

QIBA Pilot 3A Study: Inter- algorithm Performance Investigation

Pilot Summary

Last Updated: 19 April, 2012

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The Spearman correlations between the percent error readings for each lesion of each series were calculated between each pair of participants (for a total of 66 pairs). At first the correlations were found for overall data, and then also for each factor among series, shape, size, and density.

Box-Plots 46

Box Plots for the Percent Error for all Participants 46

The percent error readings for each participant are presented in box-plot form side-by-side.

Comparing Each Individual Participant with Combination of the Non-Reference Participants..... 48

Each participant's percentage error readings are presented in a box-plot beside the box-plot of the readings from all participants that are not the Reference.

Box-Plots by Each Factor for Each Participant 60

Each participant's percentage error readings are split according to the factors to display the differences within factors in box-plot format. These plots are overlaid with the plots produced from all participants together excluding the Reference.

Overview

Frequency Tables

Analysis Participant	Biomarker	Number of members	Method Class	Method Type
Reference	V	97	NA	NA
Group01A	V	97	6	Semi-automatic
	R	97*		
Group02A	V	194**	1	Fully automatic
Group03A	V	97	1	Fully automatic
Group04A	V	97	?	Semi-automatic
Group05A	V	97	1	Fully automatic
Group06A	V	97	?	Fully automatic
Group07A	V	97	3	Semi-automatic
Group08A	V	97	?	Semi-automatic
Group09A	V	97	1	Fully automatic
Group10A	V	97	1	Fully automatic
Group11A	V	97	1	Fully automatic
Group12A	V	97	?	Semi-automatic

*Only the Volume biomarker (V) was considered in this analysis, meaning that 97 of the values from Group01A were ignored so the total number of members considered from Group01A is 97.

**Group02A has repeated readings (one repeat for each case). In the analysis shown here, the repeats were ignored, so the number of members actually considered for Group02A is 97.

Frequency Table within each Participant:

Parameter	Value	Frequency
Shape	Spherical	35
	Elliptical	25
	Lobulated	27
	Spiculated	10
Density (HU)	-630	34
	-10	30
	100	33
Slice Thickness (mm)	5	44
	0.8	53
Size (mm)	8	6
	10	32
	20	48
	40	11

Notes on this data-set:

1. Of the lesions used that are spiculated, only 1 does not have an intensity of -630 HU (lesion #5).
2. The highest average volume read-out value for an intensity of -630 HU is ranked as follows:
 - a. Group 05 – the average read-out is 4316 mm³
 - b. Group 10 – the average read-out is 3265 mm³
 - c. Group 06 – the average read-out is 3084 mm³
 - d. All other participants are <3000 mm³, most around 2500

Tables of Percent Error Means, Overall and by Factors

Percent Error	Pooled % Error Mean	Pooled % Error Variance	Size Mean % Error	Shape Mean % Error	Density Mean % Error	Slice Thickness Mean % Error
REFmaster	-5.65	10720.13	38.97	-19.06	-2.81	-2.48
GRP01master	7.38	267.50	11.78	4.44	7.74	7.81
GRP02master	-5.03	139.85	-2.98	-8.11	-4.68	-4.99
GRP03master	-2.44	91.63	-0.58	-4.62	-2.22	-2.64
GRP04master	-10.30	151.16	-8.48	-13.40	-9.98	-10.41
GRP05master	9.01	3689.60	-1.15	11.16	7.87	8.28
GRP06master	-2.01	206.38	1.78	-3.16	-2.00	-1.95
GRP07master	-8.71	343.29	-3.89	-11.80	-8.54	-8.52
GRP08master	-15.62	222.54	-14.93	-18.28	-15.40	-15.72
GRP09master	-1.71	202.03	2.67	-4.19	-1.43	-1.36
GRP10master	12.25	274.52	16.68	9.16	12.67	12.72
GRP11master	-5.22	142.26	-3.18	-8.32	-4.86	-5.18
GRP12master	4.94	429.45	9.68	1.67	5.22	5.83
AllGroups	-1.46	573.22	0.62	-3.79	-1.30	-1.34
Grp Average + sd	6.94	*	9.39	5.24	6.99	7.16
Grp Average - sd	-9.86	*	-8.16	-12.81	-9.59	-9.85

Visual representation of this data found [here](#), and without reference [here](#).

Absolute Percent Error	Pooled Absolute % Error Mean	Pooled Absolute % Error Variance	Size Mean Absolute % Error	Shape Mean Absolute % Error	Density Mean Absolute % Error	Slice Thickness Mean Absolute % Error
REFmaster	68.00	6080.12	85.23	75.45	67.53	71.15
GRP01master	14.89	98.61	15.93	15.20	14.88	15.26
GRP02master	9.42	75.71	7.17	11.85	9.14	9.56
GRP03master	7.43	41.87	5.68	8.93	7.23	7.42
GRP04master	10.93	137.66	8.94	14.00	10.61	10.99
GRP05master	28.18	2968.90	27.74	28.34	27.62	28.74
GRP06master	10.23	104.75	13.00	10.17	10.28	10.35
GRP07master	16.43	147.10	16.93	18.05	16.41	16.46
GRP08master	17.90	145.07	16.49	20.05	17.73	18.17
GRP09master	10.15	100.86	10.37	12.02	10.04	10.29
GRP10master	14.99	199.23	18.26	13.81	15.27	15.32
GRP11master	9.61	76.42	7.37	12.03	9.32	9.74
GRP12master	15.95	196.89	16.75	17.25	15.90	16.30
AllGroups	13.84	383.52	13.72	15.14	13.70	14.05
Grp Average + sd	19.48	*	19.98	20.43	19.28	19.82
Grp Average - sd	8.21	*	7.45	9.85	8.12	8.28

Visual representation of this data found [here](#), and without reference [here](#).

* These values are omitted since they represent the unusual value of adding the sd to a pooled variance.

Tables of Percent Error Standard Deviations, Overall and by Factors

Percent Error Standard Deviation (SD)	Pooled % Error SD	Size Mean % Error SD	Shape Mean % Error SD	Density Mean % Error SD	Slice Thickness Mean % Error SD
REFmaster	103.54	98.09	95.03	62.84	91.48
GRP01master	16.36	12.54	15.59	12.32	15.76
GRP02master	11.83	8.42	9.64	5.52	11.93
GRP03master	9.57	6.29	7.60	5.84	9.34
GRP04master	12.29	8.41	10.29	5.49	12.15
GRP05master	60.74	40.89	45.21	41.80	60.64
GRP06master	14.37	14.11	13.08	13.83	14.49
GRP07master	18.53	18.58	15.66	17.54	18.59
GRP08master	14.92	13.18	12.61	13.24	14.75
GRP09master	14.21	8.23	13.31	11.57	13.67
GRP10master	16.57	15.16	13.88	13.63	15.82
GRP11master	11.93	8.51	9.76	5.38	12.04
GRP12master	20.72	18.22	20.38	15.87	18.48
AllGroups	23.94	21.11	21.54	21.72	24.02

Visual representation of this data found [here](#), and without reference [here](#).

Absolute Percent Error Standard Deviation (SD)	Pooled Absolute % Error SD	Size Mean Absolute % Error SD	Shape Mean Absolute % Error SD	Density Mean Absolute % Error SD	Slice Thickness Mean Absolute % Error SD
REFmaster	77.98	80.94	64.11	60.60	68.84
GRP01master	9.93	9.02	9.02	9.69	9.02
GRP02master	8.70	5.66	6.93	4.66	8.57
GRP03master	6.47	4.09	5.24	3.44	6.53
GRP04master	11.73	7.97	9.74	5.14	11.70
GRP05master	54.49	34.66	36.97	40.61	54.01
GRP06master	10.23	8.99	9.57	9.42	10.25
GRP07master	12.13	12.49	10.89	11.40	12.24
GRP08master	12.04	11.35	10.53	10.84	11.75
GRP09master	10.04	5.85	8.25	9.05	9.88
GRP10master	14.12	13.26	10.83	12.47	13.34
GRP11master	8.74	5.59	7.10	4.49	8.62
GRP12master	14.03	13.43	13.09	13.63	13.39
AllGroups	19.58	16.31	16.25	17.38	19.50

Visual representation of this data found [here](#), and without reference [here](#).

Tables of Percent Error Means for Significance Group Clusters

The participants were split into three clusters based on similarity of percent error means, and the average percent error for each factor group is calculated.

Note: Cluster A is Participants 01, 05, 10, and 12. Cluster B is Participants 03, 06, and 09. Cluster C is Participants 02, 04, 07, 08, and 11.

	Pooled % Error Mean	Pooled % Error Variance	Size Mean % Error	Shape Mean % Error	Density Mean % Error	Slice Thickness Mean % Error
Group A	8.39	1165.27	9.25	6.61	8.37	8.66
Group B	-2.06	166.68	1.29	-3.99	-1.88	-1.98
Group C	-8.98	199.82	-6.69	-11.98	-8.69	-8.96
Grp Average	-1.46	513.35	0.62	-3.79	-1.30	-1.34
Grp Average + sd	6.94	*	9.39	5.24	6.99	7.16
Grp Average - sd	-9.86	*	-8.16	-12.81	-9.59	-9.85

Visual representation of this data as well as ANOVA used to determine these clusters can be found [here](#).

The participants were split into two clusters based on similarity of absolute percent error means.

Note: Cluster A is Participants 01, 05, 07, 08, 10, and 12. Cluster B is 02, 03, 04, 06, 09, and 11.

	Pooled Absolute % Error Mean	Pooled Absolute % Error Variance	Size Mean Absolute % Error	Shape Mean Absolute % Error	Density Mean Absolute % Error	Slice Thickness Mean Absolute % Error
Group A	18.06	625.97	18.68	18.78	17.97	18.38
Group B	9.63	89.54	8.75	11.50	9.44	9.73
Grp Average	13.84	357.76	13.72	15.14	13.70	14.05
Grp Average + sd	19.48	*	19.98	20.43	19.28	19.82
Grp Average - sd	8.21	*	7.45	9.85	8.12	8.28

Visual representation of this data as well as ANOVA used to determine these clusters can be found [here](#).

* These values are omitted since they represent the unusual value of adding the sd to a pooled variance.

Table of Percent Error Means for Each Individual Characteristic

For each of the 12 participants:

	Pooled Mean	8mm	10 mm	20 mm	40 mm	ell	lob	sph	spi	-630H U	-10 HU	100 HU	.8mm	5mm
REFmaster	-5.65	186.36	-3.98	-33.71	7.20	-37.99	-10.62	38.59	-66.22	-99.41	56.64	34.33	-36.66	31.70
GRP01 master	7.38	27.62	14.01	1.11	4.38	4.09	9.37	12.69	-8.39	-7.25	14.53	15.94	3.19	12.42
GRP02 master	-5.03	-0.96	-6.05	-6.35	1.45	-9.99	-2.04	0.84	-21.28	-19.10	1.95	3.12	-5.41	-4.58
GRP03 master	-2.44	3.49	-0.10	-5.19	-0.51	-5.90	1.52	0.43	-14.53	-11.82	1.86	3.31	-0.51	-4.76
GRP04 master	-10.30	-9.33	-11.49	-11.67	-1.44	-8.93	-11.94	-5.06	-27.67	-24.83	-4.54	-0.57	-9.23	-11.59
GRP05 master	9.01	-36.84	24.22	6.25	1.79	7.26	32.95	-9.67	14.09	50.96	-14.66	-12.71	16.09	0.48
GRP06 master	-2.01	15.36	2.02	-6.47	-3.78	-5.17	0.81	-0.21	-8.07	-1.44	-1.38	-3.17	-2.60	-1.30
GRP07 master	-8.71	10.86	-5.83	-13.44	-7.12	-7.88	-8.65	-4.32	-26.35	-16.74	-5.68	-3.20	-10.64	-6.40
GRP08 master	-15.62	-12.05	-15.59	-15.97	-16.12	-13.23	-19.91	-9.86	-30.14	-25.19	-11.71	-9.30	-14.62	-16.82
GRP09 master	-1.71	16.44	1.73	-6.42	-1.09	-6.53	0.46	3.67	-14.34	-12.44	3.96	4.19	-5.13	2.41
GRP10 master	12.25	35.48	18.34	6.68	6.22	8.67	11.67	19.75	-3.45	1.12	22.21	14.67	7.68	17.76
GRP11 master	-5.22	-1.33	-6.45	-6.42	1.46	-9.87	-2.63	0.78	-21.58	-19.58	1.91	3.10	-5.61	-4.75
GRP12 master	4.94	26.91	7.30	0.93	3.58	0.99	5.46	12.18	-11.94	-12.16	8.63	19.21	-3.79	15.46
AllGroups	-1.46	6.31	1.84	-4.75	-0.93	-3.87	1.42	1.77	-14.47	-8.21	1.42	2.88	-2.55	-0.14

Visual representation of this data found [here](#).

Table of Percent Error Means for Each Individual Characteristic by Cluster

Split according to the significance clusters determined by similarity in percent error means.

Note: Cluster A is Participants 01, 05, 10, and 12. Cluster B is Participants 03, 06, and 09. Cluster C is Participants 02, 04, 07, 08, and 11.

	Pooled Mean	8mm	10 mm	20 mm	40 mm	ell	lob	sph	spi	-630 HU	-10 HU	100 HU	.8 mm	5mm
GroupA	8.39	13.29	15.97	3.74	3.99	5.25	14.86	8.74	-2.42	8.17	7.68	9.28	5.79	11.53
GroupB	-2.06	11.77	1.22	-6.02	-1.80	-5.87	0.93	1.30	-12.31	-8.57	1.48	1.44	-2.75	-1.22
GroupC	-8.98	-2.56	-9.08	-10.77	-4.36	-9.98	-9.03	-3.52	-25.40	-21.09	-3.61	-1.37	-9.10	-8.83
GroupAvg	-1.46	6.31	1.84	-4.75	-0.93	-3.87	1.42	1.77	-14.47	-8.21	1.42	2.88	-2.55	-0.14

Visual representation of this data found [here](#).

Table of Percent Error Means for Each Individual Characteristic by Method

Split according to reading method type (either fully or semi-automatic).

Note: Fully-Automatic is Participants 02, 03, 05, 06, 09, 10, and 11. Semi-Automatic is Participants 01, 04, 07, 08, and 12.

	Pooled Mean	8mm	10mm	20mm	40mm	ell	lob	sph	spi	-630 HU	-10HU	100 HU	.8mm	5mm
Fully auto	0.69	4.52	4.82	-2.56	0.79	-3.08	6.11	2.23	-9.88	-1.76	2.27	1.79	0.64	0.75
Semi auto	-4.46	8.80	-2.32	-7.81	-3.34	-4.99	-5.13	1.13	-20.90	-17.24	0.24	4.42	-7.02	-1.39
Group Avg	-1.46	6.31	1.84	-4.75	-0.93	-3.87	1.42	1.77	-14.47	-8.21	1.42	2.88	-2.55	-0.14

Visual representation of this data found [here](#).

Table of Percent Error Standard Deviations for Each Individual Characteristic

For each of the 12 participants:

	Pooled SD	8mm	10mm	20mm	40mm	ell	lob	sph	spi	-630	-10	100	.8mm	5mm
REFmaster	103.54	210.48	107.49	63.13	11.26	63.00	92.41	118.65	106.05	0.89	118.89	68.73	45.97	136.98
GRP01 master	16.36	17.08	16.05	14.83	2.18	16.07	17.14	12.82	16.35	13.63	12.99	10.36	12.68	18.85
GRP02 master	11.83	5.90	15.00	10.88	1.91	12.83	10.31	5.95	9.48	6.62	4.04	5.91	10.83	13.04
GRP03 master	9.57	2.66	11.73	8.83	1.95	11.27	9.77	3.92	5.45	9.99	3.89	3.65	9.72	8.96
GRP04 master	12.29	5.46	13.78	12.58	1.81	12.35	13.56	5.89	9.35	7.94	5.16	3.35	13.24	11.06
GRP05 master	60.74	43.57	99.21	19.91	0.87	20.22	104.30	27.74	28.59	84.44	25.94	15.01	59.65	61.62
GRP06 master	14.37	29.88	17.41	7.44	1.73	7.12	18.47	14.86	11.87	17.29	16.69	7.51	12.84	16.13
GRP07 master	18.53	34.09	23.09	11.92	5.23	16.67	16.38	20.88	8.73	16.44	22.21	13.98	16.78	20.39
GRP08 master	14.92	10.37	19.56	12.98	9.81	10.85	15.97	14.63	8.98	11.70	14.28	13.73	10.50	18.99
GRP09 master	14.21	3.96	20.92	7.03	1.01	10.59	18.20	8.63	15.81	9.50	9.78	15.43	10.21	17.12
GRP10 master	16.57	28.76	19.23	9.62	3.04	12.50	13.61	18.79	10.62	13.42	19.45	8.01	12.42	19.23
GRP11 master	11.93	6.03	15.11	10.98	1.91	12.82	10.78	6.05	9.38	6.08	4.16	5.90	10.97	13.11
GRP12 master	20.72	25.68	27.12	15.33	4.75	15.47	23.99	16.94	25.10	11.97	19.91	15.75	15.36	21.59
AllGroups	23.94	28.28	35.21	14.08	6.85	15.09	35.49	17.04	18.52	32.94	17.96	14.25	22.28	25.76

Visual representation of this data found [here](#), and without Group05 [here](#).

Table of Percent Error Standard Deviations for Each Individual Characteristic by Cluster

Split according to the significance clusters determined by similarity in percent error means.

Note: Cluster A is Participants 01, 05, 10, and 12. Cluster B is Participants 03, 06, and 09. Cluster C is Participants 02, 04, 07, 08, and 11.

	Pooled SD	8mm	10mm	20mm	40mm	ell	lob	sph	spi	-630	-10	100	.8mm	5mm
Grou pA	34.11	41.05	52.67	15.48	3.36	16.32	54.91	22.53	22.90	50.05	24.19	17.96	32.64	35.64
Grou pB	12.87	17.48	16.96	7.77	2.13	9.71	15.80	10.22	11.82	13.62	11.48	10.55	11.10	14.72
Grou pC	14.61	17.39	17.86	12.41	8.37	13.15	14.97	12.81	9.48	10.90	13.19	10.60	13.05	16.31
Grou pAvg	23.94	28.28	35.21	14.08	6.85	15.09	35.49	17.04	18.52	32.94	17.96	14.25	22.28	25.76

Visual representation of this data found [here](#).

Table of Percent Error Standard Deviations for Each Individual Characteristic by Method

Split according to reading method type (either fully or semi-automatic).

Note: Fully-Automatic is Participants 02, 03, 05, 06, 09, 10, and 11. Semi-Automatic is Participants 01, 04, 07, 08, and 12.

	Pooled SD	8mm	10mm	20mm	40mm	ell	lob	sph	spi	-630	-10	100	.8mm	5mm
Fully auto	26.72	29.85	41.55	12.67	3.41	14.68	42.51	16.62	18.27	40.21	17.47	12.33	25.79	27.85
Semi auto	19.02	26.23	23.16	15.35	9.35	15.64	20.66	17.65	17.06	14.34	18.62	16.48	15.10	22.51
Grou pAvg	23.94	28.28	35.21	14.08	6.85	15.09	35.49	17.04	18.52	32.94	17.96	14.25	22.28	25.76

Visual representation of this data found [here](#).

CT Profiles

CT Profile Excluding 5mm and -630HU, Tables of Means

The following data is obtained if all readings of density -630 HU are removed, and only slices of thickness 0.8mm are considered:

	Pooled % Error Mean	Size Mean % Error	Shape Mean % Error	Density Mean % Error	Slice Thickness Mean % Error
ref	-4.18	-4.50	-4.02	-4.15	-4.18
grp01	9.62	9.50	10.34	9.66	9.62
grp02	1.05	1.48	0.81	1.02	1.05
grp03	3.83	3.36	4.22	3.85	3.83
grp04	-0.24	-1.09	0.08	-0.20	-0.24
grp05	-3.29	-1.46	-3.96	-3.34	-3.29
grp06	-8.51	-8.44	-8.56	-8.46	-8.51
grp07	-5.87	-3.26	-5.21	-5.75	-5.87
grp08	-9.34	-9.01	-9.67	-9.30	-9.34
grp09	-0.31	2.49	-0.33	-0.34	-0.31
grp10	13.85	11.91	14.34	13.82	13.85
grp11	1.08	1.50	0.85	1.05	1.08
grp12	4.43	4.88	4.90	4.64	4.43
AllGroups	0.53	0.99	0.65	0.55	0.53

Visual representation of this data found [here](#).

	Pooled Absolute % Error Mean	Size Mean Absolute % Error	Shape Mean Absolute % Error	Density Mean Absolute % Error	Slice Thickness Mean Absolute % Error
ref	5.01	5.11	5.10	5.00	5.01
grp01	9.62	9.50	10.34	9.66	9.62
grp02	3.01	2.96	3.32	3.03	3.01
grp03	3.92	3.49	4.29	3.94	3.92
grp04	1.96	2.32	2.08	1.95	1.96
grp05	6.51	5.67	6.96	6.57	6.51
grp06	8.51	8.44	8.56	8.46	8.51
grp07	13.49	15.13	13.31	13.43	13.49
grp08	10.32	9.73	10.92	10.30	10.32
grp09	5.53	6.90	5.65	5.50	5.53
grp10	13.86	11.93	14.35	13.83	13.86
grp11	3.04	2.97	3.35	3.06	3.04
grp12	8.82	8.29	9.69	8.90	8.82
AllGroups	7.38	7.28	7.74	7.39	7.38

Visual representation of this data found [here](#).

CT Profile Excluding 5mm and -630HU, Tables of Standard Deviations

And here are the SD values for only thickness 0.8 mm and no density -630 HU:

	Pooled % Error SD	Size Mean % Error SD	Shape Mean % Error SD	Density Mean % Error SD	Thickness Mean % Error SD
ref	6.01	3.68	4.71	5.77	6.01
grp01	6.46	4.63	6.03	6.42	6.46
grp02	4.65	2.87	4.06	4.19	4.65
grp03	3.58	2.23	3.37	3.56	3.58
grp04	3.17	2.07	2.51	2.88	3.17
grp05	8.52	6.32	8.15	8.22	8.52
grp06	3.91	1.62	3.65	3.66	3.91
grp07	16.65	17.59	15.85	16.30	16.65
grp08	6.97	5.91	7.23	6.84	6.97
grp09	7.27	3.26	6.22	7.24	7.27
grp10	9.63	3.92	9.27	9.73	9.63
grp11	4.65	2.90	4.08	4.20	4.65
grp12	11.77	10.16	12.30	9.34	11.77
AllGroups	10.44	9.43	10.61	10.41	10.44

Visual representation of this data found [here](#).

And the corresponding absolute value SD's:

	Pooled Absolute % Error SD	Size Mean Absolute % Error SD	Shape Mean Absolute % Error SD	Density Mean Absolute % Error SD	Thickness Mean Absolute % Error SD
ref	5.32	2.94	4.49	5.22	5.32
grp01	6.46	4.63	6.03	6.42	6.46
grp02	3.67	1.96	3.26	3.37	3.67
grp03	3.47	2.05	3.28	3.47	3.47
grp04	2.49	1.65	2.24	2.40	2.49
grp05	6.33	4.43	6.14	5.91	6.33
grp06	3.91	1.62	3.65	3.66	3.91
grp07	11.20	9.46	10.27	11.09	11.20
grp08	5.36	4.82	5.00	5.40	5.36
grp09	4.64	1.79	4.49	4.61	4.64
grp10	9.61	3.88	9.26	9.71	9.61
grp11	3.65	1.99	3.21	3.37	3.65
grp12	8.87	7.45	8.61	8.21	8.87
AllGroups	7.40	6.13	7.27	7.41	7.40

Visual representation of this data found [here](#).

CT Profile Excluding 5mm and -630HU and 8mm, Percent Error Means

The following data is obtained if all readings of density -630 HU, thickness 5mm, and size 8mm are removed:

	Pooled % Error Mean	Size Mean % Error	Shape Mean % Error	Density Mean % Error	Slice Thickness Mean % Error
ref	-4.06	-4.17	-3.92	-4.13	-4.06
grp01	9.21	8.00	9.77	9.09	9.21
grp02	0.79	0.71	0.65	0.84	0.79
grp03	3.86	3.30	4.11	3.81	3.86
grp04	0.17	0.08	0.34	0.11	0.17
grp05	-3.85	-2.85	-4.19	-3.75	-3.85
grp06	-8.19	-7.30	-8.27	-8.27	-8.19
grp07	-6.93	-6.16	-6.27	-7.28	-6.93
grp08	-9.25	-8.59	-9.48	-9.35	-9.25
grp09	-1.73	-1.64	-1.45	-1.76	-1.73
grp10	14.18	12.45	14.48	14.27	14.18
grp11	0.83	0.74	0.70	0.88	0.83
grp12	3.93	3.25	4.36	3.40	3.93
AllGroups	0.25	0.17	0.40	0.17	0.25

Visual representation of this data found [here](#).

	Pooled Absolute % Error Mean	Size Mean Absolute % Error	Shape Mean Absolute % Error	Density Mean Absolute % Error	Slice Thickness Mean Absolute % Error
ref	4.97	4.98	4.99	4.99	4.97
grp01	9.21	8.00	9.77	9.09	9.21
grp02	2.94	2.68	3.17	2.88	2.94
grp03	3.96	3.47	4.20	3.92	3.96
grp04	1.71	1.56	1.85	1.70	1.71
grp05	6.60	5.69	6.91	6.48	6.60
grp06	8.19	7.30	8.27	8.27	8.19
grp07	12.22	11.15	12.37	12.28	12.22
grp08	10.32	9.54	10.73	10.36	10.32
grp09	4.65	4.24	4.90	4.65	4.65
grp10	14.19	12.48	14.49	14.28	14.19
grp11	2.97	2.71	3.21	2.91	2.97
grp12	8.73	7.79	9.32	8.52	8.73
AllGroups	7.14	6.38	7.43	7.11	7.14

Visual representation of this data found [here](#).

CT Profile Excluding 5mm and -630HU and 8mm, Percent Error Standard Deviations

And here are the SD values for excluded thickness 5 mm and density -630 HU and size 8 mm:

	Pooled % Error SD	Size Mean % Error SD	Shape Mean % Error SD	Density Mean % Error SD	Slice Thickness Mean % Error SD
ref	6.28	4.78	4.81	5.96	6.28
grp01	6.35	3.71	5.27	6.01	6.35
grp02	4.78	3.39	3.97	4.19	4.78
grp03	3.74	2.77	3.41	3.73	3.74
grp04	2.99	2.39	2.21	2.64	2.99
grp05	8.52	6.06	8.13	8.08	8.52
grp06	3.94	1.81	3.65	3.76	3.94
grp07	14.14	10.95	13.43	12.66	14.14
grp08	6.93	4.91	6.73	6.64	6.93
grp09	5.76	3.56	4.35	5.77	5.76
grp10	10.02	5.07	9.64	10.07	10.02
grp11	4.78	3.42	3.99	4.21	4.78
grp12	11.79	9.46	11.51	7.43	11.79
AllGroups	10.14	8.21	10.18	10.00	10.14

Visual representation of this data found [here](#).

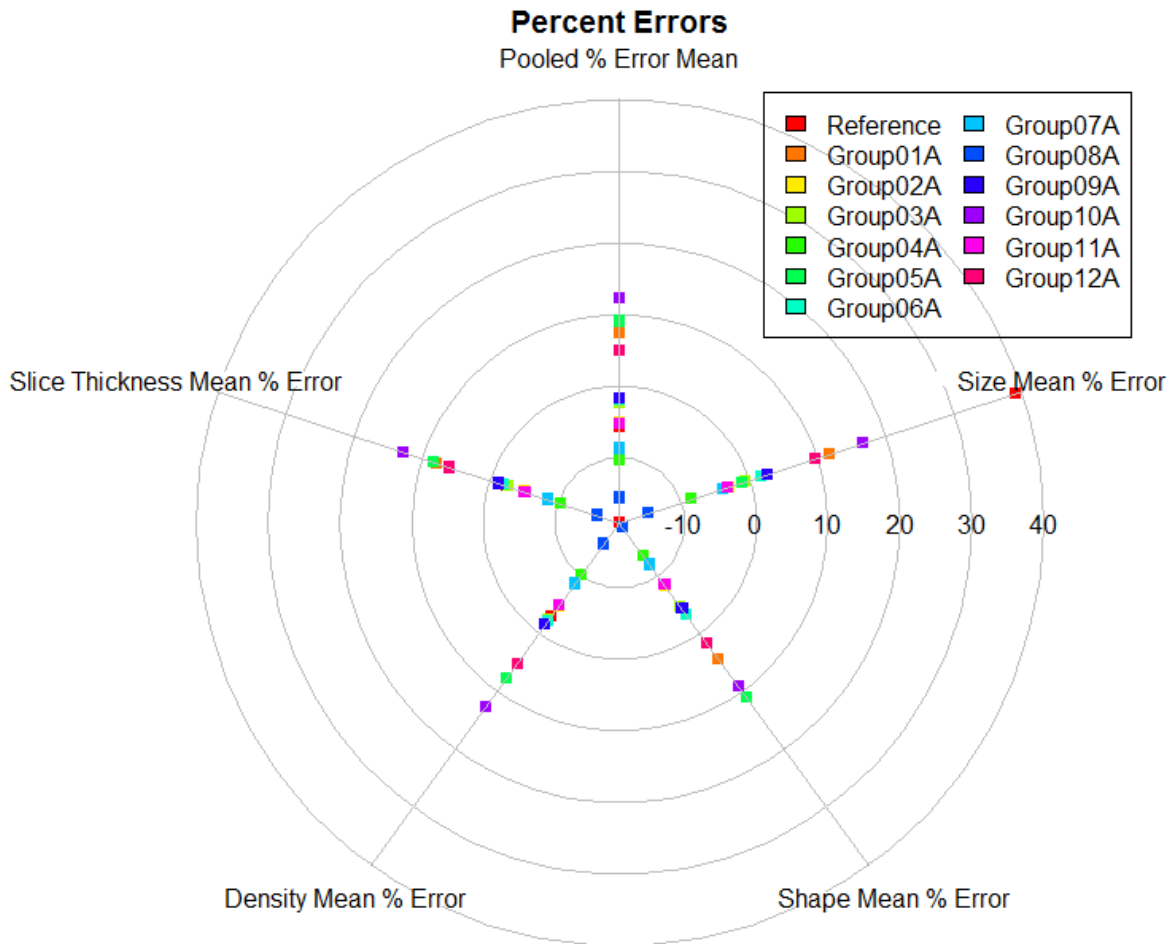
And the corresponding absolute value SD's:

	Pooled Absolute % Error SD	Size Mean Absolute % Error SD	Shape Mean Absolute % Error SD	Density Mean Absolute % Error SD	Slice Thickness Mean Absolute % Error SD
ref	5.57	3.80	4.59	5.41	5.57
grp01	6.35	3.71	5.27	6.01	6.35
grp02	3.82	2.18	3.15	3.36	3.82
grp03	3.63	2.54	3.32	3.63	3.63
grp04	2.44	1.81	1.91	2.13	2.44
grp05	6.56	4.67	6.20	5.98	6.56
grp06	3.94	1.81	3.65	3.76	3.94
grp07	9.76	6.35	9.35	9.86	9.76
grp08	5.14	3.46	4.49	5.20	5.14
grp09	3.74	1.60	3.36	3.68	3.74
grp10	10.00	5.02	9.63	10.05	10.00
grp11	3.80	2.20	3.11	3.37	3.80
grp12	8.74	5.84	7.62	7.28	8.74
AllGroups	7.19	5.18	6.97	7.15	7.19

Visual representation of this data found [here](#).

Radial Plots for Percent Error Means

Percent Error Means for all Participants, Overall and by Factor

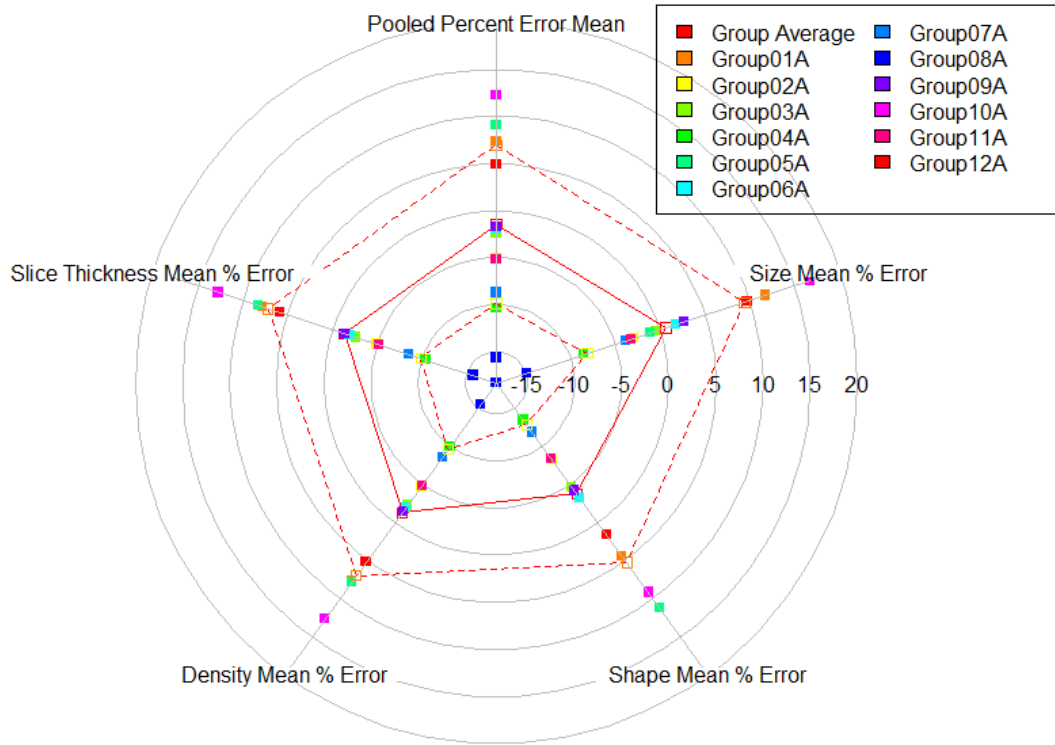


The table containing this data in number form can be found [here](#).

Percent Error for all Participants without Reference

The average value for all 12 participants is shown by the solid red polygon. The dotted polygons mark the mean \pm sd values. Note, in the plot, the group average marking squares are empty rather than filled in to distinguish between them and the individual participant points.

Percent Errors without Reference Compared with Mean



The table containing this data in number form can be found [here](#).

Percent Error Means for Clusters, Overall and by Factor

With the visual aid of this plot in addition to running ANOVA, the 12 Participants can be divided into clusters of similar Percent Errors:

Transformation for Normality of linear model: (Bias + 79)^{0.4}

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	5.72286	0.10326	55.424	< 2e-16 ***
as.factor(True.Shape)lobulated	0.06195	0.04395	1.410	0.158950
as.factor(True.Shape)spherical	0.10236	0.05143	1.990	0.046780 *
as.factor(True.Shape)spiculated	-0.23926	0.06118	-3.911	9.74e-05 ***
as.factor(True.Density.HU)-10	0.20931	0.04895	4.276	2.06e-05 ***
as.factor(True.Density.HU)100	0.32149	0.04241	7.580	7.12e-14 ***
as.factor(Actual.Reconstruction.SliceThickness.)	5 0.04841	0.03296	1.469	0.142193
as.factor(Nominal.Diameter.mm)10	0.07836	0.07969	0.983	0.325696
as.factor(Nominal.Diameter.mm)20	-0.06901	0.07834	-0.881	0.378578
as.factor(Nominal.Diameter.mm)40	-0.13738	0.08329	-1.649	0.099342 .
as.factor(AnalysisSWModel)Group02A_PILOT	-0.35008	0.07820	-4.477	8.34e-06 ***
as.factor(AnalysisSWModel)Group03A_PILOT	-0.26523	0.07820	-3.392	0.000719 ***
as.factor(AnalysisSWModel)Group04A_PILOT	-0.51764	0.07820	-6.619	5.54e-11 ***
as.factor(AnalysisSWModel)Group05A_PILOT	-0.16958	0.07820	-2.168	0.030326 *
as.factor(AnalysisSWModel)Group06A_PILOT	-0.26243	0.07820	-3.356	0.000818 ***
as.factor(AnalysisSWModel)Group07A_PILOT	-0.48712	0.07820	-6.229	6.59e-10 ***
as.factor(AnalysisSWModel)Group08A_PILOT	-0.70304	0.07820	-8.990	< 2e-16 ***
as.factor(AnalysisSWModel)Group09A_PILOT	-0.25390	0.07820	-3.247	0.001201 **
as.factor(AnalysisSWModel)Group10A_PILOT	0.13646	0.07820	1.745	0.081263 .
as.factor(AnalysisSWModel)Group11A_PILOT	-0.35610	0.07820	-4.554	5.84e-06 ***
as.factor(AnalysisSWModel)Group12A_PILOT	-0.08255	0.07820	-1.056	0.291401

MSE = 0.297

Residual degrees of freedom = 1143

To determine similar Percent Errors, the p-values shown in the above table were compared. Each value here is the comparison between Group01 with each of the listed participants. Participants with p-value compared to 01 of over 0.01 were placed in Cluster A, participants with the p-value ranging 0.0005-0.01 were placed in Cluster B, and the participants with p-value compared to 01 of less than 0.0005 were placed in Cluster C.

Cluster A: 1, 5, 10, 12

Cluster B: 3, 6, 9

Cluster C: 2, 4, 7, 8, 11

Differences between these clusters were compared using a contrast to test if the mean % error for each cluster is equal to that of each other cluster:

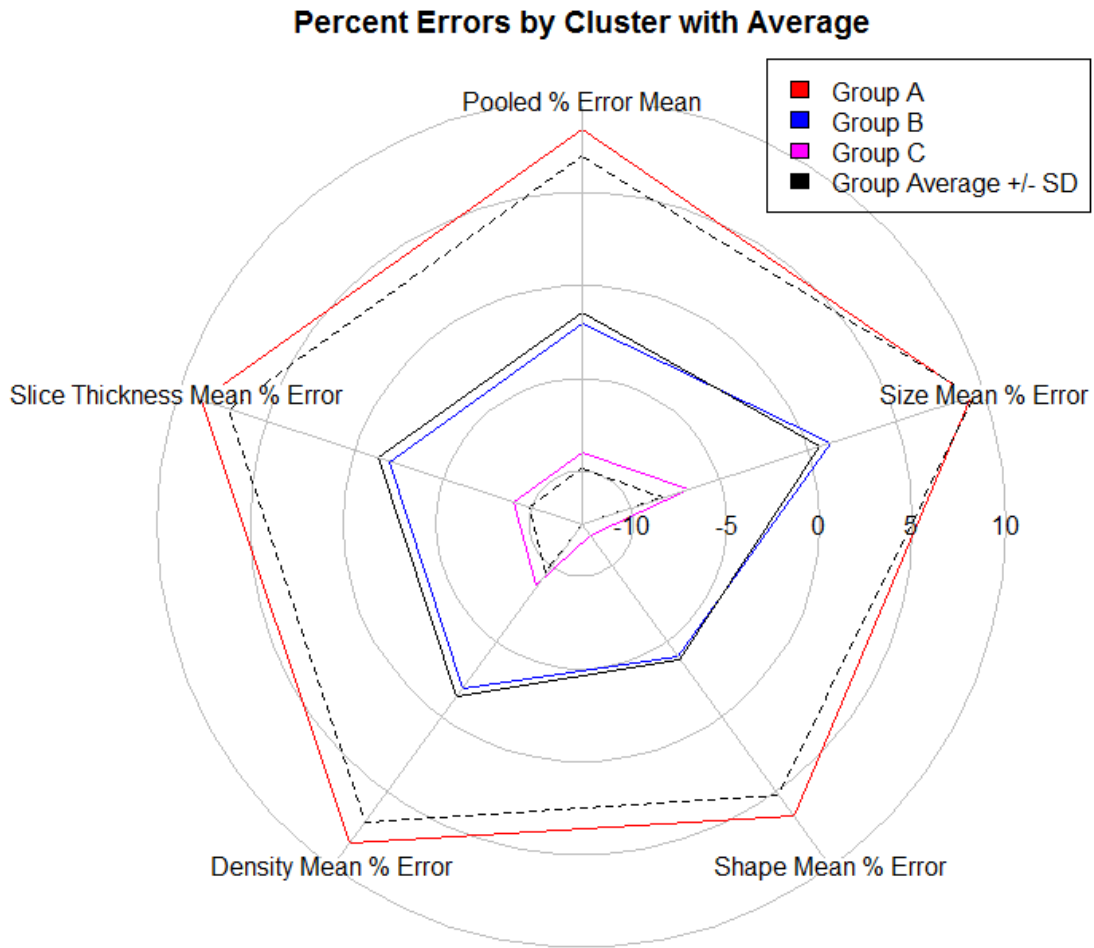
Clusters compared	p-value
A and B	<0.001
A and C	<0.001
B and C	<0.001

So, even with Bonferroni correction ($\alpha_c = 0.05/3 = 0.017$), we see that these clusters are significantly different.

P-value obtained from a Kruskal-Wallis test of the three sets of untransformed means: 0.008

So there is still strong evidence that the clusters are not all the same

The following plot shows these three cluster averages and overlays the overall participant average \pm one standard deviation.



For reference:

Cluster A: 1, 5, 10, 12

Cluster B: 3, 6, 9

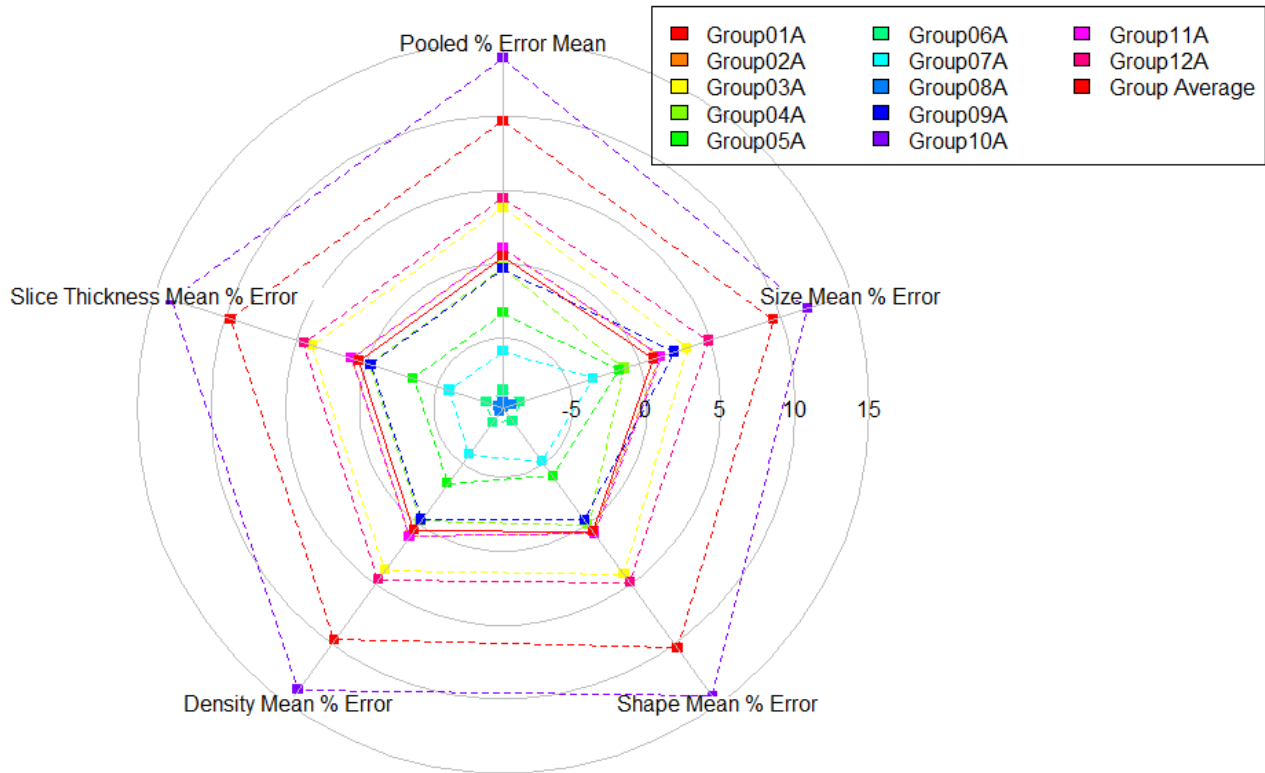
Cluster C: 2, 4, 7, 8, 11

The table containing this data in number form can be found [here](#).

CT Profile Excluding 5mm and -630HU Percent Error Plot

Plotting only thickness of 0.8 mm and density of -10 HU or 100 HU (not -630 HU):

Percent Errors for Each Factor, Group Average Shown in Solid Line



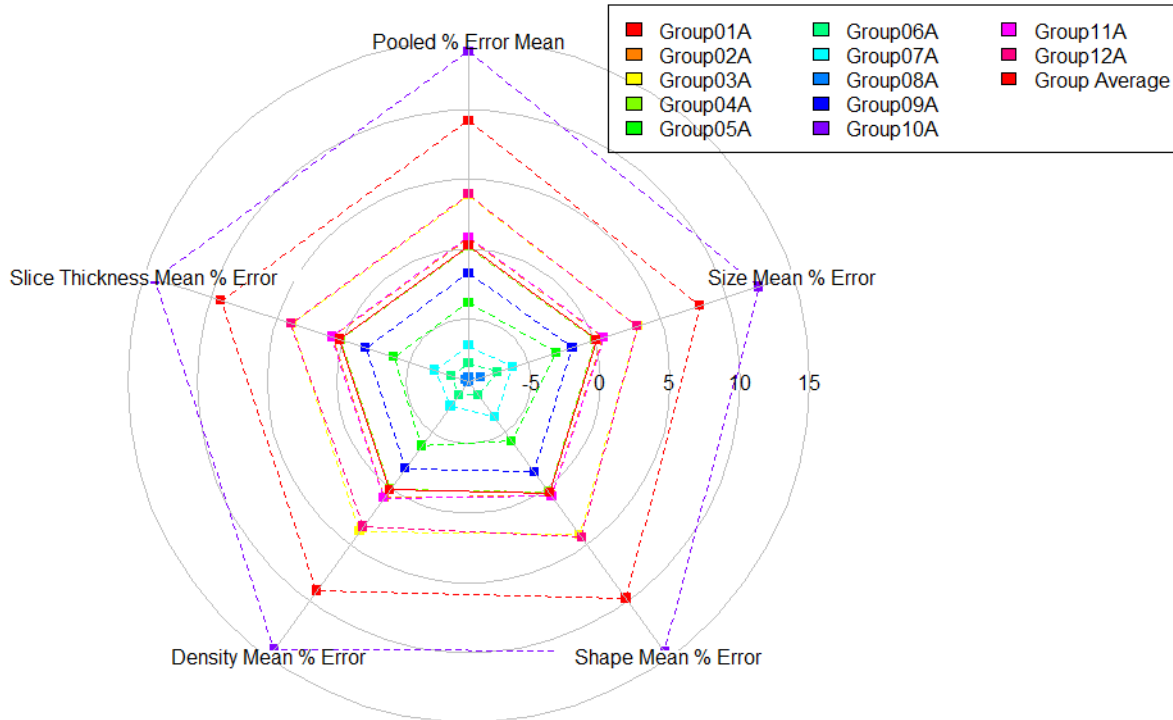
The table containing this data in number form can be found [here](#).

Note: Group02 and Group11 present very similar values, and as such overlap in the radial plot. Since Group11 is plotted after Group02, it is the markers of Group11 that are visible and not Group02, though they should be at the same location roughly.

CT Profile Excluding 5mm and -630HU and 8mm Percent Error Plot

Plotting only thickness of 0.8 mm and no density of -630 HU or size of 8mm:

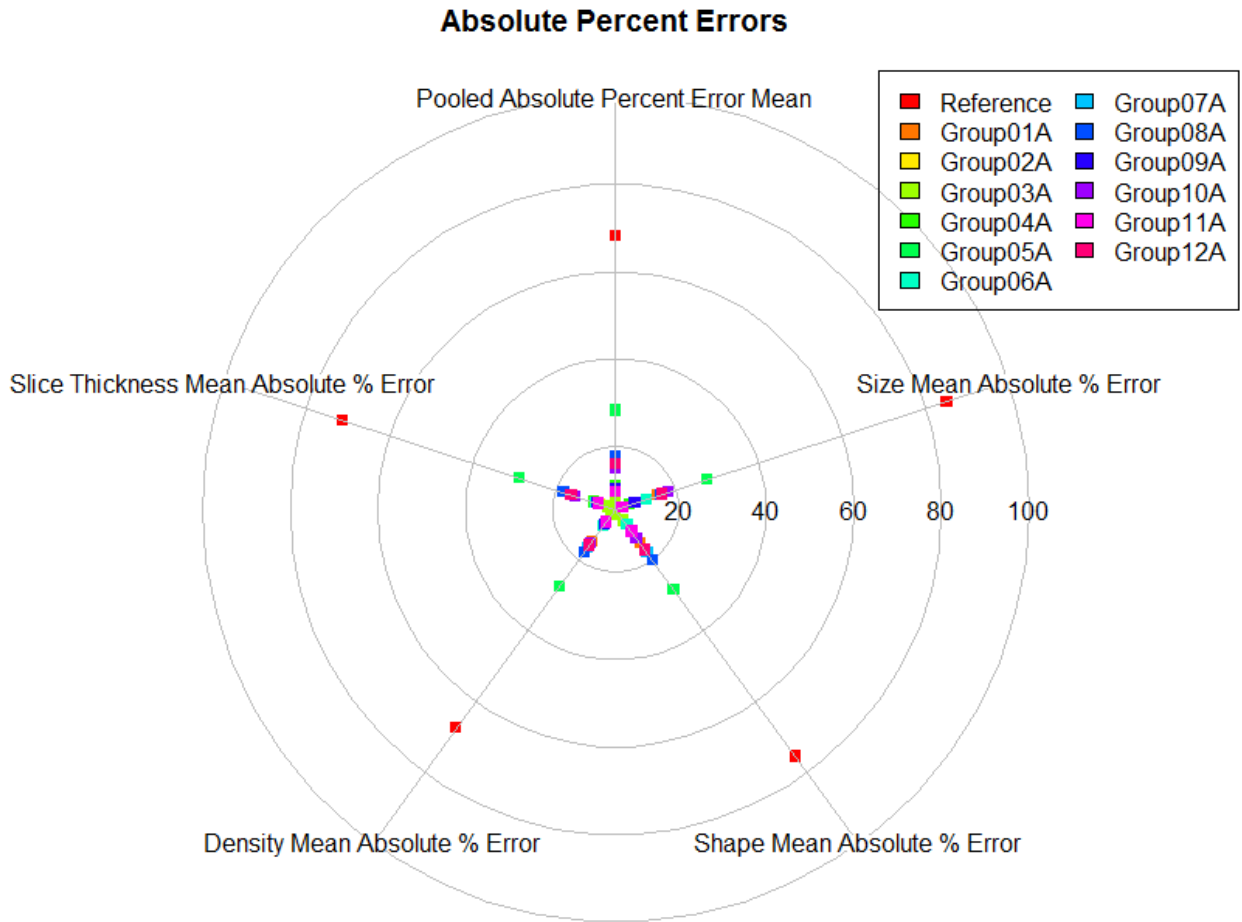
Percent Errors for Each Factor, Group Average Shown in Solid Line



The table containing this data in number form can be found [here](#).

Note: Group02 and Group11 present very similar values, and as such overlap in the radial plot. Since Group11 is plotted after Group02, it is the markers of Group11 that are visible and not Group02, though they should be at the same location roughly.

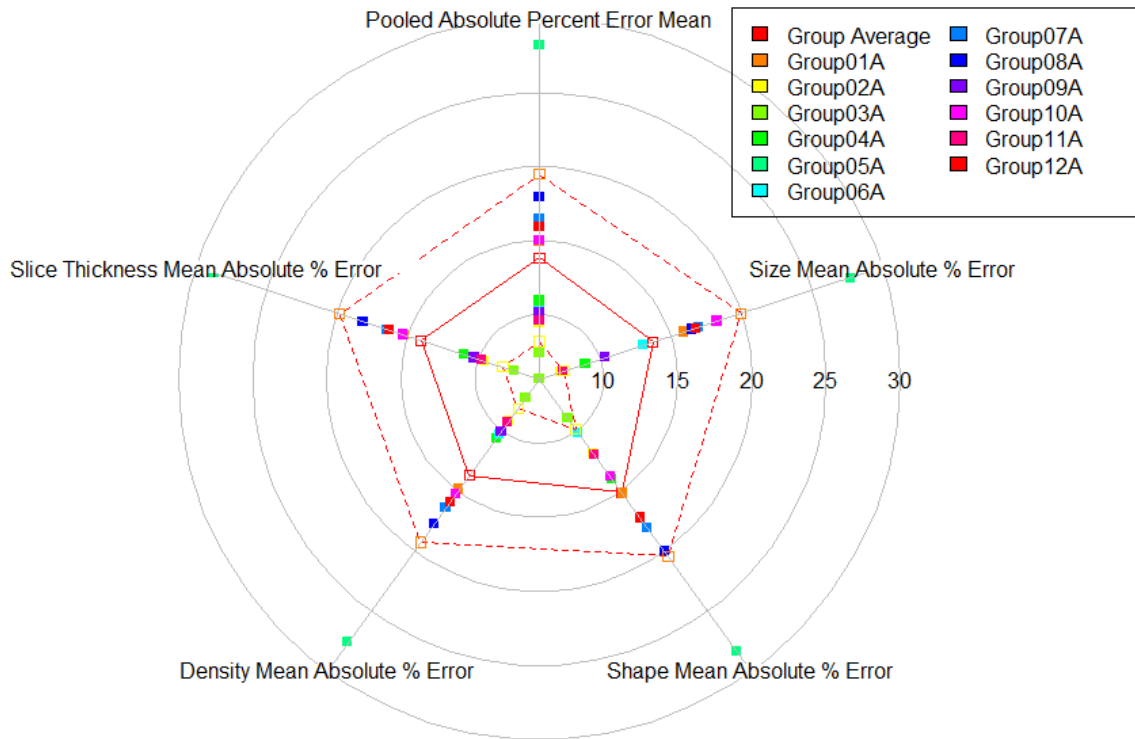
Absolute Percent Error Means for all Participants



The table containing this data in number form can be found [here](#).

Absolute Percent Error Means for all Participants except Reference

Absolute Percent Errors without Reference Compared with Mean



The average value for all 12 participants is shown by the solid red polygon and unfilled markers. The dotted polygons mark the mean \pm sd values. The table containing this data in number form can be found [here](#).

Absolute Percent Error Means for Clusters

With the visual aid of this plot in addition to running ANOVA, the 12 Participants can be divided into clusters of similar Absolute Percent Errors:

Transformation for normality of linear model: (AbsoluteBias)^{0.25}

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	2.29973	0.07530	30.542	< 2e-16 ***
as.factor(True.Shape)lobulated	0.04645	0.03205	1.449	0.147575
as.factor(True.Shape)spherical	-0.04121	0.03750	-1.099	0.271978
as.factor(True.Shape)spiculated	0.14888	0.04461	3.337	0.000874 ***
as.factor(True.Density.HU)-10	-0.32157	0.03569	-9.009	< 2e-16 ***
as.factor(True.Density.HU)100	-0.27972	0.03093	-9.044	< 2e-16 ***
as.factor(Actual.Reconstruction.SliceThickness.)	5 0.19740	0.02404	8.212	5.81e-16 ***
as.factor(Nominal.Diameter.mm)10	-0.18571	0.05811	-3.196	0.001433 **
as.factor(Nominal.Diameter.mm)20	-0.40560	0.05713	-7.100	2.19e-12 ***
as.factor(Nominal.Diameter.mm)40	-0.63932	0.06074	-10.526	< 2e-16 ***
as.factor(AnalysisSWModel)Group02A_PILOT	-0.31081	0.05703	-5.450	6.16e-08 ***
as.factor(AnalysisSWModel)Group03A_PILOT	-0.38433	0.05703	-6.739	2.52e-11 ***
as.factor(AnalysisSWModel)Group04A_PILOT	-0.32432	0.05703	-5.687	1.64e-08 ***
as.factor(AnalysisSWModel)Group05A_PILOT	0.07593	0.05703	1.331	0.183311
as.factor(AnalysisSWModel)Group06A_PILOT	-0.22148	0.05703	-3.884	0.000109 ***
as.factor(AnalysisSWModel)Group07A_PILOT	0.02857	0.05703	0.501	0.616441
as.factor(AnalysisSWModel)Group08A_PILOT	0.07670	0.05703	1.345	0.178913
as.factor(AnalysisSWModel)Group09A_PILOT	-0.27187	0.05703	-4.767	2.11e-06 ***
as.factor(AnalysisSWModel)Group10A_PILOT	-0.02725	0.05703	-0.478	0.632893
as.factor(AnalysisSWModel)Group11A_PILOT	-0.29919	0.05703	-5.247	1.85e-07 ***
as.factor(AnalysisSWModel)Group12A_PILOT	-0.03341	0.05703	-0.586	0.558068

MSE = 0.158

Residual Degrees of Freedom = 1143

To determine similar Absolute Percent Errors, the p-values shown in the above table were compared. Each value here is the comparison between Group01 with each of the listed participants. Participants with p-value compared to 01 of over 0.01 were placed in Cluster A, and participants of less than 0.01 were placed in Cluster B.

Cluster A: 1, 5, 7, 8, 10, 12

Cluster B: 2, 3, 4, 6, 9, 11

Differences between these clusters were compared using a contrast to test if the mean % error for each cluster is equal to that of each other cluster:

Clusters compared	p-value
A and B	<0.001

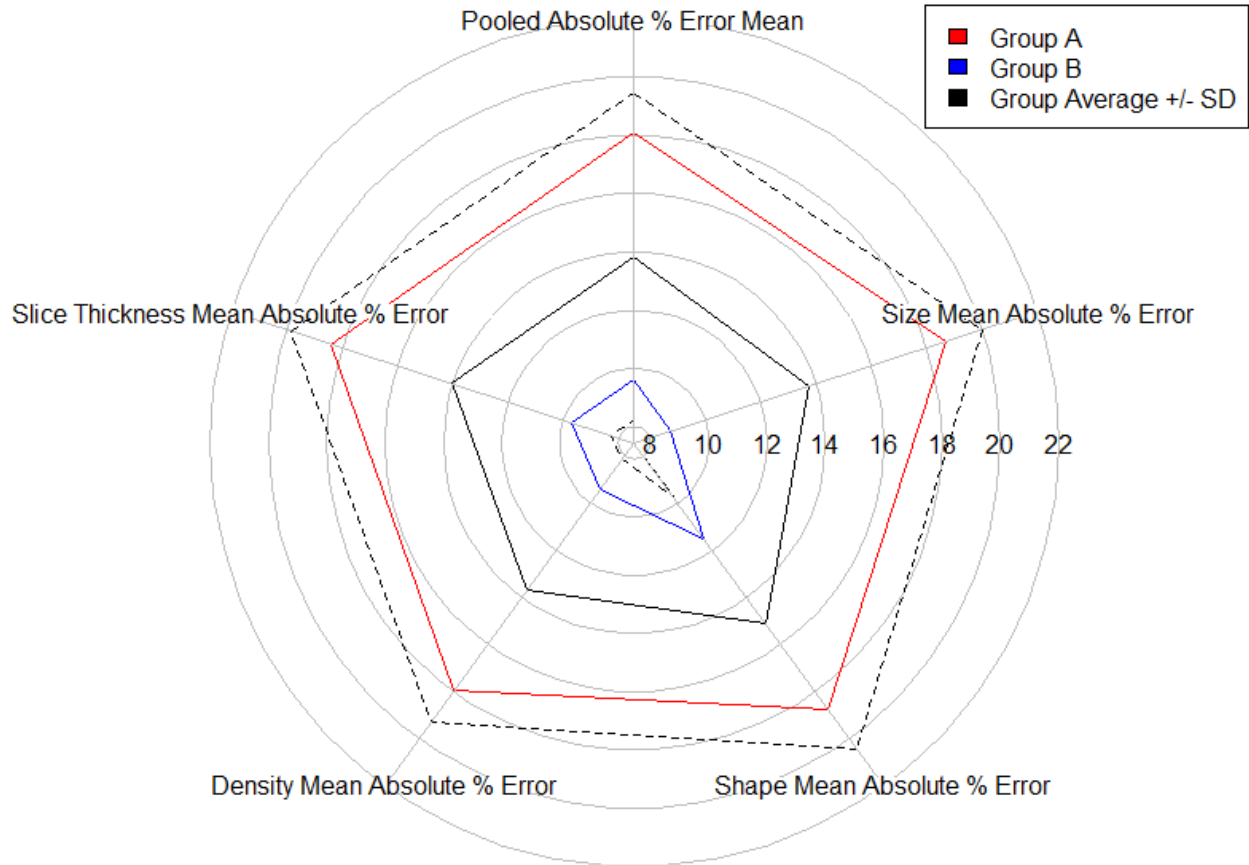
P-value obtained from a Wilcoxon test of just the two, untransformed, sets of cluster means: 0.002

P-value obtained from a Kruskal-Wallis test of just the two, untransformed, means: 0.004

So, we see that these clusters are significantly different.

The following plot shows these two cluster averages and overlays the overall participant average \pm one standard deviation.

Absolute Percent Errors by Cluster with Average



For reference:

Cluster A: 1, 5, 7, 8, 10, 12

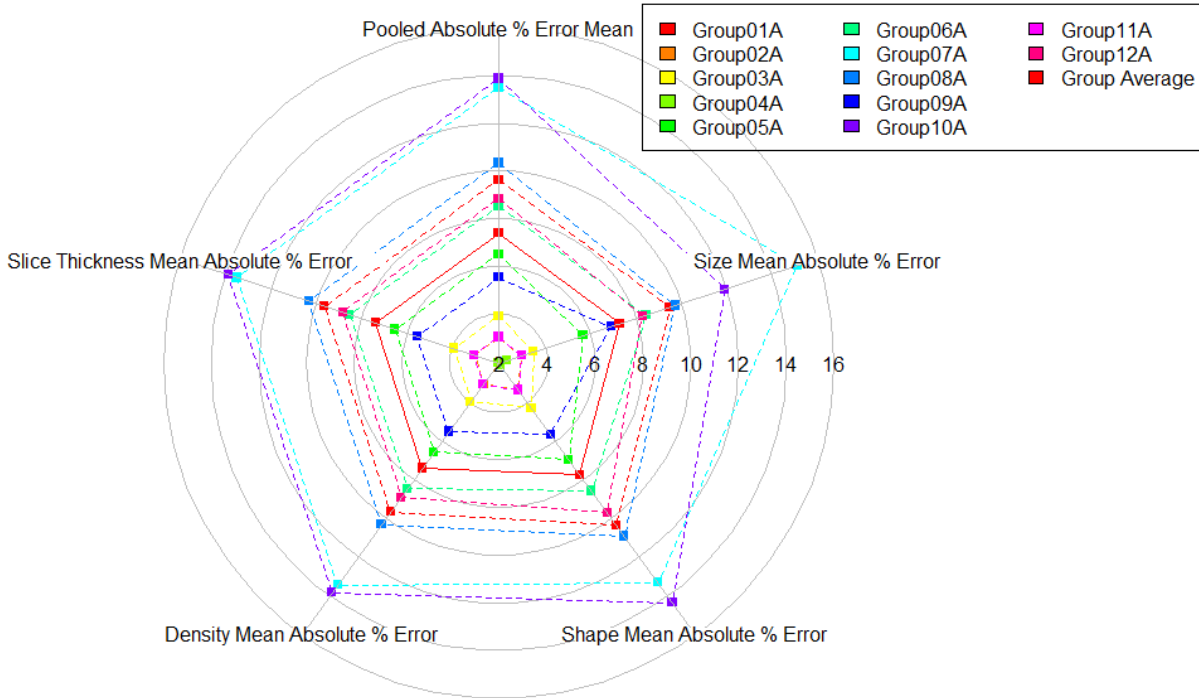
Cluster B: 2, 3, 4, 6, 9, 11

The table containing this data in number form can be found [here](#).

CT Profile Excluding 5mm and -630HU Absolute Percent Error Plot

Plotting only thickness of 0.8 mm and density of -10 HU or 100 HU (so not -630 HU):

Absolute Percent Errors for Each Factor, Group Average Shown in Solid Line



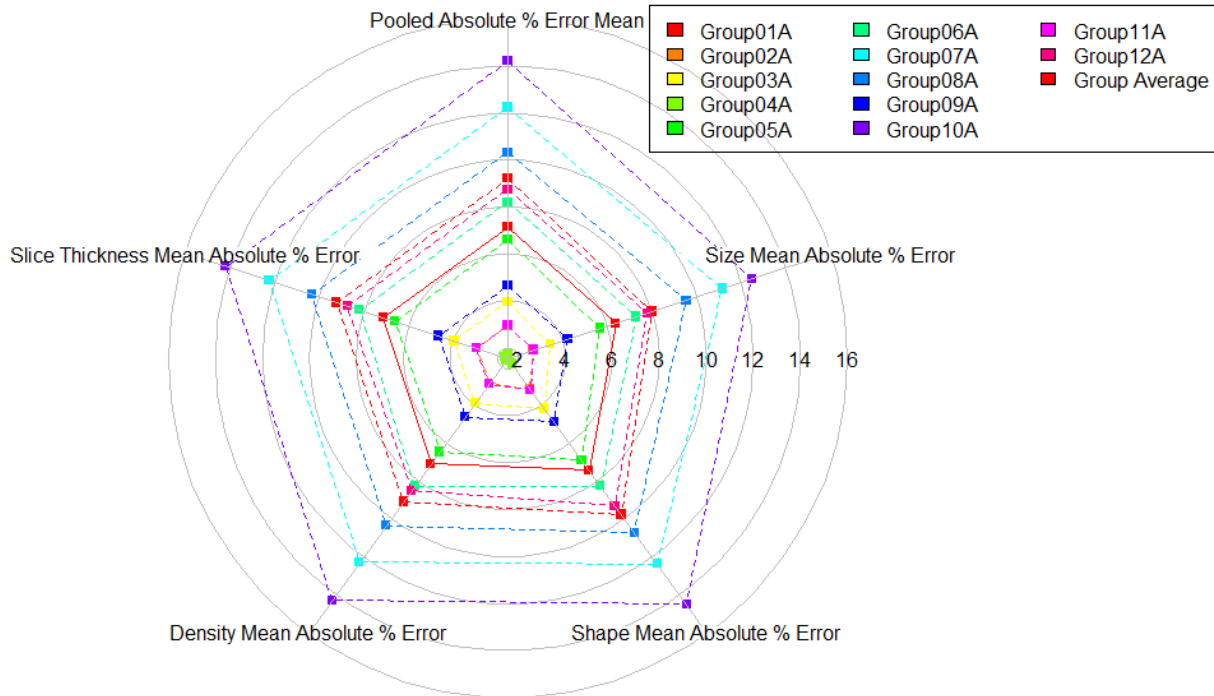
The table containing this data in number form can be found [here](#).

Note: Group02 and Group11 present very similar values, and as such overlap in the radial plot. Since Group11 is plotted after Group02, it is the markers of Group11 that are visible and not Group02, though they should be at the same location roughly.

CT Profile Excluding 5mm and -630HU and 8mm Absolute Percent Error Plot

Plotting only thickness of 0.8 mm and no density of -630 HU or size of 8 mm:

Absolute Percent Errors for Each Factor, Group Average Shown in Solid Line



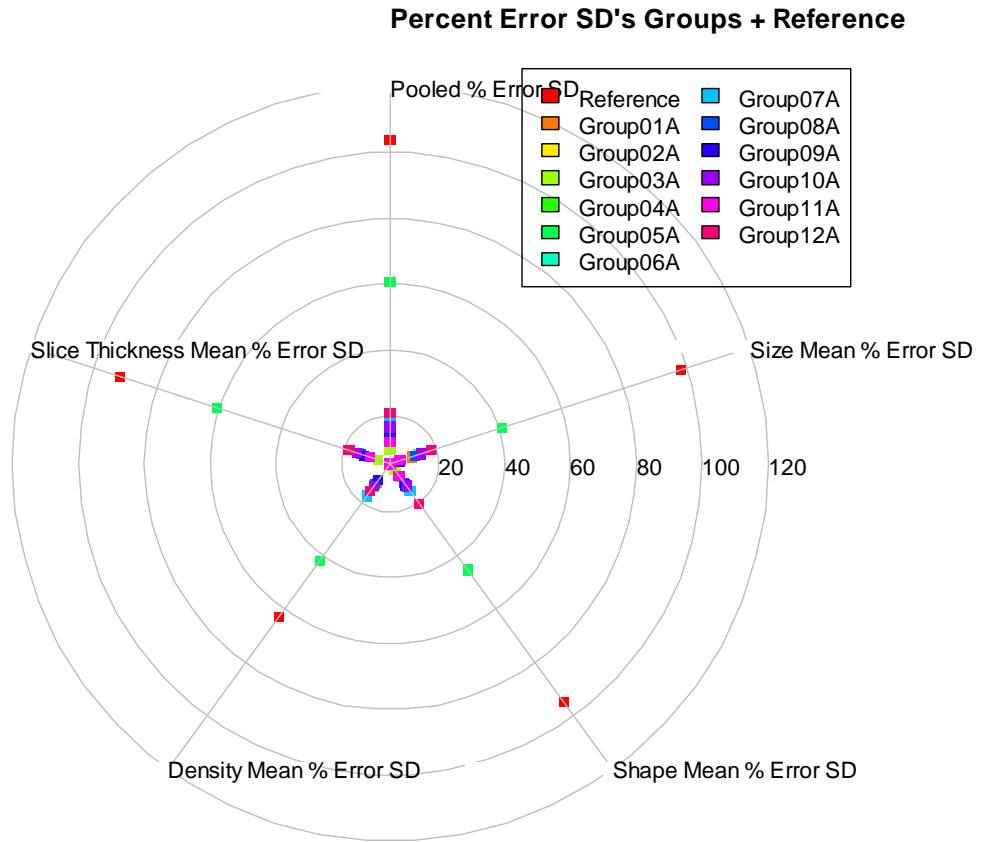
The table containing this data in number form can be found [here](#).

Note: Group02 and Group11 present very similar values, and as such overlap in the radial plot. Since Group11 is plotted after Group02, it is the markers of Group11 that are visible and not Group02, though they should be at the same location roughly.

Radial Plots for Percent Error Standard Deviations

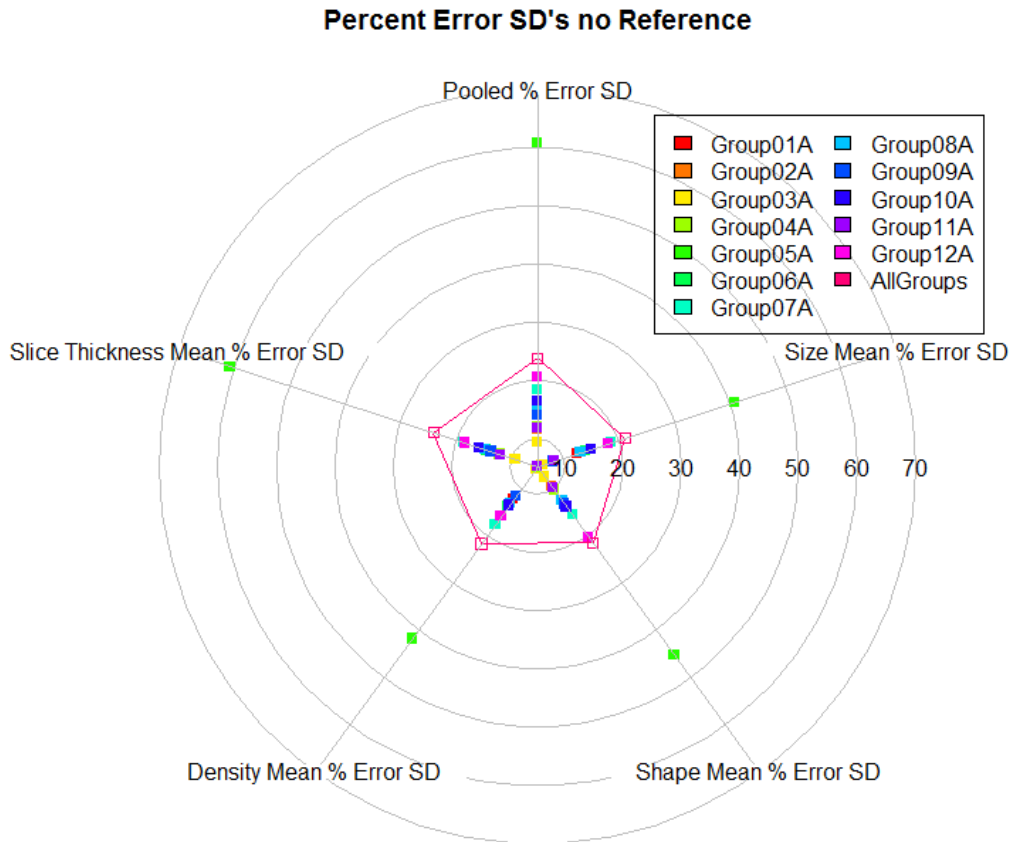
Note: for the factors, the SD shown is the average of the SD's for each factor.

Percent Error Standard Deviation for all Participants



The table containing this data in number form can be found [here](#).

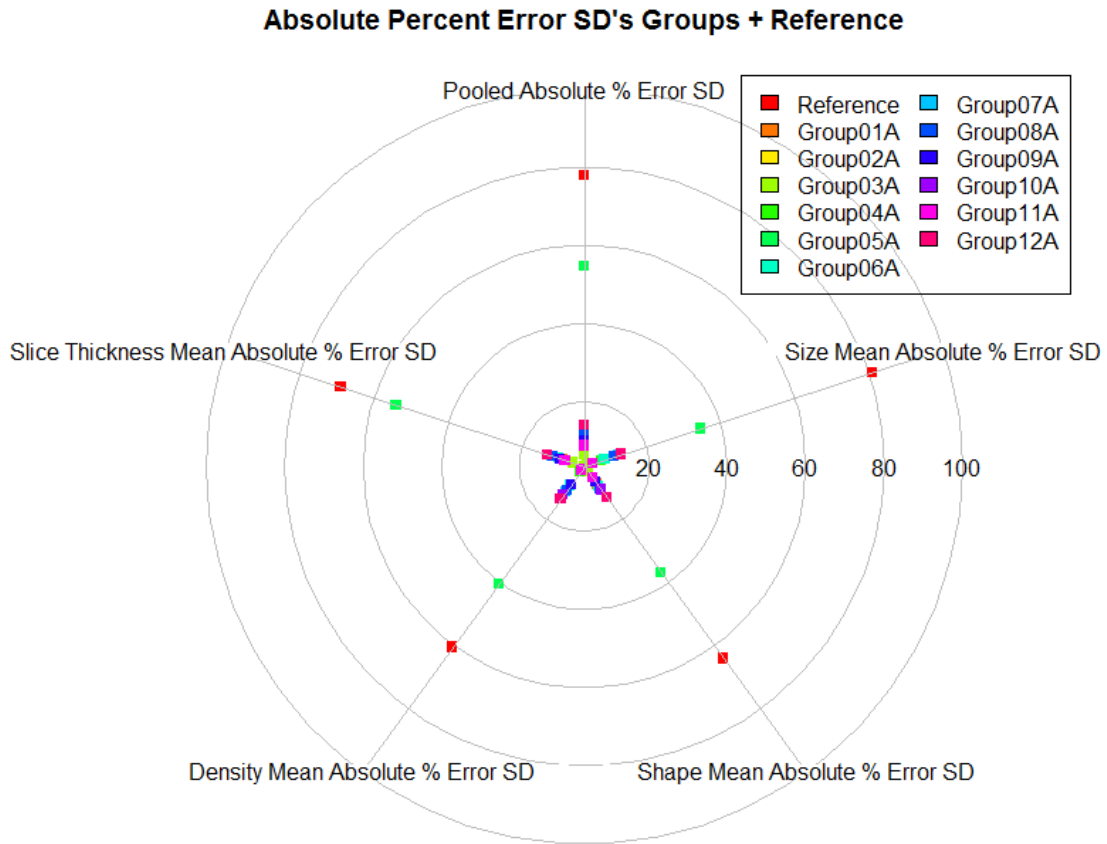
Percent Error Standard Deviations for all Participants without Reference



The table containing this data in number form can be found [here](#).

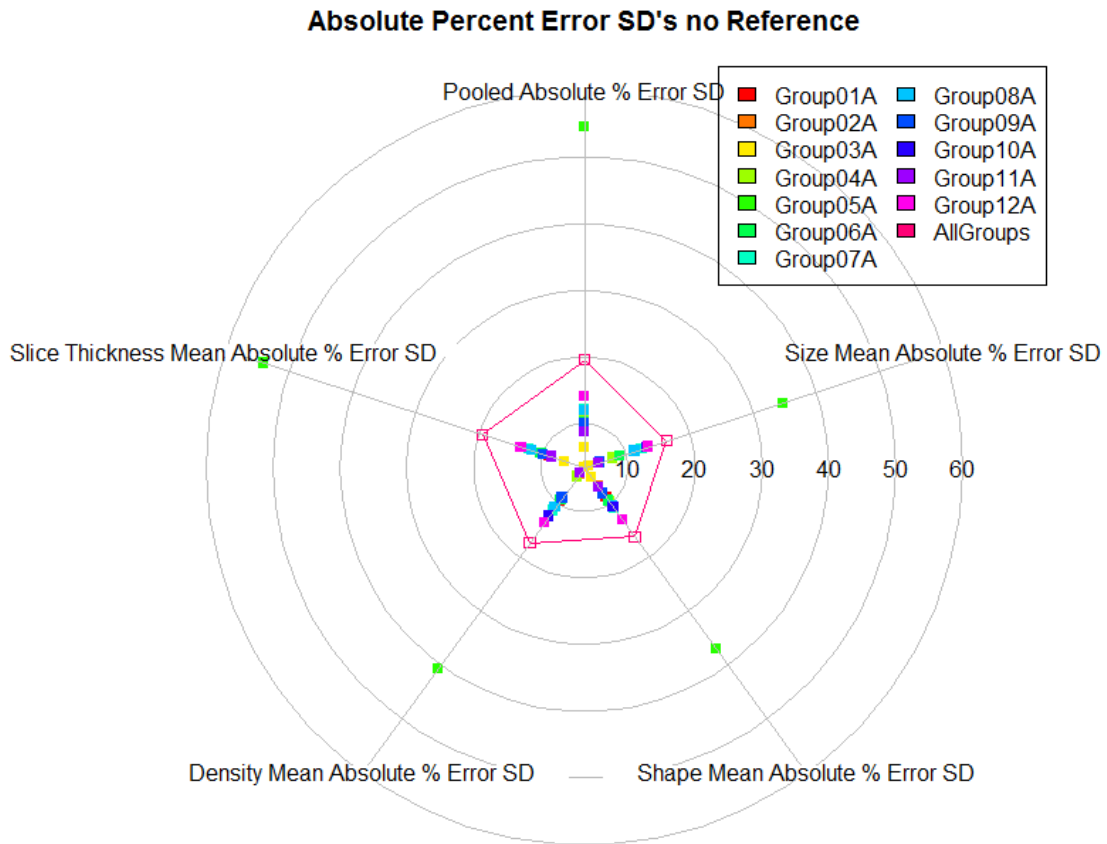
Note: Group02 and Group11 present very similar SD values, and as such overlap in the radial plot. Since Group11 is plotted after Group02, it is the markers of Group11 that are visible and not Group02, though they should be at the same location roughly.

Absolute Percent Error Standard Deviation for all Participants



The table containing this data in number form can be found [here](#).

Absolute Percent Error Standard Deviations for all Participants without Reference



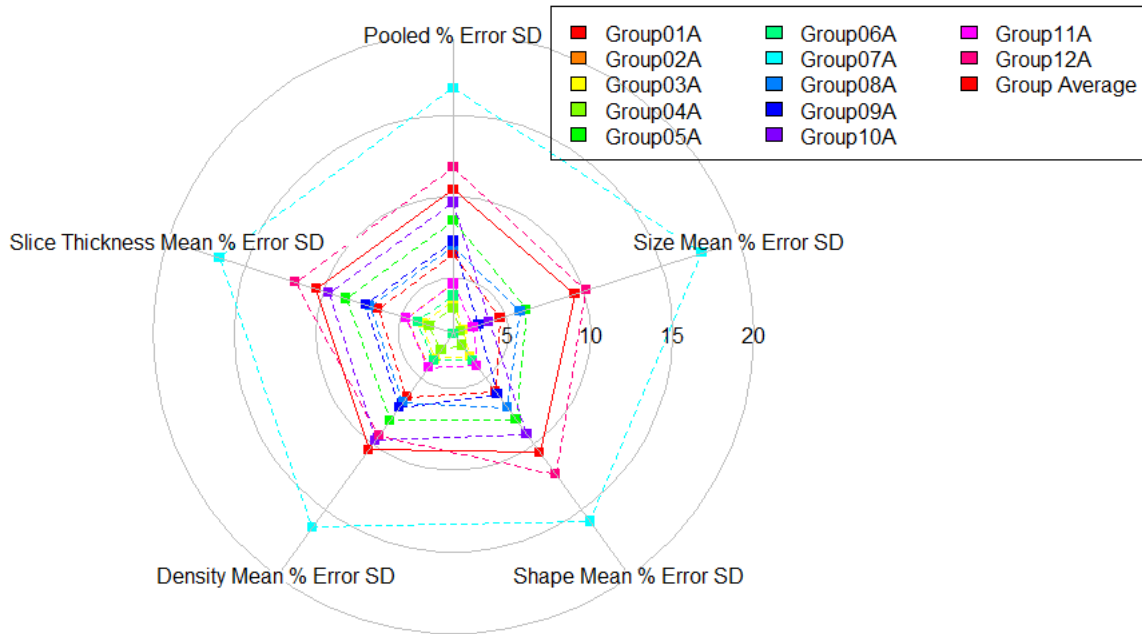
The table containing this data in number form can be found [here](#).

Note: Group02 and Group11 present very similar SD values, and as such overlap in the radial plot. Since Group11 is plotted after Group02, it is the markers of Group11 that are visible and not Group02, though they should be at the same location roughly.

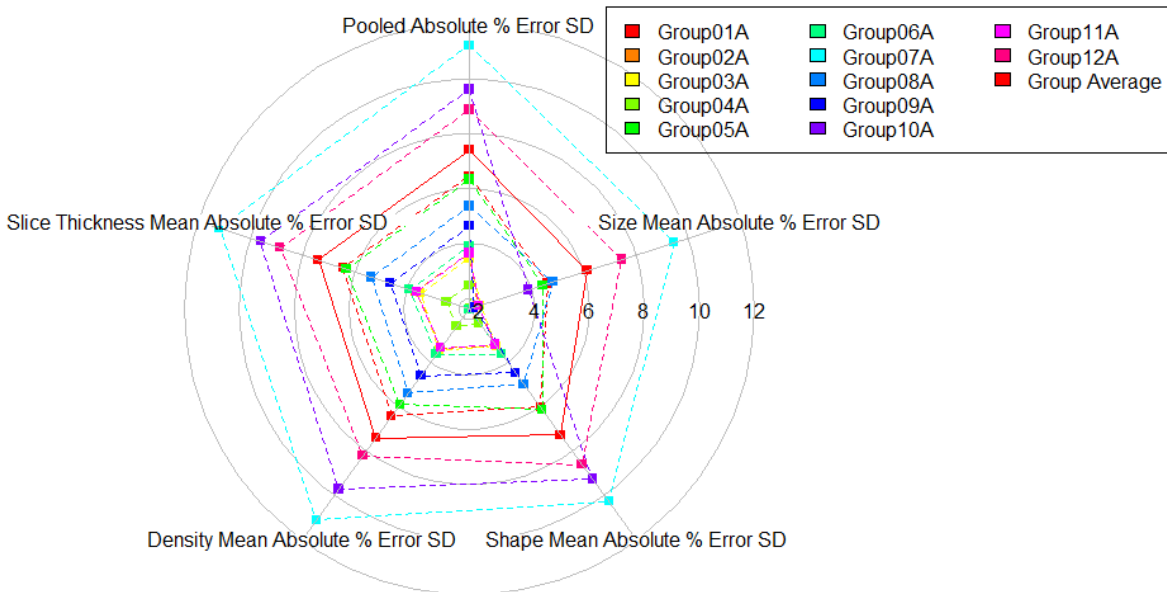
CT Profile Excluding 5mm and -630HU Percent Error and Absolute Percent Error Standard Deviation Plots

The SD plots when only 0.8mm thickness is considered and -630 HU density is excluded

Percent Error SDs for Each Factor, Group Average Shown in Solid Line



Absolute Percent Error SDs for Each Factor, Group Average Shown in Solid Line



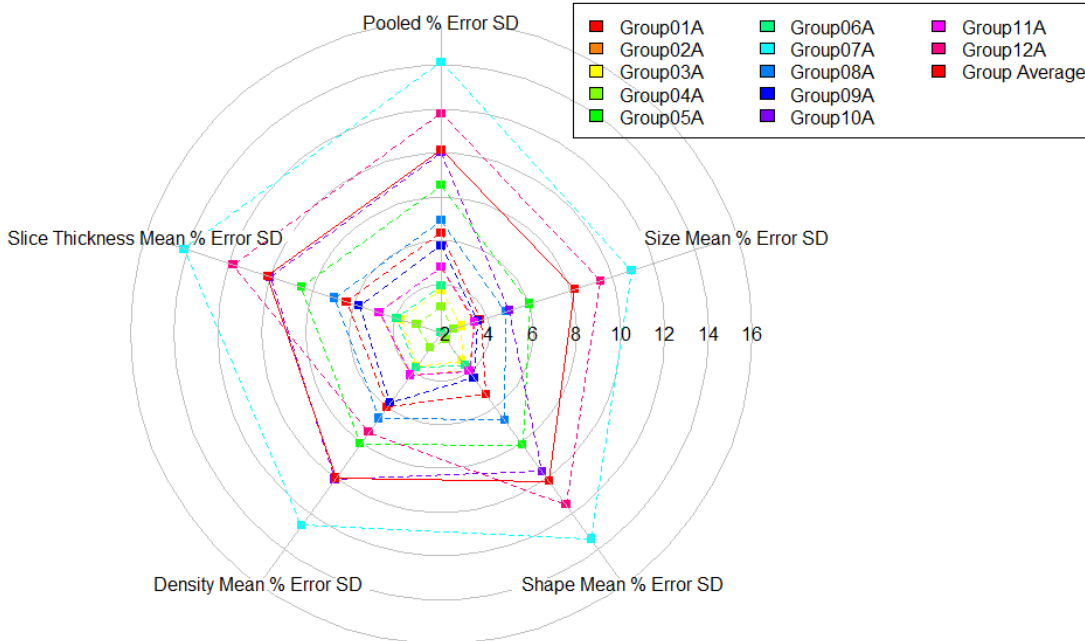
The table containing this data in number form can be found [here](#).

Note: Group02 and Group11 present very similar values, and as such overlap in the radial plot. Since Group11 is plotted after Group02, it is the markers of Group11 that are visible and not Group02, though they should be at the same location roughly.

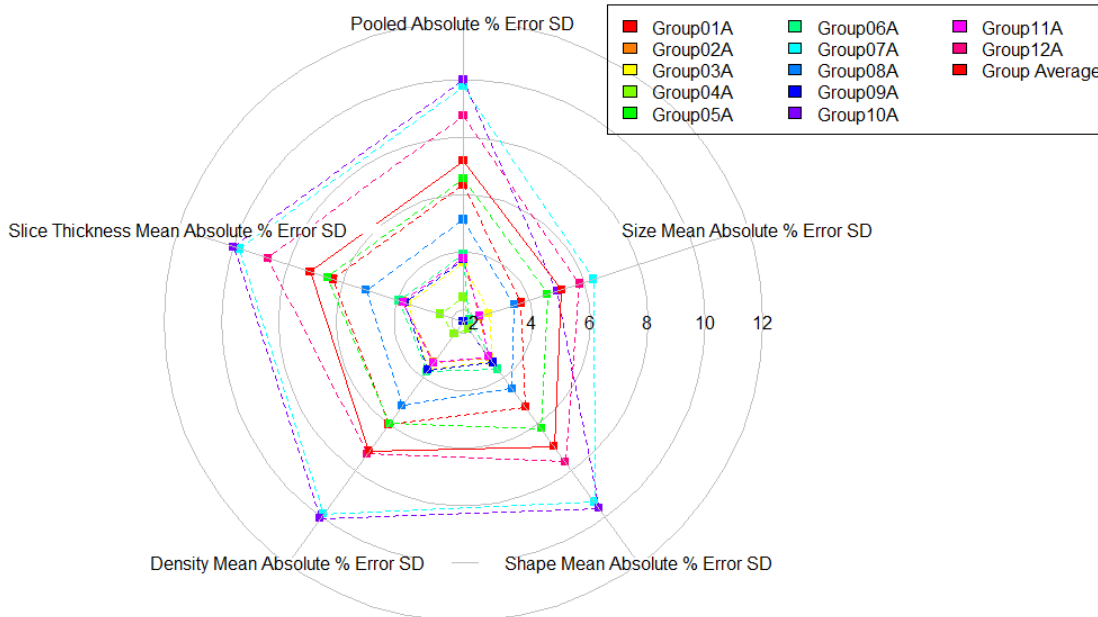
CT Profile Excluding 5mm, -630HU, and 8mm Percent Error and Absolute Percent Error Standard Deviation Plots

The SD plots when only 0.8mm thickness is considered and -630 HU density and 8mm size is excluded

Percent Error SDs for Each Factor, Group Average Shown in Solid Line



Absolute Percent Error SDs for Each Factor, Group Average Shown in Solid Line



The table containing this data in number form can be found [here](#).

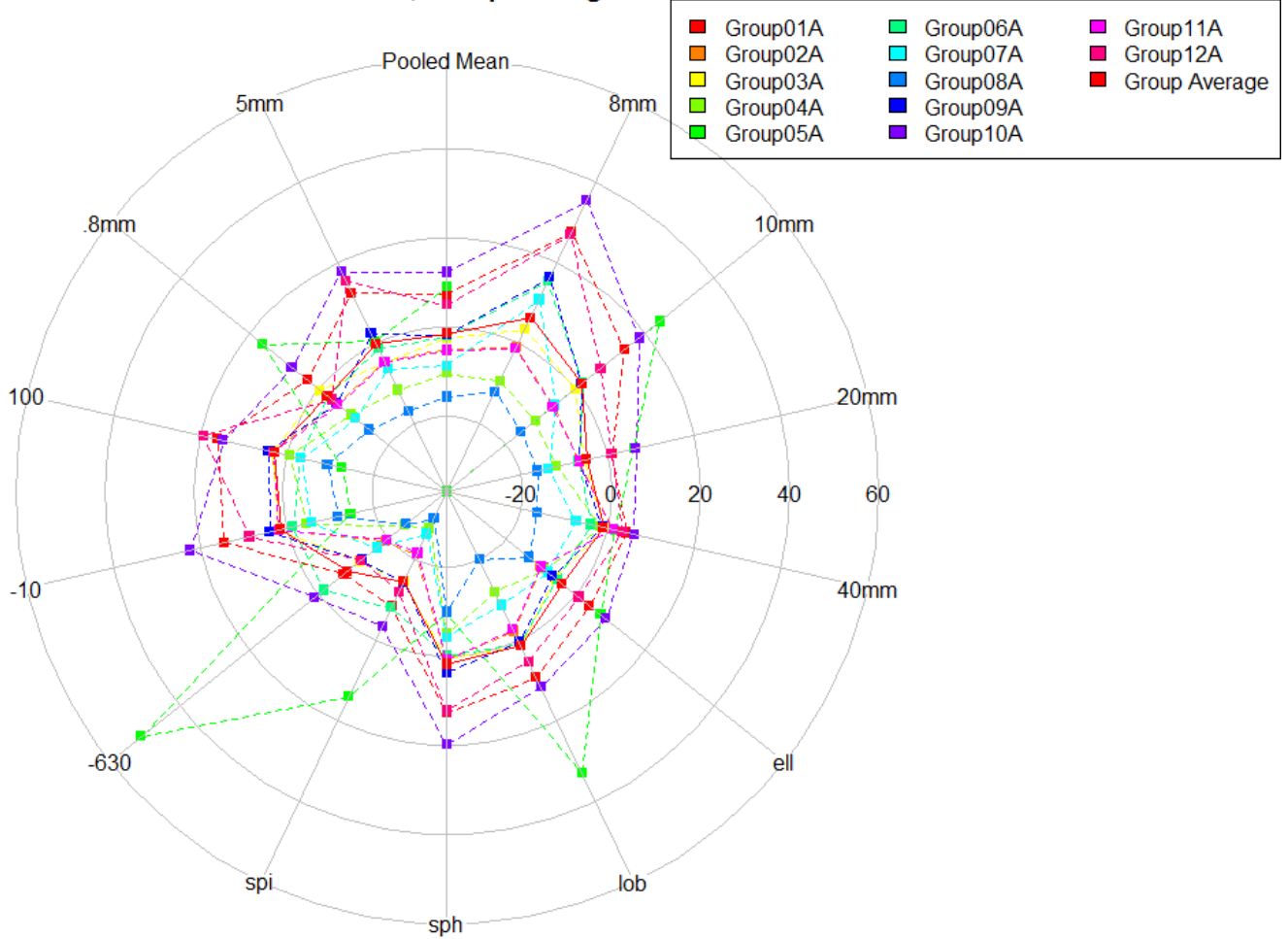
Note: Group02 and Group11 present very similar values, and as such overlap in the radial plot. Since Group11 is plotted after Group02, it is the markers of Group11 that are visible and not Group02, though they should be at the same location roughly.

Radial Plots of All Factors Individually

To depict how the 12 participants vary in each Factor, the following show the mean and sd of each participant for each factor. The solid red lines are the combined data of all 12 participants.

Percent Error Means for Each Individual Factor in All Participants except Reference

Percent Errors for Each Factor, Group Average Shown in Solid Line

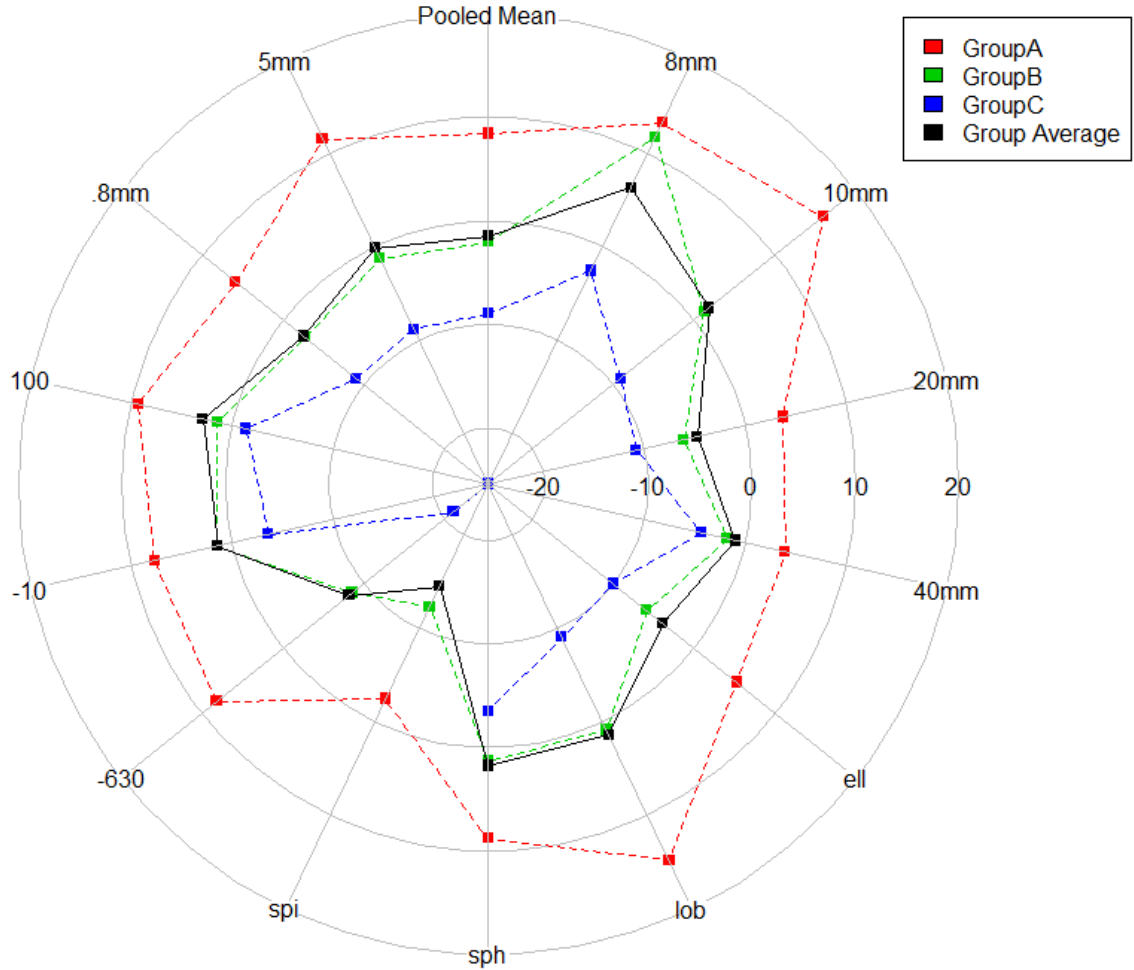


The table containing this data in number form can be found [here](#).

Percent Error Means for Each Individual Factor Split into the Three Clusters

Split into clusters A, B, and C:

Percent Errors for Each Factor for Each Group Cluster, Group Average Shown in Solid Line



The table containing this data in number form can be found [here](#).

For reference:

Cluster A: 1, 5, 10, 12

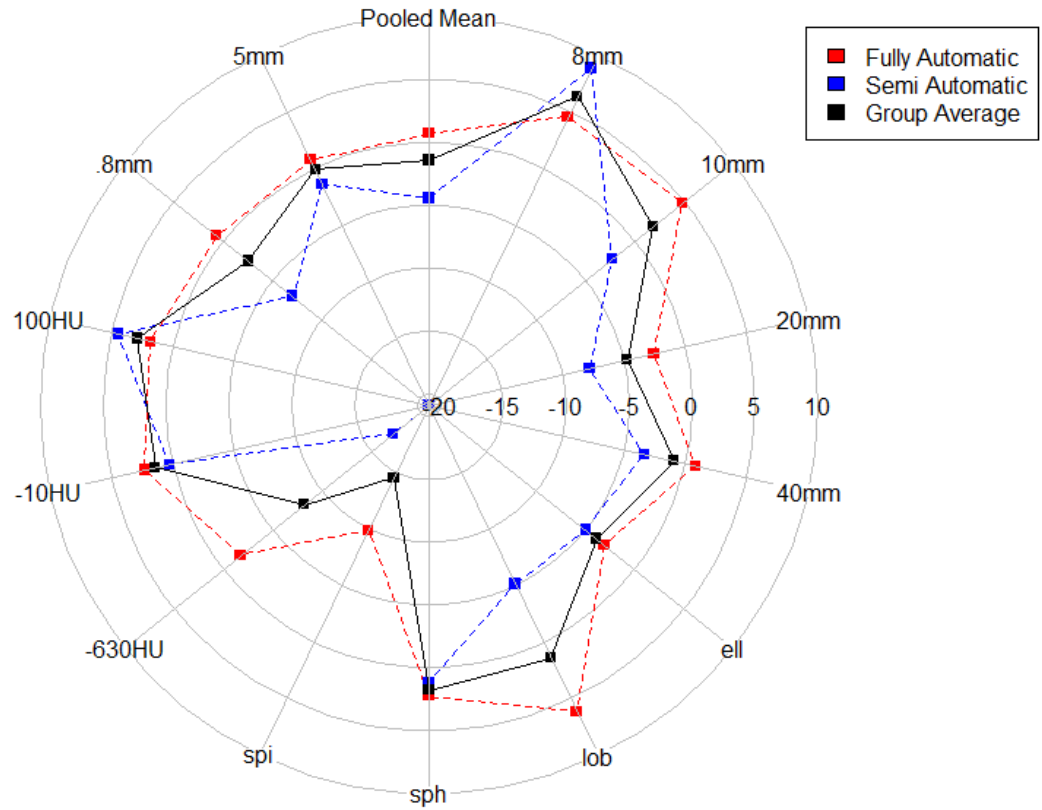
Cluster B: 3, 6, 9

Cluster C: 2, 4, 7, 8, 11

Percent Error Means for Each Individual Factor Split into the Reading Method Type

Splitting the participants according to the method type employed, either fully or semi automatic:

Percent Errors for Each Factor for Each Method Type, Group Average Shown in Solid Line



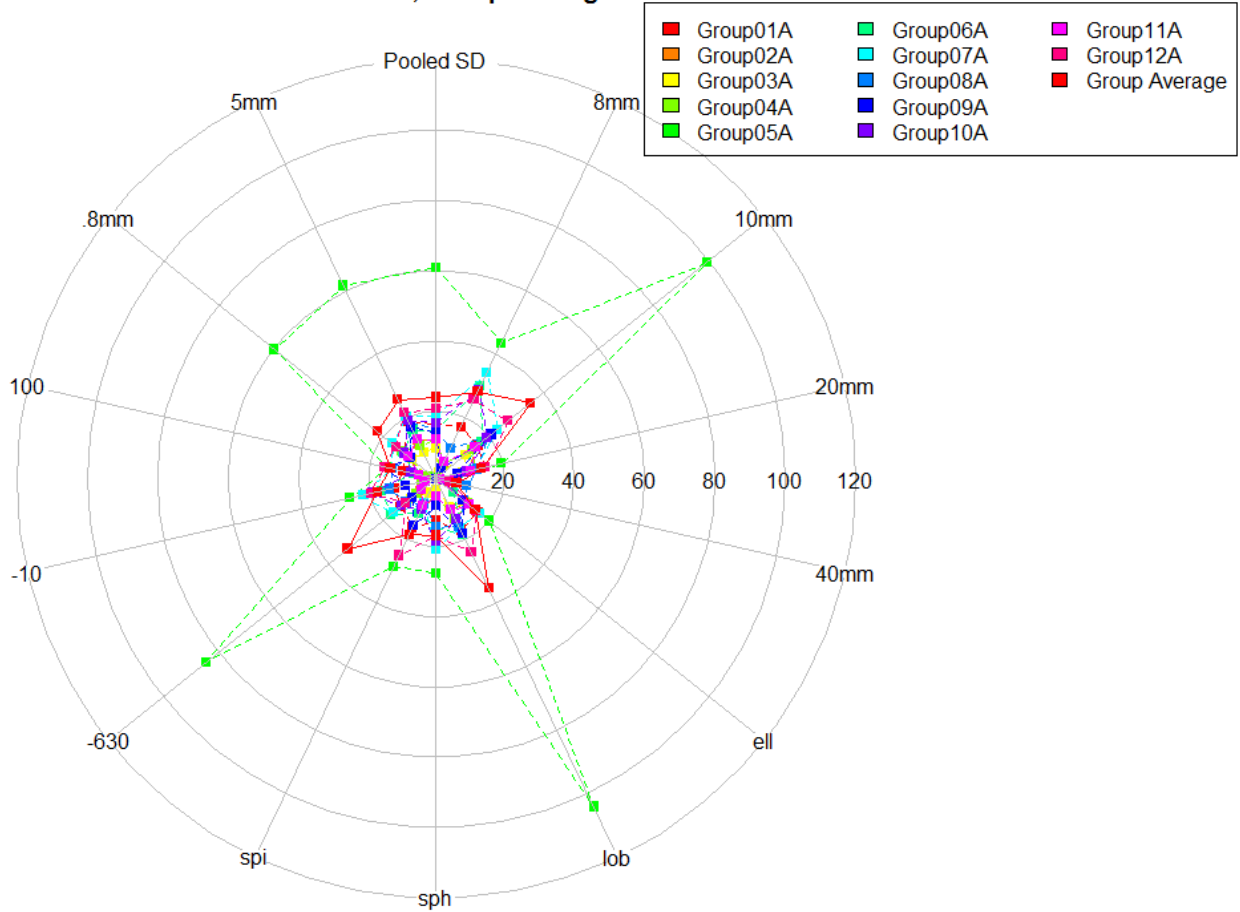
Fully Automatic: Group 02, Group 03, Group 05, Group 06, Group 09, Group 10, Group 11

Semi Automatic: Group 01, Group 04, Group 07, Group 08, Group 12

The table containing this data in number form can be found [here](#).

Percent Error Standard Deviations for Each Individual Factor in all Participants Excluding Reference

SD Percent Errors for Each Factor, Group Average shown in a Solid Line

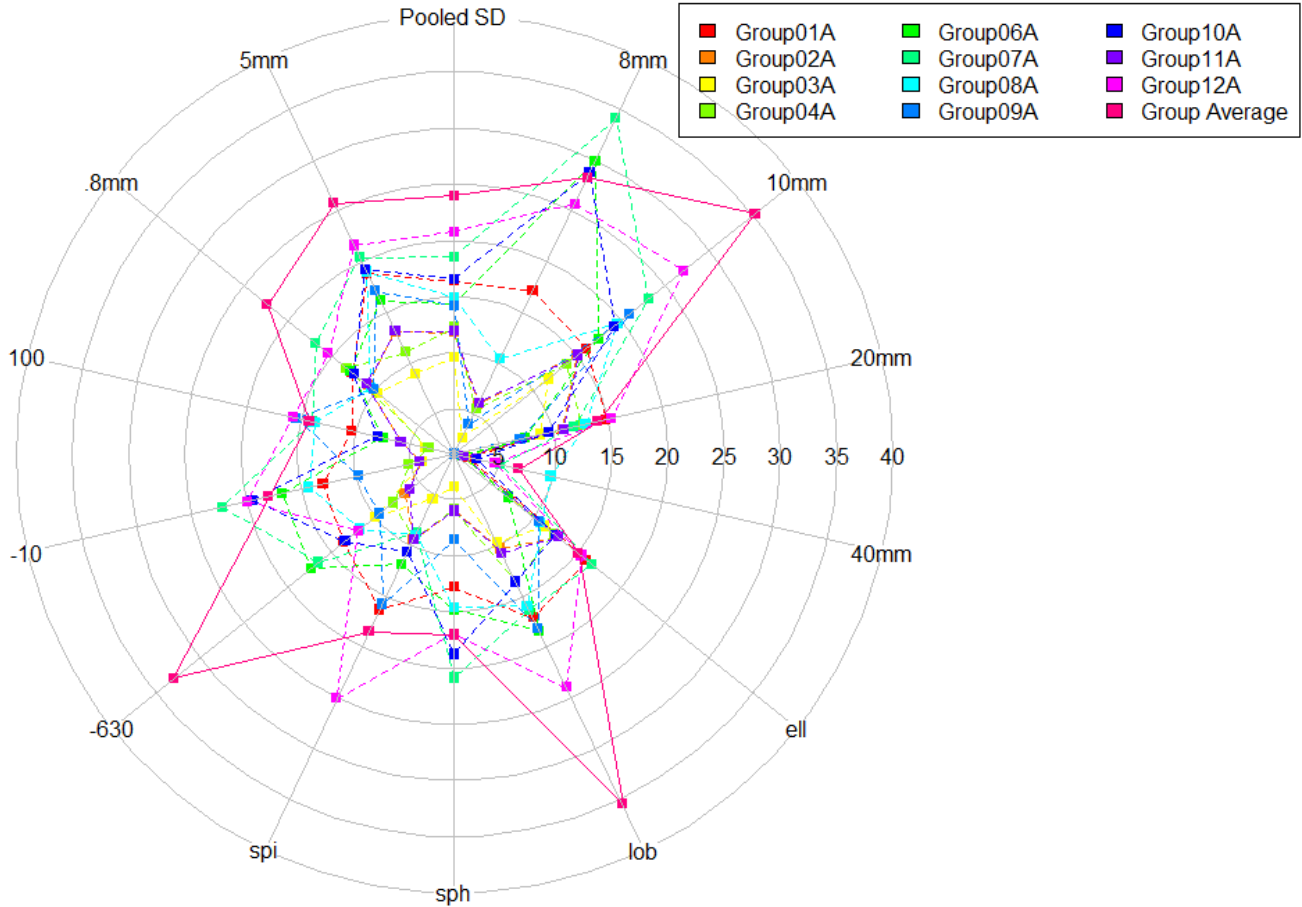


The table containing this data in number form can be found [here](#).

Since Group 05 seems really bad in this plot right above, the following plot was also made, excluding both the reference and group 05.

Percent Error Standard Deviations for Each Individual Factor in all Participants Excluding Reference and Group05A

SD Percent Errors, Group 05 Ignored, and Average in Solid Line



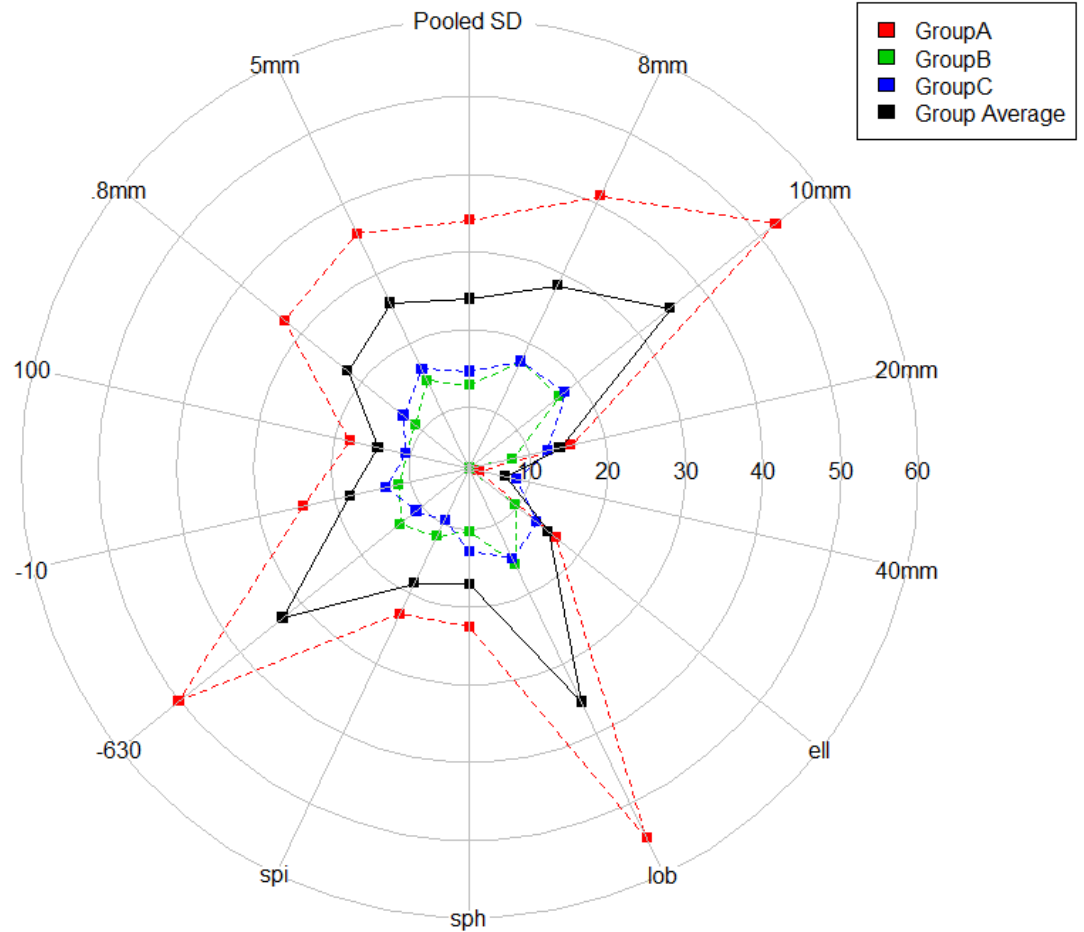
The table containing this data in number form can be found [here](#).

Note: Group02 and Group11 present very similar SD values, and as such overlap in the radial plot. Since Group11 is plotted after Group02, it is the markers of Group11 that are visible and not Group02, though they should be at the same location roughly.

Percent Error Standard Deviations for Each Individual Factor Split into the Three Clusters

Split into clusters A, B, and C and including Group 05:

SD Percent Errors for Each Factor for Each Group Cluster, Group Average shown in a Solid Line



The table containing this data in number form can be found [here](#).

For reference:

Cluster A: 1, 5, 10, 12

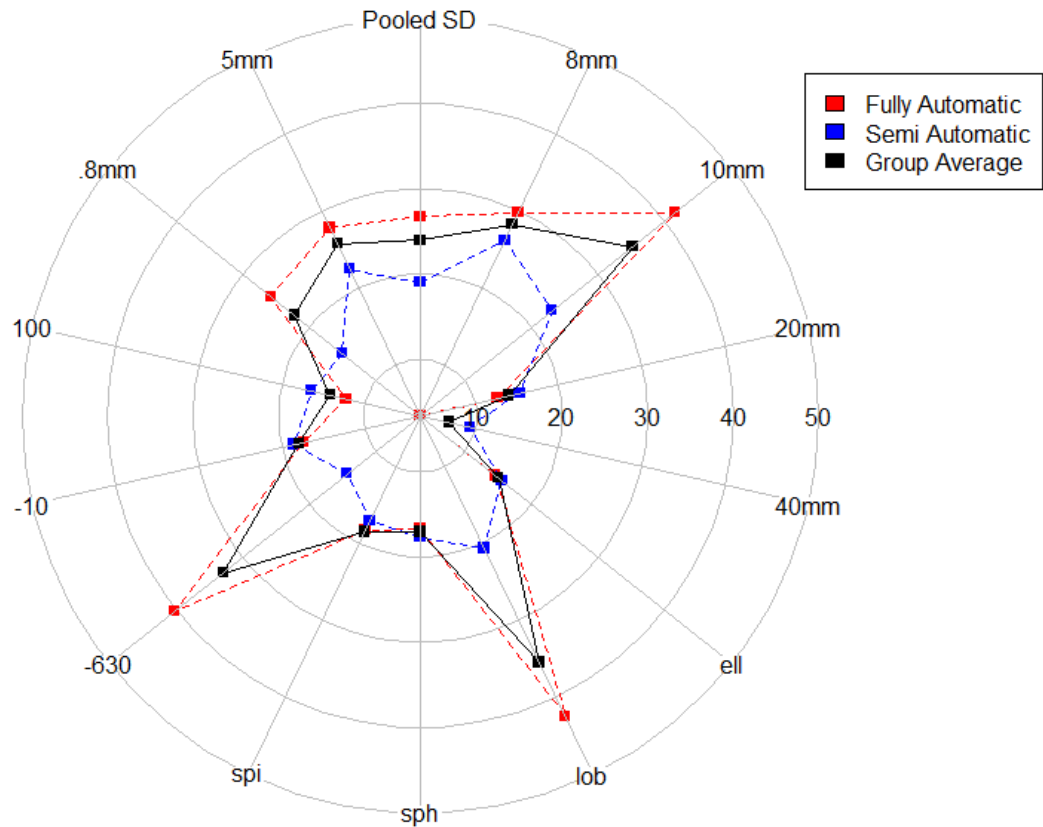
Cluster B: 3, 6, 9

Cluster C: 2, 4, 7, 8, 11

Percent Error Standard Deviations for Each Individual Factor Split into the Reading Method Type

Splitting the participants according to the method type employed:

SD Percent Errors for Each Factor by Method, Group Average shown in a Solid Line



Fully Automatic: Group 02, Group 03, Group 05, Group 06, Group 09, Group 10, Group 11

Semi Automatic: Group 01, Group 04, Group 07, Group 08, Group 12

The table containing this data in number form can be found [here](#).

Spearman Correlations

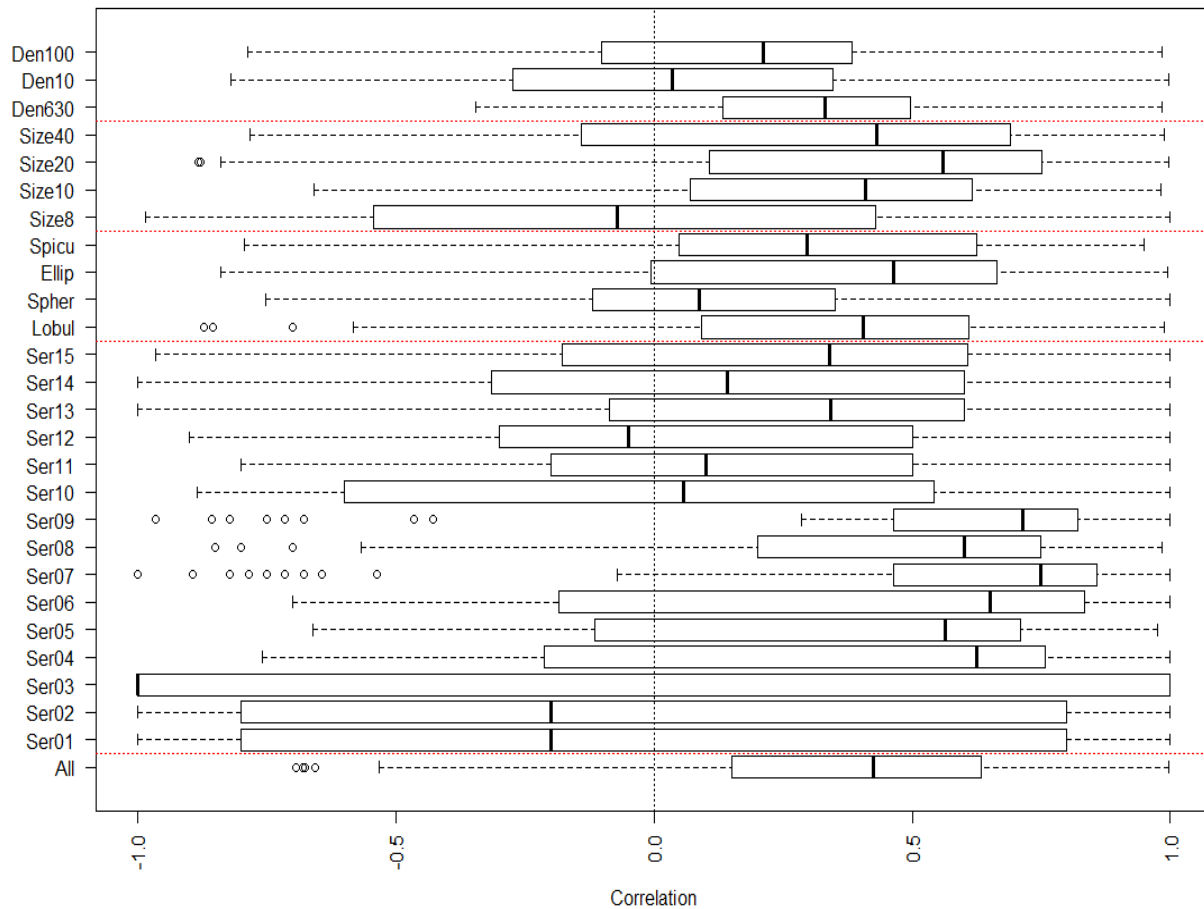
The Spearman correlations between the percent error readings for each lesion of each series were calculated between each pair of participants. At first the correlations were found for overall data, and then also for each factor among series, shape, size, and density.

The following box-plot shows the information for each set of 66 correlations:

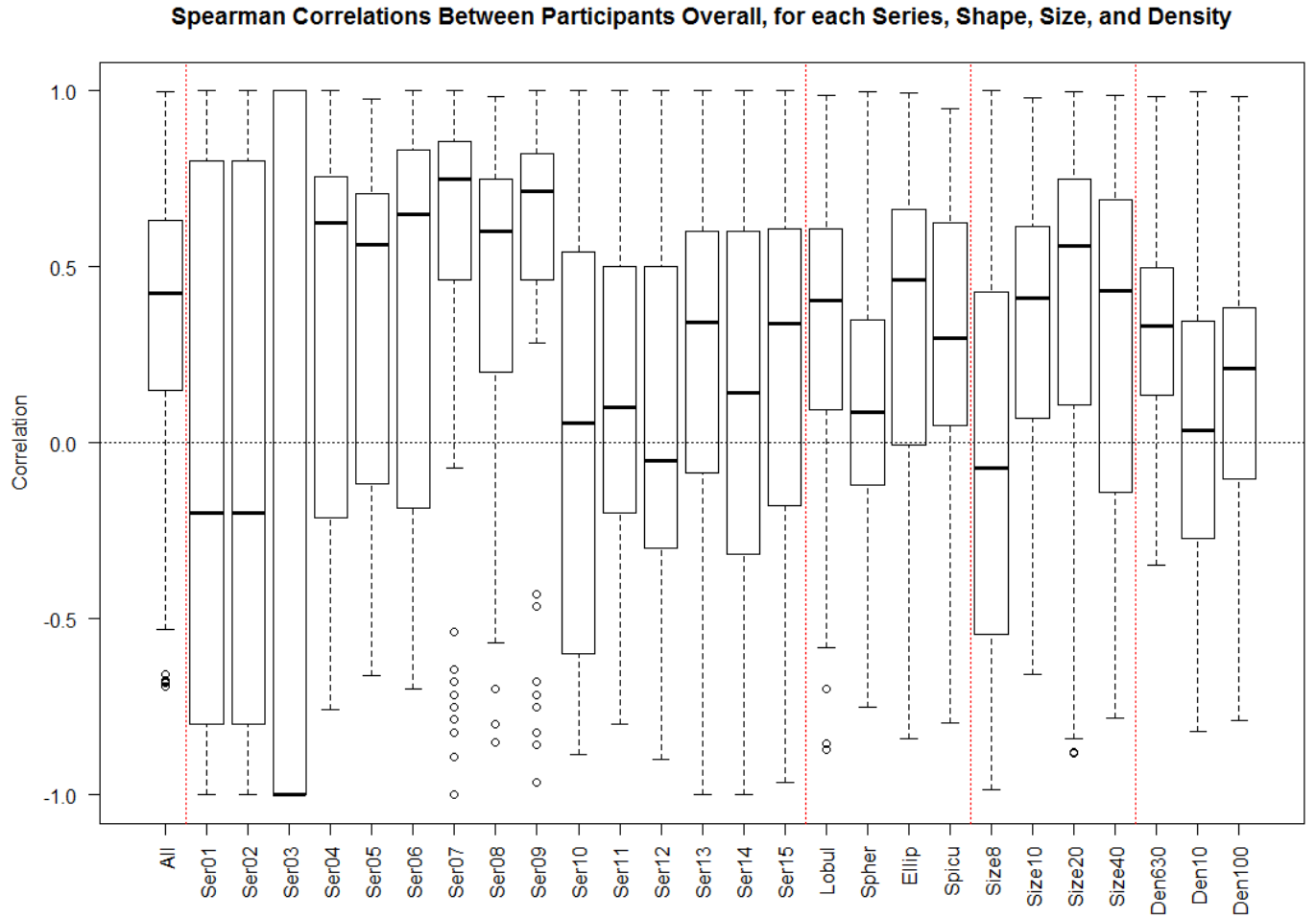
(Note: Series03 only has 2 lesions, so the correlation has very little meaning there)

(Note2: the red dotted lines indicate where different factor sections begin, so it separates the series plots from the shape plots from the size plots from the density plots)

Spearman Correlations Between Participants Overall, for each Series, Shape, Size, and Density

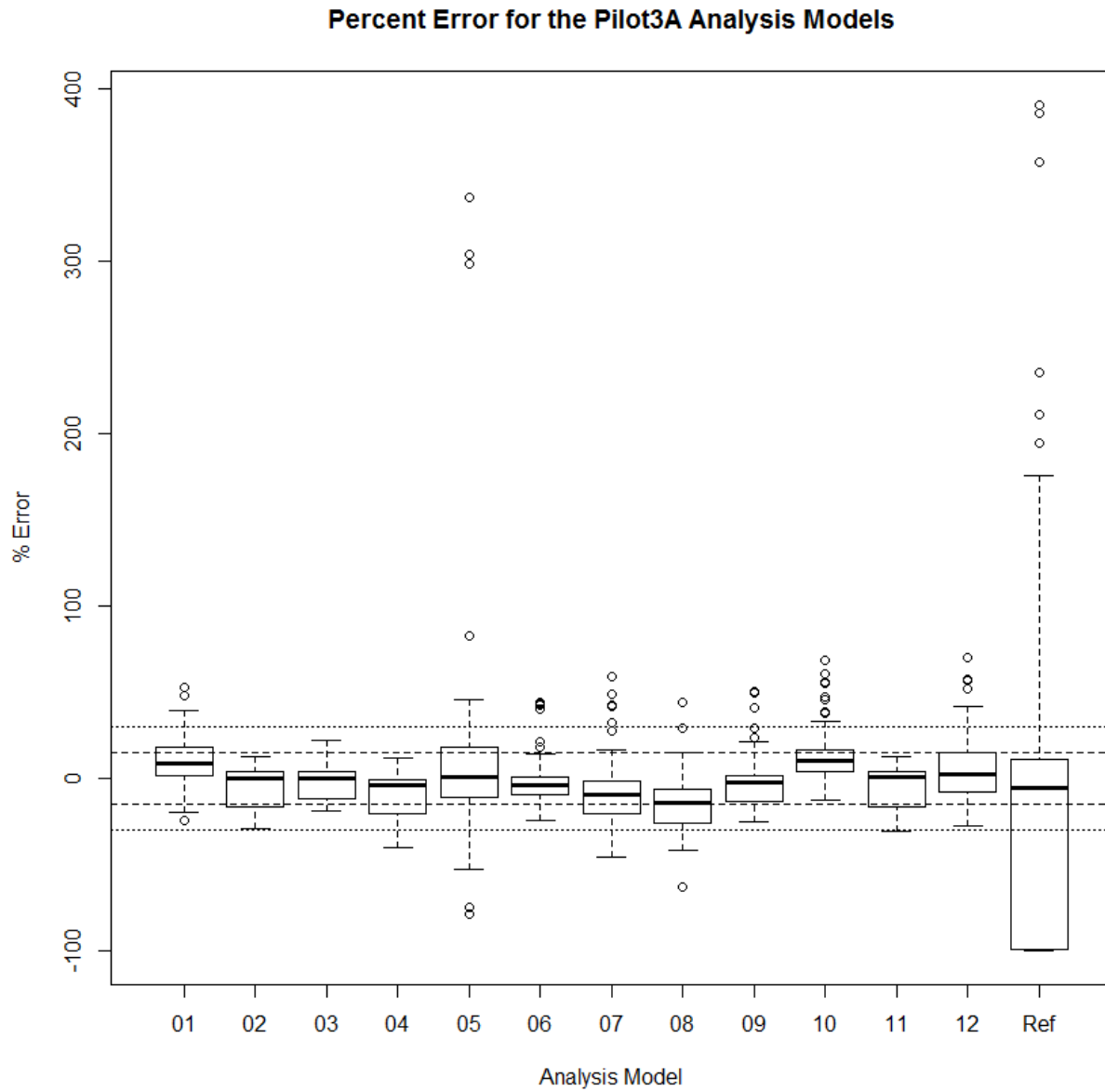


And here are plots of the same correlations, except oriented vertically.



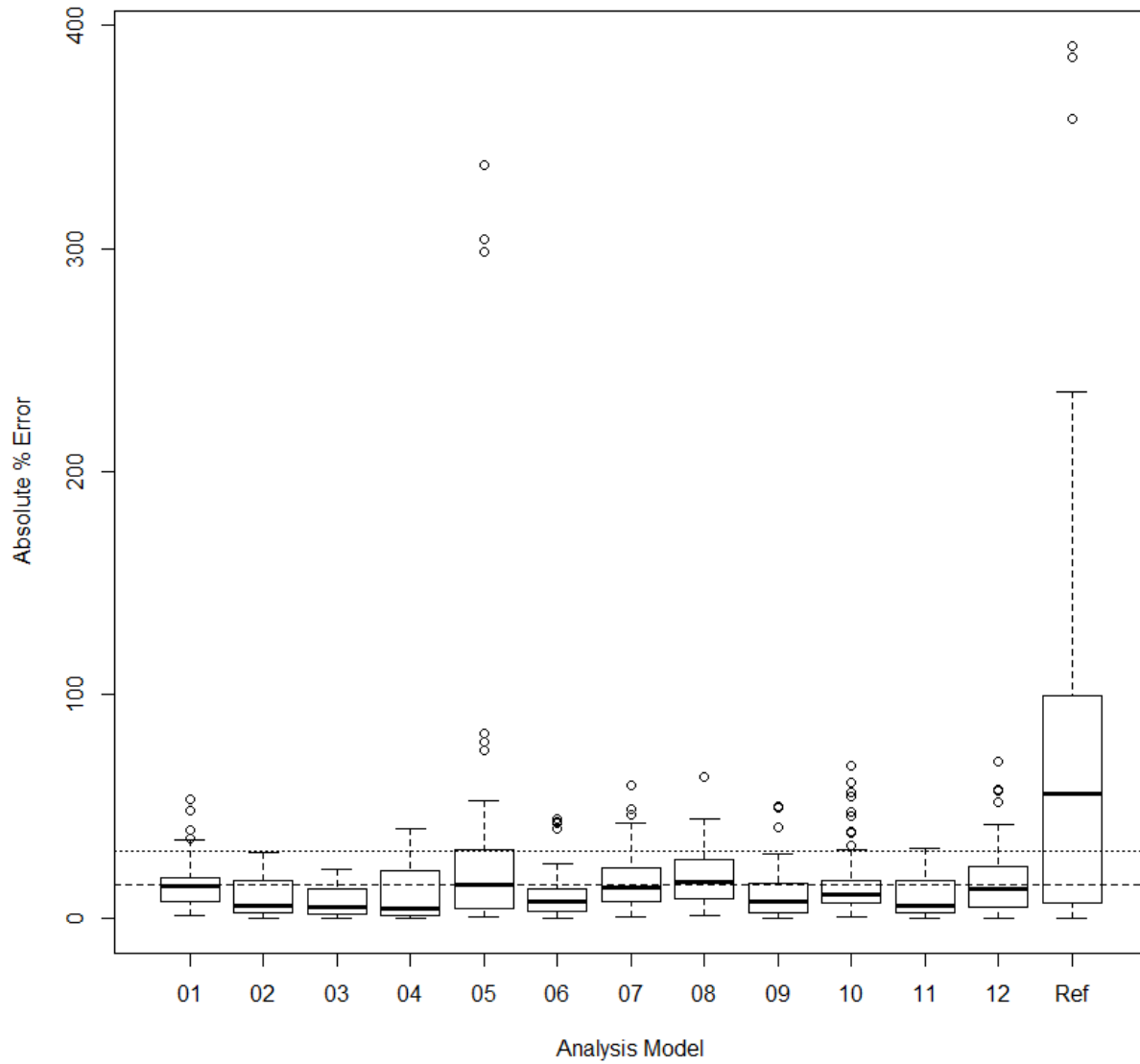
Box-Plots

Box Plots for the Percent Error for all Participants



The thicker dotted lines represent $\pm 15\%$, and the smaller dotted lines show the location of $\pm 30\%$.

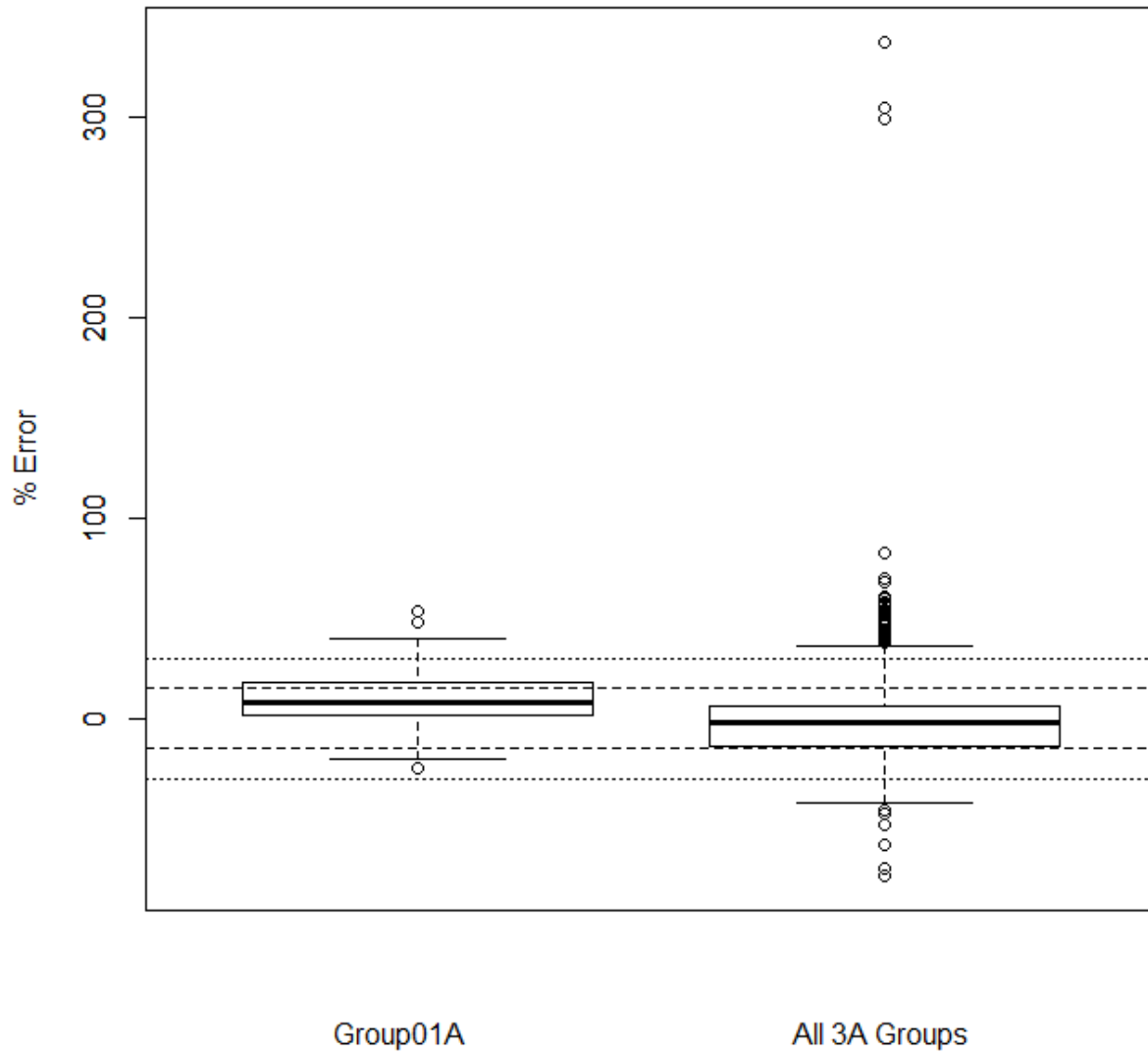
Absolute Percent Error for the Pilot3A Analysis Models



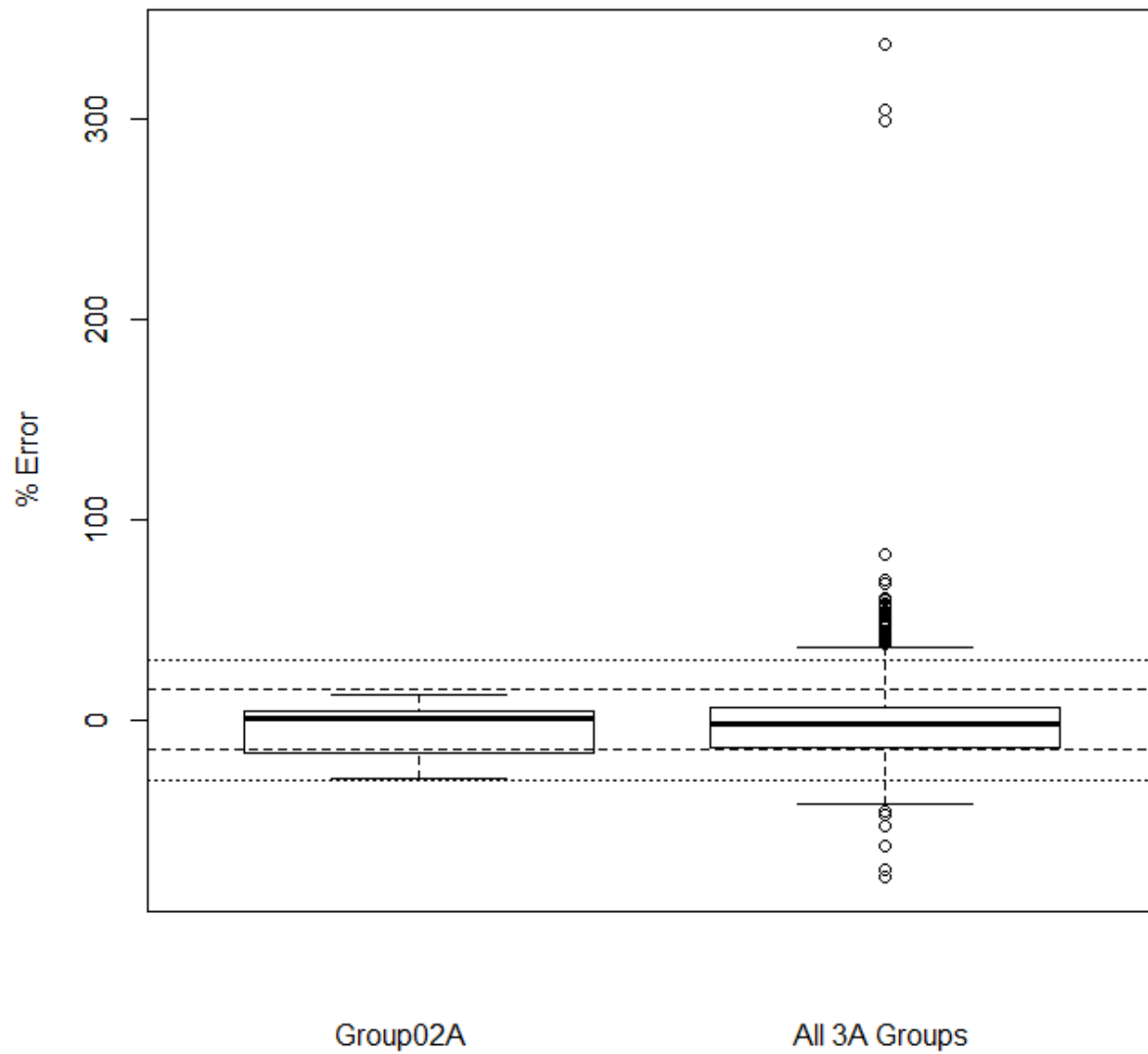
The thicker dotted lines represent 15%, and the smaller dotted lines show the location of 30%.

Comparing Each Individual Participant with Combination of the Non-Reference Participants

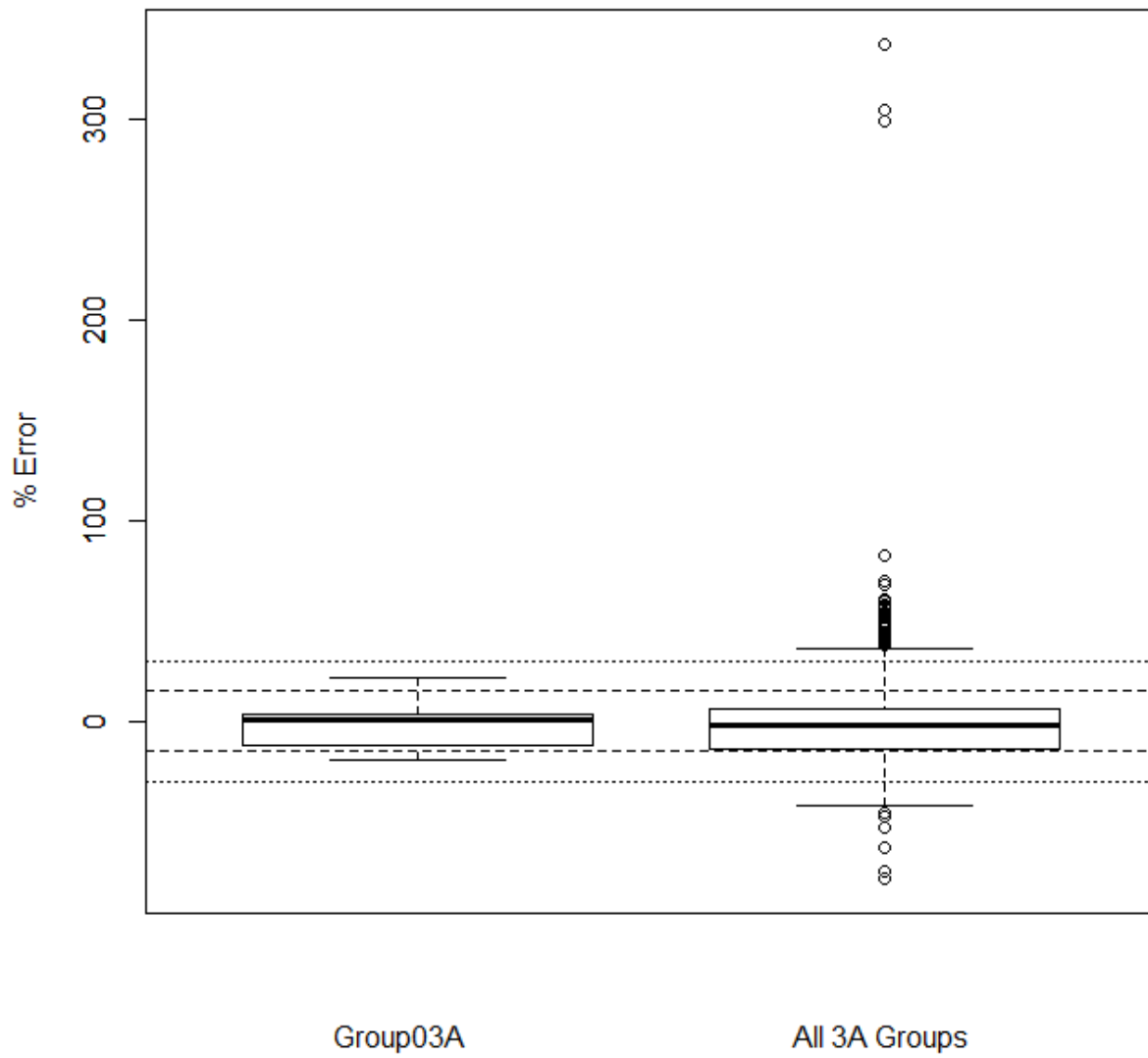
Percent Error in Group01A vs All Other Groups (no Reference)



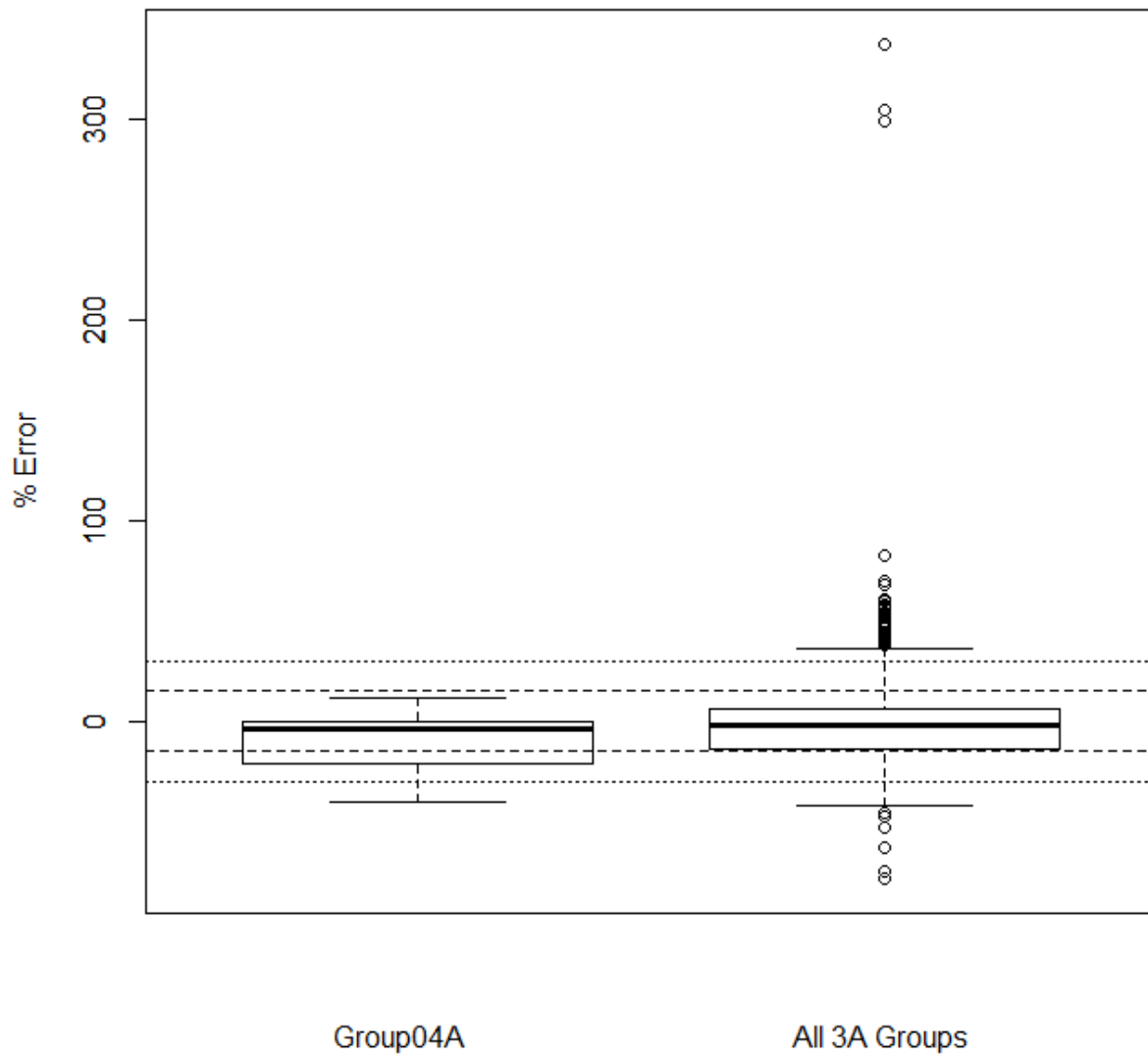
Percent Error in Group02A vs All Other Groups (no Reference)



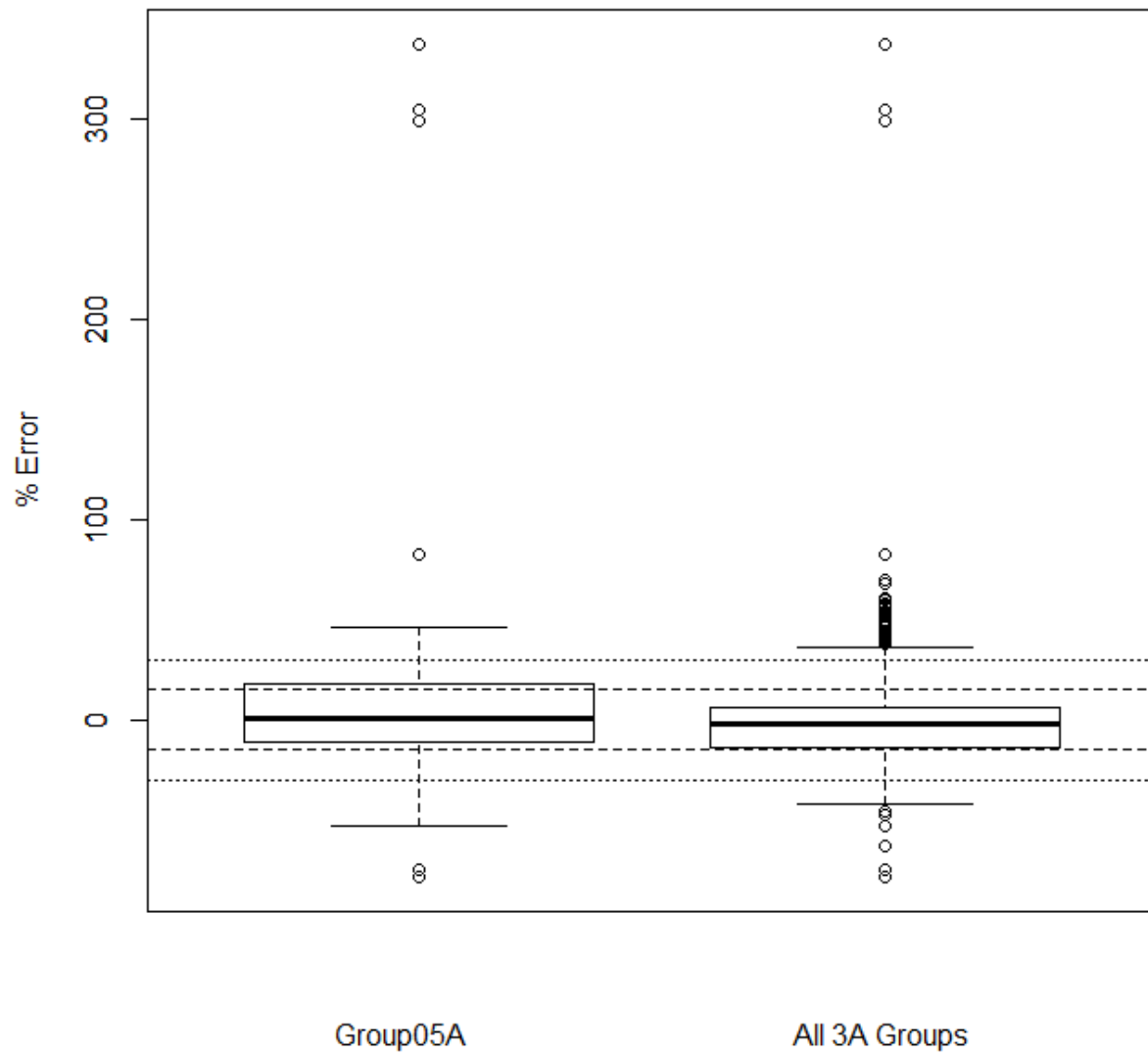
Percent Error in Group03A vs All Other Groups (no Reference)



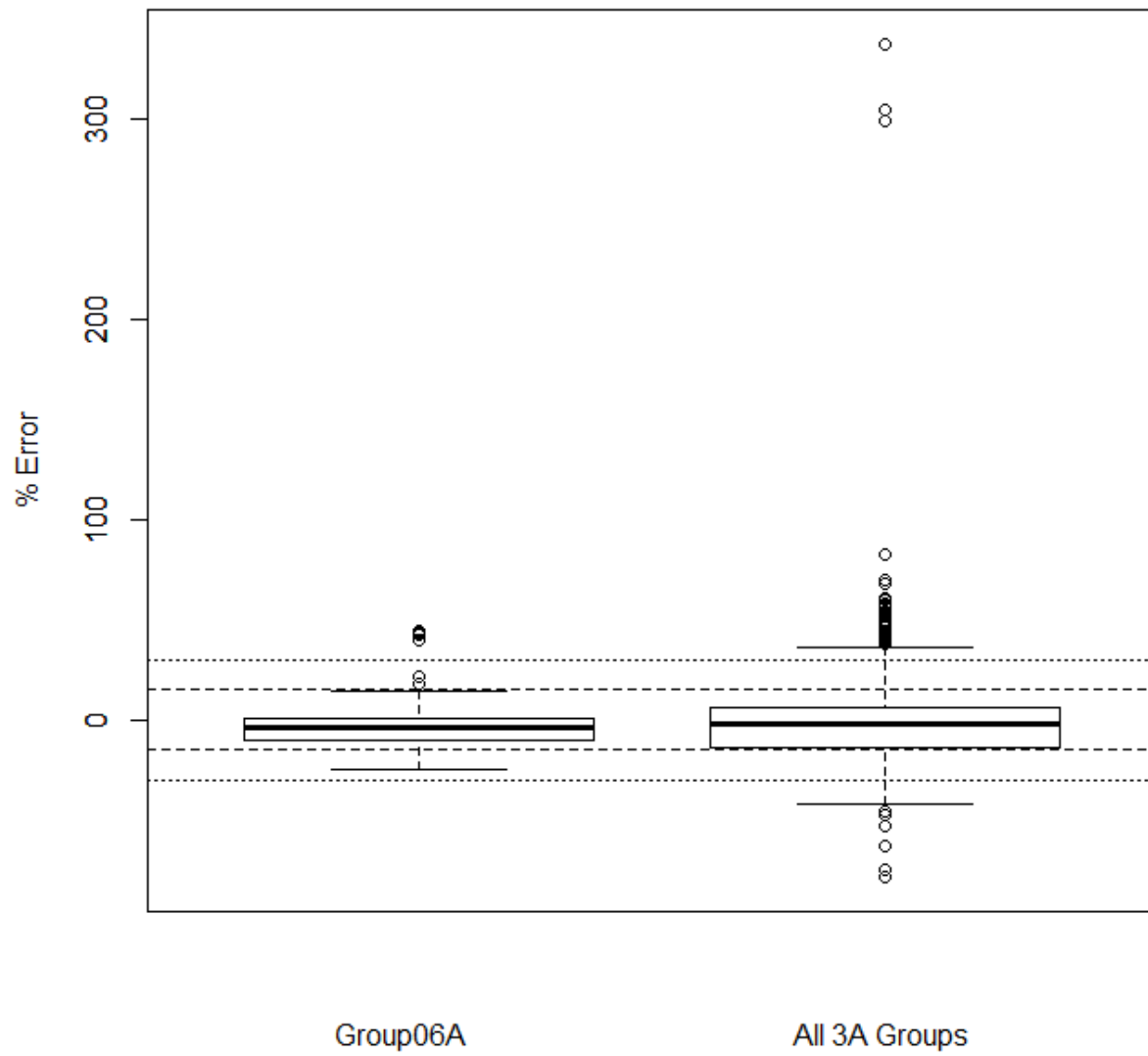
Percent Error in Group04A vs All Other Groups (no Reference)



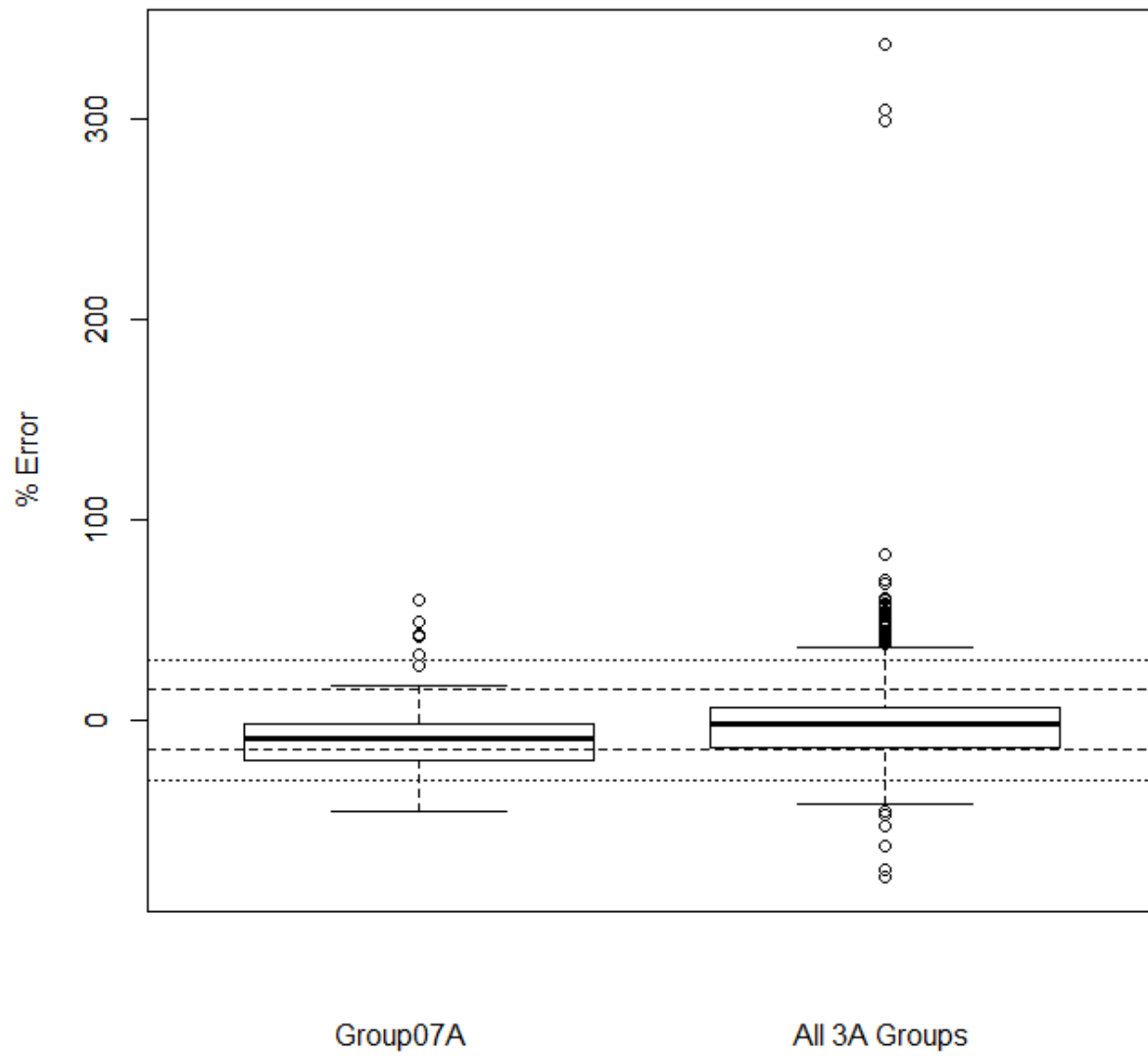
Percent Error in Group05A vs All Other Groups (no Reference)



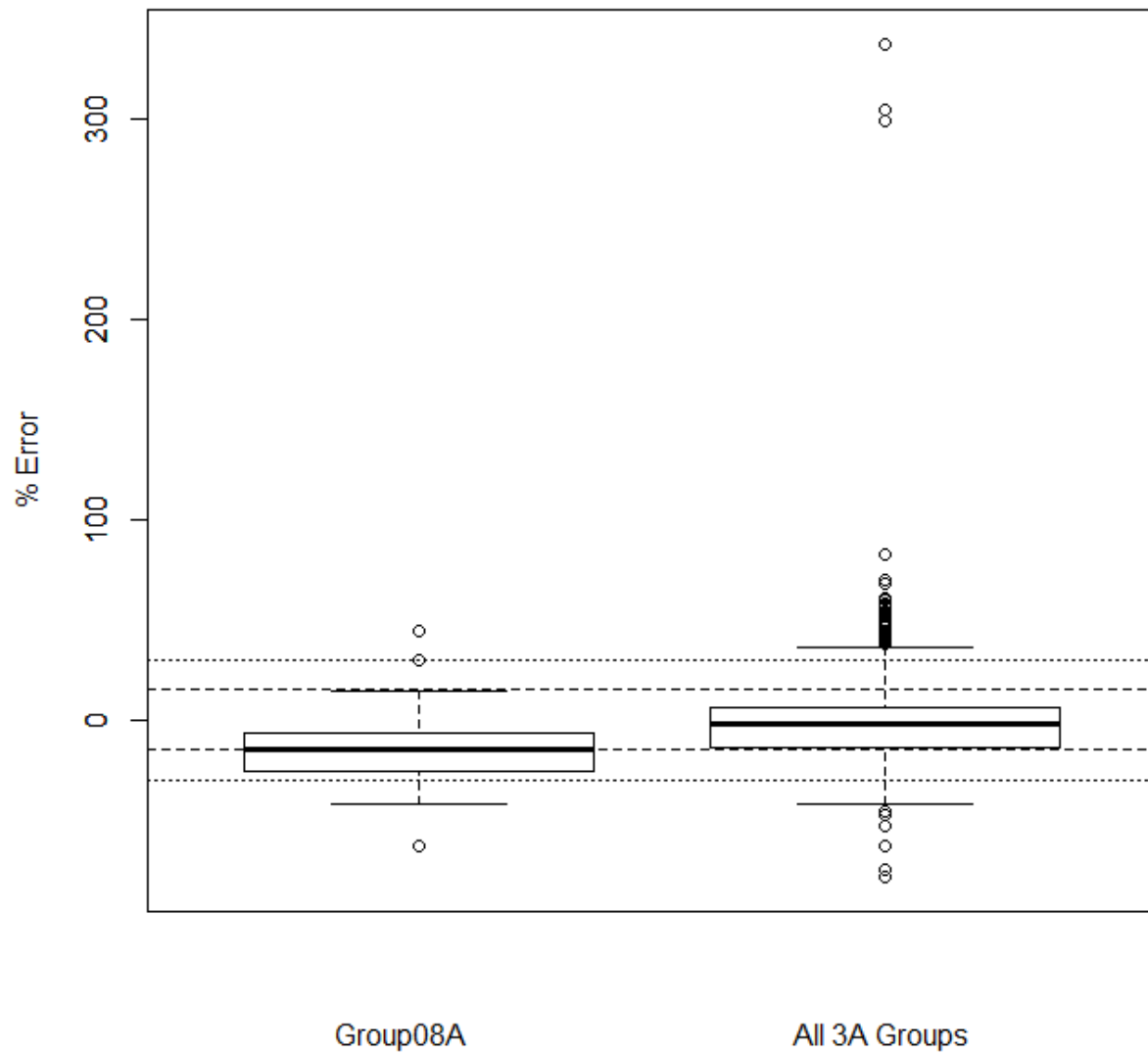
Percent Error in Group06A vs All Other Groups (no Reference)



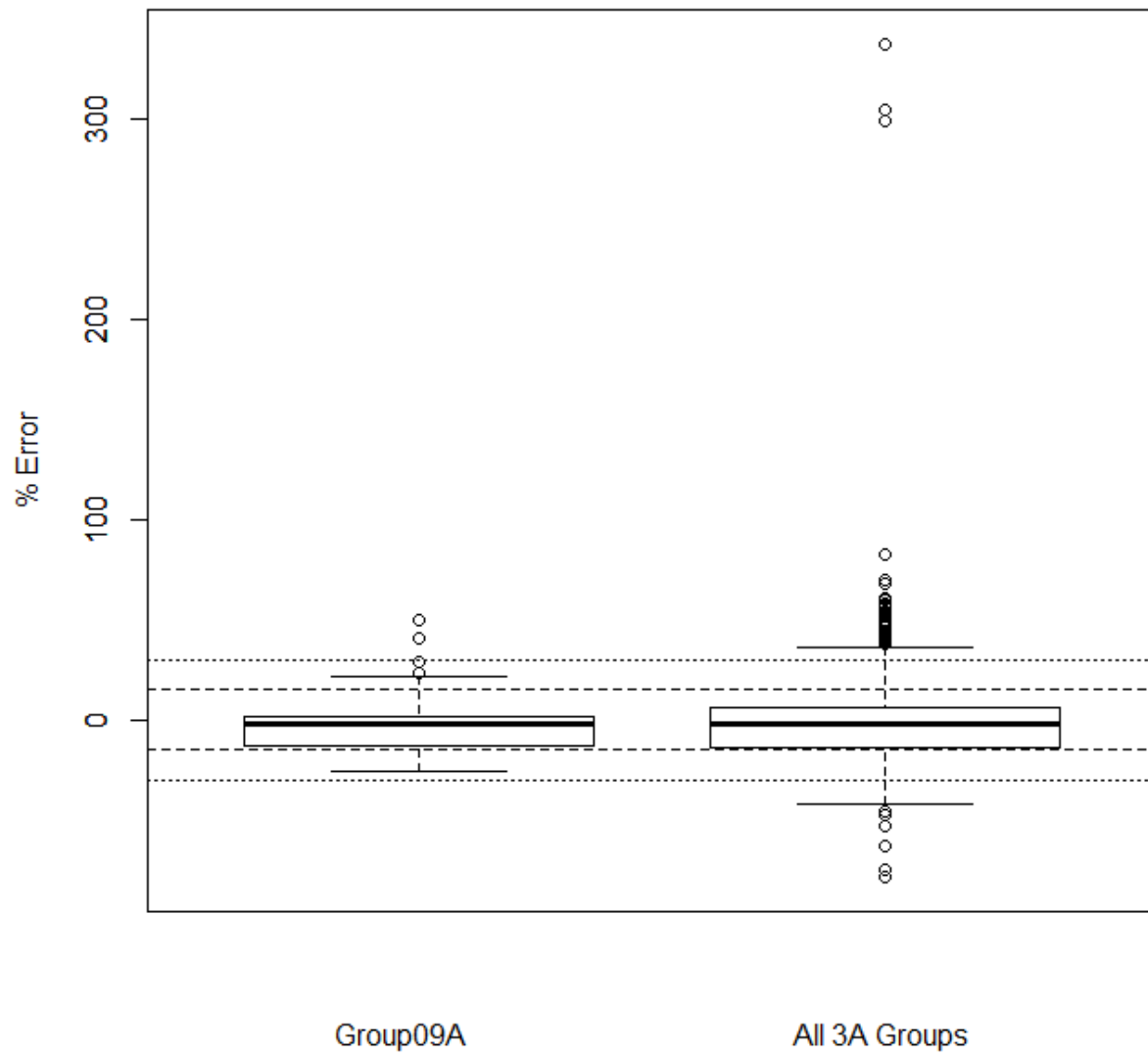
Percent Error in Group07A vs All Other Groups (no Reference)



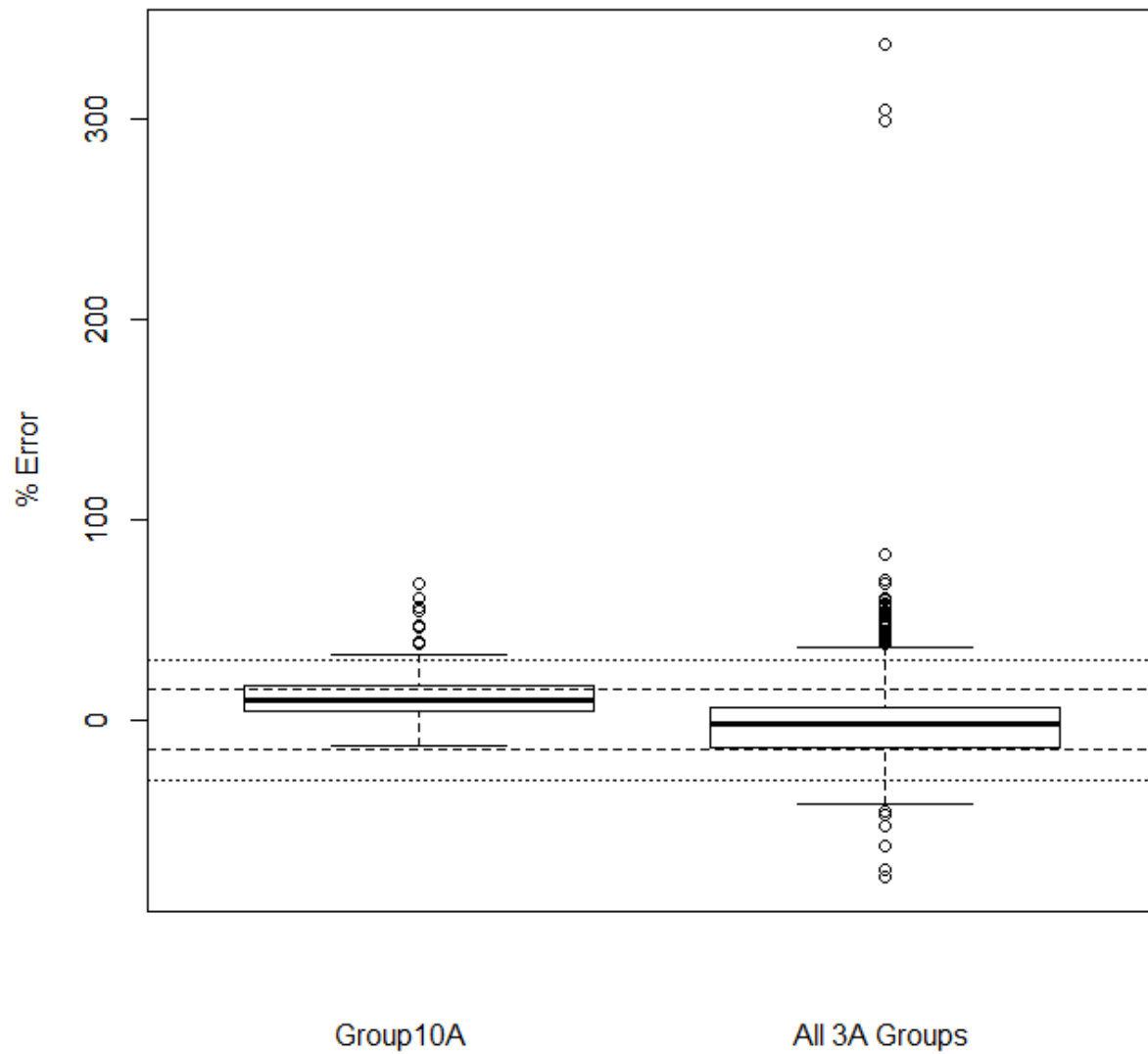
Percent Error in Group08A vs All Other Groups (no Reference)



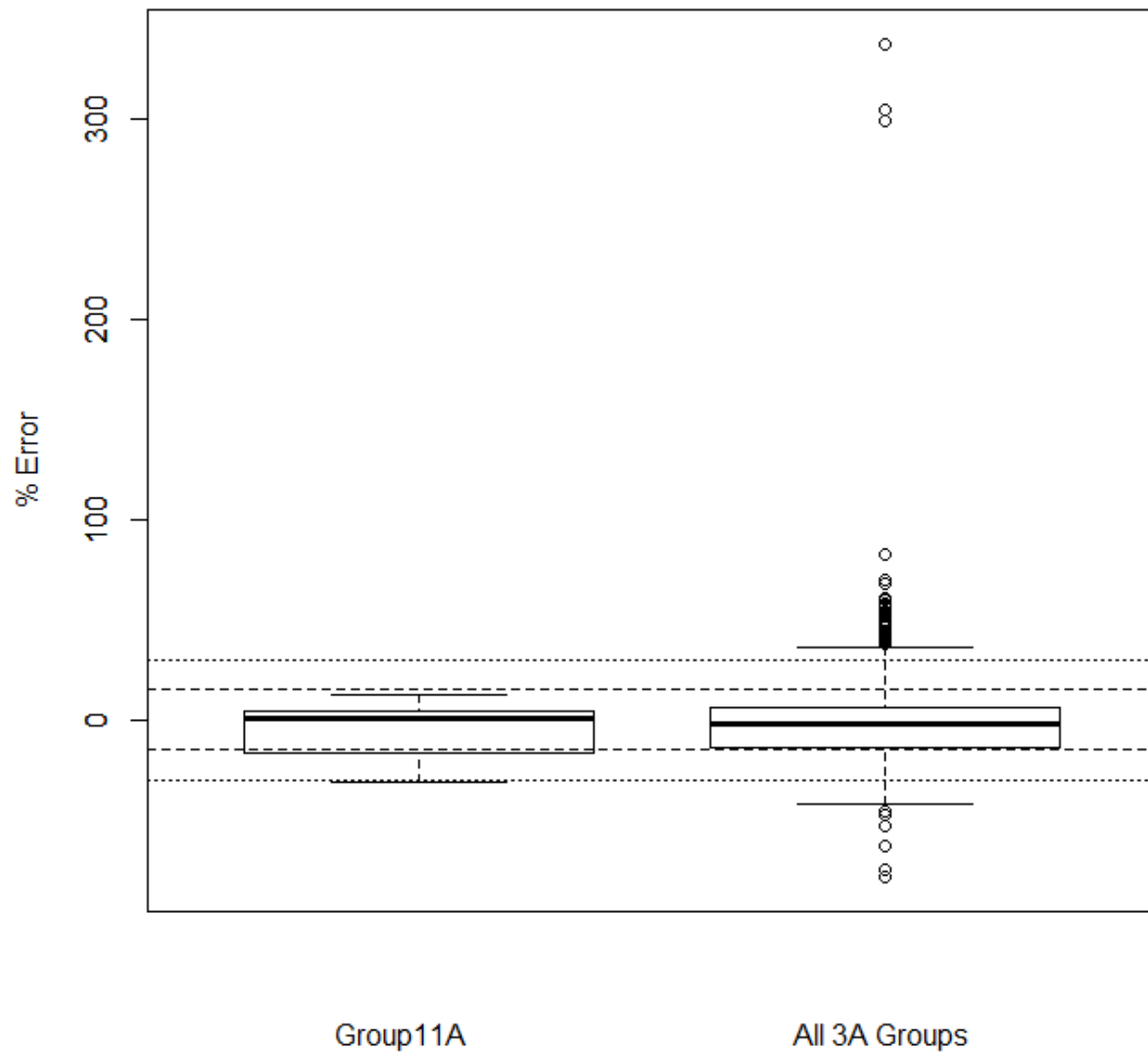
Percent Error in Group09A vs All Other Groups (no Reference)



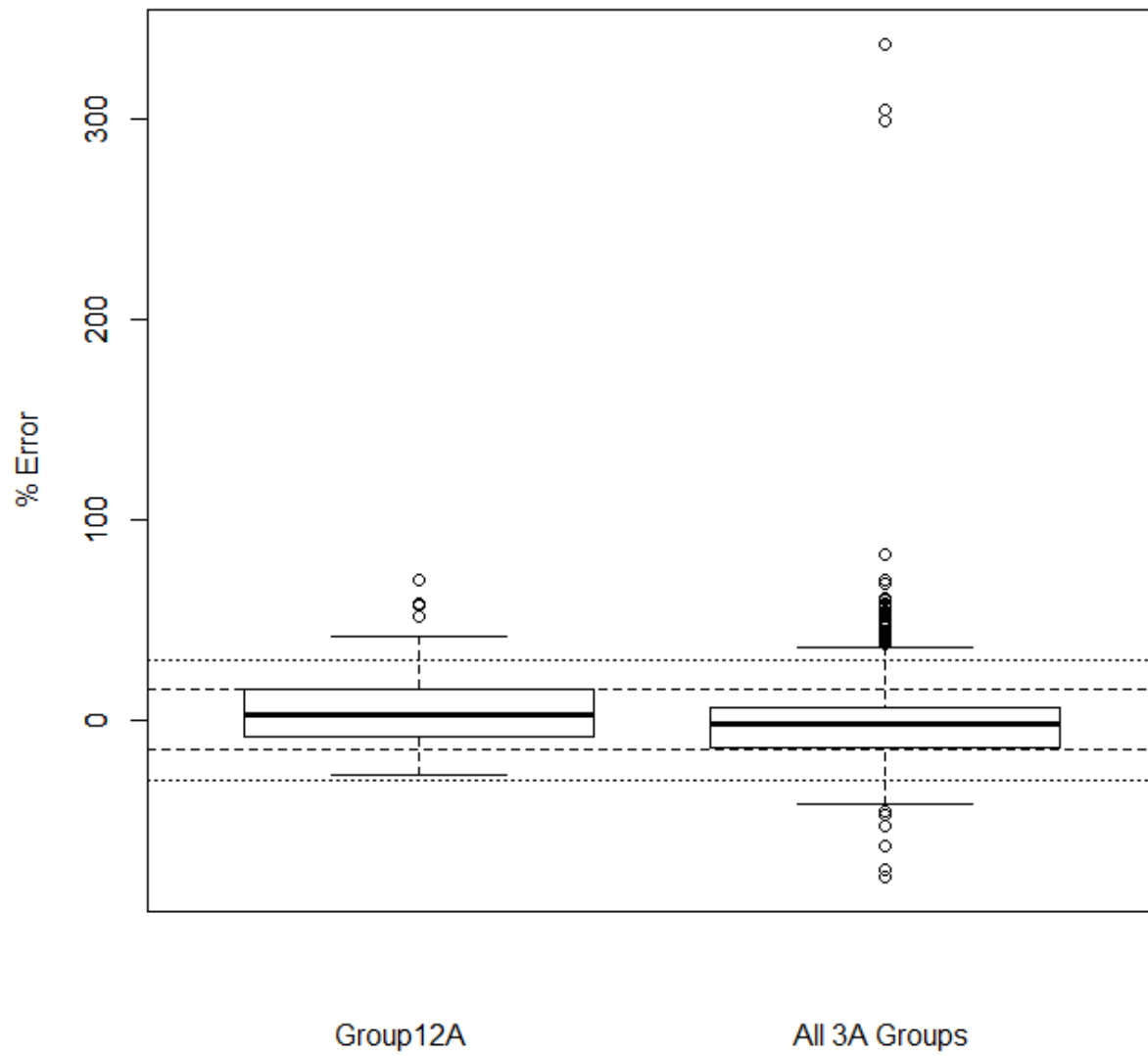
Percent Error in Group10A vs All Other Groups (no Reference)



Percent Error in Group11A vs All Other Groups (no Reference)

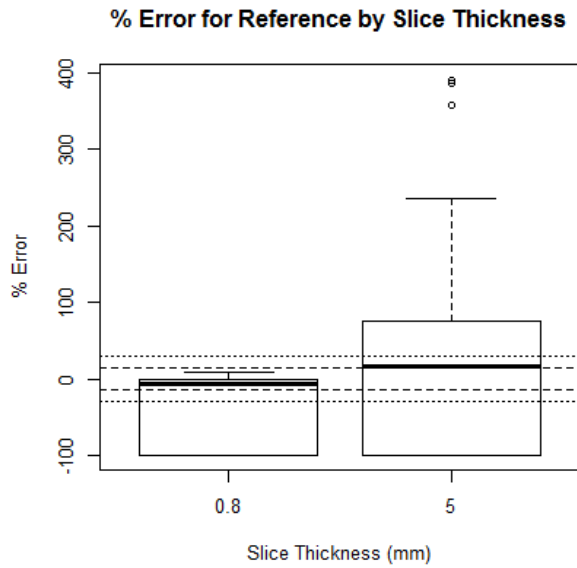
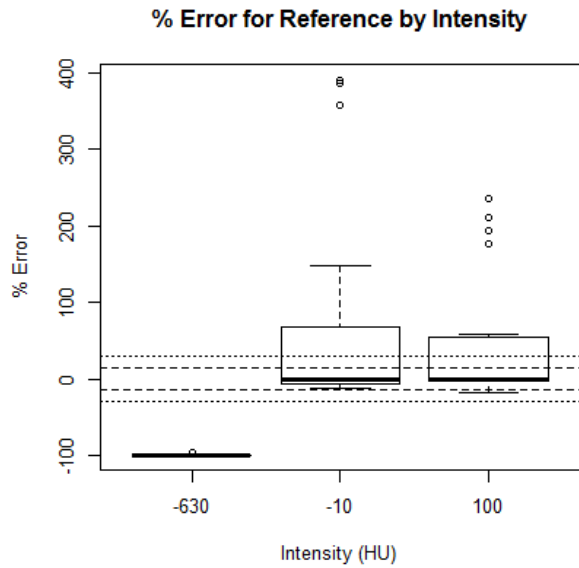
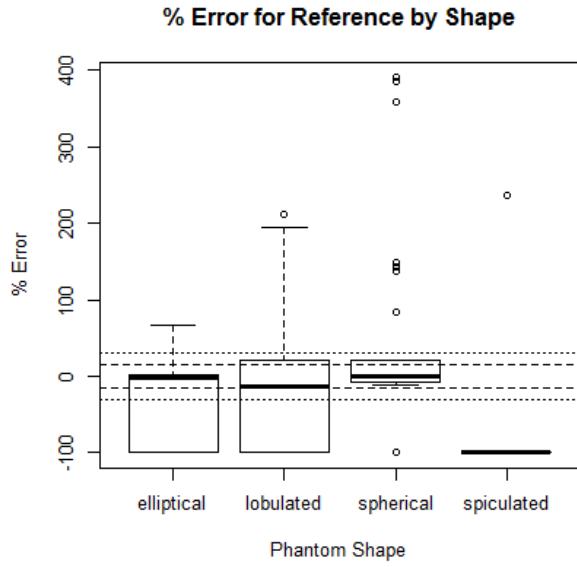
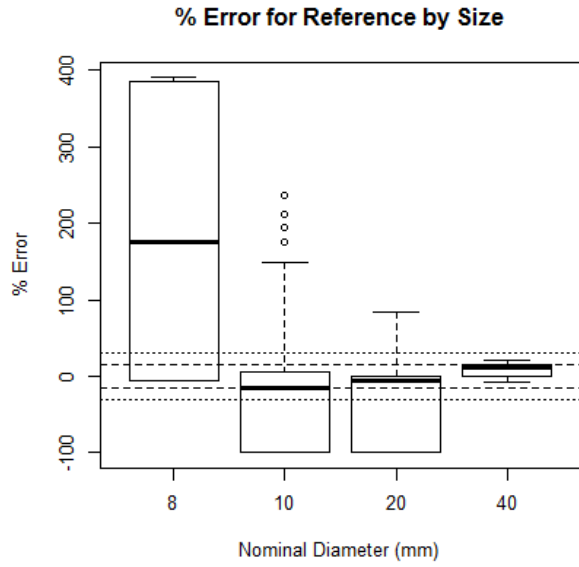


Percent Error in Group12A vs All Other Groups (no Reference)



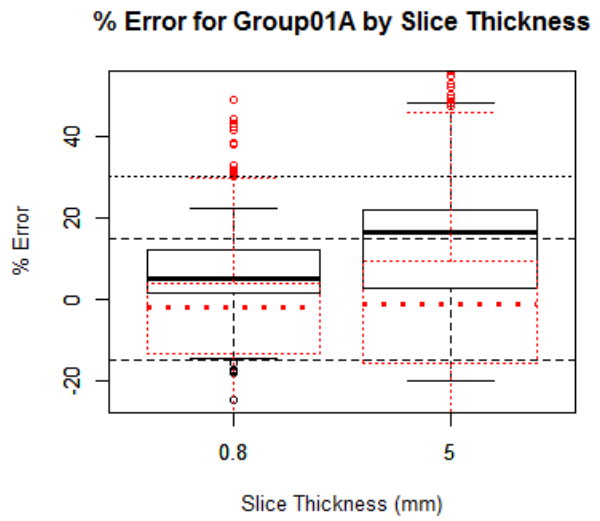
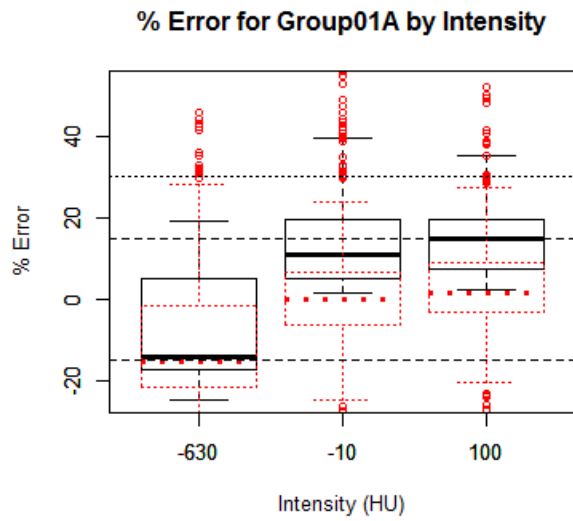
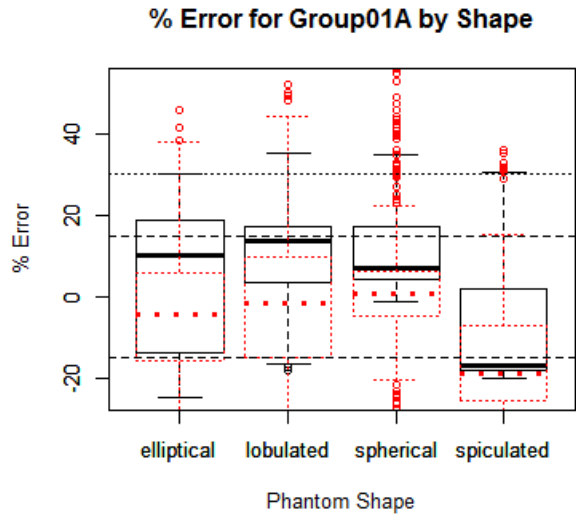
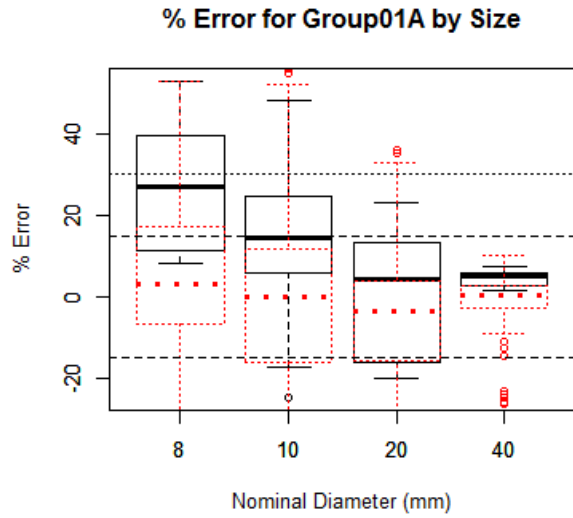
Box-Plots by Each Factor for Each Participant

Box Plots for the Reference by each Factor

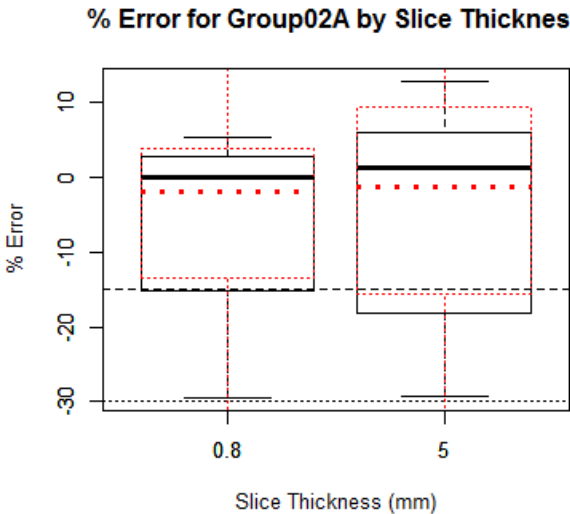
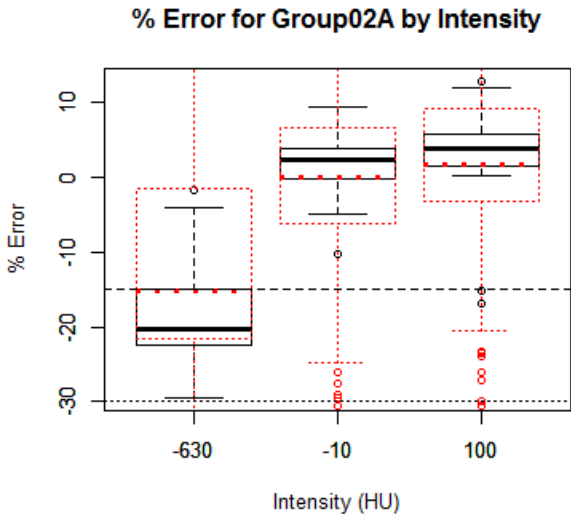
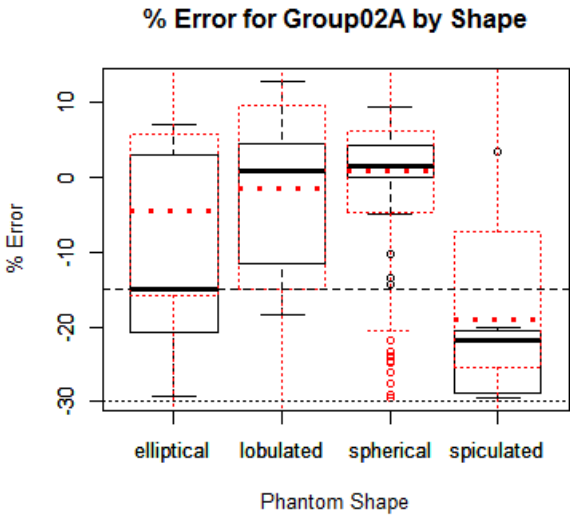
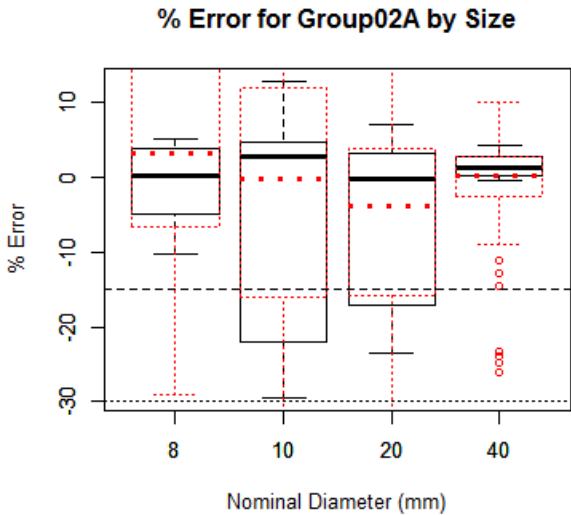


NOTE: For all following box-plots, the red dotted-line plots are the plots of the data from all Analysis Participants combined, excluding the Reference.

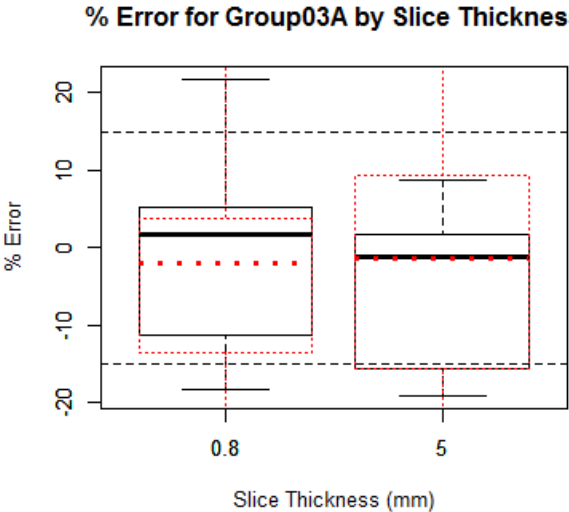
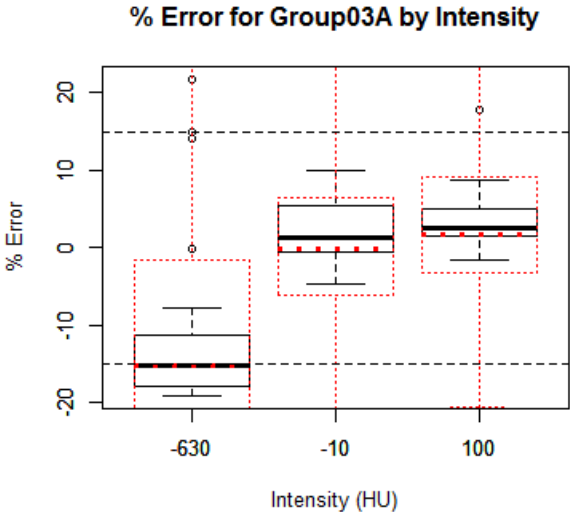
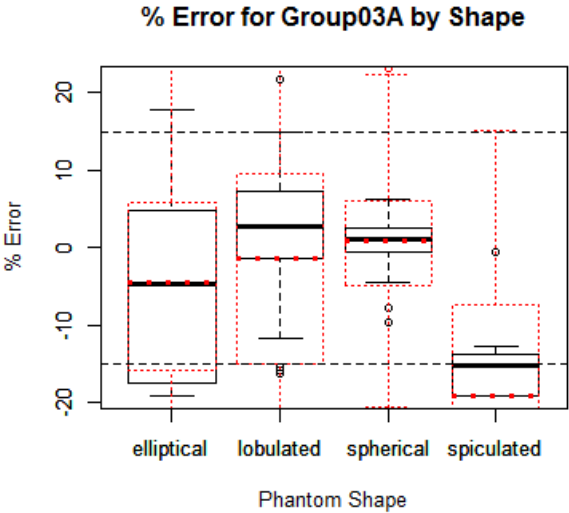
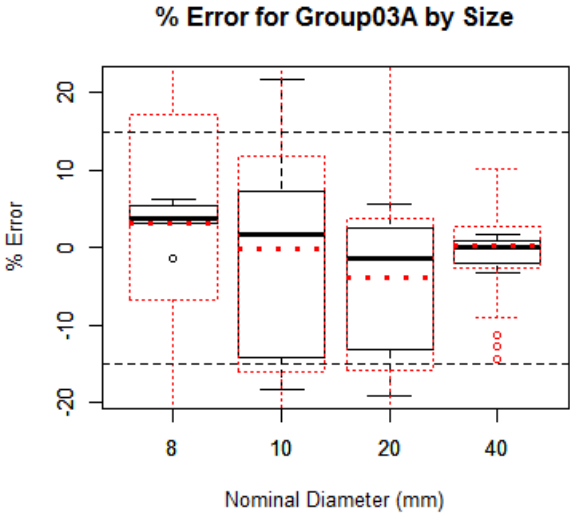
Box Plots for the Group01A by each Factor



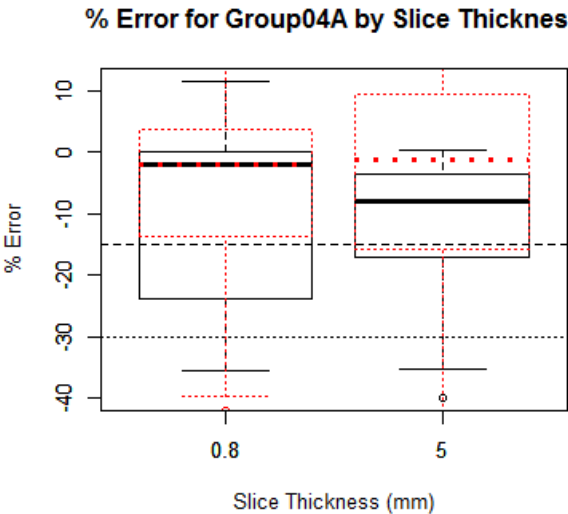
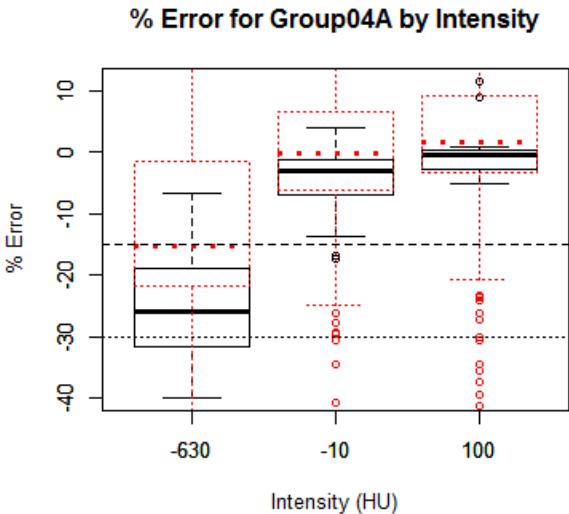
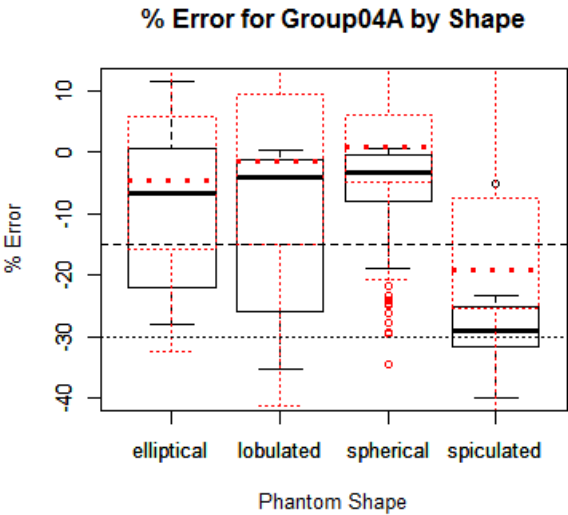
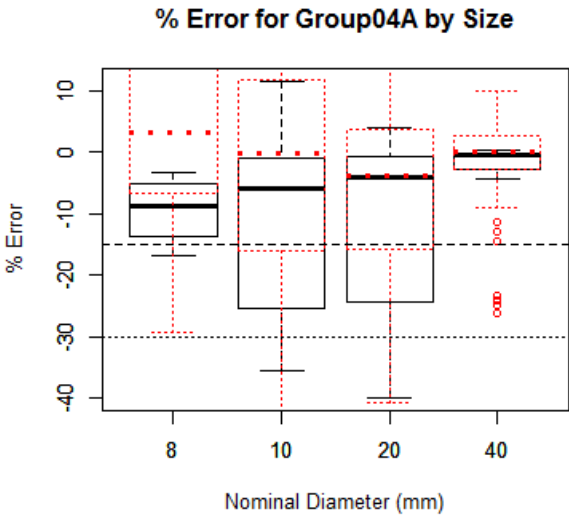
Box Plots for the Group02A by each Factor



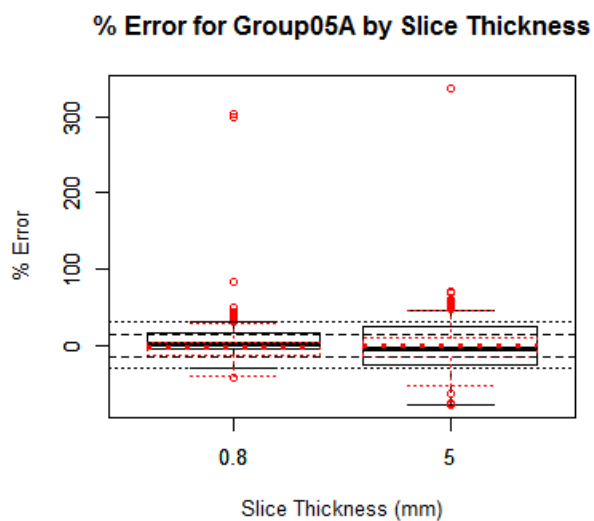
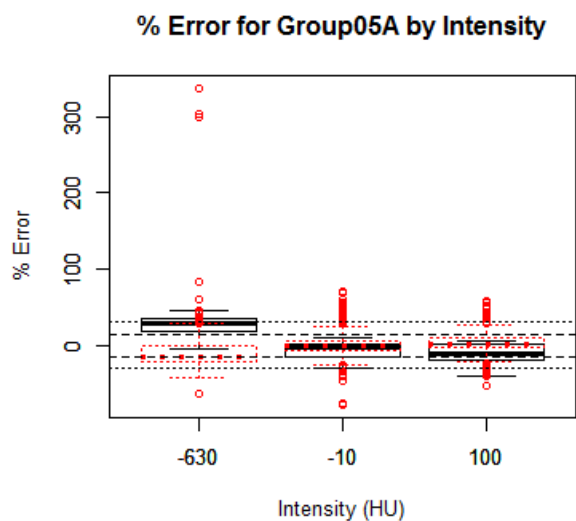
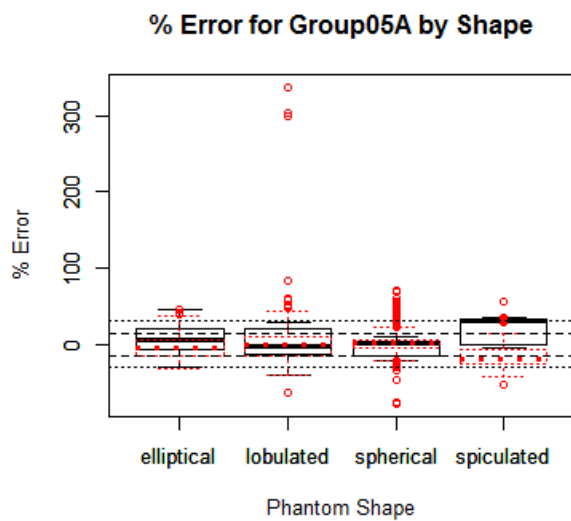
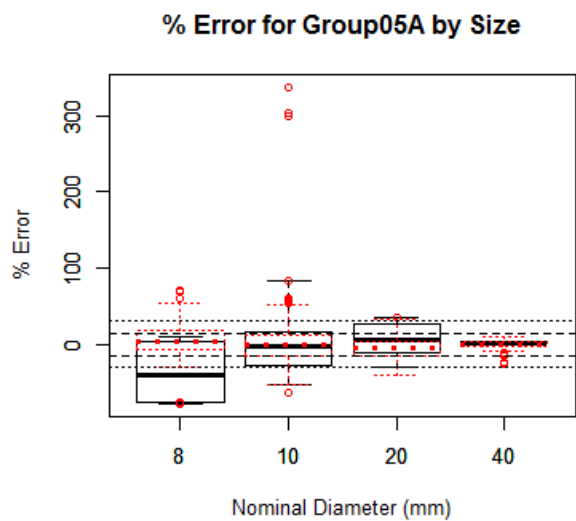
Box Plots for the Group03A by each Factor



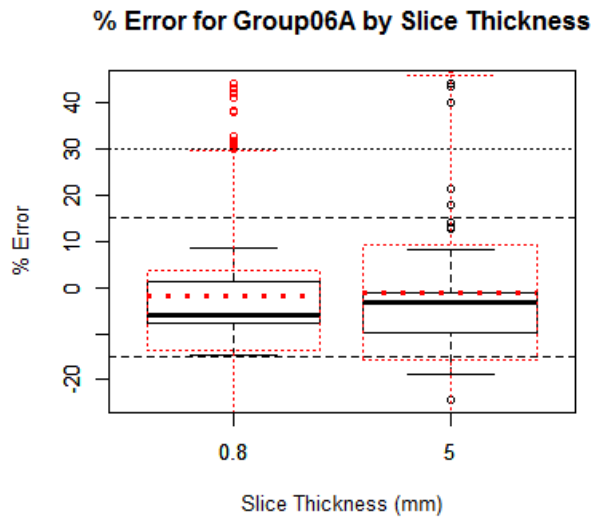
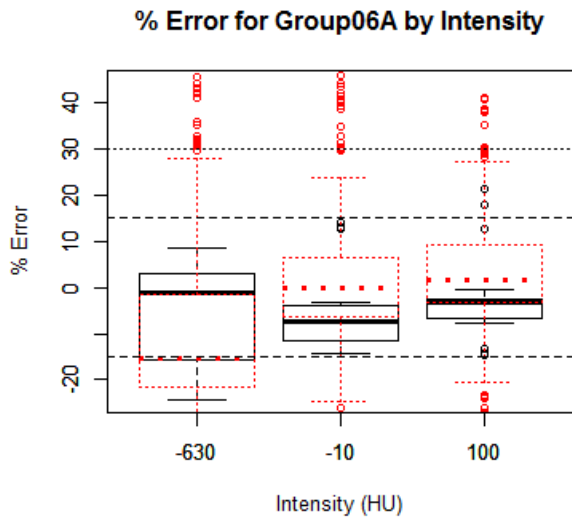
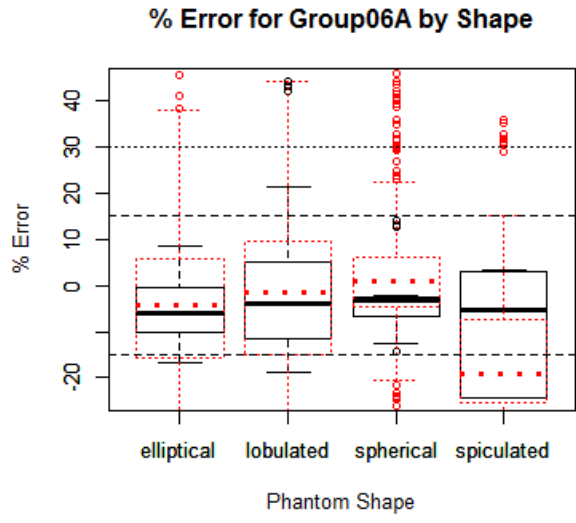
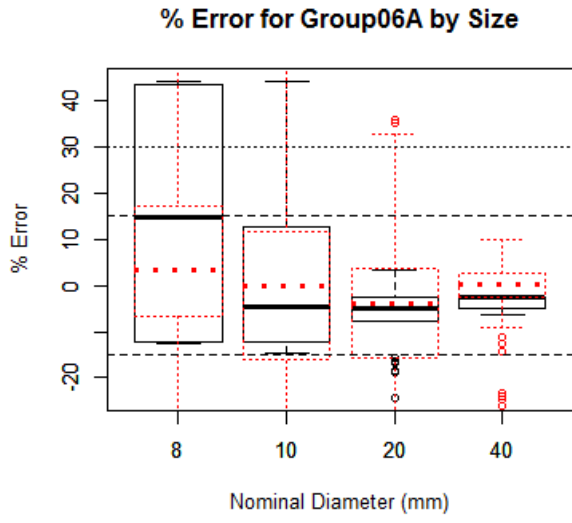
Box Plots for the Group04A by each Factor



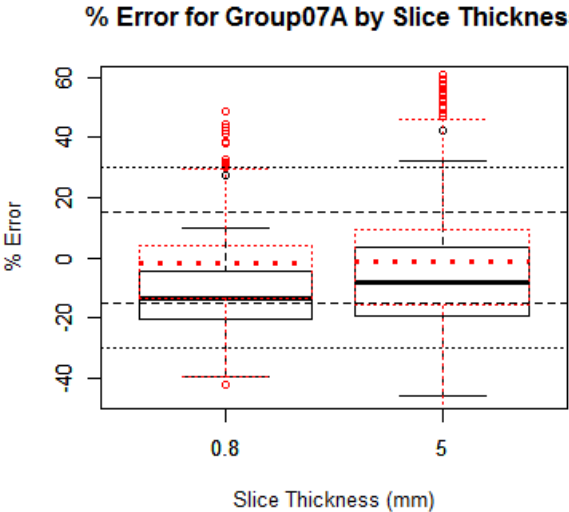
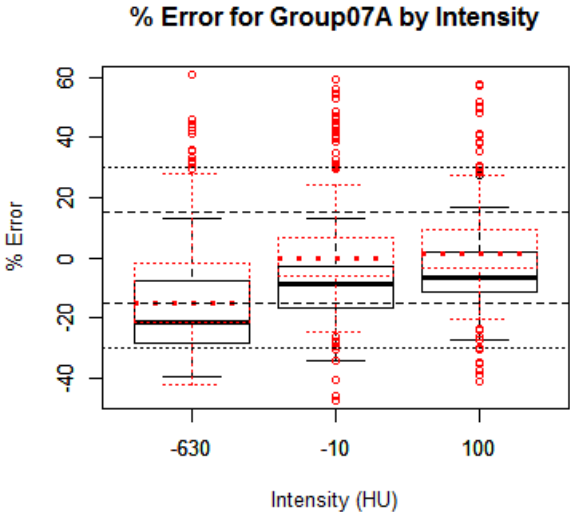
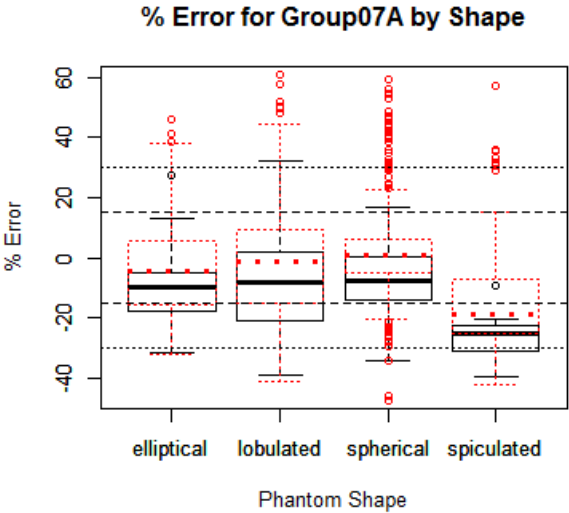
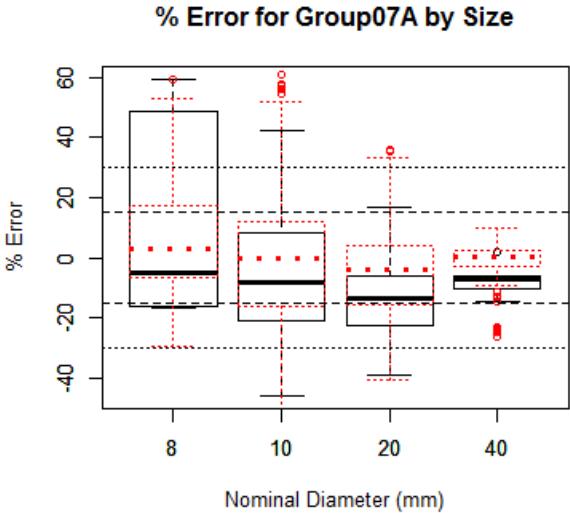
Box Plots for the Group05A by each Factor



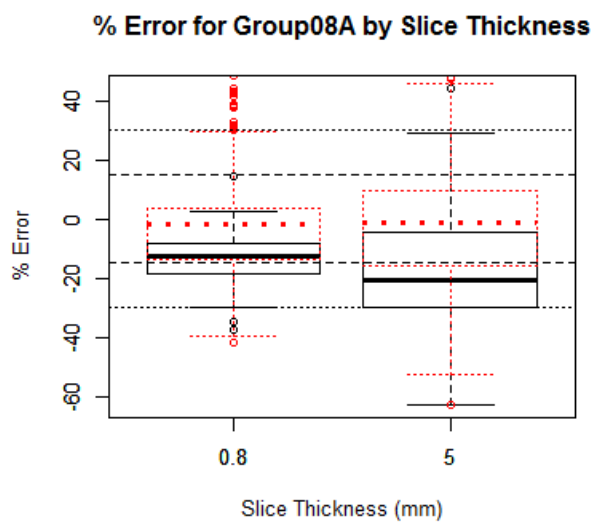
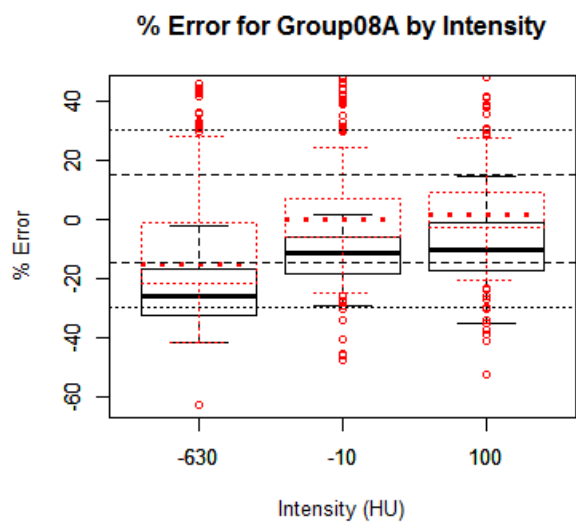
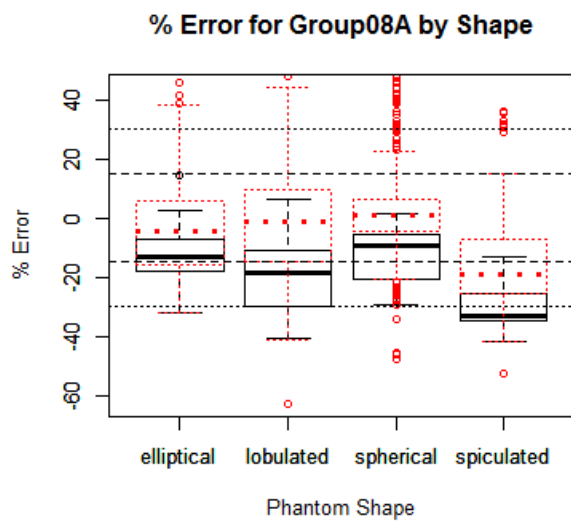
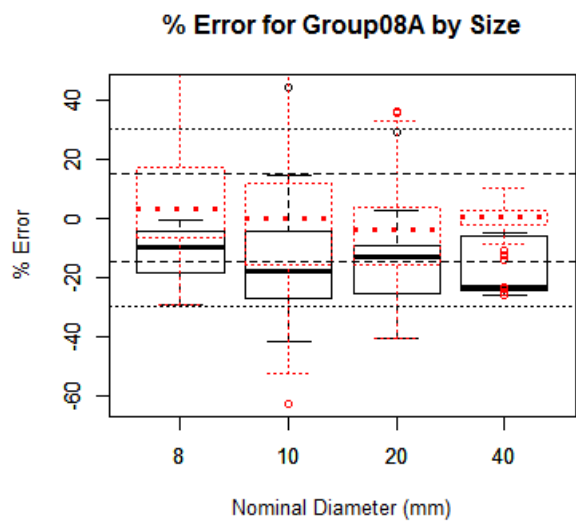
Box Plots for the Group06A by each Factor



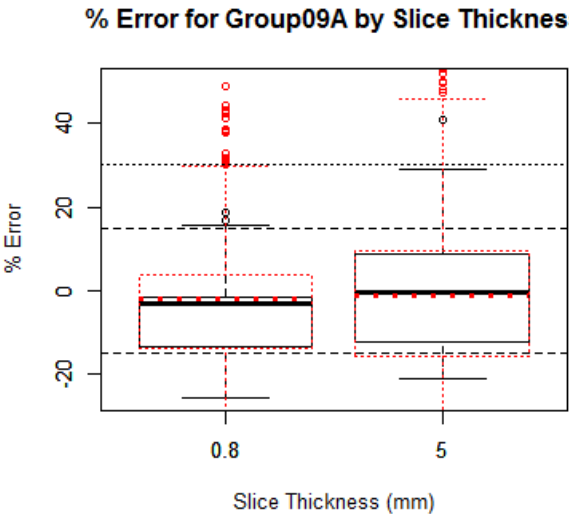
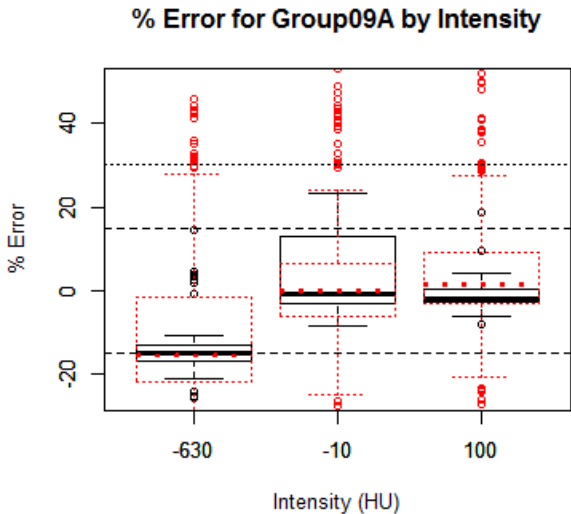
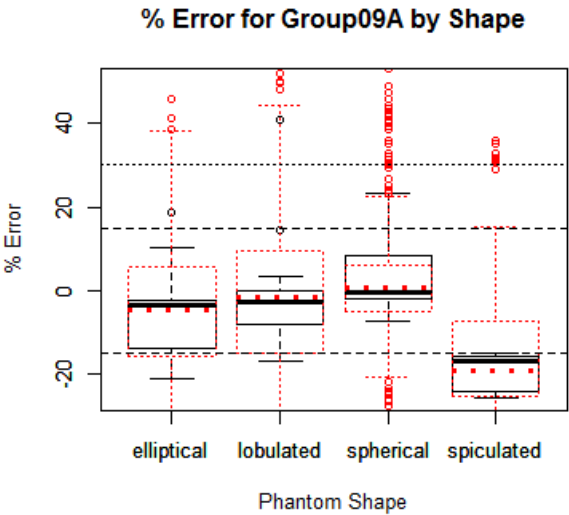
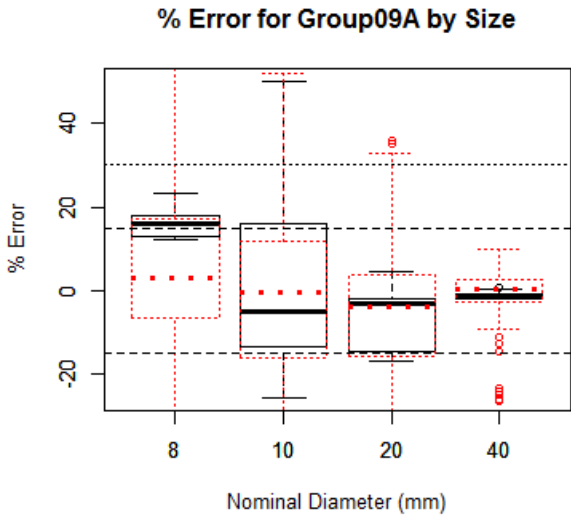
Box Plots for the Group07A by each Factor



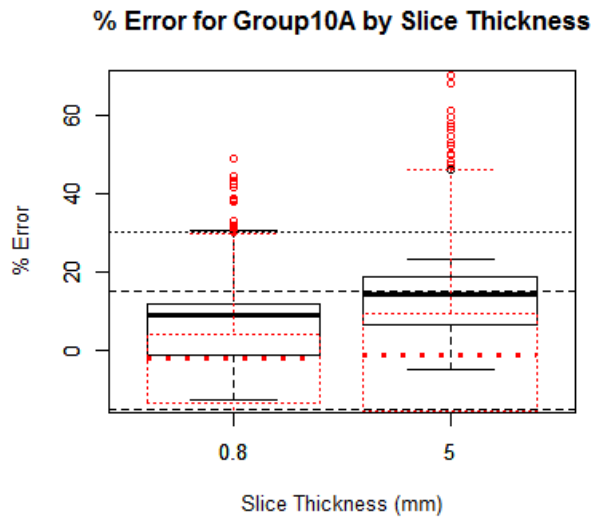
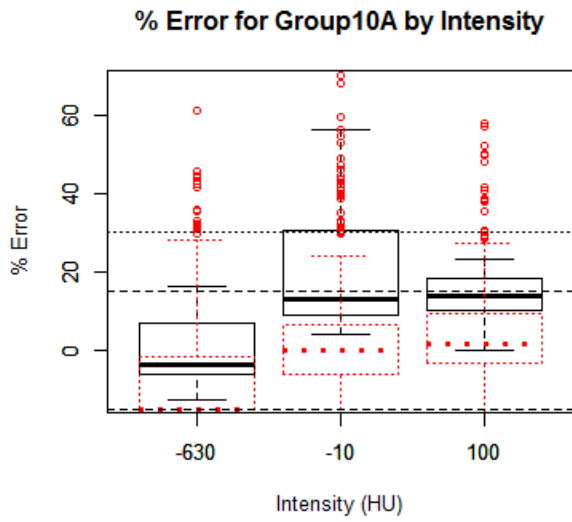
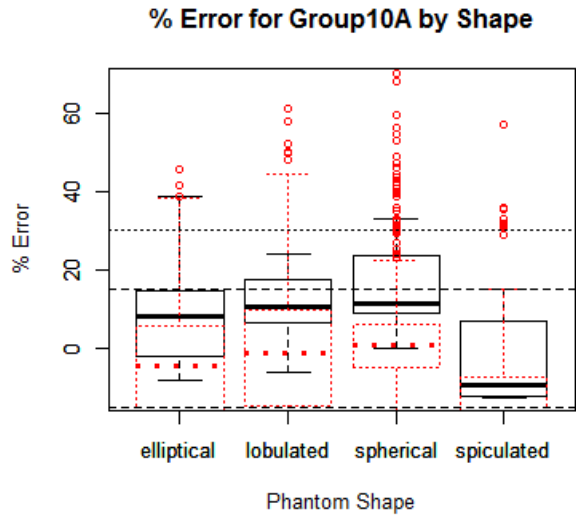
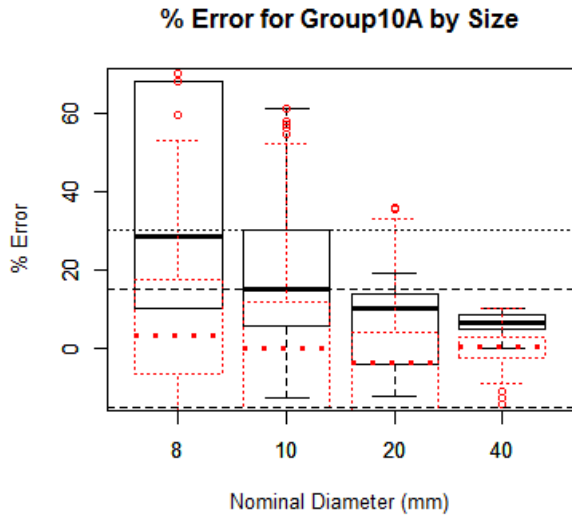
Box Plots for the Group08A by each Factor



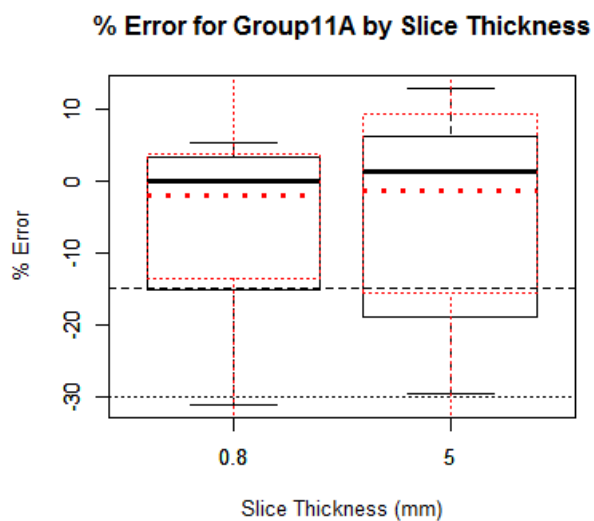
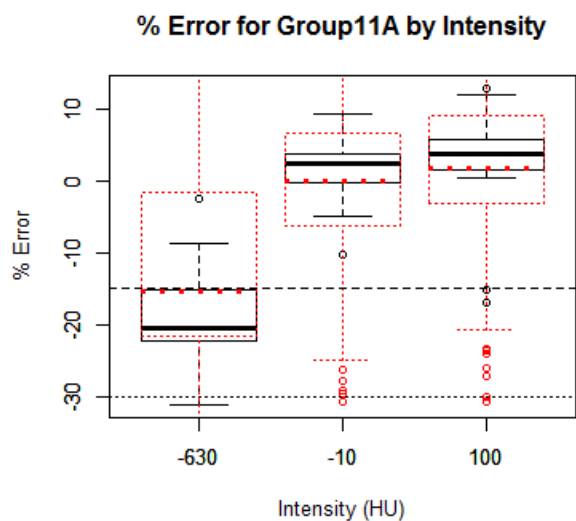
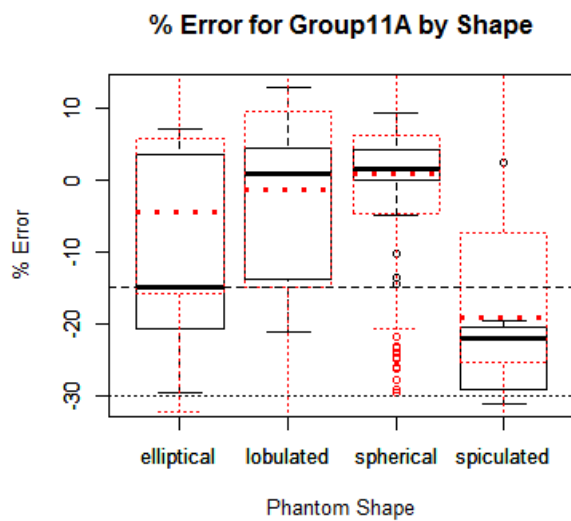
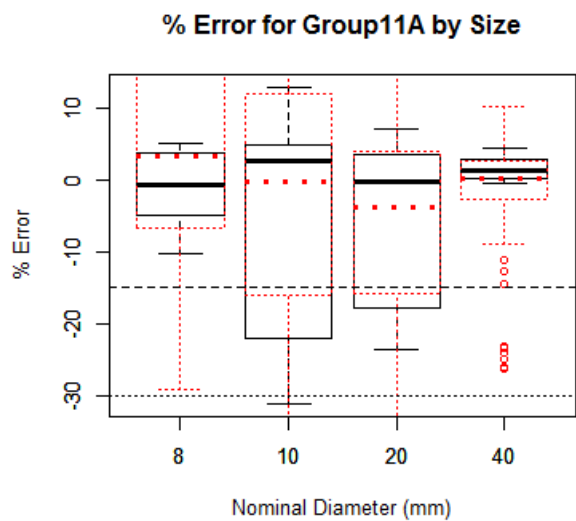
Box Plots for the Group09A by each Factor



Box Plots for the Group10A by each Factor



Box Plots for the Group11A by each Factor



Box Plots for the Group12A by each Factor

