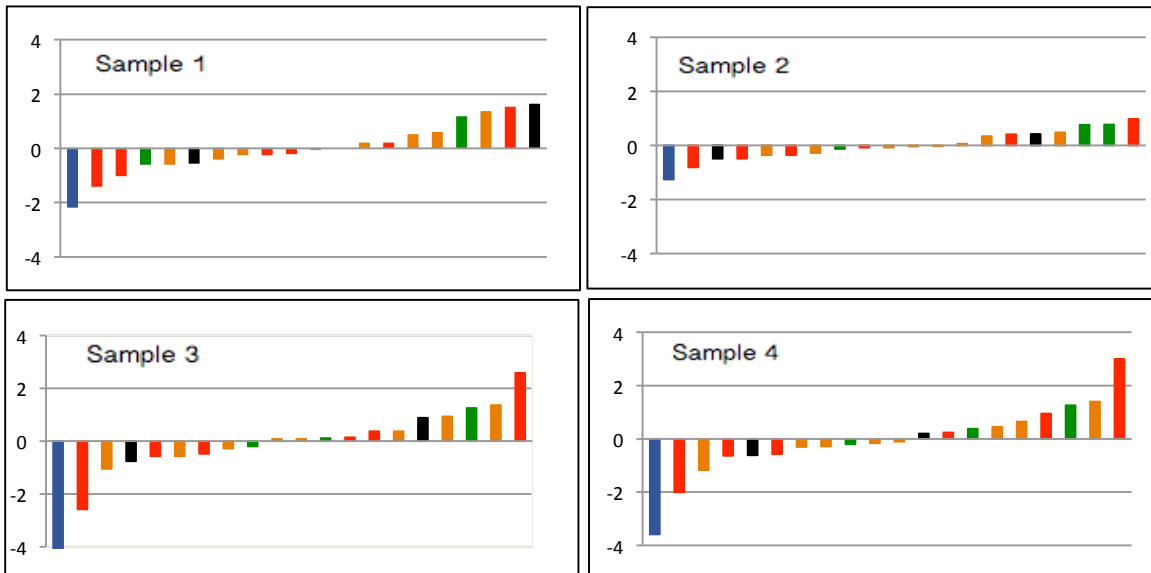
Method	C40A-1	C40A-2	C40A-3	C40A-4
GC/FID-1	1	1	1	1
P/T-GCMS	6	6	6	6
GC/MSE	3	3	3	3
HS-GCMS	8	8	8	8
HS-GCF	2	2	2	2

All summary stats and the plots below are based on the data excluding any flagged outliers

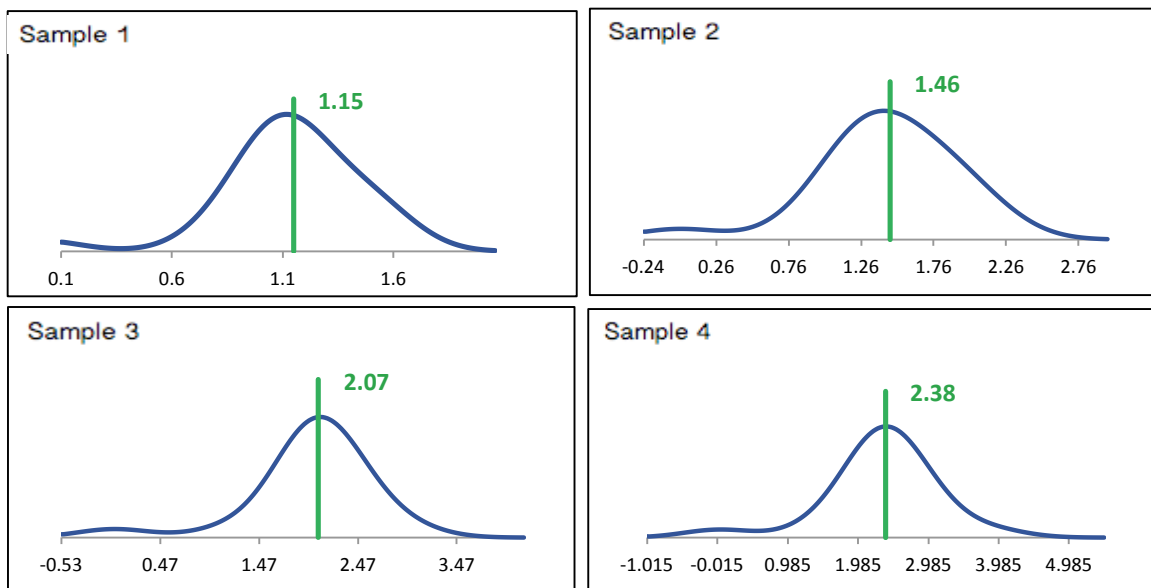


BENZENE

z-Score Plots

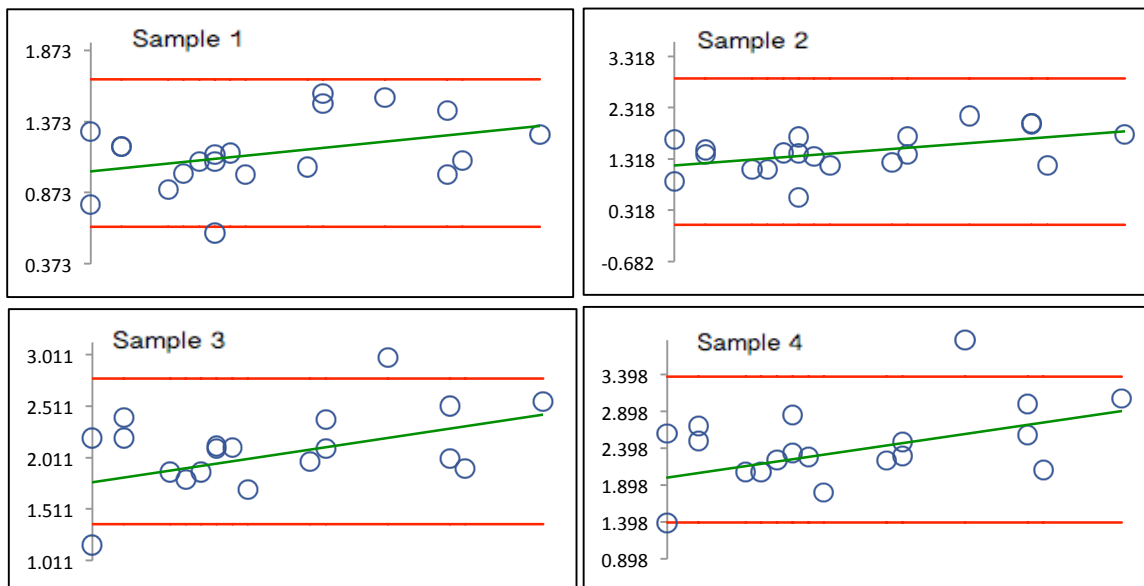


Kernel Density Plots



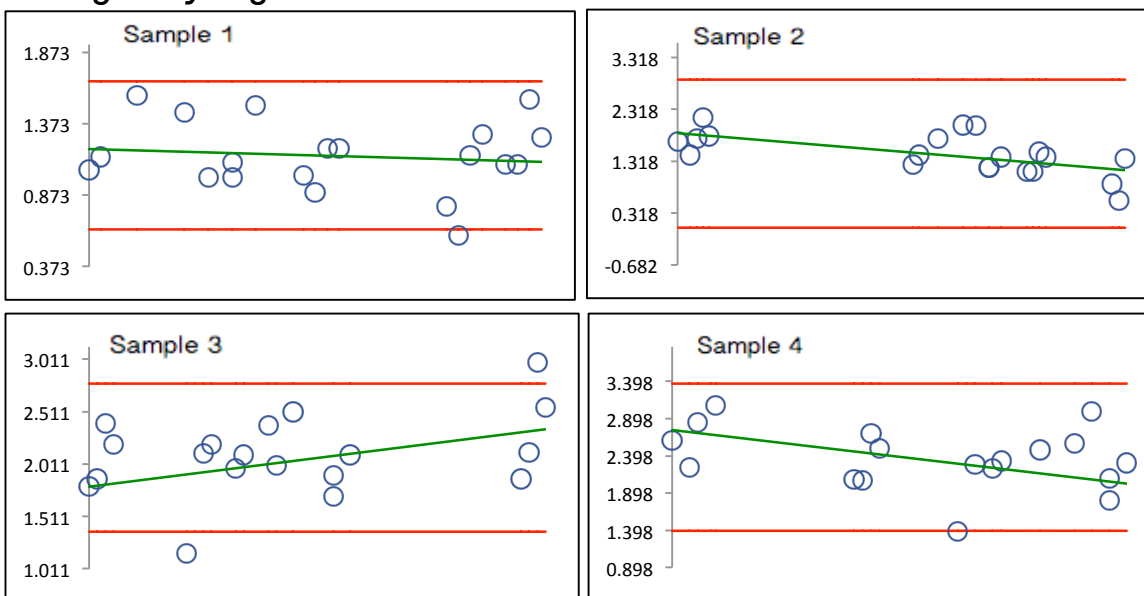
BENZENE

Stability Regression



Reported results (Y-axis) plotted against reported analysis date (X-axis)

Homogeneity Regression



Reported results (Y-axis) plotted against bottling order (X-axis).

ETHYLBENZENE

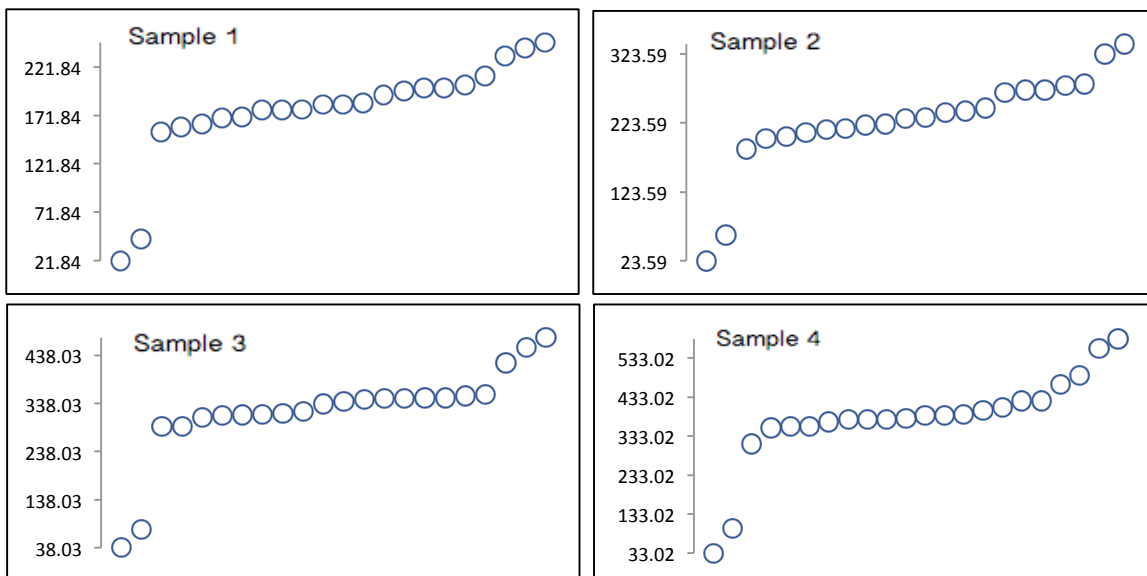
Summary Statistics

Statistic	C40A-1	C40A-2	C40A-3	C40A-4
N	22	22	22	22
Median	183	231	339	381
Robust Mean	185	235	333	390
U	7.8	11.7	10.6	16.1
Robust Standard Deviation	29.3	43.9	39.8	60.6
Regression Standard Deviation	27.8	35.2	49.9	58.5
Stability Flag				
Homogeneity Flag		Homogeneity		
Standard Deviation Used (SDPA)	29.3	103.0	49.9	60.6
Outliers	0	0	0	0
$ z > 3.0$	2	0	2	3
$2 < z < 3$	1	1	2	1

Methods Used

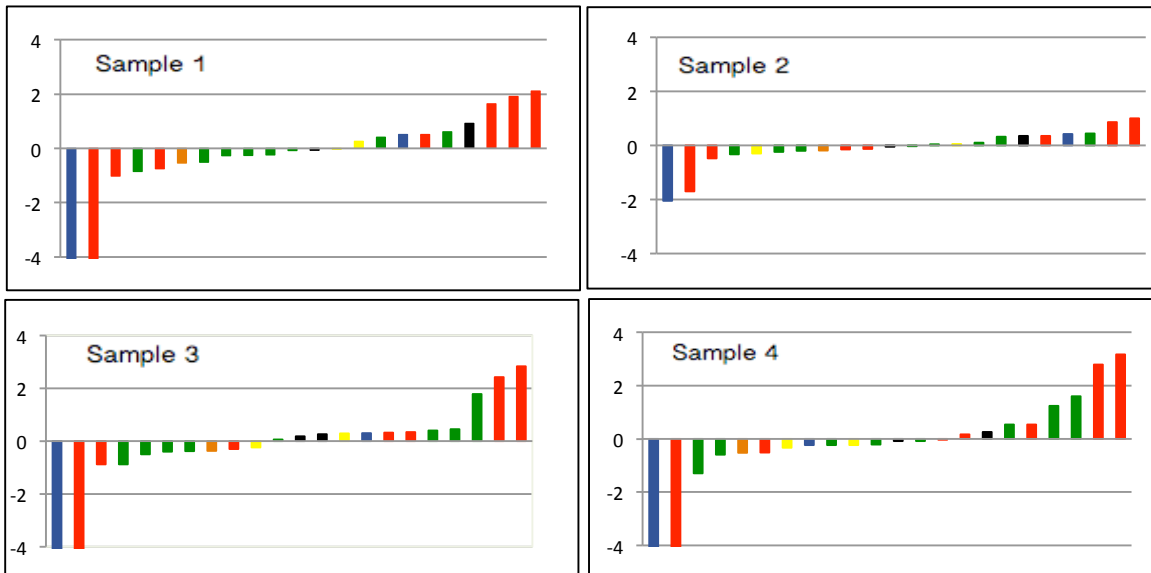
Method	C40A-1	C40A-2	C40A-3	C40A-4
GC/FID-1	2	2	2	2
P/T-GCMS	7	7	7	7
HS-GCMS	8	8	8	8
GC/PID	1	1	1	1
GC/MSE	2	2	2	2
HS-GCF	2	2	2	2

All summary stats and the plots below are based on the data excluding any flagged outliers

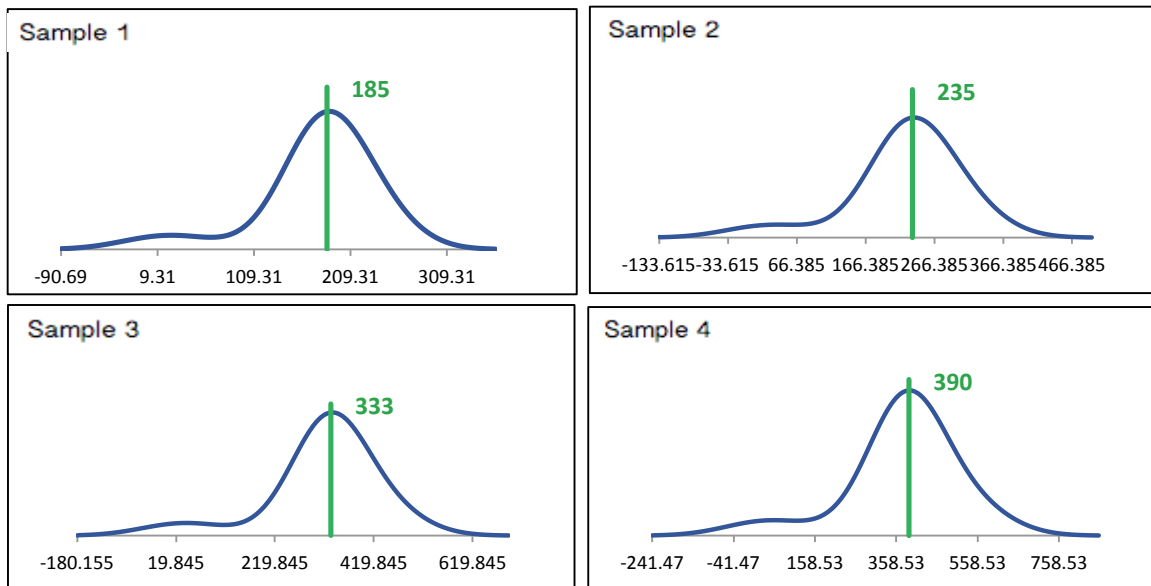


ETHYLBENZENE

z-Score Plots

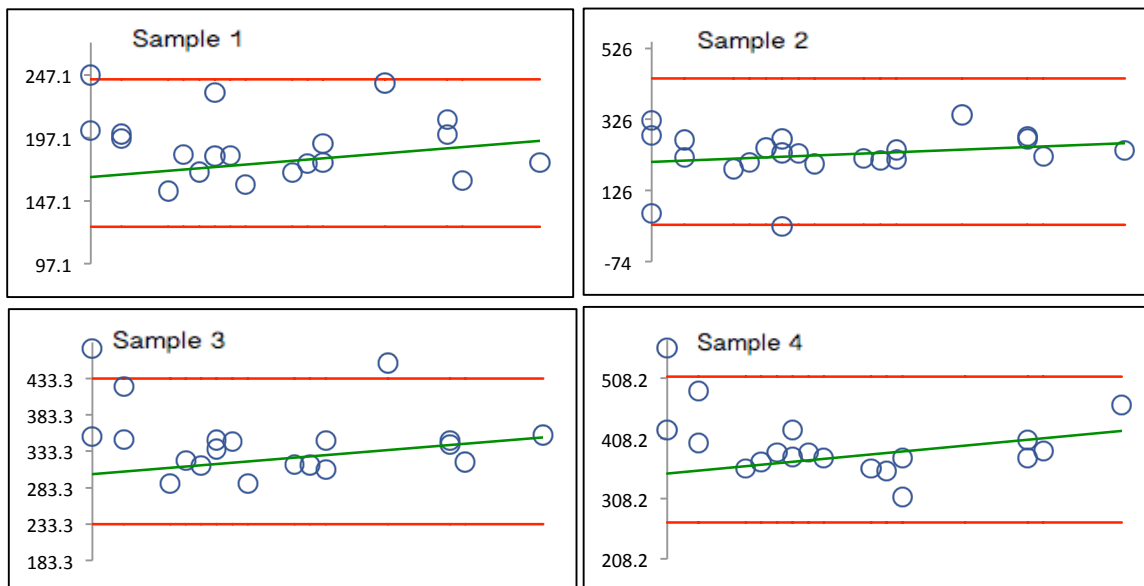


Kernel Density Plots



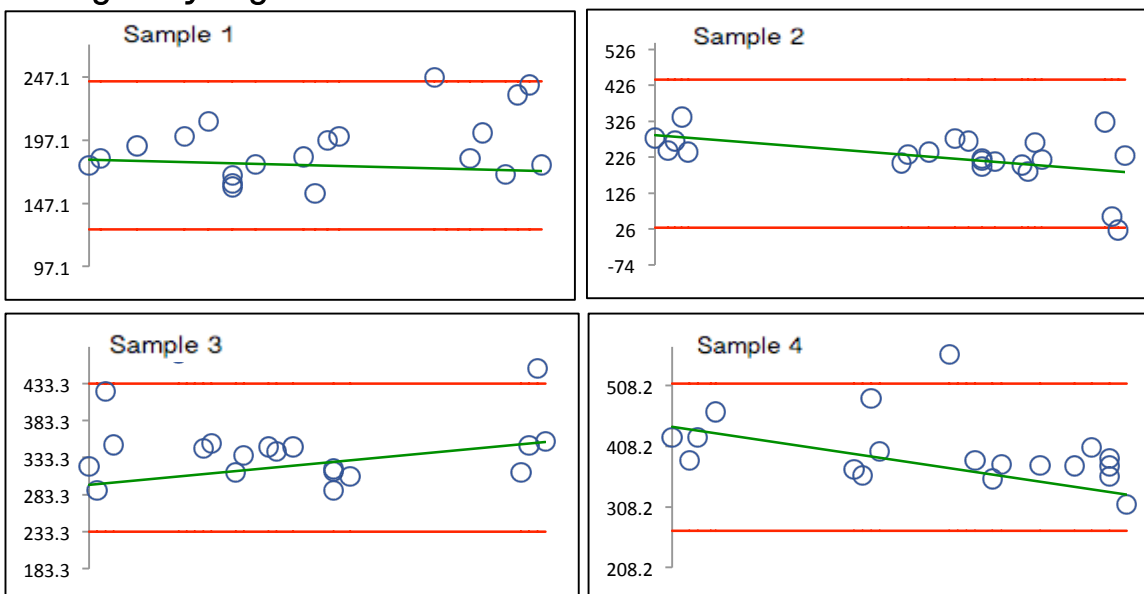
ETHYLBENZENE

Stability Regression



Reported results (Y-axis) plotted against reported analysis date (X-axis)

Homogeneity Regression



Reported results (Y-axis) plotted against bottling order (X-axis).

F1: C6-C10

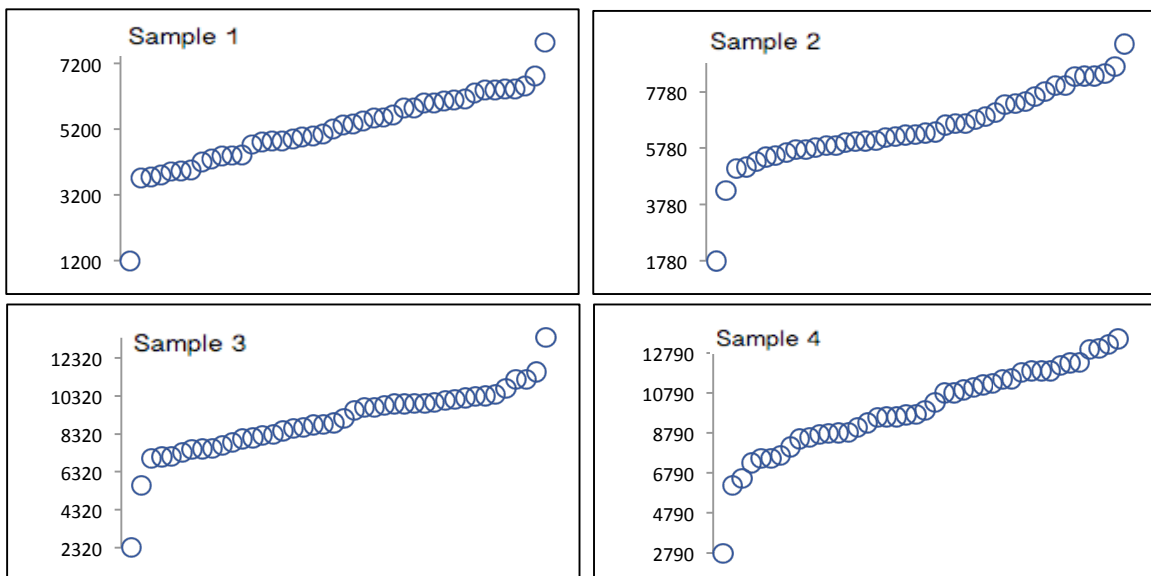
Summary Statistics

Statistic	C40A-1	C40A-2	C40A-3	C40A-4
N	42	42	42	42
Median	5260	6280	9020	9820
Robust Mean	5230	6580	9050	10100
U	208	241	299	420
Robust Standard Deviation	1080	1250	1550	2180
Regression Standard Deviation	966	1190	1590	1750
Stability Flag				
Homogeneity Flag		Homogeneity		Homogeneity
Standard Deviation Used (SDPA)	1080	1500	1590	2340
Outliers	0	0	0	0
$ z > 3.0$	1	1	1	1
$2 < z < 3$	1	0	2	0

Methods Used

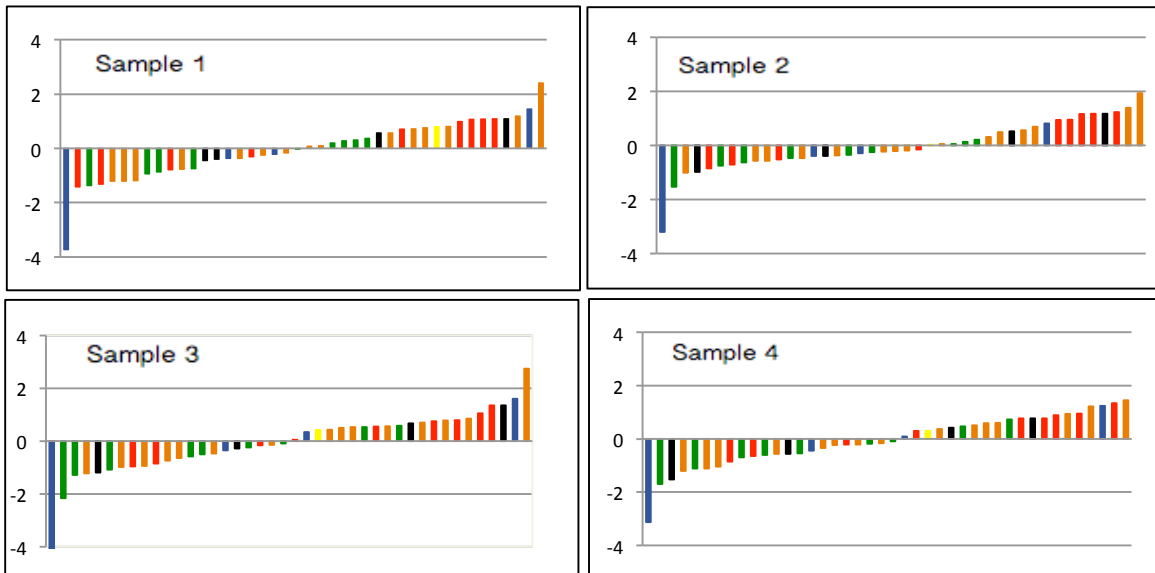
Method	C40A-1	C40A-2	C40A-3	C40A-4
P/T-GCMS	4	4	4	4
GC/FID-1	9	9	9	9
P/T-FID	9	9	9	9
HS-GCF	15	15	15	15
HS-GCMS	4	4	4	4
GC/MSF	1	1	1	1

All summary stats and the plots below are based on the data excluding any flagged outliers

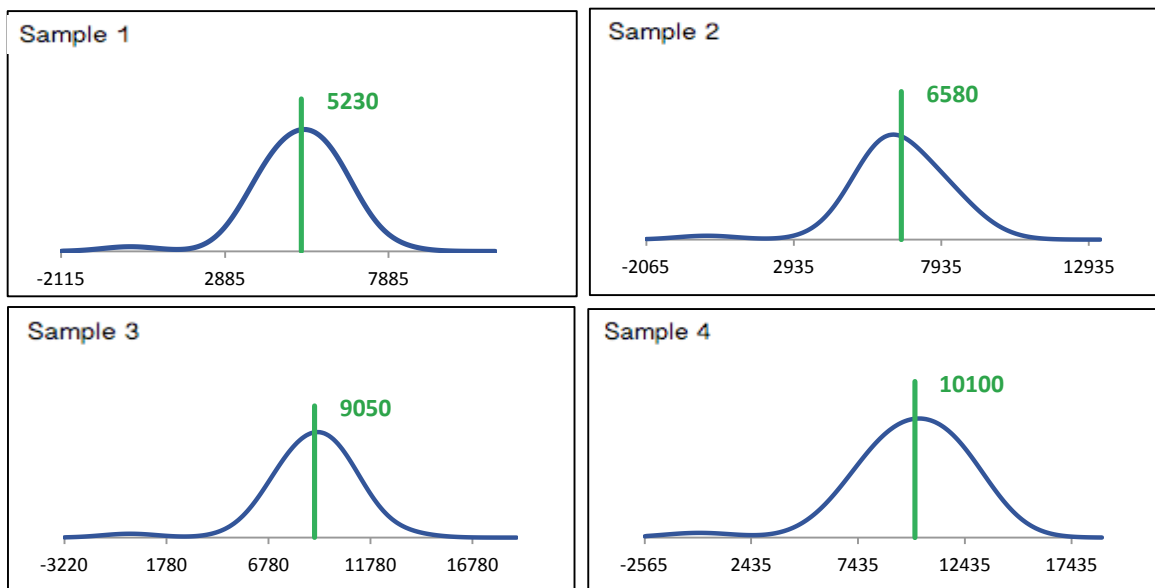


F1: C6-C10

z-Score Plots

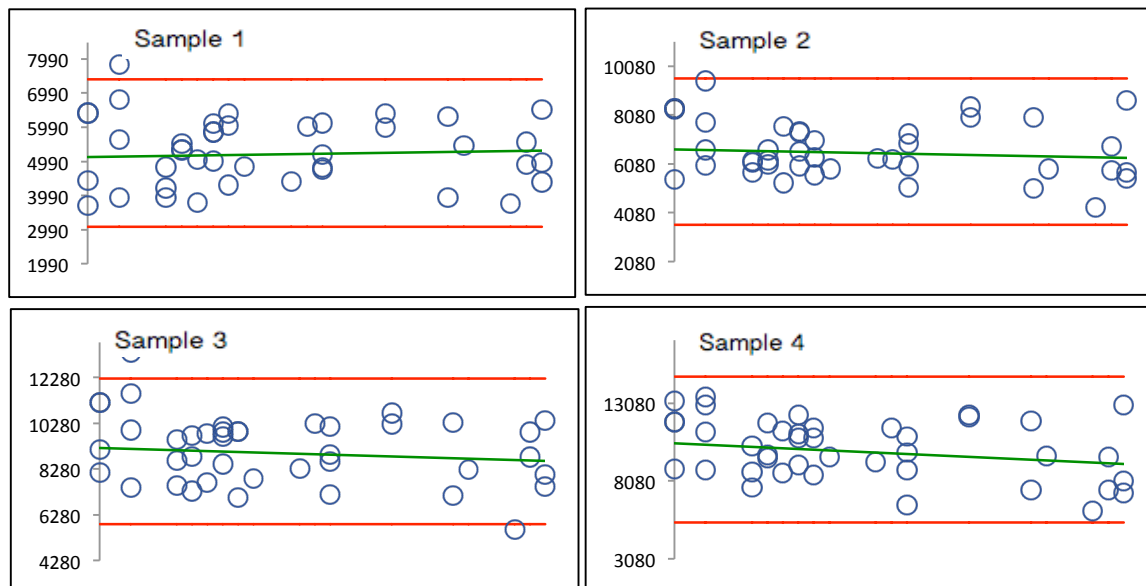


Kernel Density Plots



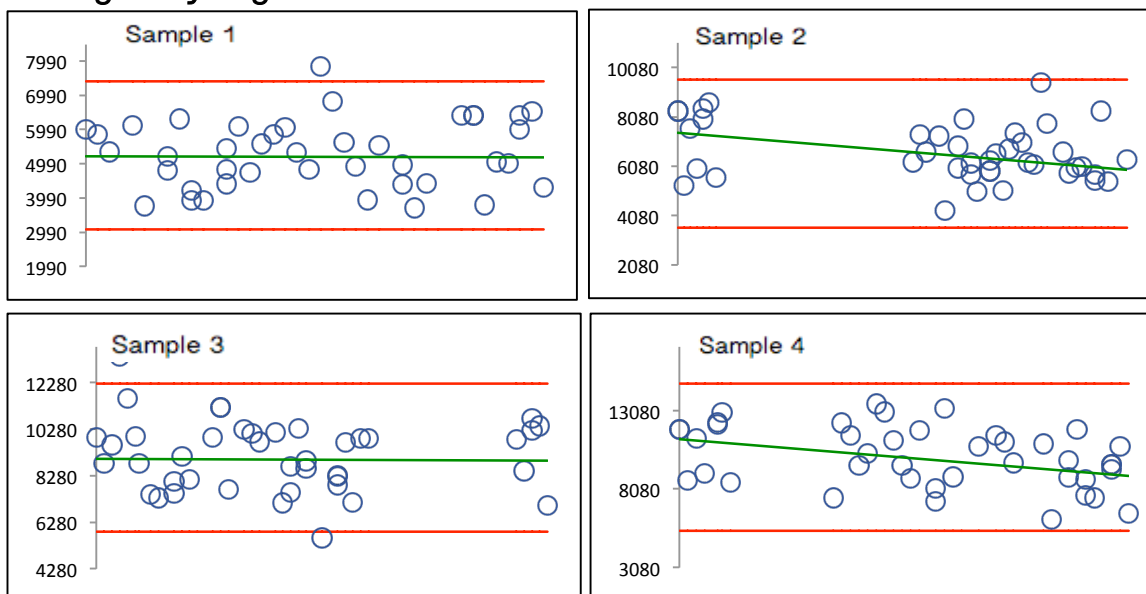
F1: C6-C10

Stability Regression



Reported results (Y-axis) plotted against reported analysis date (X-axis)

Homogeneity Regression



Reported results (Y-axis) plotted against bottling order (X-axis).

M,P-XYLENE

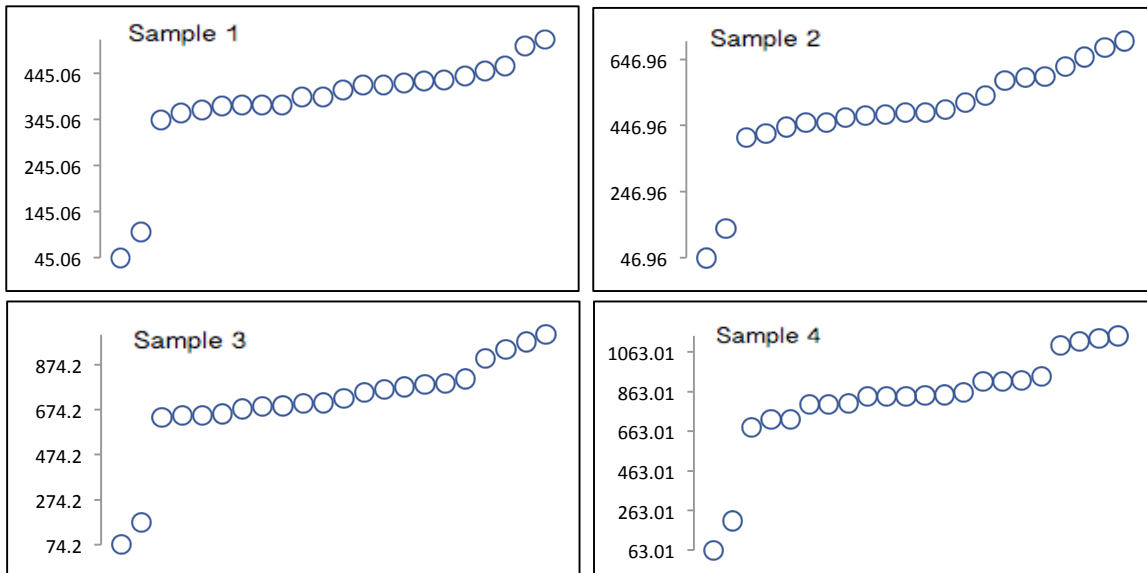
Summary Statistics

Statistic	C40A-1	C40A-2	C40A-3	C40A-4
N	22	22	22	22
Median	402	487	713	843
Robust Mean	403	510	738	861
U	14	29	34	46
Robust Standard Deviation	51.2	109	127	173
Regression Standard Deviation	60.4	76.5	111	129
Stability Flag				
Homogeneity Flag				
Standard Deviation Used (SDPA)	60.4	109	127	173
Outliers	0	0	0	0
$ z > 3.0$	2	2	2	2
$2 < z < 3$	0	0	1	0

Methods Used

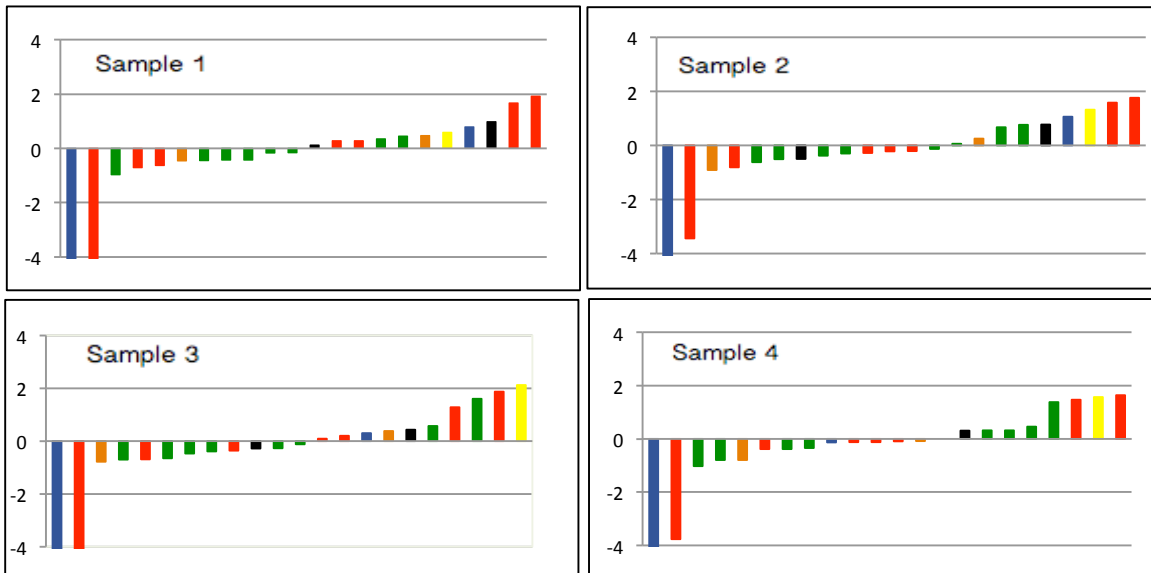
Method	C40A-1	C40A-2	C40A-3	C40A-4
GC/FID-1	2	2	2	2
P/T-GCMS	7	7	7	7
HS-GCMS	8	8	8	8
HS-GCF	2	2	2	2
GC/MSE	2	2	2	2
GC/PID	1	1	1	1

All summary stats and the plots below are based on the data excluding any flagged outliers

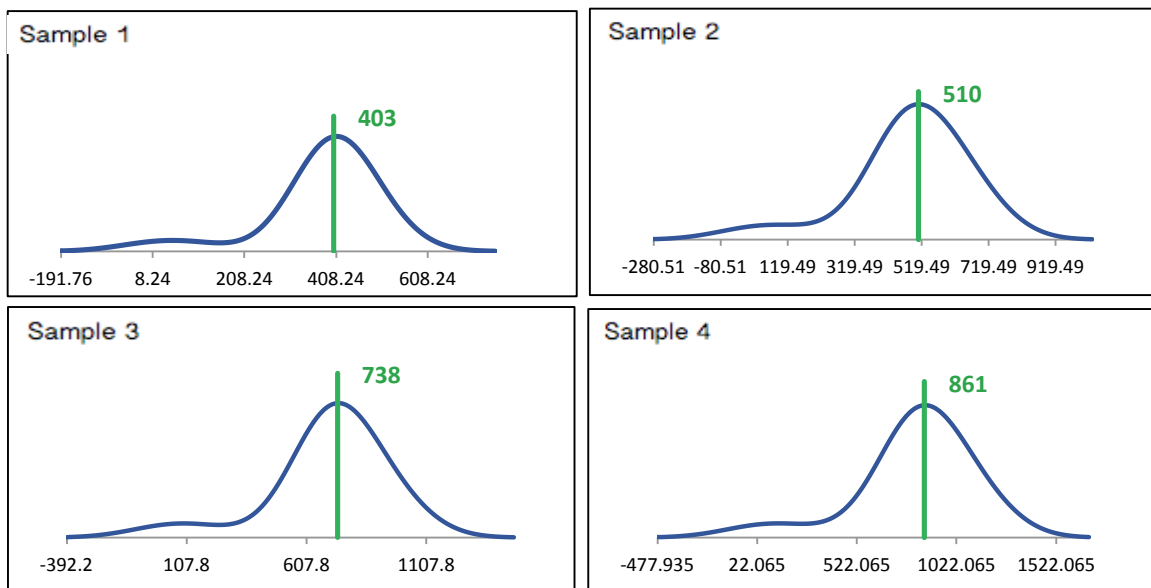


M,P-XYLENE

z-Score Plots

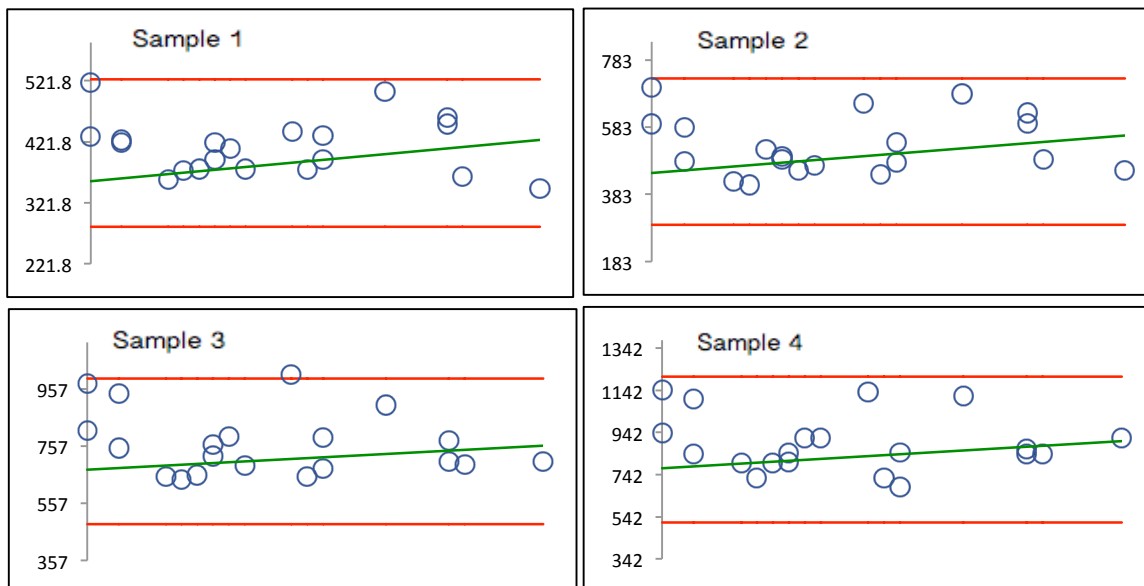


Kernel Density Plots



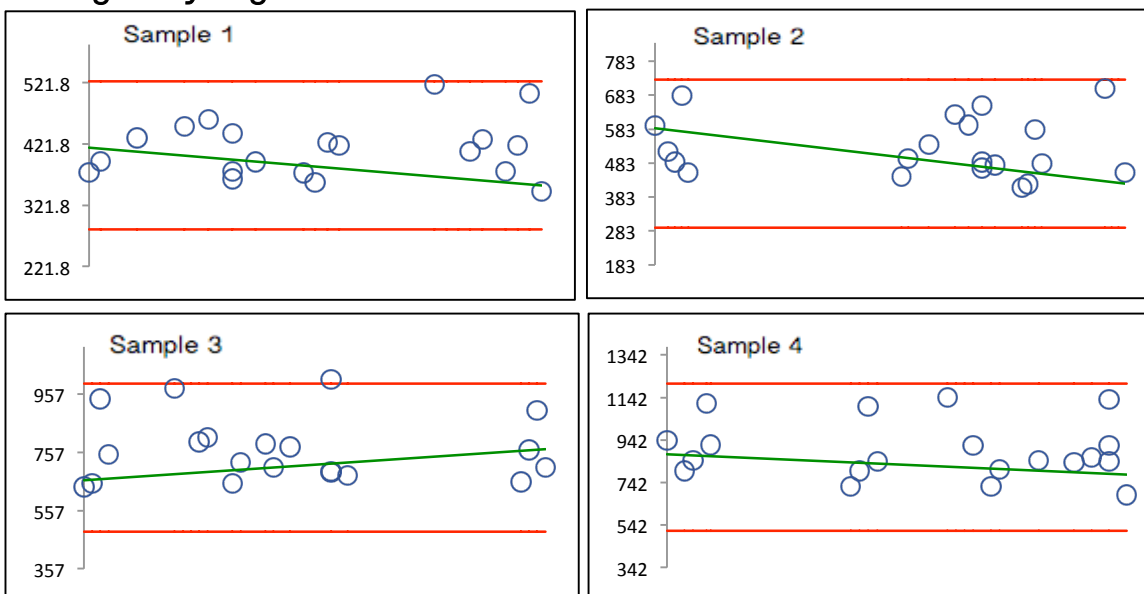
M,P-XYLENE

Stability Regression



Reported results (Y-axis) plotted against reported analysis date (X-axis)

Homogeneity Regression



Reported results (Y-axis) plotted against bottling order (X-axis).

O-XYLENE

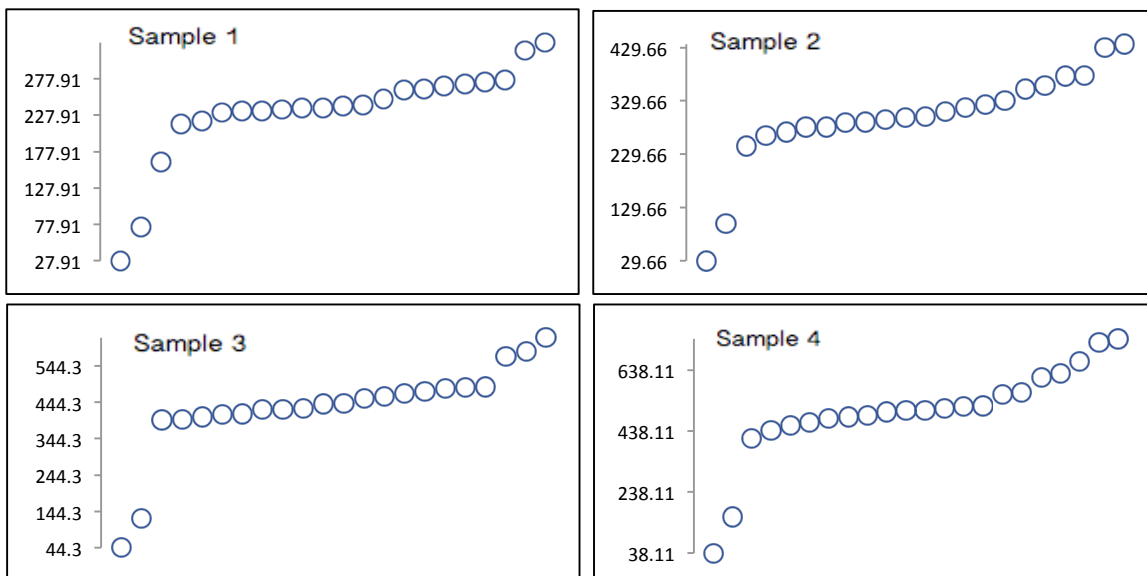
Summary Statistics

Statistic	C40A-1	C40A-2	C40A-3	C40A-4
N	22	22	22	22
Median	240	299	441	504
Robust Mean	244	309	446	518
U	9.0	15	15	27
Robust Standard Deviation	33.9	57.9	56.9	100
Regression Standard Deviation	36.6	46.3	66.9	77.7
Stability Flag				
Homogeneity Flag		Homogeneity		
Standard Deviation Used (SDPA)	36.6	115	66.9	100
Outliers	0	0	0	0
$ z > 3.0$	2	0	2	2
$2 < z < 3$	2	1	2	2

Methods Used

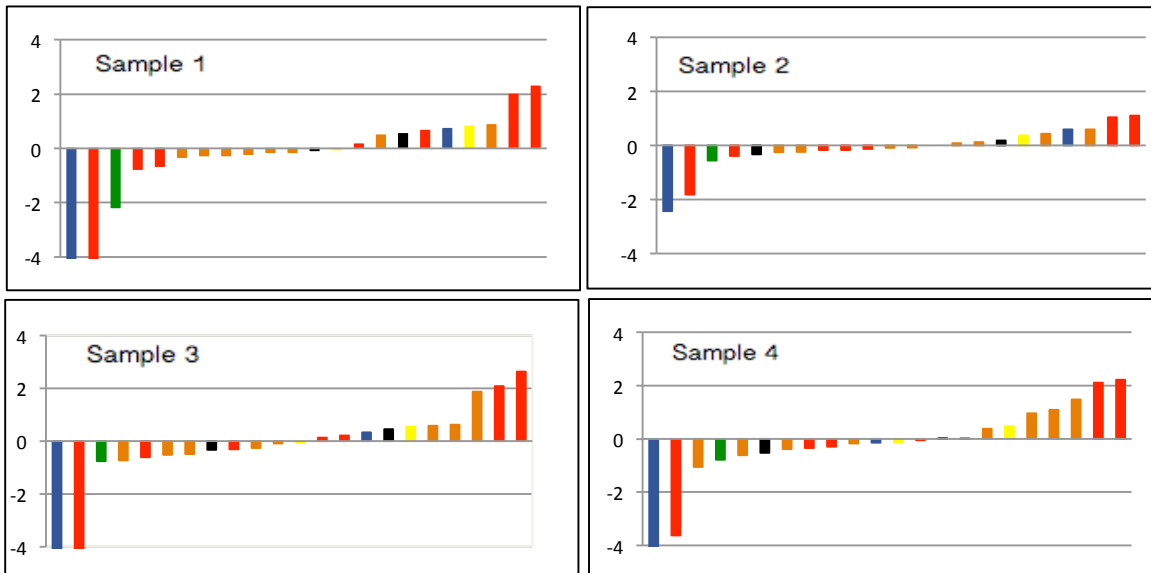
Method	C40A-1	C40A-2	C40A-3	C40A-4
GC/FID-1	2	2	2	2
P/T-GCMS	7	7	7	7
GC/PID	1	1	1	1
HS-GCMS	8	8	8	8
HS-GCF	2	2	2	2
GC/MSE	2	2	2	2

All summary stats and the plots below are based on the data excluding any flagged outliers

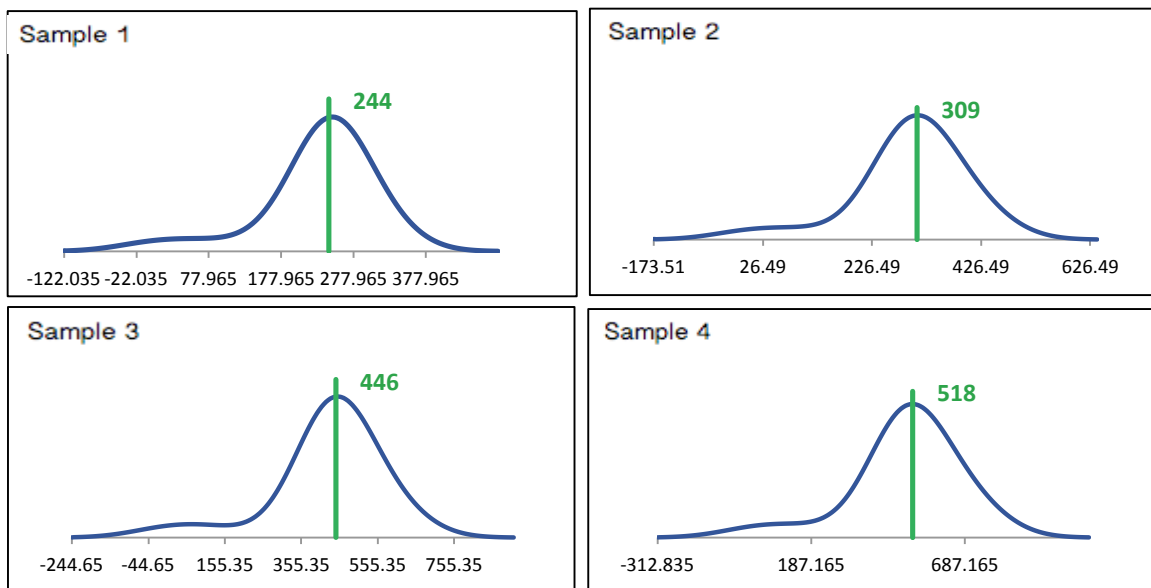


O-XYLENE

z-Score Plots

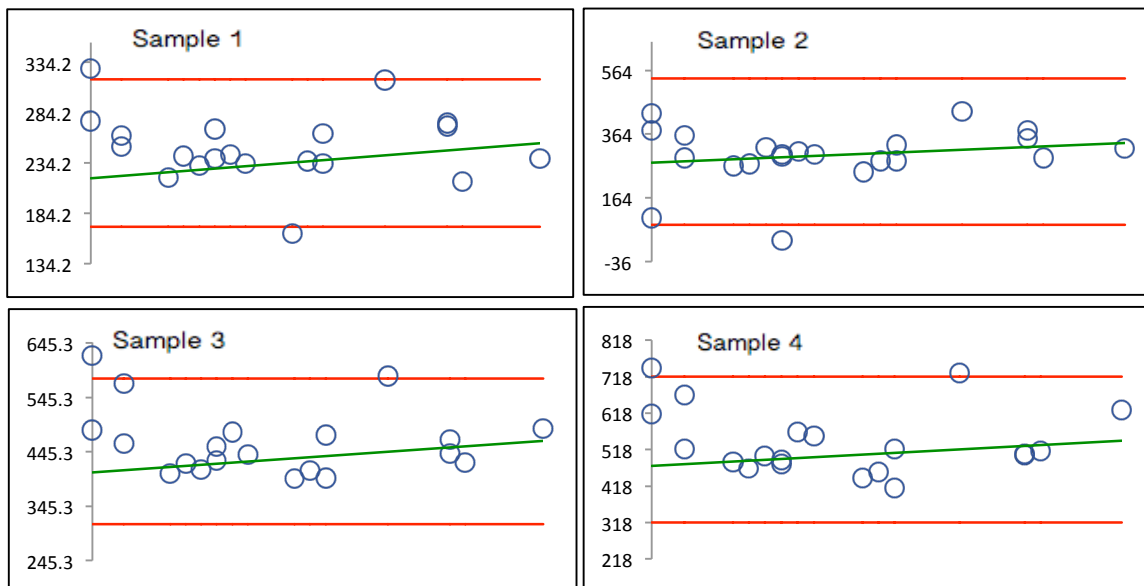


Kernel Density Plots



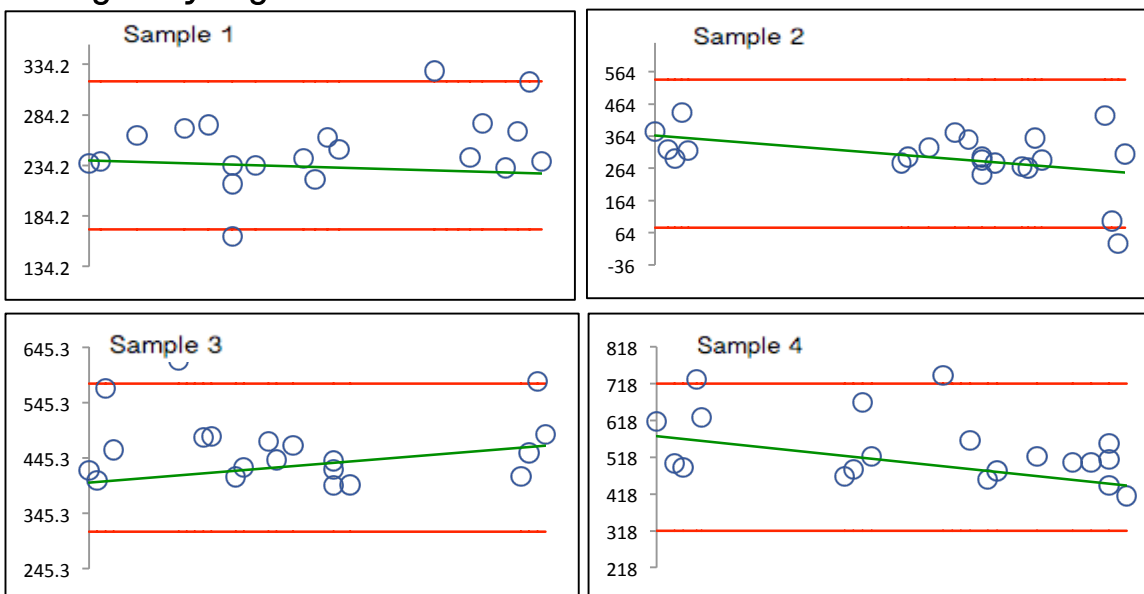
O-XYLENE

Stability Regression



Reported results (Y-axis) plotted against reported analysis date (X-axis)

Homogeneity Regression



Reported results (Y-axis) plotted against bottling order (X-axis).

TOLUENE

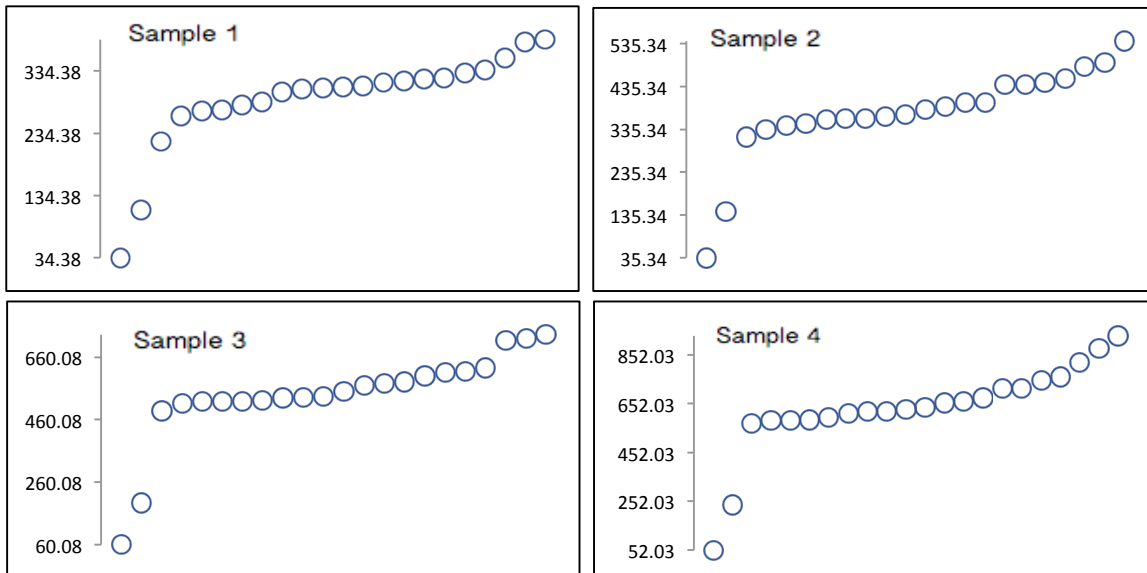
Summary Statistics

Statistic	C40A-1	C40A-2	C40A-3	C40A-4
N	22	22	22	22
Median	308	375	542	631
Robust Mean	302	387	560	654
U	12.2	19	20	29
Robust Standard Deviation	45.9	69.9	75.5	108
Regression Standard Deviation	45.3	58.1	84.0	98.1
Stability Flag				
Homogeneity Flag				
Standard Deviation Used (SDPA)	45.9	69.9	84.0	108
Outliers	0	0	0	0
$ z > 3.0$	2	2	2	2
$2 < z < 3$	0	1	1	2

Methods Used

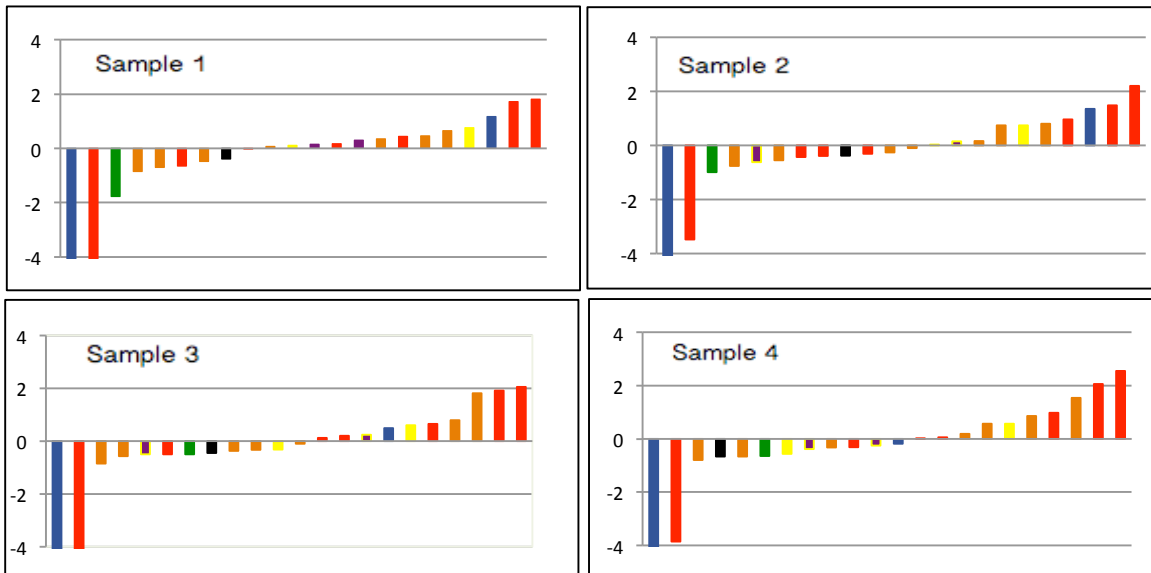
Method	C40A-1	C40A-2	C40A-3	C40A-4
GC/FID-1	2	2	2	2
P/T-GCMS	7	7	7	7
GC/PID	1	1	1	1
HS-GCMS	7	7	7	7
HS-GCP	1	1	1	1
GC/MSE	2	2	2	2
HS-GCF	2	2	2	2

All summary stats and the plots below are based on the data excluding any flagged outliers

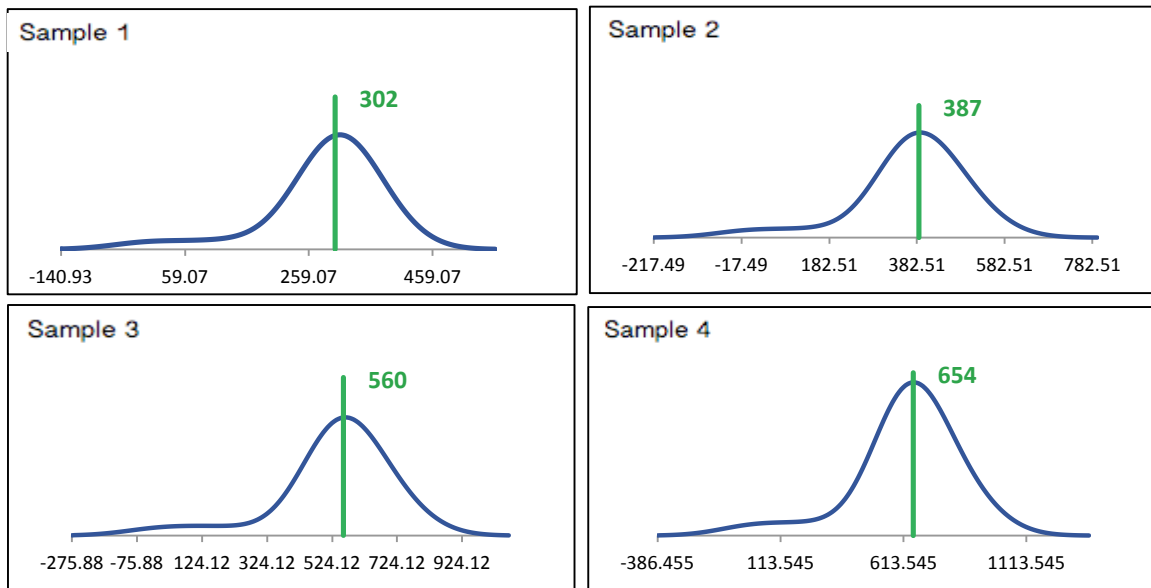


TOLUENE

z-Score Plots

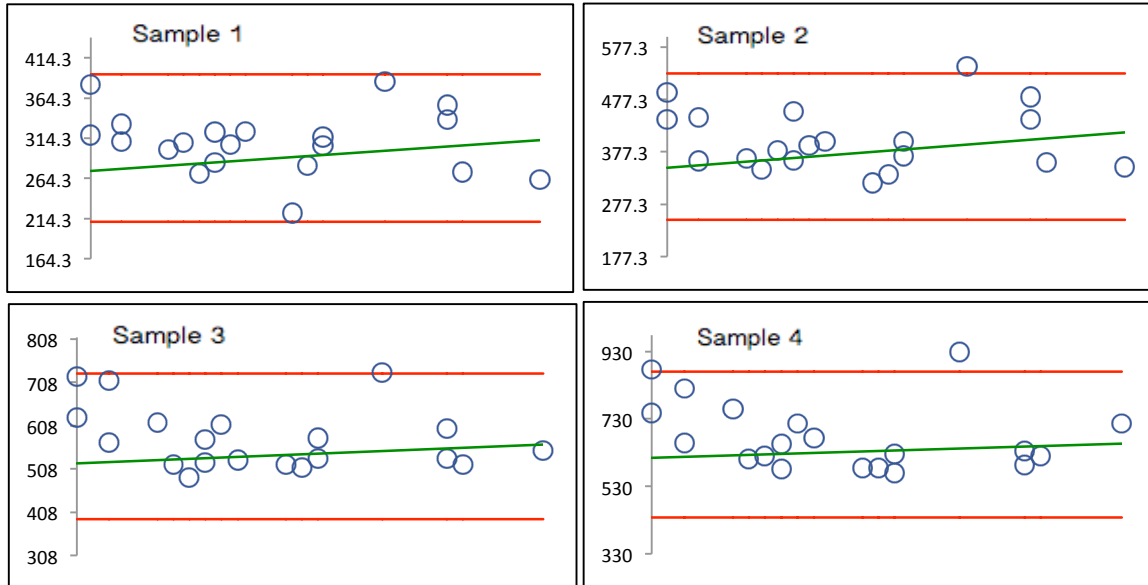


Kernel Density Plots



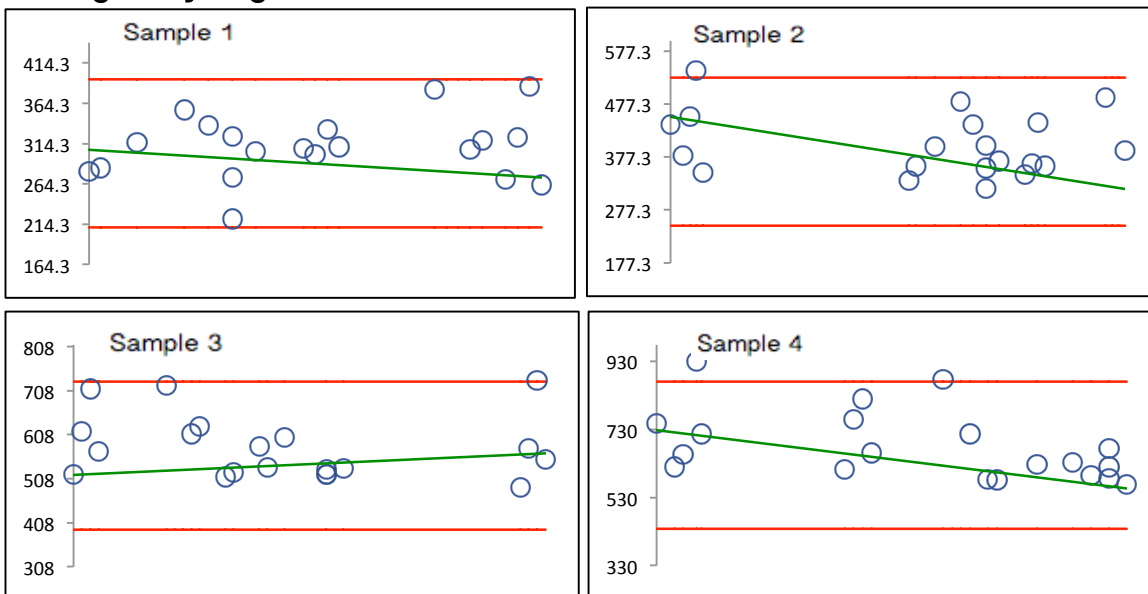
TOLUENE

Stability Regression



Reported results (Y-axis) plotted against reported analysis date (X-axis)

Homogeneity Regression



Reported results (Y-axis) plotted against bottling order (X-axis).

VH: C6-C10

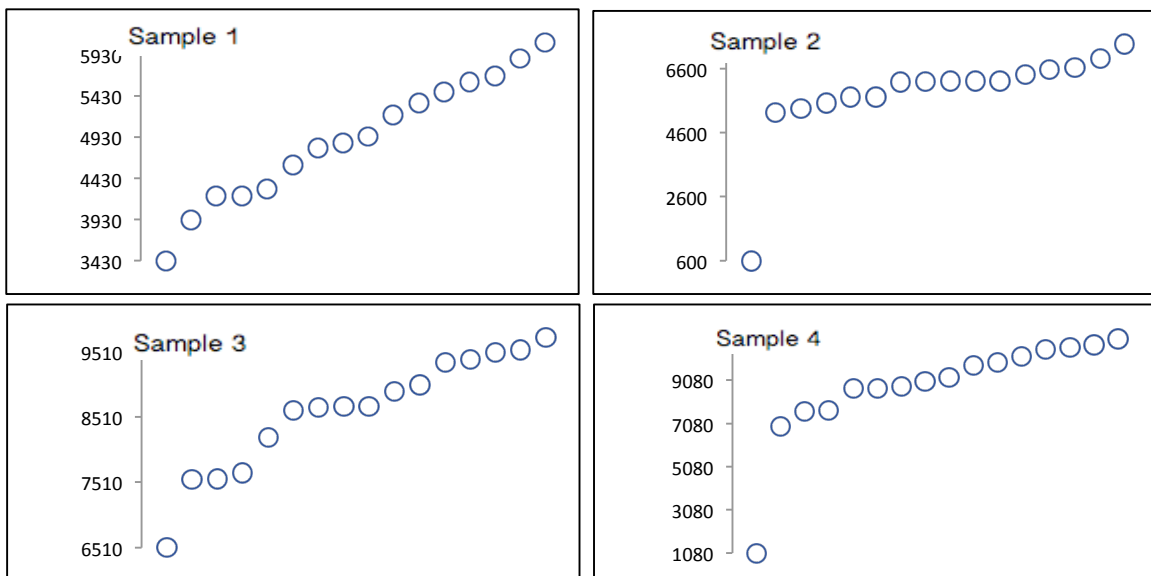
Summary Statistics

Statistic	C40A-1	C40A-2	C40A-3	C40A-4
N	16	16	16	16
Median	4900	6200	8670	9110
Robust Mean	4920	6080	8640	9140
U	257	210	279	475
Robust Standard Deviation	822	671	893	1520
Regression Standard Deviation	917	1100	1520	1600.0
Stability Flag				
Homogeneity Flag				
Standard Deviation Used (SDPA)	917	1100	1520	1600
Outliers	0	0	0	0
$ z > 3.0$	0	1	0	1
$2 < z < 3$	0	0	0	0

Methods Used

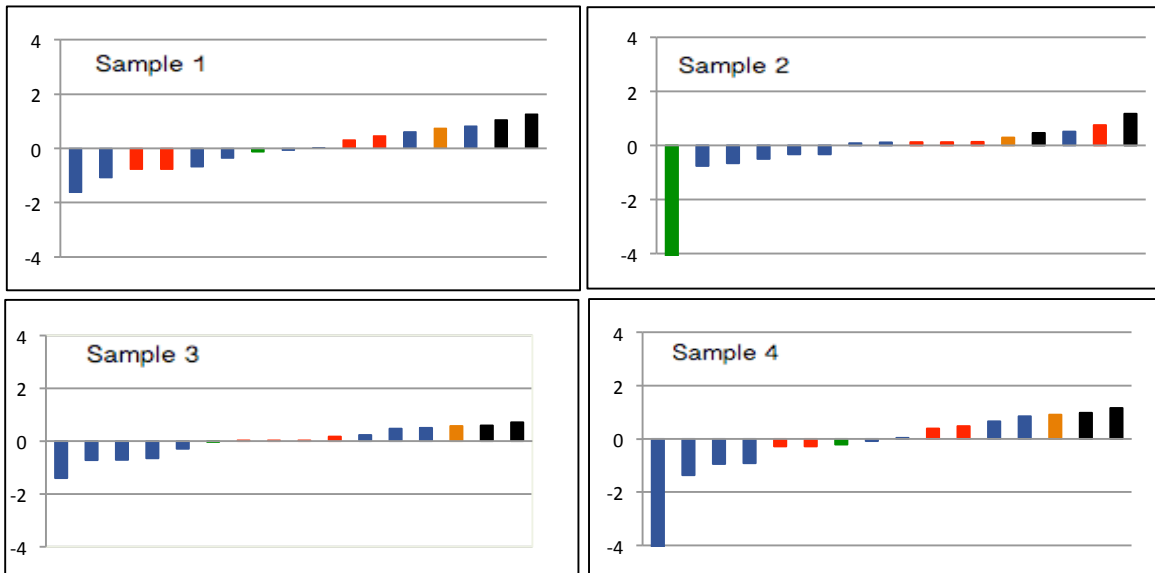
Method	C40A-1	C40A-2	C40A-3	C40A-4
HS-GCF	8	8	8	8
P/T-FID	4	4	4	4
HS-GCMS	1	1	1	1
P/T-GCMS	1	1	1	1
GC/FID-1	2	2	2	2

All summary stats and the plots below are based on the data excluding any flagged outliers

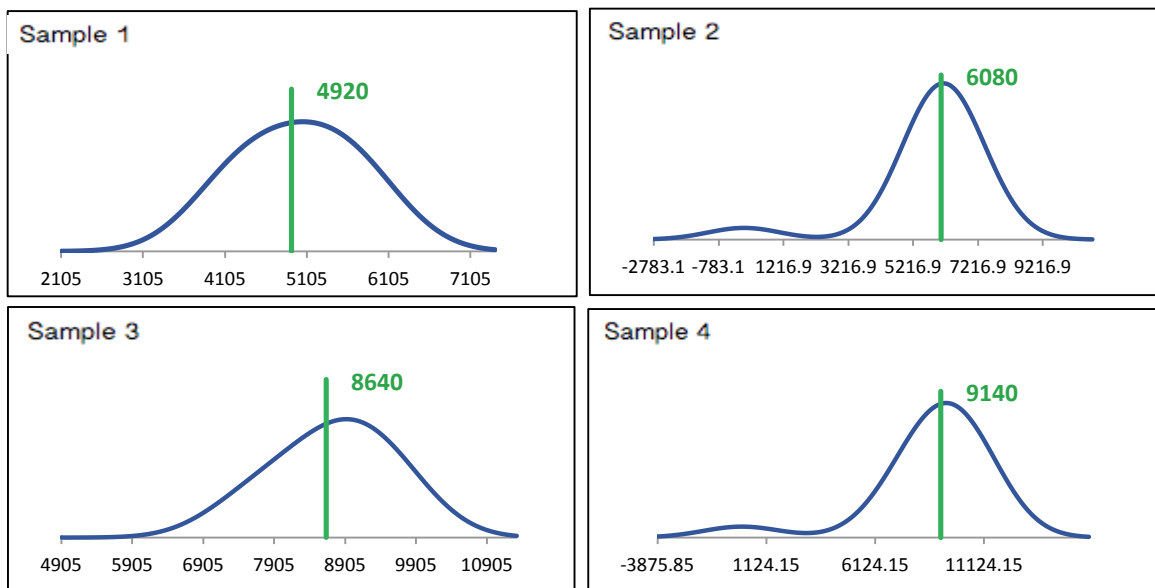


VH: C6-C10

z-Score Plots

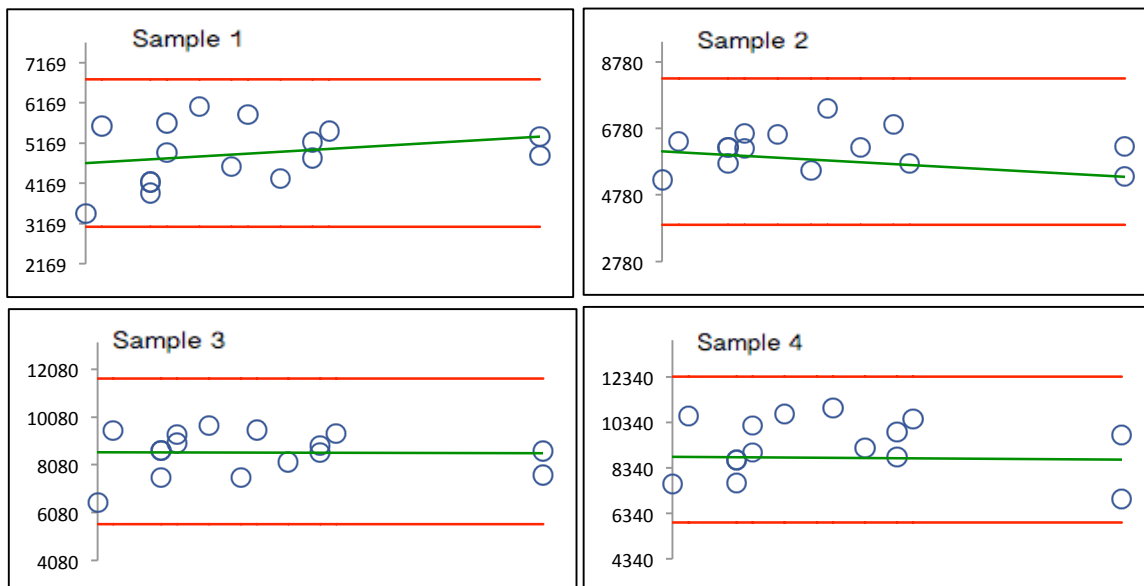


Kernel Density Plots



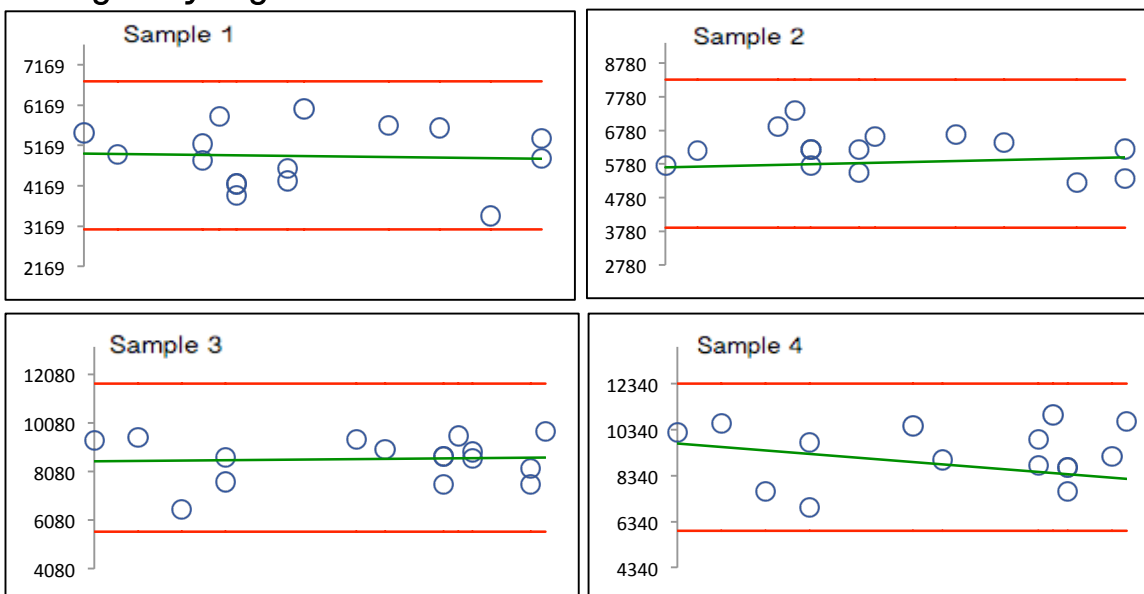
VH: C6-C10

Stability Regression



Reported results (Y-axis) plotted against reported analysis date (X-axis)

Homogeneity Regression



Reported results (Y-axis) plotted against bottling order (X-axis).