The National Marine Biological
Analytical Quality Control Scheme
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Particle Size Analysis Results for PS48

2013/2014 (Year 20)

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Table 1. Summary of the replicate benchmark analysis and particle size information received from participating laboratories for exercise PS48.

Benchmark Data

Sample	Method	% Gravel	% Sand	% Mud	Median ϕ	Mean ϕ	Sediment Description (Post analysis)
PS48 TUM01	NMBAQC	0.00	96.54	3.46	1.599	1.585	Sand
PS48 TUM02	NMBAQC	0.00	97.95	2.05	1.611	1.600	Sand
PS48 TUM03	NMBAQC	0.00	98.28	1.72	1.592	1.584	Sand
PS48 TUM04	NMBAQC	0.00	98.32	1.68	1.611	1.603	Sand
PS48 TUM05	NMBAQC	0.00	98.20	1.80	1.587	1.581	Sand
PS48 TUM06	NMBAQC	0.00	93.10	6.90	1.588	1.564	Sand
PS48 TUM07	NMBAQC	0.00	95.47	4.53	1.617	1.596	Sand
PS48 TUM08	NMBAQC	0.00	95.51	4.49	1.550	1.544	Sand
PS48 TUM09	NMBAQC	0.00	96.59	3.41	1.586	1.579	Sand
PS48 TUM10	NMBAQC	0.00	94.52	5.48	1.594	1.578	Sand
TUM AVERAGE	NMBAQC	0.00	96.45	3.55	1.59	1.58	

Participant Data

Lab	Method	% Gravel	% Sand	% Mud	Sediment Description (Post analysis)
LB2003	NMBAQC	0.00	90.98	9.02	Muddy Sand
LB2007	NMBAQC and OTHER	0.00	99.78	0.22	Muddy Sand
LB2015	NMBAQC	0.00	79.76	20.24	Muddy Sand
LB2020	OTHER	0.00	87.49	12.51	Muddy Sand
LB2021	NMBAQC	0.00	85.92	14.08	Muddy Sand
LB2022	NMBAQC	0.00	88.77	11.23	Muddy Sand
LB2027	NMBAQC	0.01	89.13	10.87	Muddy Sand
LB2029	NMBAQC	0.00	54.69	45.31	Muddy Sand
LB2031	NMBAQC	0.00	89.84	10.16	Sand
LB2032	NMBAQC	0.00	89.91	10.09	Sand
LB2054	NMBAQC	0.00	81.61	18.39	Muddy Sand
LB2056	OTHER	0.00	76.95	23.05	Muddy Sand
LB2057	NMBAQC	0.00	84.00	16.00	Muddy Sand
LB2060	NMBAQC and OTHER	0.00	91.29	8.71	Sand

Key to methods

NMBAQC - States following NMBAQC PSA SOP for supporting biological data

OTHER - Following a different SOP.

Figure 1. Particle size distribution curves resulting from analysis of ten replicate samples of sediment distributed as PS48 (Benchmark Data).

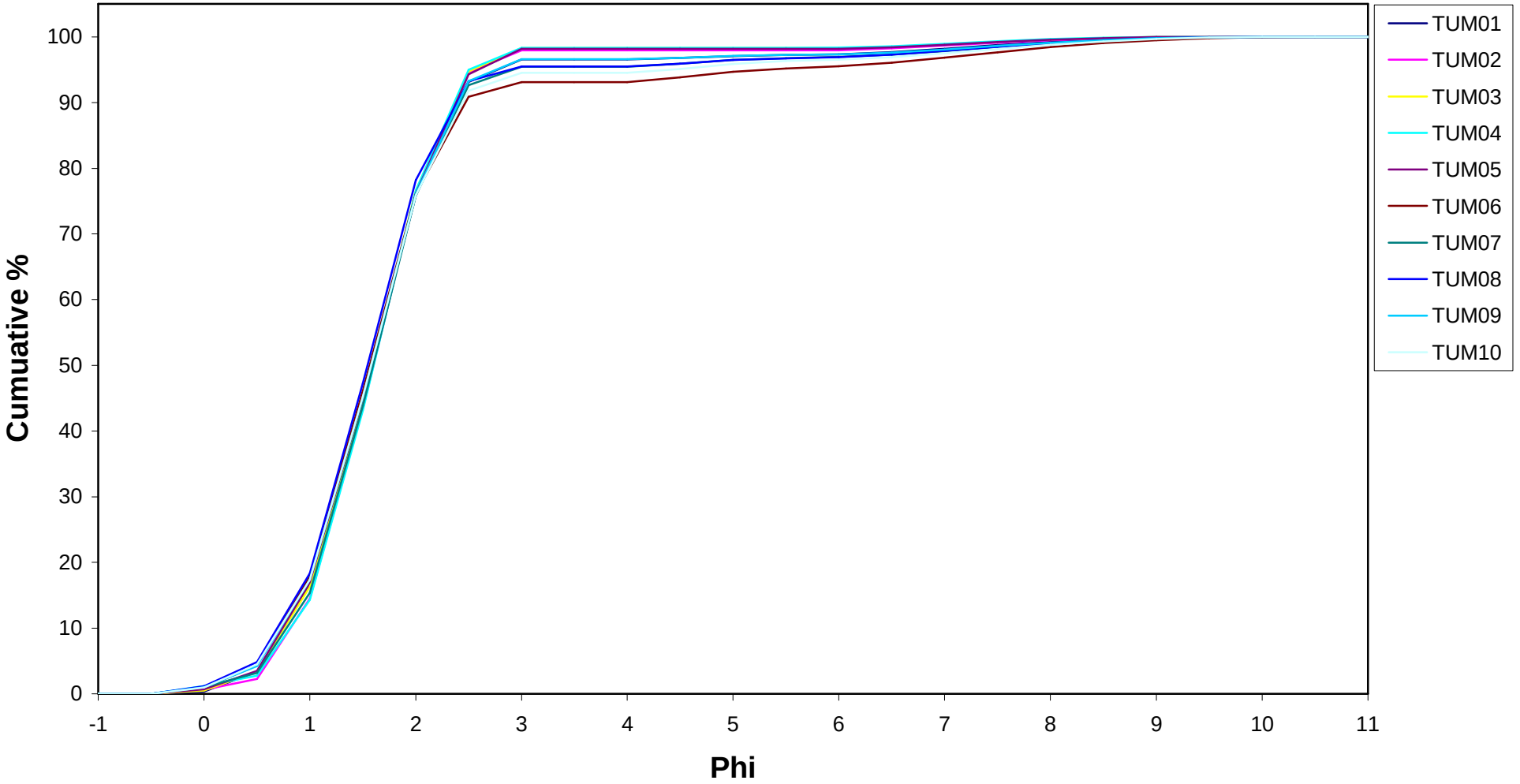


Figure 2. Particle size distribution curves from all participating laboratories for sediment samples from PS48.

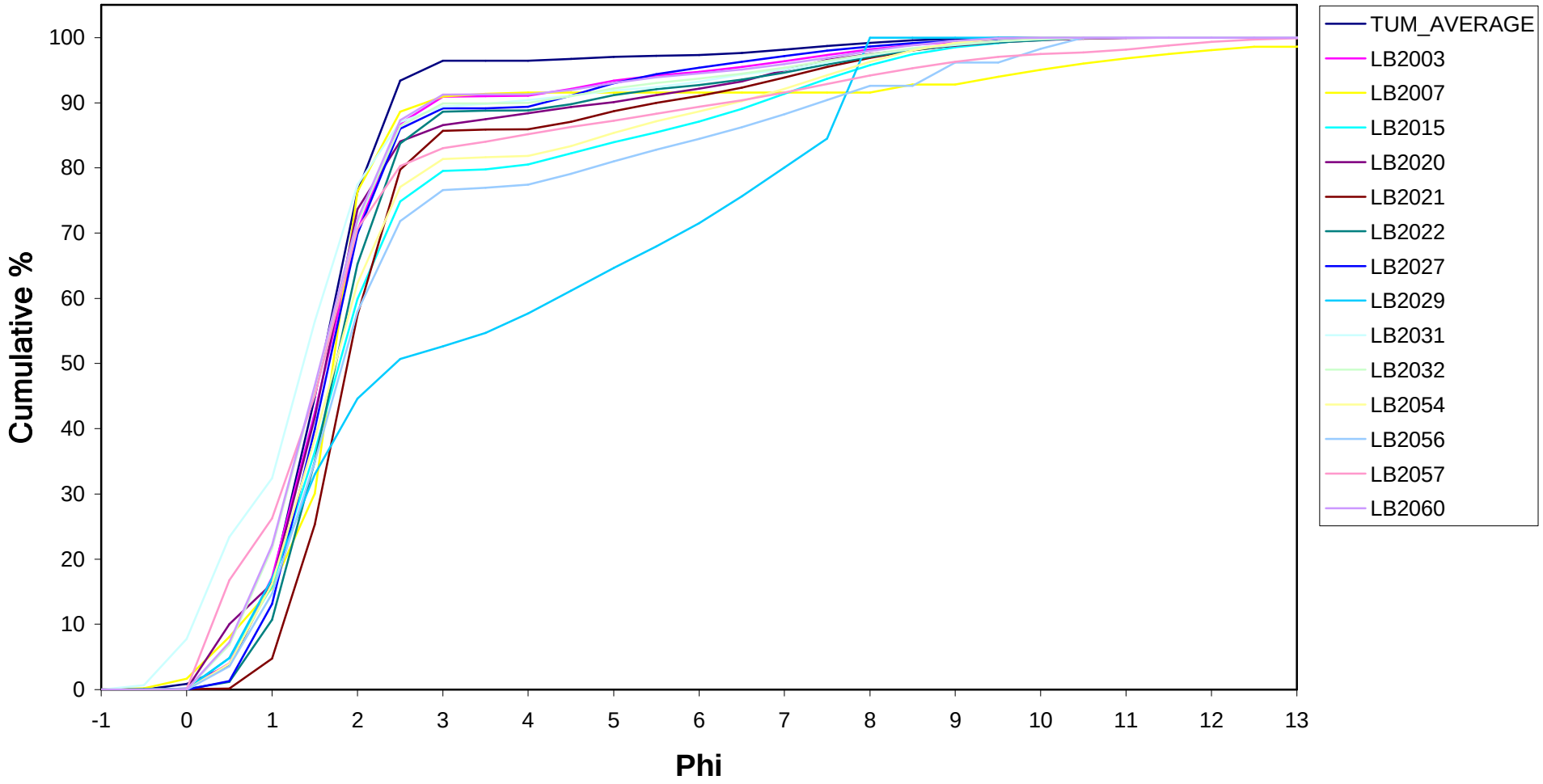


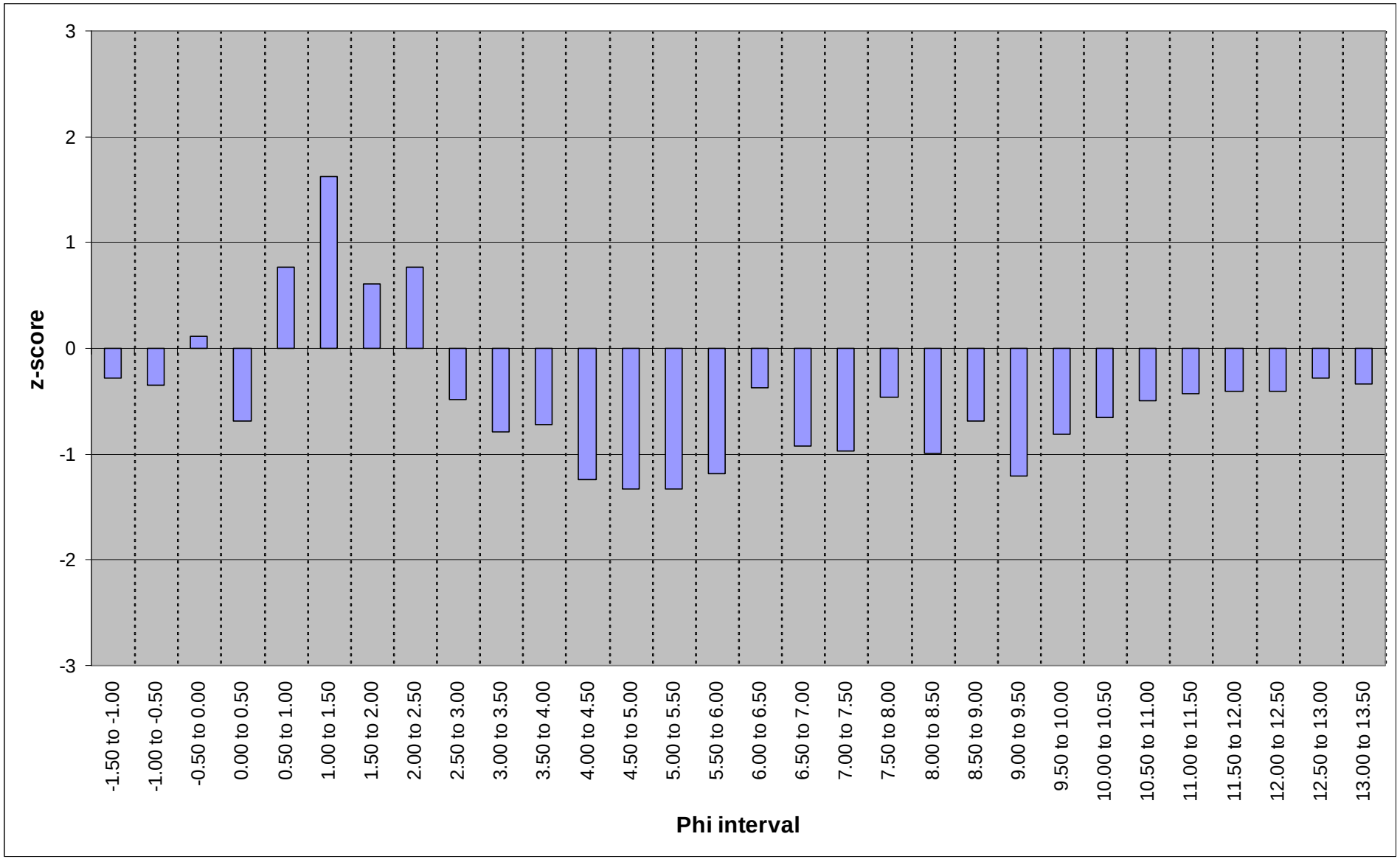
Table 2. Summary of z-scores for each half-phi interval for PS48; data from all participating laboratories included in mean and standard deviation calculations.

	-2.50 to -2.00	-2.00 to -1.50	-1.50 to -1.00	-1.00 to -0.50	-0.50 to 0.00	0.00 to 0.50	0.50 to 1.00	1.00 to 1.50	1.50 to 2.00	2.00 to 2.50	2.50 to 3.00	3.00 to 3.50	3.50 to 4.00	4.00 to 4.50	4.50 to 5.00	5.00 to 5.50
TUM AVERAGE	0	0	-0.277	-0.345	0.118	-0.689	0.773	1.621	0.608	0.763	-0.484	-0.793	-0.719	-1.240	-1.331	-1.334
LB2003	0	0	-0.277	-0.363	-0.291	-0.459	0.880	0.844	0.119	0.622	0.392	-0.675	-0.614	-0.216	-0.232	-0.542
LB2007	0	0	-0.277	0.577	0.470	0.054	-1.042	-1.898	2.589	-0.424	-1.115	-0.094	-0.465	-1.569	-1.733	-1.561
LB2015	0	0	-0.277	-0.363	-0.334	-0.282	0.183	-0.367	-0.476	0.251	0.880	-0.344	0.276	0.549	0.304	0.401
LB2020	0	0	-0.277	-0.363	-0.327	0.784	-1.442	0.886	0.657	-0.867	-1.007	0.958	0.431	-0.387	-0.787	-0.252
LB2021	0	0	-0.277	-0.336	-0.322	-1.246	-1.997	-0.360	0.688	2.076	1.997	-0.439	-0.671	-0.173	0.235	0.061
LB2022	0	0	-0.277	-0.093	-0.350	-1.032	-0.344	0.602	0.430	1.142	1.025	-0.506	-0.689	-0.323	-0.115	-0.368
LB2027	0	0	3.596	-0.363	-0.349	-0.994	0.426	1.235	0.390	0.552	-0.465	-0.774	-0.379	0.530	0.581	0.222
LB2029	0	0	-0.277	-0.363	-0.289	-0.302	0.553	-1.535	-2.061	-1.932	-1.493	2.968	3.136	2.745	2.500	2.613
LB2031	0	0	-0.277	3.481	3.526	1.934	-0.500	0.515	-0.809	-1.062	-1.091	-0.007	0.023	-0.753	-0.738	-0.909
LB2032	0	0	-0.277	-0.363	-0.348	0.143	1.421	0.649	-0.199	0.196	-0.145	-0.741	-0.611	-0.317	-0.264	-0.486
LB2054	0	0	-0.277	-0.363	-0.347	-0.450	0.571	0.050	-0.412	0.206	0.575	-0.408	-0.429	0.334	0.710	0.699
LB2056	0	0	-0.277	-0.363	-0.350	-0.529	0.190	-0.445	-0.530	-0.016	0.976	-0.188	-0.108	0.535	0.537	0.753
LB2057	0	0	-0.277	-0.363	-0.338	2.159	-0.354	-0.807	-0.191	-1.058	-0.754	0.924	0.819	-0.221	-0.590	-0.157
LB2060	0	0	-0.277	-0.363	-0.350	0.220	1.456	0.631	-0.196	0.314	0.225	-0.674	-0.719	-0.734	-0.408	-0.475
Mean	0	0	0.001	0.060	0.644	6.155	10.549	21.986	27.024	13.903	3.650	0.434	0.562	1.251	1.446	1.221
St. Dev	0	0	0.003	0.166	1.837	4.890	2.979	3.908	7.456	4.044	1.164	0.547	0.782	0.797	0.834	0.783

	5.50 to 6.00	6.00 to 6.50	6.50 to 7.00	7.00 to 7.50	7.50 to 8.00	8.00 to 8.50	8.50 to 9.00	9.00 to 9.50	9.50 to 10.00	10.00 to 10.50	10.50 to 11.00	11.00 to 11.50	11.50 to 12.00	12.00 to 12.50	12.50 to 13.00	13.00 to 13.50
TUM AVERAGE	-1.186	-0.987	-0.928	-0.969	-0.466	-0.993	-0.691	-1.211	-0.808	-0.653	-0.501	-0.426	-0.410	-0.403	-0.279	-0.338
LB2003	-0.659	-0.582	-0.547	-0.562	-0.364	-0.425	-0.418	-0.500	-0.516	-0.428	-0.480	-0.426	-0.410	-0.403	-0.279	-0.338
LB2007	-1.325	-1.311	-1.415	-1.501	-0.596	0.716	-1.001	2.234	1.119	1.347	3.118	2.621	2.411	2.822	-0.279	3.541
LB2015	0.634	0.683	0.820	0.750	-0.045	1.589	0.242	0.489	0.715	-0.666	-0.501	-0.426	-0.410	-0.403	-0.279	-0.338
LB2020	-0.133	-0.173	0.258	0.052	-0.353	-0.518	-0.277	0.181	-0.198	-0.206	-0.049	-0.279	-0.359	-0.379	-0.247	-0.338
LB2021	-0.078	0.008	0.096	0.051	-0.216	0.450	-0.048	0.092	-0.287	-0.150	-0.031	-0.424	-0.410	-0.403	-0.279	-0.338
LB2022	-0.532	-0.472	-0.363	-0.314	-0.281	0.238	-0.111	-0.031	-0.328	0.226	-0.501	-0.426	-0.410	-0.403	-0.279	-0.338
LB2027	-0.152	-0.369	-0.549	-0.734	-0.424	-0.752	-0.563	-0.774	-0.563	-0.500	-0.501	-0.426	-0.410	-0.403	-0.279	-0.338
LB2029	2.884	2.984	2.844	2.815	3.537	-1.725	-1.001	-1.595	-0.887	-0.666	-0.501	-0.426	-0.410	-0.403	-0.279	-0.338
LB2031	-0.383	-0.151	-0.694	-0.437	-0.295	0.122	-0.298	0.302	-0.275	-0.345	0.008	-0.311	-0.410	-0.403	-0.279	0.295
LB2032	-0.577	-0.536	-0.497	-0.495	-0.328	-0.020	-0.184	-0.035	-0.328	-0.223	-0.424	-0.426	-0.410	-0.403	-0.279	-0.338
LB2054	0.443	0.333	0.411	0.520	-0.048	1.627	0.448	0.504	-0.620	-0.666	-0.501	-0.426	-0.410	-0.403	-0.279	-0.338
LB2056	0.596	0.555	0.519	0.614	-0.013	-1.725	3.244	-1.595	2.987	3.047	-0.501	-0.426	-0.410	-0.403	-0.279	-0.338
LB2057	-0.079	-0.289	-0.259	-0.213	-0.249	0.396	0.158	1.000	-0.090	-0.104	1.367	2.230	2.460	1.989	3.596	-0.120
LB2060	-0.639	-0.679	-0.623	-0.547	-0.323	0.027	-0.190	-0.271	-0.730	-0.666	-0.501	-0.426	-0.410	-0.403	-0.279	-0.338
Mean	1.125	1.266	1.453	1.551	2.237	0.896	0.839	0.479	0.481	0.311	0.111	0.099	0.084	0.062	0.014	0.124
St. Dev	0.849	0.966	1.027	1.033	3.751	0.520	0.838	0.300	0.542	0.467	0.222	0.232	0.204	0.155	0.051	0.368

z-score >1.96 or <-1.96
All values equal 0

Figure 3. Summary of z-scores for the benchmark data (TUM Average); data from all participating laboratories are included in mean and standard deviation calculations.



Results of SIMPROF testing on PSA Ring test PS48 data

Data was entered into PRIMER v. 6.1.13 in half-phi intervals; any missing data was entered as zero. The data did not need to be transformed as all data was on a similar percentage scale. A Euclidean distance matrix was created from the data; The Euclidean distance between two samples (labs) *j* and *k,* is defined algebraically as $d_{jk} = \sqrt{\sum_{i=1}^{p}(y_{ij} - y_{ik})^2}$. From this distance matrix cluster analysis was carried out including a SIMPROF test at a 5% significance level. The red SIMPROF lines on the dendrogram indicate labs that cannot be distinguished from each other at the 5% significance level; the black lines indicate labs that can be distinguished from each other. The results are presented as a cluster dendrogram (Figure 4) and non-metric Multi-Dimensional Scaling (MDS) diagrams (Figures 5) below. It is important to note that, although the MDS plot is bounded by a box, the box does not represent either axes or scale. Two samples with a high similarity index will appear close together while those less similar will appear further apart. The 'correct' configuration of sample points will be multidimensional and the plot represents the best 2-dimensional solution to the problem. The technique should be viewed as complementary to cluster analysis, offering a different perspective of the same information.

Figure 4. Cluster dendrogram of PS48 including all laboratories, with the benchmark replicates (TUM average).

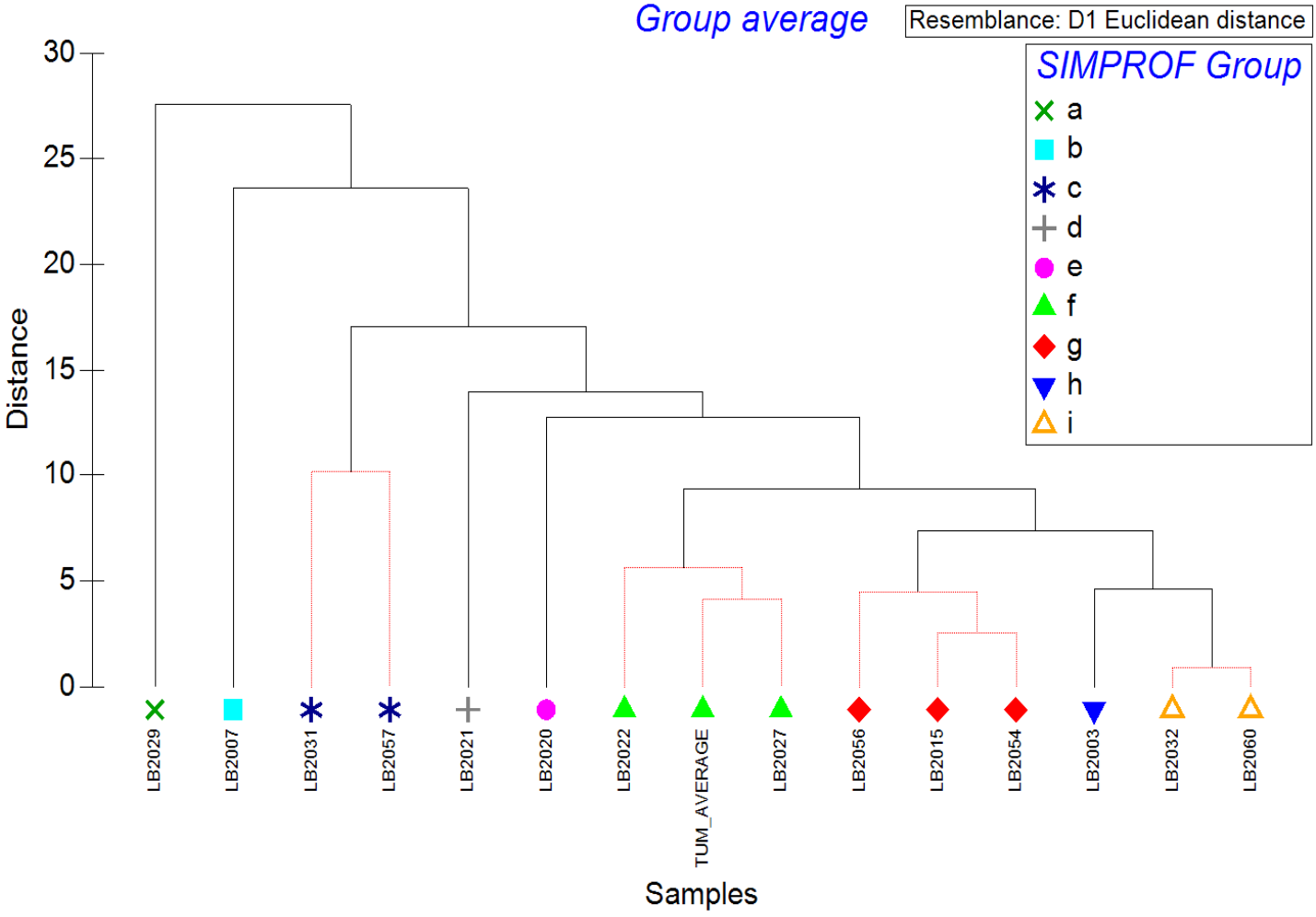
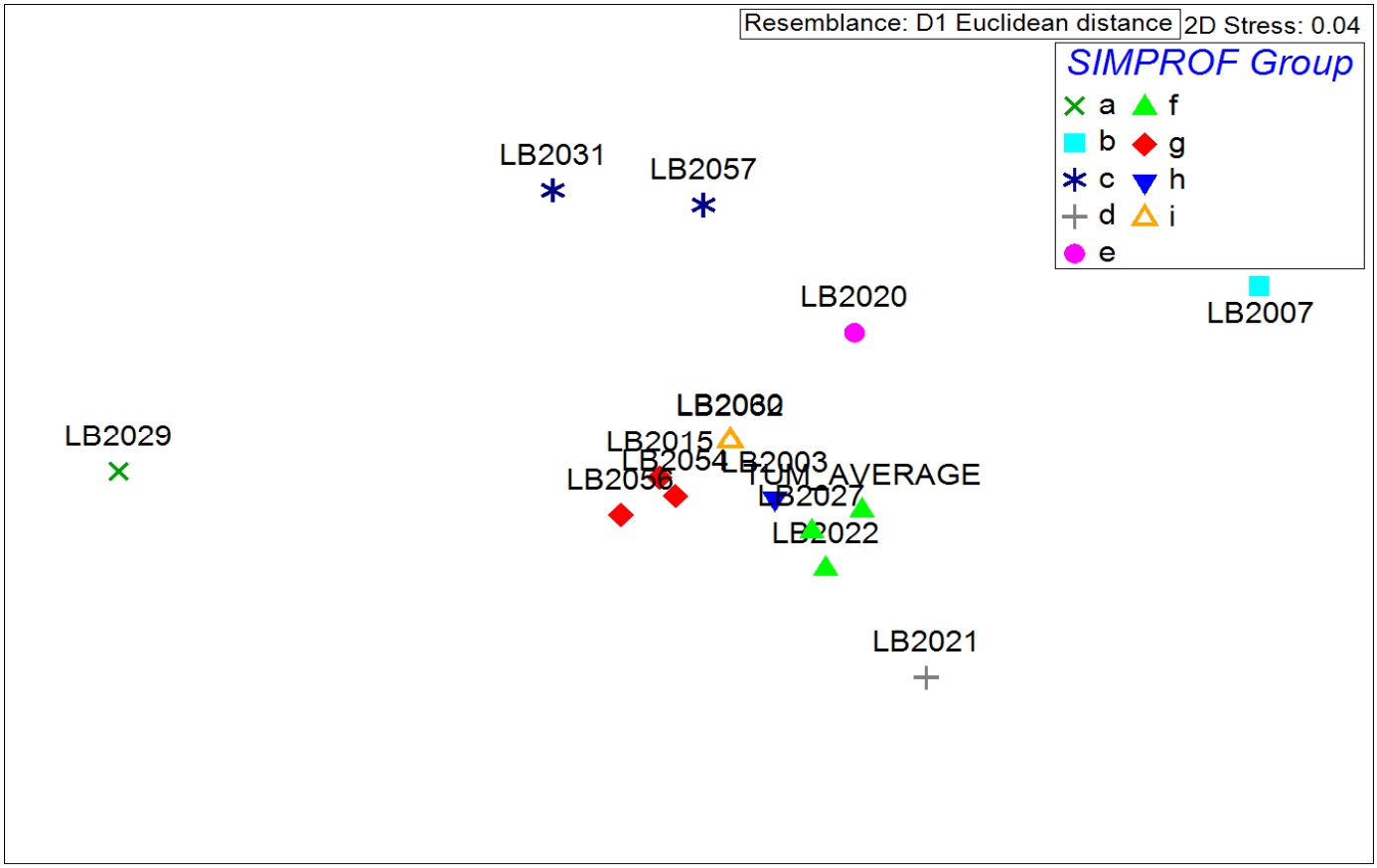
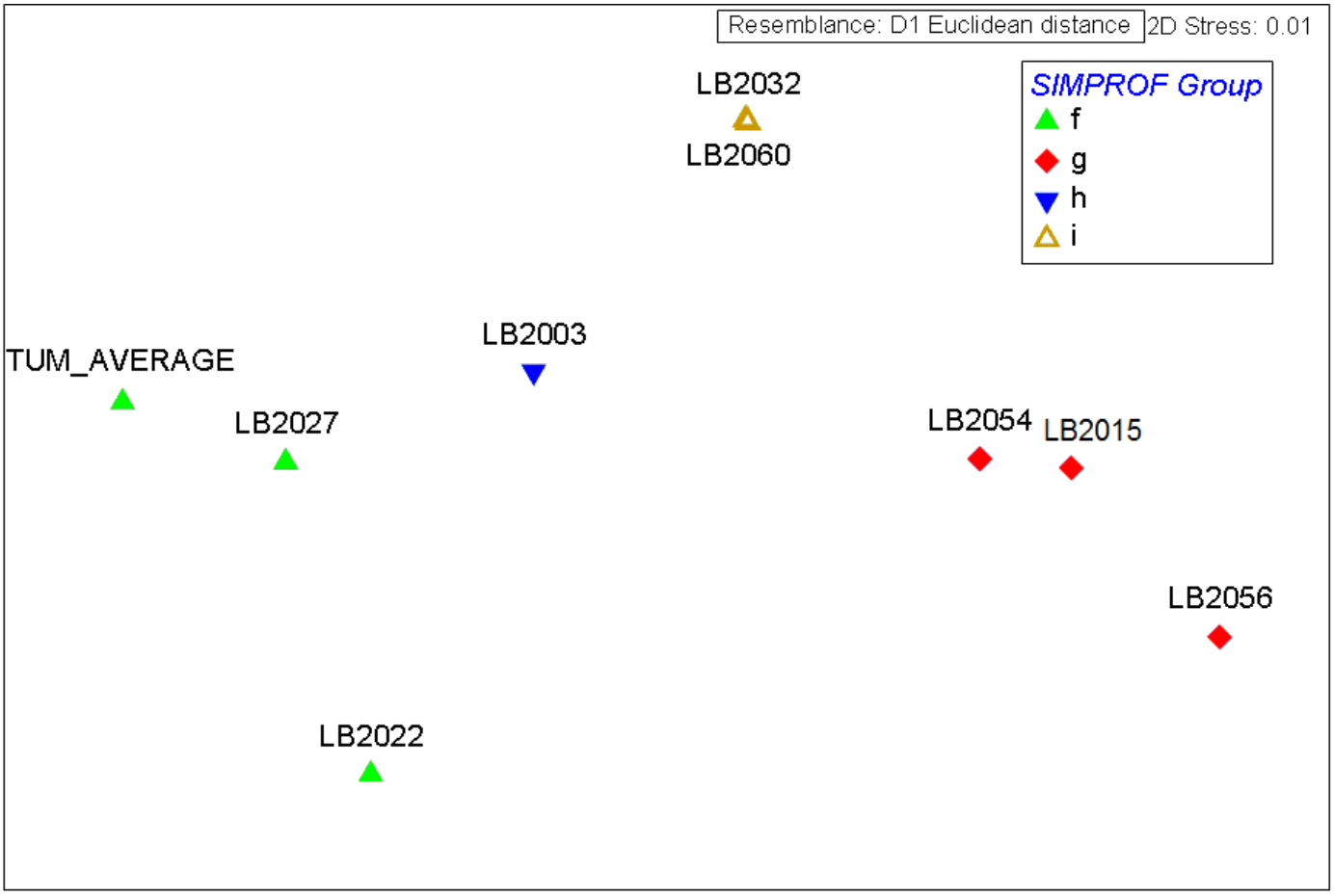


Figure 5. a) MDS plot of PS48 with the benchmark replicates (TUM AVERAGE) averaged; and b) a subset of cluster groups f, g, h and i.

a)



b)



Due to a problem with the distributed workbook formulas, the data received was merged independently before further analyses were performed. Statistical analysis is based on the results presented in Appendix 2.

The cluster analysis separates the laboratories into 9 SIMPROF cluster groups; five of these groups each comprise a single laboratory.

Cluster group a is formed of a single laboratory (LB2029). The cumulative percentage curve in Figure 2 shows that LB2029 continued recording greater values of particles between phi intervals 2 and 7.5 compared to other laboratories. This is partly explained in Table 1 by this laboratory recording a greater percentage of mud.

Cluster group b is formed of a single laboratory (LB2007). The cumulative percentage curve in Figure 2 shows that LB2007 stopped recording values between phi 4.5 and 8. The z-scores in Table 2 also show a greater variation in sediment proportions recorded between phi 9 and 13.5 compared to other laboratories. This may be due to this laboratory using different methodology when analysing sediment <1mm.

Cluster group c comprises two laboratories (LB2031 and LB2057). Figure 2 shows that LB2031 recorded higher percentage values of sediment between phi -0.5 and 2. This also explains the z-score results between -1 and 0 shown in Figure 2 for this laboratory. The difference shown could be due to the apparatus used to analyse particles ≥1mm. Table 2 shows that LB2057 recorded different phi values between 11 and 13 than other laboratories (omitting LB2007).

Cluster group d is formed of a single laboratory (LB2021). Figure 2 shows that LB2021 started recording at phi 0.5. It also shows that this participant recorded proportionately higher values between phi 2 and 3. This is corroborated by the z-score differences for those phi intervals in Table 2.

Cluster group e is formed of a single laboratory (LB2020). Figure 2 shows that there is a small difference between the z-score recorded at the 0.5 to 1 phi interval (omitting LB2060) compared to other participants. However, this difference is not marked enough for it to be flagged.

Cluster groups f (LB2022, TUM AVERAGE and LB2027), g (LB2056, LB2015 and LB2054), h (LB2003) and i (LB2032 and LB2060) show a euclidean distance below 10. Therefore Figure 2 and Table 2 show no obvious differences between these participants due to their increasing degree of similarity. Figure 4 and 5b show discreet variability between these groups derived from the percentage values of each half phi interval. The differences between these groups occur mainly between phi intervals 3 and 13.5 suggesting subtle variations during the laser analysis stage. These figures show a particularly marked similarity for cluster group i.

Appendices

Appendix 1. Final Summary Data sheets as supplied by participating laboratories (arranged by Lab Code).

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Return to Thomson Unicomarine Ltd. by 29-11-13

Exercise Code:	**PS48**
LabCode:	**LB2003**
Sample Code:	**PS482003**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume % (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.0000**
-3.50 to -3.00; 8 mm	**0.0000**
-3.00 to -2.50; 5.6 mm	**0.0000**
-2.50 to -2.00; 4 mm	**0.0000**
-2.00 to -1.50; 2.8 mm	**0.0000**
-1.50 to -1.00; 2 mm	**0.0000**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.1000**
0.00 to 0.50; (707 µm)	3.6058
0.50 to 1.00; (500 µm)	12.1530
1.00 to 1.50; (353.6 µm)	23.3309
1.50 to 2.00; (250 µm)	25.7567
2.00 to 2.50; (176.8 µm)	15.1488
2.50 to 3.00; (125 µm)	3.7890
3.00 to 3.50; (88.39 µm)	0.0595
3.50 to 4.00; (62.5 µm)	0.0755
4.00 to 4.50; (44.19 µm)	0.9947
4.50 to 5.00; (31.25 µm)	1.1552
5.00 to 5.50; (22.097 µm)	0.7358
5.50 to 6.00; (15.625 µm)	0.5223
6.00 to 6.50; (11.049 µm)	0.6501
6.50 to 7.00; (7.813 µm)	0.8220
7.00 to 7.50; (5.524 µm)	0.8958
7.50 to 8.00; (3.906 µm)	0.8043
8.00 to 8.50; (2.762 µm)	0.6231
8.50 to 9.00; (1.953 µm)	0.4514
9.00 to 9.50; (1.381 µm)	0.3034
9.50 to 10.00; (0.977 µm)	0.1855
10.00 to 10.50; (0.691 µm)	0.1027
10.50 to 11.00; (0.488 µm)	0.0044
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS48**
LabCode:	**LB2007**
Sample Code:	**PS482007**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume % (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.0000**
-3.50 to -3.00; 8 mm	**0.0000**
-3.00 to -2.50; 5.6 mm	**0.0000**
-2.50 to -2.00; 4 mm	**0.0000**
-2.00 to -1.50; 2.8 mm	**0.0000**
-1.50 to -1.00; 2 mm	**0.0000**
-1.00 to -0.50; 1.4 mm	**0.0860**
-0.50 to 0.00; 1 mm	**0.6170**
0.00 to 0.50; (707 µm)	6.8520
0.50 to 1.00; (500 µm)	6.9330
1.00 to 1.50; (353.6 µm)	8.9740
1.50 to 2.00; (250 µm)	48.1110
2.00 to 2.50; (176.8 µm)	19.0020
2.50 to 3.00; (125 µm)	5.8850
3.00 to 3.50; (88.39 µm)	1.1310
3.50 to 4.00; (62.5 µm)	0.6320
4.00 to 4.50; (44.19 µm)	0.0000
4.50 to 5.00; (31.25 µm)	0.0000
5.00 to 5.50; (22.097 µm)	0.0000
5.50 to 6.00; (15.625 µm)	0.0000
6.00 to 6.50; (11.049 µm)	0.0000
6.50 to 7.00; (7.813 µm)	0.0000
7.00 to 7.50; (5.524 µm)	0.0000
7.50 to 8.00; (3.906 µm)	0.0000
8.00 to 8.50; (2.762 µm)	5.6630
8.50 to 9.00; (1.953 µm)	0.0000
9.00 to 9.50; (1.381 µm)	5.1350
9.50 to 10.00; (0.977 µm)	4.8530
10.00 to 10.50; (0.691 µm)	4.2000
10.50 to 11.00; (0.488 µm)	3.5810
11.00 to 11.50; (0.345 µm)	3.1510
11.50 to 12.00; (0.244 µm)	2.5690
12.00 to 12.50; (0.173 µm)	2.2300
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	6.3660

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Exercise Code:	**PS48**
LabCode:	**LB2015**
Sample Code:	**PS482015**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume % (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.0000**
-3.50 to -3.00; 8 mm	**0.0000**
-3.00 to -2.50; 5.6 mm	**0.0000**
-2.50 to -2.00; 4 mm	**0.0000**
-2.00 to -1.50; 2.8 mm	**0.0000**
-1.50 to -1.00; 2 mm	**0.0000**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0308**
0.00 to 0.50; (707 µm)	4.7770
0.50 to 1.00; (500 µm)	11.0930
1.00 to 1.50; (353.6 µm)	20.5513
1.50 to 2.00; (250 µm)	23.4765
2.00 to 2.50; (176.8 µm)	14.9169
2.50 to 3.00; (125 µm)	4.6742
3.00 to 3.50; (88.39 µm)	0.2456
3.50 to 4.00; (62.5 µm)	0.7780
4.00 to 4.50; (44.19 µm)	1.6881
4.50 to 5.00; (31.25 µm)	1.6993
5.00 to 5.50; (22.097 µm)	1.5350
5.50 to 6.00; (15.625 µm)	1.6635
6.00 to 6.50; (11.049 µm)	1.9257
6.50 to 7.00; (7.813 µm)	2.2949
7.00 to 7.50; (5.524 µm)	2.3261
7.50 to 8.00; (3.906 µm)	2.0671
8.00 to 8.50; (2.762 µm)	1.7222
8.50 to 9.00; (1.953 µm)	1.0424
9.00 to 9.50; (1.381 µm)	0.6260
9.50 to 10.00; (0.977 µm)	0.8683
10.00 to 10.50; (0.691 µm)	0.0000
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS48**
LabCode:	**LB2020**
Sample Code:	**PS482020**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume % (mark as "0" for not analysed or no material)
63 mm	**0.0000**
50 mm	**0.0000**
37.5 mm	**0.0000**
28 mm	**0.0000**
20 mm	**0.0000**
14 mm	**0.0000**
10 mm	**0.0000**
6.3 mm	**0.0000**
5 mm	**0.0000**
3.35 mm	**0.0000**
2 mm	**0.0000**
1.18 mm	**0.0000**
1 mm	**0.2000**
0.08 to 0.48 (717 m)	47.3870
0.61 to 1.02 (494 m)	29.6592
1.15 to 1.56 (440 m)	120.7281
1.69 to 2.09 (234 m)	151.4611
2.23 to 2.63 (161 m)	49.3327
2.77 to 3.17 (111 m)	11.7534
3.31 to 3.71 (76 m)	4.5457
3.84 to 4.25 (53 m)	4.2648
4.38 to 4.79 (36 m)	4.4707
4.92 to 5.32 (25 m)	3.7414
5.46 to 5.86 (17 m)	4.8582
6.00 to 6.40 (12 m)	4.8041
6.53 to 6.94 (8 m)	5.2164
7.07 to 7.48 (5.6 m)	8.1473
7.61 to 8.02 (3.9 m)	7.6168
8.15 to 8.55 (2.7 m)	4.3342
8.69 to 9.09 (1.8 m)	2.9749
9.23 to 9.63 (1.3 m)	2.8790
9.77 to 10.17 (0.9 m)	2.5312
10.30 to 10.71 (0.6 m)	1.7730
10.84 to 11.25 (0.4 m)	1.0203
11.38 to 11.78 (0.3 m)	0.4754
11.92 to 12.32 (0.2 m)	0.1623
12.46 to 12.87 (0.13 m)	0.0491
13.00 to 13.39 (0.1 m)	0.0176
13.54 to 13.93 (0.06 m)	0.0078

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Exercise Code:	**PS48**
LabCode:	**LB2021**
Sample Code:	**PS482021**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume % (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.0000**
-3.50 to -3.00; 8 mm	**0.0000**
-3.00 to -2.50; 5.6 mm	**0.0000**
-2.50 to -2.00; 4 mm	**0.0000**
-2.00 to -1.50; 2.8 mm	**0.0000**
-1.50 to -1.00; 2 mm	**0.0000**
-1.00 to -0.50; 1.4 mm	**0.0200**
-0.50 to 0.00; 1 mm	**0.2400**
0.00 to 0.50; (707 µm)	0.2784
0.50 to 1.00; (500 µm)	20.9257
1.00 to 1.50; (353.6 µm)	93.6379
1.50 to 2.00; (250 µm)	146.3021
2.00 to 2.50; (176.8 µm)	101.4514
2.50 to 3.00; (125 µm)	27.1840
3.00 to 3.50; (88.39 µm)	0.8807
3.50 to 4.00; (62.5 µm)	0.1677
4.00 to 4.50; (44.19 µm)	5.0628
4.50 to 5.00; (31.25 µm)	7.4719
5.00 to 5.50; (22.097 µm)	5.7732
5.50 to 6.00; (15.625 µm)	4.8203
6.00 to 6.50; (11.049 µm)	5.7985
6.50 to 7.00; (7.813 µm)	7.0606
7.00 to 7.50; (5.524 µm)	7.2981
7.50 to 8.00; (3.906 µm)	6.4887
8.00 to 8.50; (2.762 µm)	5.1436
8.50 to 9.00; (1.953 µm)	3.6364
9.00 to 9.50; (1.381 µm)	2.3055
9.50 to 10.00; (0.977 µm)	1.4809
10.00 to 10.50; (0.691 µm)	1.0974
10.50 to 11.00; (0.488 µm)	0.4739
11.00 to 11.50; (0.345 µm)	0.0025
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS48**
LabCode:	**LB2022**
Sample Code:	**PS482022**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume % (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.0000**
-3.50 to -3.00; 8 mm	**0.0000**
-3.00 to -2.50; 5.6 mm	**0.0000**
-2.50 to -2.00; 4 mm	**0.0000**
-2.00 to -1.50; 2.8 mm	**0.0000**
-1.50 to -1.00; 2 mm	**0.0000**
-1.00 to -0.50; 1.4 mm	**0.2100**
-0.50 to 0.00; 1 mm	**0.0000**
0.00 to 0.50; (707 µm)	5.2235
0.50 to 1.00; (500 µm)	44.8159
1.00 to 1.50; (353.6 µm)	114.5416
1.50 to 2.00; (250 µm)	142.2594
2.00 to 2.50; (176.8 µm)	87.1690
2.50 to 3.00; (125 µm)	22.7922
3.00 to 3.50; (88.39 µm)	0.7373
3.50 to 4.00; (62.5 µm)	0.1098
4.00 to 4.50; (44.19 µm)	4.6745
4.50 to 5.00; (31.25 µm)	6.3530
5.00 to 5.50; (22.097 µm)	4.3922
5.50 to 6.00; (15.625 µm)	3.1686
6.00 to 6.50; (11.049 µm)	3.8118
6.50 to 7.00; (7.813 µm)	5.0824
7.00 to 7.50; (5.524 µm)	5.7726
7.50 to 8.00; (3.906 µm)	5.5686
8.00 to 8.50; (2.762 µm)	4.8000
8.50 to 9.00; (1.953 µm)	3.5137
9.00 to 9.50; (1.381 µm)	2.2118
9.50 to 10.00; (0.977 µm)	1.4275
10.00 to 10.50; (0.691 µm)	1.9608
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS48**
LabCode:	**LB2027**
Sample Code:	**PS482027**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume % (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.0000**
-3.50 to -3.00; 8 mm	**0.0000**
-3.00 to -2.50; 5.6 mm	**0.0000**
-2.50 to -2.00; 4 mm	**0.0000**
-2.00 to -1.50; 2.8 mm	**0.0000**
-1.50 to -1.00; 2 mm	**0.0600**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0100**
0.00 to 0.50; (707 µm)	5.9810
0.50 to 1.00; (500 µm)	54.5209
1.00 to 1.50; (353.6 µm)	123.6997
1.50 to 2.00; (250 µm)	138.0859
2.00 to 2.50; (176.8 µm)	74.4422
2.50 to 3.00; (125 µm)	14.3401
3.00 to 3.50; (88.39 µm)	0.0461
3.50 to 4.00; (62.5 µm)	1.2249
4.00 to 4.50; (44.19 µm)	7.7184
4.50 to 5.00; (31.25 µm)	8.9074
5.00 to 5.50; (22.097 µm)	6.4371
5.50 to 6.00; (15.625 µm)	4.5972
6.00 to 6.50; (11.049 µm)	4.1975
6.50 to 7.00; (7.813 µm)	4.1001
7.00 to 7.50; (5.524 µm)	3.6593
7.50 to 8.00; (3.906 µm)	2.9777
8.00 to 8.50; (2.762 µm)	2.3319
8.50 to 9.00; (1.953 µm)	1.6964
9.00 to 9.50; (1.381 µm)	1.1378
9.50 to 10.00; (0.977 µm)	0.8098
10.00 to 10.50; (0.691 µm)	0.3588
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS48**
LabCode:	**LB2029**
Sample Code:	**PS482029**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume % (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.0000**
-3.50 to -3.00; 8 mm	**0.0000**
-3.00 to -2.50; 5.6 mm	**0.0000**
-2.50 to -2.00; 4 mm	**0.0000**
-2.00 to -1.50; 2.8 mm	**0.0000**
-1.50 to -1.00; 2 mm	**0.0000**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.5000**
0.00 to 0.50; (707 µm)	20.7797
0.50 to 1.00; (500 µm)	54.1730
1.00 to 1.50; (353.6 µm)	71.0153
1.50 to 2.00; (250 µm)	51.7817
2.00 to 2.50; (176.8 µm)	27.0617
2.50 to 3.00; (125 µm)	8.4926
3.00 to 3.50; (88.39 µm)	9.1435
3.50 to 4.00; (62.5 µm)	13.3907
4.00 to 4.50; (44.19 µm)	15.2760
4.50 to 5.00; (31.25 µm)	15.6889
5.00 to 5.50; (22.097 µm)	14.5106
5.50 to 6.00; (15.625 µm)	15.8778
6.00 to 6.50; (11.049 µm)	18.4245
6.50 to 7.00; (7.813 µm)	19.4253
7.00 to 7.50; (5.524 µm)	19.8150
7.50 to 8.00; (3.906 µm)	68.8740
8.00 to 8.50; (2.762 µm)	0.0000
8.50 to 9.00; (1.953 µm)	0.0000
9.00 to 9.50; (1.381 µm)	0.0000
9.50 to 10.00; (0.977 µm)	0.0000
10.00 to 10.50; (0.691 µm)	0.0000
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS48**
LabCode:	**LB2031**
Sample Code:	**PS482031**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume % (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.0000**
-3.50 to -3.00; 8 mm	**0.0000**
-3.00 to -2.50; 5.6 mm	**0.0000**
-2.50 to -2.00; 4 mm	**0.0000**
-2.00 to -1.50; 2.8 mm	**0.0000**
-1.50 to -1.00; 2 mm	**0.0000**
-1.00 to -0.50; 1.4 mm	**0.6365**
-0.50 to 0.00; 1 mm	**7.1200**
0.00 to 0.50; (707 µm)	15.6100
0.50 to 1.00; (500 µm)	9.0600
1.00 to 1.50; (353.6 µm)	24.0000
1.50 to 2.00; (250 µm)	20.9900
2.00 to 2.50; (176.8 µm)	9.6100
2.50 to 3.00; (125 µm)	2.3800
3.00 to 3.50; (88.39 µm)	0.4300
3.50 to 4.00; (62.5 µm)	0.5800
4.00 to 4.50; (44.19 µm)	0.6500
4.50 to 5.00; (31.25 µm)	0.8300
5.00 to 5.50; (22.097 µm)	0.5100
5.50 to 6.00; (15.625 µm)	0.8000
6.00 to 6.50; (11.049 µm)	1.1200
6.50 to 7.00; (7.813 µm)	0.7400
7.00 to 7.50; (5.524 µm)	1.1000
7.50 to 8.00; (3.906 µm)	1.1300
8.00 to 8.50; (2.762 µm)	0.9600
8.50 to 9.00; (1.953 µm)	0.5900
9.00 to 9.50; (1.381 µm)	0.5700
9.50 to 10.00; (0.977 µm)	0.3320
10.00 to 10.50; (0.691 µm)	0.1500
10.50 to 11.00; (0.488 µm)	0.1130
11.00 to 11.50; (0.345 µm)	0.0268
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.2328

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Exercise Code:	**PS48**
LabCode:	**LB2032**
Sample Code:	**PS482032**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume % (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.0000**
-3.50 to -3.00; 8 mm	**0.0000**
-3.00 to -2.50; 5.6 mm	**0.0000**
-2.50 to -2.00; 4 mm	**0.0000**
-2.00 to -1.50; 2.8 mm	**0.0000**
-1.50 to -1.00; 2 mm	**0.0000**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0200**
0.00 to 0.50; (707 µm)	27.7994
0.50 to 1.00; (500 µm)	59.9607
1.00 to 1.50; (353.6 µm)	99.4702
1.50 to 2.00; (250 µm)	103.5985
2.00 to 2.50; (176.8 µm)	59.6075
2.50 to 3.00; (125 µm)	14.1186
3.00 to 3.50; (88.39 µm)	0.1154
3.50 to 4.00; (62.5 µm)	0.3410
4.00 to 4.50; (44.19 µm)	4.0461
4.50 to 5.00; (31.25 µm)	4.9698
5.00 to 5.50; (22.097 µm)	3.4115
5.50 to 6.00; (15.625 µm)	2.5763
6.00 to 6.50; (11.049 µm)	3.0353
6.50 to 7.00; (7.813 µm)	3.8215
7.00 to 7.50; (5.524 µm)	4.2163
7.50 to 8.00; (3.906 µm)	4.0804
8.00 to 8.50; (2.762 µm)	3.5946
8.50 to 9.00; (1.953 µm)	2.7778
9.00 to 9.50; (1.381 µm)	1.9016
9.50 to 10.00; (0.977 µm)	1.2285
10.00 to 10.50; (0.691 µm)	0.8394
10.50 to 11.00; (0.488 µm)	0.0695
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS48**
LabCode:	**LB2054**
Sample Code:	**PS482054**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume % (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.0000**
-3.50 to -3.00; 8 mm	**0.0000**
-3.00 to -2.50; 5.6 mm	**0.0000**
-2.50 to -2.00; 4 mm	**0.0000**
-2.00 to -1.50; 2.8 mm	**0.0000**
-1.50 to -1.00; 2 mm	**0.0000**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0300**
0.00 to 0.50; (707 µm)	18.0542
0.50 to 1.00; (500 µm)	55.9327
1.00 to 1.50; (353.6 µm)	101.2850
1.50 to 2.00; (250 µm)	109.3493
2.00 to 2.50; (176.8 µm)	67.2815
2.50 to 3.00; (125 µm)	19.7238
3.00 to 3.50; (88.39 µm)	0.9615
3.50 to 4.00; (62.5 µm)	1.0343
4.00 to 4.50; (44.19 µm)	6.9259
4.50 to 5.00; (31.25 µm)	9.3060
5.00 to 5.50; (22.097 µm)	8.0731
5.50 to 6.00; (15.625 µm)	6.8574
6.00 to 6.50; (11.049 µm)	7.2505
6.50 to 7.00; (7.813 µm)	8.5586
7.00 to 7.50; (5.524 µm)	9.5386
7.50 to 8.00; (3.906 µm)	9.3957
8.00 to 8.50; (2.762 µm)	7.9544
8.50 to 9.00; (1.953 µm)	5.5462
9.00 to 9.50; (1.381 µm)	2.8789
9.50 to 10.00; (0.977 µm)	0.6622
10.00 to 10.50; (0.691 µm)	0.0000
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

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Exercise Code:	**PS48**
LabCode:	**LB2056**
Sample Code:	**PS482056**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume % (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.0000**
-3.50 to -3.00; 8 mm	**0.0000**
-3.00 to -2.50; 5.6 mm	**0.0000**
-2.50 to -2.00; 4 mm	**0.0000**
-2.00 to -1.50; 2.8 mm	**0.0000**
-1.50 to -1.00; 2 mm	**0.0000**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0000**
0.00 to 0.50; (707 µm)	3.5658
0.50 to 1.00; (500 µm)	11.1134
1.00 to 1.50; (353.6 µm)	20.2457
1.50 to 2.00; (250 µm)	23.0760
2.00 to 2.50; (176.8 µm)	13.8372
2.50 to 3.00; (125 µm)	4.7860
3.00 to 3.50; (88.39 µm)	0.3311
3.50 to 4.00; (62.5 µm)	0.4774
4.00 to 4.50; (44.19 µm)	1.6767
4.50 to 5.00; (31.25 µm)	1.8939
5.00 to 5.50; (22.097 µm)	1.8103
5.50 to 6.00; (15.625 µm)	1.6319
6.00 to 6.50; (11.049 µm)	1.8021
6.50 to 7.00; (7.813 µm)	1.9856
7.00 to 7.50; (5.524 µm)	2.1855
7.50 to 8.00; (3.906 µm)	2.1885
8.00 to 8.50; (2.762 µm)	
8.50 to 9.00; (1.953 µm)	3.5584
9.00 to 9.50; (1.381 µm)	
9.50 to 10.00; (0.977 µm)	2.0994
10.00 to 10.50; (0.691 µm)	1.7351
10.50 to 11.00; (0.488 µm)	
11.00 to 11.50; (0.345 µm)	
11.50 to 12.00; (0.244 µm)	
12.00 to 12.50; (0.173 µm)	
12.50 to 13.00; (0.122 µm)	
13.00 to 13.50; (0.086 µm)	

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Exercise Code:	**PS48**
LabCode:	**LB2057**
Sample Code:	**PS482057**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume % (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.0000**
-3.50 to -3.00; 8 mm	**0.0000**
-3.00 to -2.50; 5.6 mm	**0.0000**
-2.50 to -2.00; 4 mm	**0.0000**
-2.00 to -1.50; 2.8 mm	**0.0000**
-1.50 to -1.00; 2 mm	**0.0000**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.1000**
0.00 to 0.50; (707 µm)	72.3831
0.50 to 1.00; (500 µm)	41.1221
1.00 to 1.50; (353.6 µm)	81.5595
1.50 to 2.00; (250 µm)	110.8669
2.00 to 2.50; (176.8 µm)	41.6838
2.50 to 3.00; (125 µm)	12.0051
3.00 to 3.50; (88.39 µm)	4.0697
3.50 to 4.00; (62.5 µm)	5.2061
4.00 to 4.50; (44.19 µm)	4.6537
4.50 to 5.00; (31.25 µm)	4.1283
5.00 to 5.50; (22.097 µm)	4.7574
5.50 to 6.00; (15.625 µm)	4.5851
6.00 to 6.50; (11.049 µm)	4.2736
6.50 to 7.00; (7.813 µm)	5.1399
7.00 to 7.50; (5.524 µm)	5.7639
7.50 to 8.00; (3.906 µm)	5.6384
8.00 to 8.50; (2.762 µm)	4.7743
8.50 to 9.00; (1.953 µm)	4.2078
9.00 to 9.50; (1.381 µm)	3.3771
9.50 to 10.00; (0.977 µm)	1.8724
10.00 to 10.50; (0.691 µm)	1.1382
10.50 to 11.00; (0.488 µm)	1.7935
11.00 to 11.50; (0.345 µm)	2.6653
11.50 to 12.00; (0.244 µm)	2.5353
12.00 to 12.50; (0.173 µm)	1.6044
12.50 to 13.00; (0.122 µm)	0.8490
13.00 to 13.50; (0.086 µm)	0.3464

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Exercise Code:	**PS48**
LabCode:	**LB2060**
Sample Code:	**PS482060**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume % (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**0.0000**
-3.50 to -3.00; 8 mm	**0.0000**
-3.00 to -2.50; 5.6 mm	**0.0000**
-2.50 to -2.00; 4 mm	**0.0000**
-2.00 to -1.50; 2.8 mm	**0.0000**
-1.50 to -1.00; 2 mm	**0.0000**
-1.00 to -0.50; 1.4 mm	**0.0000**
-0.50 to 0.00; 1 mm	**0.0000**
0.00 to 0.50; (707 µm)	7.2327
0.50 to 1.00; (500 µm)	14.8850
1.00 to 1.50; (353.6 µm)	24.4539
1.50 to 2.00; (250 µm)	25.5653
2.00 to 2.50; (176.8 µm)	15.1744
2.50 to 3.00; (125 µm)	3.9123
3.00 to 3.50; (88.39 µm)	0.0648
3.50 to 4.00; (62.5 µm)	0.0000
4.00 to 4.50; (44.19 µm)	0.6656
4.50 to 5.00; (31.25 µm)	1.1056
5.00 to 5.50; (22.097 µm)	0.8499
5.50 to 6.00; (15.625 µm)	0.5826
6.00 to 6.50; (11.049 µm)	0.6103
6.50 to 7.00; (7.813 µm)	0.8134
7.00 to 7.50; (5.524 µm)	0.9864
7.50 to 8.00; (3.906 µm)	1.0240
8.00 to 8.50; (2.762 µm)	0.9103
8.50 to 9.00; (1.953 µm)	0.6802
9.00 to 9.50; (1.381 µm)	0.3977
9.50 to 10.00; (0.977 µm)	0.0854
10.00 to 10.50; (0.691 µm)	0.0000
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

Appendix 2. Percentage proportion of participant phi-intervals using independently merged data.

Laboratory	LB2003	LB2007	LB2015	LB2020	LB2021	LB2022	LB2027	LB2029	LB2031	LB2032	LB2054	LB2056	LB2057	LB2060
Phi-interval														
-6.50 to -6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-6.00 to -5.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-5.50 to -5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-5.00 to -4.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-4.50 to -4.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-4.00 to -3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-3.50 to -3.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-3.00 to -2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-2.50 to -2.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-2.00 to -1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-1.50 to -1.00	0	0	0	0	0	0	0.013006	0	0	0	0	0	0	0
-1.00 to -0.50	0	0.170081	0	0	0.004396	0.044605	0	0	0.6365	0	0	0	0	0
-0.50 to 0.00	0.108378	1.645262	0.030819	0.042159	0.052747	0	0.002168	0.112554	7.12	0.004931	0.00657	0	0.023089	0
0.00 to 0.50	3.907876	7.010847	4.777288	9.988574	0.061187	1.109986	1.296441	4.677683	15.61	6.853905	3.954047	3.565834	16.71278	7.232727
0.50 to 1.00	13.17108	8.13364	11.09278	6.25179	4.599032	9.523212	11.81794	12.1948	9.06	14.78321	12.24983	11.11337	9.494826	14.88504
1.00 to 1.50	25.28552	15.91243	20.55088	25.44796	20.57966	24.33969	26.81311	15.98614	24	24.5242	22.18243	20.24571	18.83155	24.45386
1.50 to 2.00	27.91447	50.60864	23.47602	31.92609	32.15414	30.22962	29.93146	11.6565	20.99	25.54203	23.94861	23.07596	25.59846	25.56535
2.00 to 2.50	16.41788	13.31616	14.91652	10.39872	22.29689	18.5231	16.13608	6.091827	9.61	14.69614	14.73534	13.83718	9.624512	15.17444
2.50 to 3.00	4.10644	2.56911	4.674078	2.477463	5.974466	4.843272	3.108348	1.911751	2.38	3.480916	4.319711	4.786031	2.771901	3.912305
3.00 to 3.50	0.064511	0.417499	0.245519	0.958179	0.193556	0.156665	0.009998	2.05828	0.43	0.028463	0.210584	0.331094	0.939658	0.064794
3.50 to 4.00	0.081796	0.216336	0.777987	0.898965	0.036868	0.023333	0.265509	3.014352	0.58	0.084075	0.226529	0.477434	1.202051	0
4.00 to 4.50	1.078057	0	1.688087	0.942373	1.112696	0.993321	1.673042	3.438763	0.65	0.997557	1.516834	1.676654	1.07452	0.665578
4.50 to 5.00	1.251963	0	1.699272	0.788648	1.64217	1.349983	1.930775	3.531708	0.83	1.2253	2.038116	1.893866	0.953191	1.105559
5.00 to 5.50	0.797395	0	1.53496	1.024051	1.268829	0.933321	1.395313	3.266462	0.51	0.841102	1.768101	1.810269	1.098454	0.849913
5.50 to 6.00	0.566087	0	1.663461	1.012642	1.059393	0.673325	0.996493	3.574226	0.8	0.635194	1.501838	1.631909	1.05867	0.582627
6.00 to 6.50	0.704584	0	1.925653	1.099543	1.274381	0.80999	0.909842	4.147502	1.12	0.748347	1.587934	1.802136	0.986738	0.61034
6.50 to 7.00	0.890886	0	2.294864	1.71734	1.551778	1.079986	0.888734	4.372804	0.74	0.942193	1.874427	1.985611	1.186772	0.813398
7.00 to 7.50	0.970861	0	2.32602	1.605532	1.60397	1.226651	0.793195	4.460516	1.1	1.039517	2.089057	2.185468	1.330856	0.98641
7.50 to 8.00	0.871666	0	2.06705	0.913597	1.426072	1.183318	0.645443	15.50412	1.13	1.006017	2.057746	2.1885	1.301879	1.024039
8.00 to 8.50	0.675281	0	1.72212	0.627064	1.130464	1.019987	0.505468	0	0.96	0.886232	1.742095	0	1.102346	0.910327
8.50 to 9.00	0.489173	0	1.042367	0.606862	0.799209	0.746657	0.367714	0	0.59	0.68487	1.214665	3.558446	0.971548	0.680201
9.00 to 9.50	0.328868	0	0.626015	0.533541	0.50671	0.469994	0.246624	0	0.57	0.468827	0.630514	0	0.779745	0.3977
9.50 to 10.00	0.201072	0	0.868246	0.373724	0.32548	0.303329	0.175525	0	0.332	0.302886	0.145024	2.099446	0.432328	0.085398
10.00 to 10.50	0.11135	0	0	0.215077	0.241195	0.416661	0.077764	0	0.15	0.206945	0	1.735083	0.2628	0
10.50 to 11.00	0.00481	0	0	0.10021	0.104163	0	0	0	0.113	0.017145	0	0	0.414101	0
11.00 to 11.50	0	0	0	0.034206	0.000555	0	0	0	0.0268	0	0	0	0.615399	0
11.50 to 12.00	0	0	0	0.01034	0	0	0	0	0	0	0	0	0.585381	0
12.00 to 12.50	0	0	0	0.003712	0	0	0	0	0	0	0	0	0.370437	0
12.50 to 13.00	0	0	0	0.001647	0	0	0	0	0	0	0	0	0.19602	0
13.00 to 13.50	0	0	0	0	0	0	0	0	0.2328	0	0	0	0.079981	0

Appendix 3. Z-score calculations when data from all participating laboratories are included in mean and standard deviation calculations.

	-1.50 to -1.00	z-score	-1.00 to -0.50	z-score	-0.50 to 0.00	z-score	0.00 to 0.50	z-score	0.50 to 1.00	z-score	1.00 to 1.50	z-score
TUM AVERAGE	0.000	-0.277	0.003	-0.345	0.859	0.118	2.784	-0.689	12.850	0.773	28.322	1.621
LB2003	0.000	-0.277	0.000	-0.363	0.108	-0.291	3.908	-0.459	13.171	0.880	25.286	0.844
LB2007	0.000	-0.277	0.156	0.577	1.506	0.470	6.418	0.054	7.446	-1.042	14.567	-1.898
LB2015	0.000	-0.277	0.000	-0.363	0.031	-0.334	4.777	-0.282	11.093	0.183	20.551	-0.367
LB2020	0.000	-0.277	0.000	-0.363	0.042	-0.327	9.989	0.784	6.252	-1.442	25.448	0.886
LB2021	0.000	-0.277	0.004	-0.336	0.053	-0.322	0.061	-1.246	4.599	-1.997	20.580	-0.360
LB2022	0.000	-0.277	0.045	-0.093	0.000	-0.350	1.110	-1.032	9.523	-0.344	24.340	0.602
LB2027	0.013	3.596	0.000	-0.363	0.002	-0.349	1.296	-0.994	11.818	0.426	26.813	1.235
LB2029	0.000	-0.277	0.000	-0.363	0.113	-0.289	4.678	-0.302	12.195	0.553	15.986	-1.535
LB2031	0.000	-0.277	0.637	3.481	7.120	3.526	15.610	1.934	9.060	-0.500	24.000	0.515
LB2032	0.000	-0.277	0.000	-0.363	0.005	-0.348	6.854	0.143	14.783	1.421	24.524	0.649
LB2054	0.000	-0.277	0.000	-0.363	0.007	-0.347	3.954	-0.450	12.250	0.571	22.182	0.050
LB2056	0.000	-0.277	0.000	-0.363	0.000	-0.350	3.566	-0.529	11.113	0.190	20.246	-0.445
LB2057	0.000	-0.277	0.000	-0.363	0.023	-0.338	16.713	2.159	9.495	-0.354	18.832	-0.807
LB2060	0.000	-0.277	0.000	-0.363	0.000	-0.350	7.233	0.220	14.885	1.456	24.454	0.631
Mean	0.001		0.060		0.644		6.155		10.549		21.986	
St. Dev	0.003		0.166		1.837		4.890		2.979		3.908	

	1.50 to 2.00	z-score	2.00 to 2.50	z-score	2.50 to 3.00	z-score	3.00 to 3.50	z-score	3.50 to 4.00	z-score	4.00 to 4.50	z-score
TUM AVERAGE	31.555	0.608	16.989	0.763	3.086	-0.484	0.000	-0.793	0.000	-0.719	0.262	-1.240
LB2003	27.914	0.119	16.418	0.622	4.106	0.392	0.065	-0.675	0.082	-0.614	1.078	-0.216
LB2007	46.329	2.589	12.190	-0.424	2.352	-1.115	0.382	-0.094	0.198	-0.465	0.000	-1.569
LB2015	23.476	-0.476	14.917	0.251	4.674	0.880	0.246	-0.344	0.778	0.276	1.688	0.549
LB2020	31.926	0.657	10.399	-0.867	2.477	-1.007	0.958	0.958	0.899	0.431	0.942	-0.387
LB2021	32.154	0.688	22.297	2.076	5.974	1.997	0.194	-0.439	0.037	-0.671	1.113	-0.173
LB2022	30.230	0.430	18.523	1.142	4.843	1.025	0.157	-0.506	0.023	-0.689	0.993	-0.323
LB2027	29.931	0.390	16.136	0.552	3.108	-0.465	0.010	-0.774	0.266	-0.379	1.673	0.530
LB2029	11.657	-2.061	6.092	-1.932	1.912	-1.493	2.058	2.968	3.014	3.136	3.439	2.745
LB2031	20.990	-0.809	9.610	-1.062	2.380	-1.091	0.430	-0.007	0.580	0.023	0.650	-0.753
LB2032	25.542	-0.199	14.696	0.196	3.481	-0.145	0.028	-0.741	0.084	-0.611	0.998	-0.317
LB2054	23.949	-0.412	14.735	0.206	4.320	0.575	0.211	-0.408	0.227	-0.429	1.517	0.334
LB2056	23.076	-0.530	13.837	-0.016	4.786	0.976	0.331	-0.188	0.477	-0.108	1.677	0.535
LB2057	25.598	-0.191	9.625	-1.058	2.772	-0.754	0.940	0.924	1.202	0.819	1.075	-0.221
LB2060	25.565	-0.196	15.174	0.314	3.912	0.225	0.065	-0.674	0.000	-0.719	0.666	-0.734
Mean	27.024		13.903		3.650		0.434		0.562		1.251	
St. Dev	7.456		4.044		1.164		0.547		0.782		0.797	

	4.50 to 5.00	z-score	5.00 to 5.50	z-score	5.50 to 6.00	z-score	6.00 to 6.50	z-score
TUM AVERAGE	0.335	-1.331	0.177	-1.334	0.118	-1.186	0.705	-0.370
LB2003	1.252	-0.232	0.797	-0.542	0.566	-0.659	0.000	-1.067
LB2007	0.000	-1.733	0.000	-1.561	0.000	-1.325	0.000	-1.067
LB2015	1.699	0.304	1.535	0.401	1.663	0.634	1.100	0.021
LB2020	0.789	-0.787	1.024	-0.252	1.013	-0.133	1.274	0.194
LB2021	1.642	0.235	1.269	0.061	1.059	-0.078	0.810	-0.266
LB2022	1.350	-0.115	0.933	-0.368	0.673	-0.532	0.910	-0.167
LB2027	1.931	0.581	1.395	0.222	0.996	-0.152	4.148	3.037
LB2029	3.532	2.500	3.266	2.613	3.574	2.884	1.120	0.041
LB2031	0.830	-0.738	0.510	-0.909	0.800	-0.383	0.748	-0.327
LB2032	1.225	-0.264	0.841	-0.486	0.635	-0.577	1.588	0.504
LB2054	2.038	0.710	1.768	0.699	1.502	0.443	1.802	0.716
LB2056	1.894	0.537	1.810	0.753	1.632	0.596	0.987	-0.091
LB2057	0.953	-0.590	1.098	-0.157	1.059	-0.079	0.610	-0.463
LB2060	1.106	-0.408	0.850	-0.475	0.583	-0.639	0.000	-1.067
Mean	1.446		1.221		1.125		1.078	
St. Dev	0.834		0.783		0.849		1.011	

	6.50 to 7.00	z-score	7.00 to 7.50	z-score	7.50 to 8.00	z-score	8.00 to 8.50	z-score	8.50 to 9.00	z-score
TUM AVERAGE	0.500	-0.928	0.549932	-0.968906	0.490162	-0.46578	0.380207	-0.993152	0.260425	-0.690763
LB2003	0.891	-0.547	0.970861	-0.561618	0.871666	-0.364061	0.675281	-0.425467	0.489173	-0.417852
LB2007	0.000	-1.415	0	-1.501016	0	-0.59647	1.268673	0.716143	0	-1.001466
LB2015	2.295	0.820	2.32602	0.749623	2.06705	-0.045341	1.72212	1.588518	1.042367	0.242143
LB2020	1.717	0.258	1.605532	0.052485	0.913597	-0.352881	0.627064	-0.518231	0.606862	-0.277442
LB2021	1.552	0.096	1.60397	0.050973	1.426072	-0.216242	1.130464	0.450246	0.799209	-0.04796
LB2022	1.080	-0.363	1.226651	-0.314118	1.183318	-0.280966	1.019987	0.237703	0.746657	-0.110657
LB2027	0.889	-0.549	0.793195	-0.733526	0.645443	-0.424378	0.505468	-0.752167	0.367714	-0.562761
LB2029	4.373	2.844	4.460516	2.814945	15.50412	3.53733	0	-1.724622	0	-1.001466
LB2031	0.740	-0.694	1.1	-0.436664	1.13	-0.295182	0.96	0.122296	0.59	-0.297559
LB2032	0.942	-0.497	1.039517	-0.495187	1.006017	-0.328239	0.886232	-0.019625	0.68487	-0.184373
LB2054	1.874	0.411	2.089057	0.520339	2.057746	-0.047821	1.742095	1.626946	1.214665	0.447705
LB2056	1.986	0.519	2.185468	0.613626	2.1885	-0.012959	0	-1.724622	3.558446	3.243983
LB2057	1.187	-0.259	1.330856	-0.21329	1.301879	-0.249355	1.102346	0.396152	0.971548	0.157651
LB2060	0.813	-0.623	0.98641	-0.546573	1.024039	-0.323434	0.910327	0.026732	0.680201	-0.189944

Mean	1.453	1.55129	2.237104	0.896433	0.839408
St. Dev	1.027	1.033493	3.750575	0.519785	0.838179

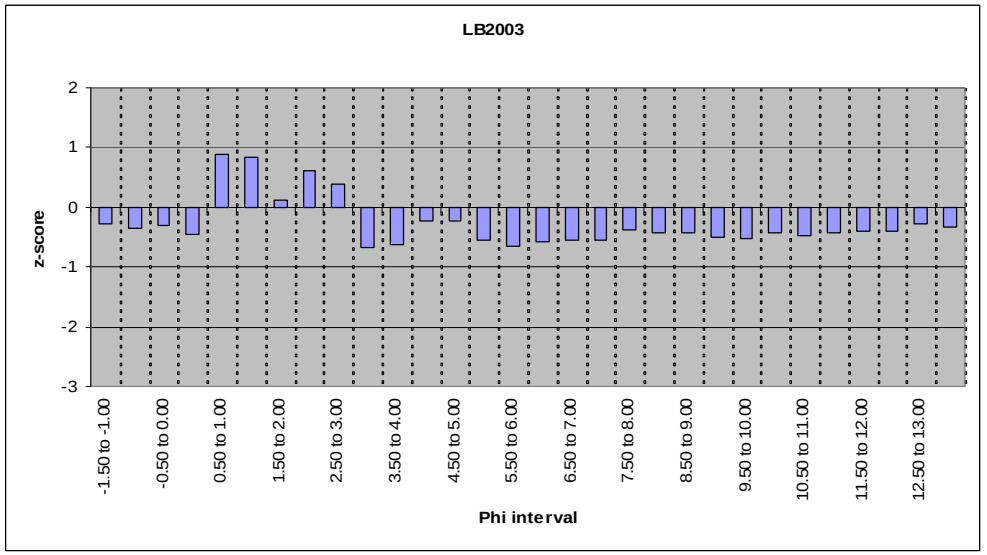
	9.00 to 9.50	z-score	9.50 to 10.00	z-score	10.00 to 10.50	z-score	10.50 to 11.00	z-score	11.00 to 11.50	z-score
TUM AVERAGE	0.115481	-1.21075	0.043002	-0.807905	0.006248	-0.652742	0	-0.501361	0	-0.426358
LB2003	0.328868	-0.500444	0.201072	-0.516227	0.11135	-0.427827	0.00481	-0.479658	0	-0.426358
LB2007	1.150386	2.234163	1.08721	1.11891	0.940919	1.347433	0.802246	3.118295	0.705913	2.620635
LB2015	0.626015	0.488679	0.868246	0.71487	0	-0.666113	0	-0.501361	0	-0.426358
LB2020	0.533541	0.180858	0.373724	-0.197643	0.215077	-0.205853	0.10021	-0.049223	0.034206	-0.278712
LB2021	0.50671	0.091543	0.32548	-0.286664	0.241195	-0.149961	0.104163	-0.03139	0.000555	-0.423961
LB2022	0.469994	-0.030673	0.303329	-0.327538	0.416661	0.225533	0	-0.501361	0	-0.426358
LB2027	0.246624	-0.774211	0.175525	-0.563368	0.077764	-0.499699	0	-0.501361	0	-0.426358
LB2029	0	-1.595154	0	-0.887253	0	-0.666113	0	-0.501361	0	-0.426358
LB2031	0.57	0.302219	0.332	-0.274634	0.15	-0.345116	0.113	0.008484	0.0268	-0.310679
LB2032	0.468827	-0.034558	0.302886	-0.328357	0.206945	-0.223256	0.017145	-0.424004	0	-0.426358
LB2054	0.630514	0.503653	0.145024	-0.61965	0	-0.666113	0	-0.501361	0	-0.426358
LB2056	0	-1.595154	2.099446	2.986729	1.735083	3.046926	0	-0.501361	0	-0.426358
LB2057	0.779745	1.000401	0.432328	-0.089504	0.2628	-0.103726	0.414101	1.367024	0.615399	2.229941
LB2060	0.3977	-0.271321	0.085398	-0.729674	0	-0.666113	0	-0.501361	0	-0.426358

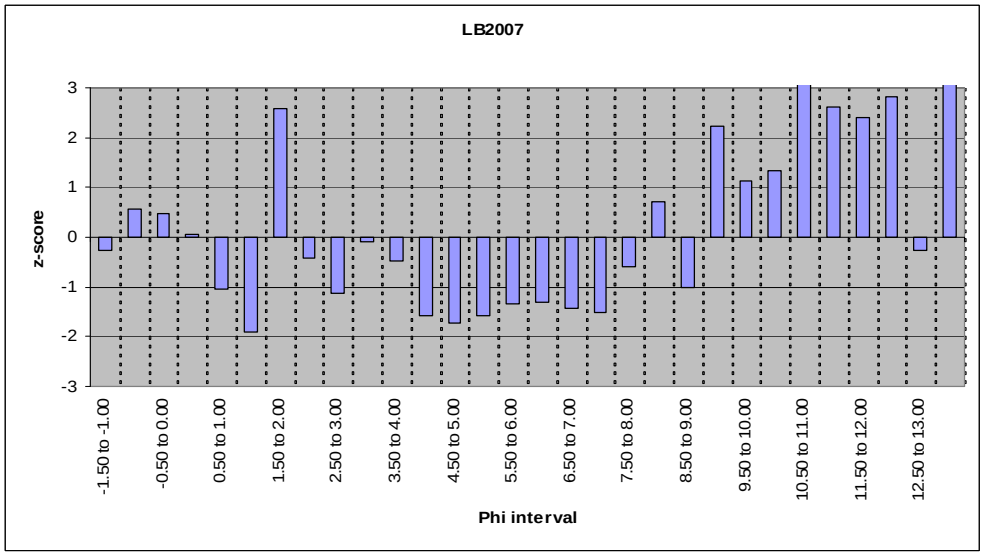
Mean	0.479209	0.480833	0.311271	0.11112	0.098777
St. Dev	0.300415	0.541935	0.467295	0.221636	0.231675

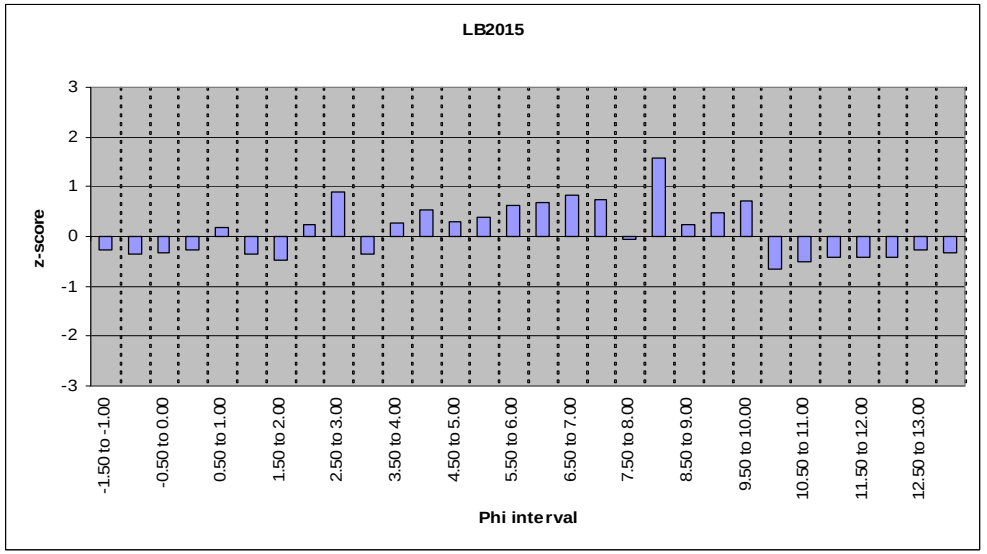
	11.50 to 12.00	z-score	12.00 to 12.50	z-score	12.50 to 13.00	z-score	13.00 to 13.50	z-score
TUM AVERAGE	0	-0.410125	0	-0.402895	0	-0.279124	0	-0.337795
LB2003	0	-0.410125	0	-0.402895	0	-0.279124	0	-0.337795
LB2007	0.575529	2.411258	0.499583	2.822252	0	-0.279124	1.426165	3.540715
LB2015	0	-0.410125	0	-0.402895	0	-0.279124	0	-0.337795
LB2020	0.01034	-0.359435	0.003712	-0.378929	0.001647	-0.246565	0	-0.337795
LB2021	0	-0.410125	0	-0.402895	0	-0.279124	0	-0.337795
LB2022	0	-0.410125	0	-0.402895	0	-0.279124	0	-0.337795
LB2027	0	-0.410125	0	-0.402895	0	-0.279124	0	-0.337795
LB2029	0	-0.410125	0	-0.402895	0	-0.279124	0	-0.337795
LB2031	0	-0.410125	0	-0.402895	0	-0.279124	0.2328	0.295314
LB2032	0	-0.410125	0	-0.402895	0	-0.279124	0	-0.337795
LB2054	0	-0.410125	0	-0.402895	0	-0.279124	0	-0.337795
LB2056	0	-0.410125	0	-0.402895	0	-0.279124	0	-0.337795
LB2057	0.585381	2.459557	0.370437	1.988525	0.19602	3.596049	0.079981	-0.120283
LB2060	0	-0.410125	0	-0.402895	0	-0.279124	0	-0.337795

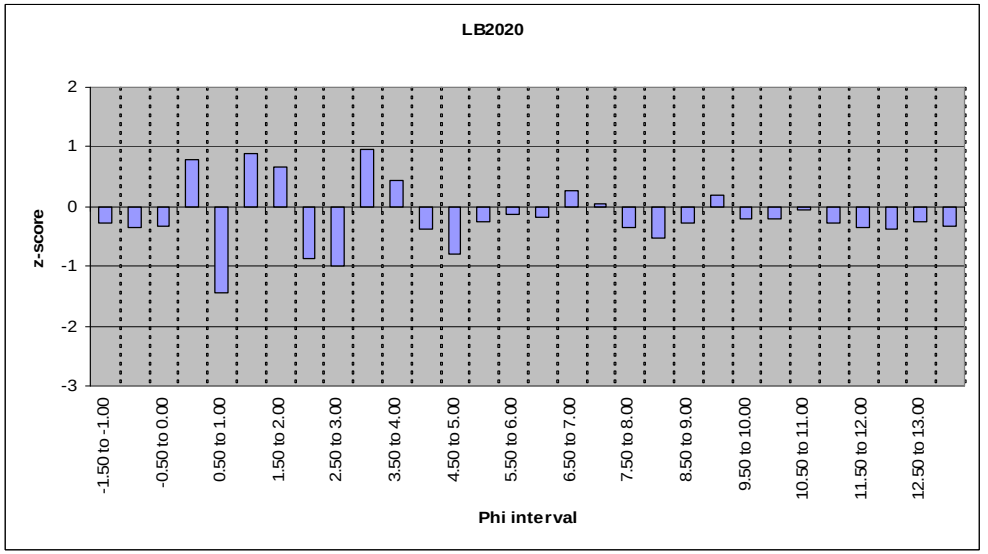
Mean	0.083661	0.062409	0.014119	0.12421	
St. Dev	0.203988	0.154902	0.050584	0.367709	

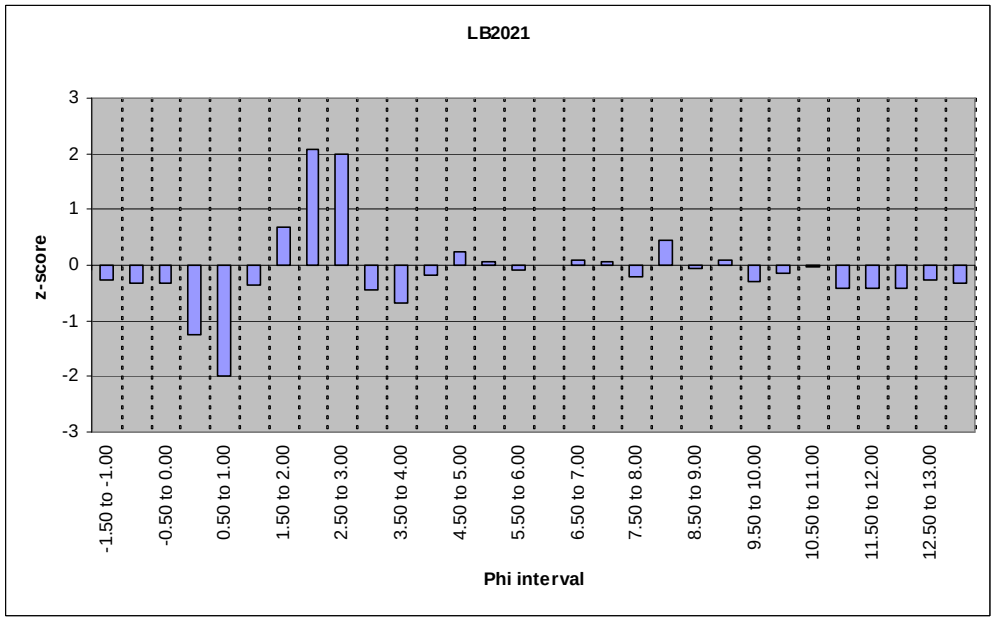
Appendix 4. Summary of z-scores for each half-phi interval for PS48; when data from all participating laboratories included in the mean and standard deviation calculations.

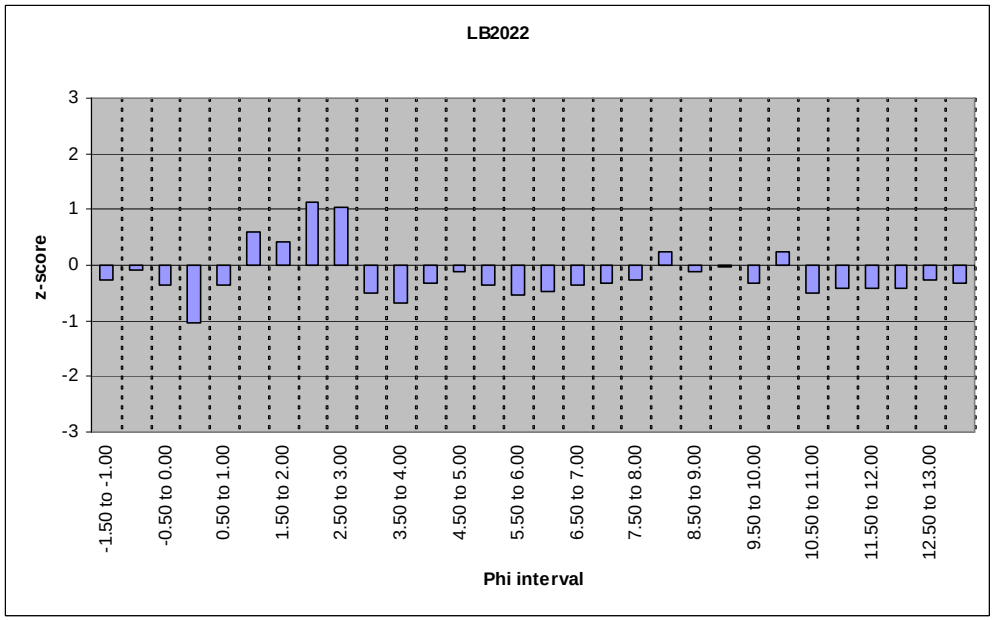


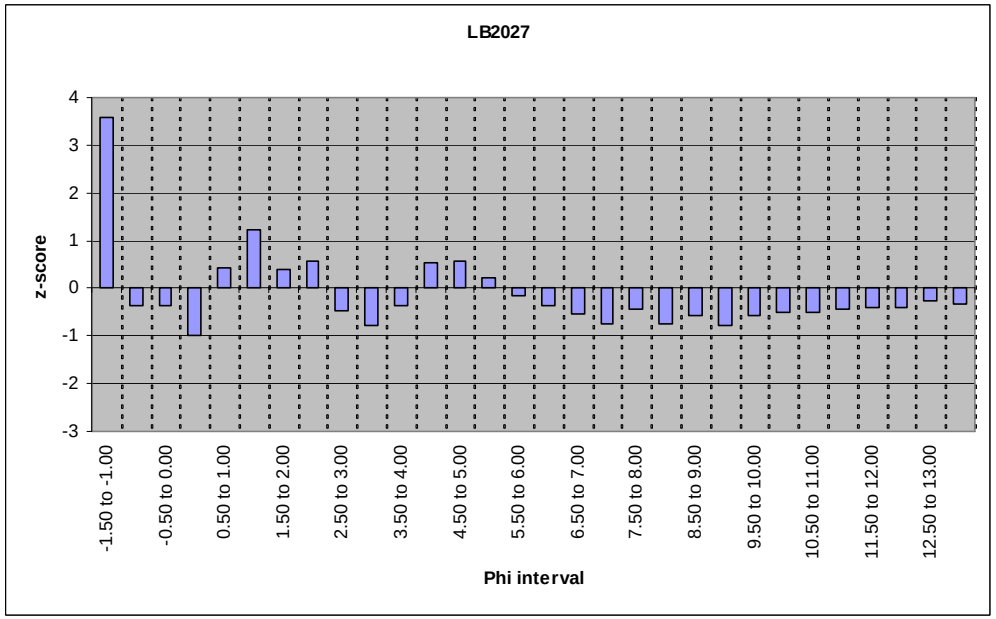


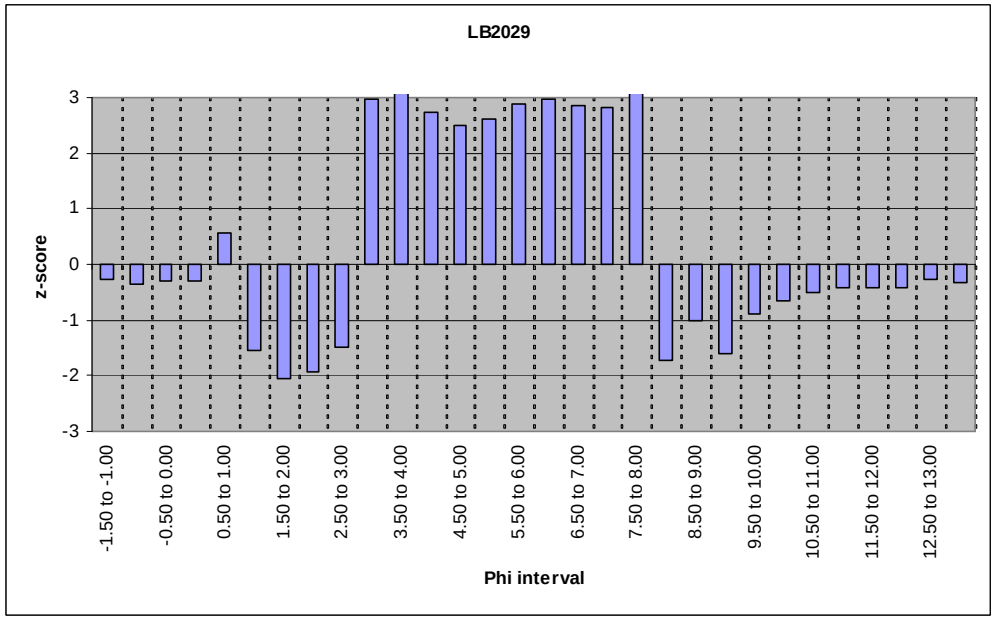


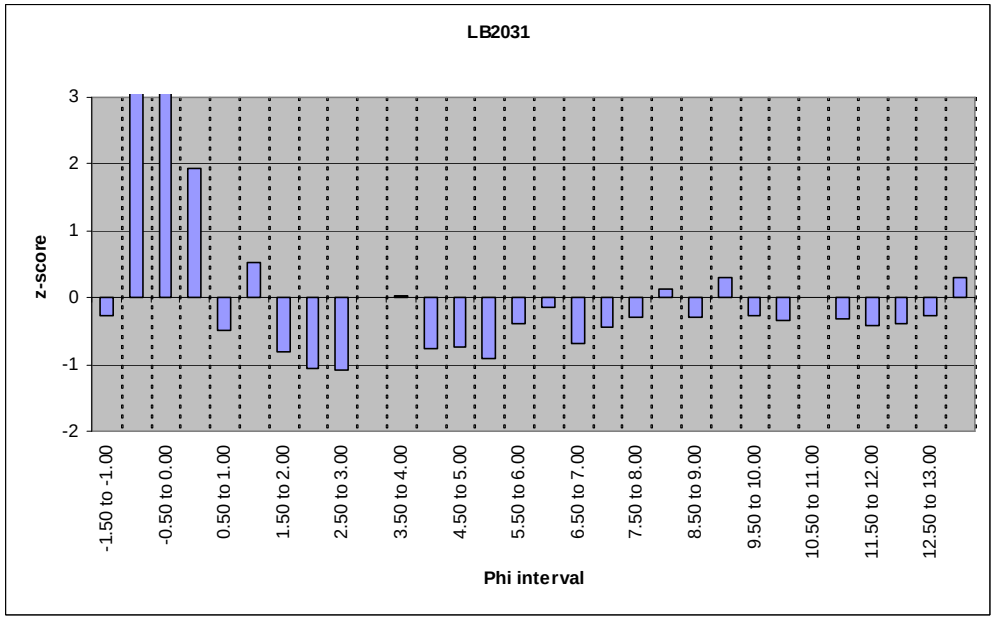


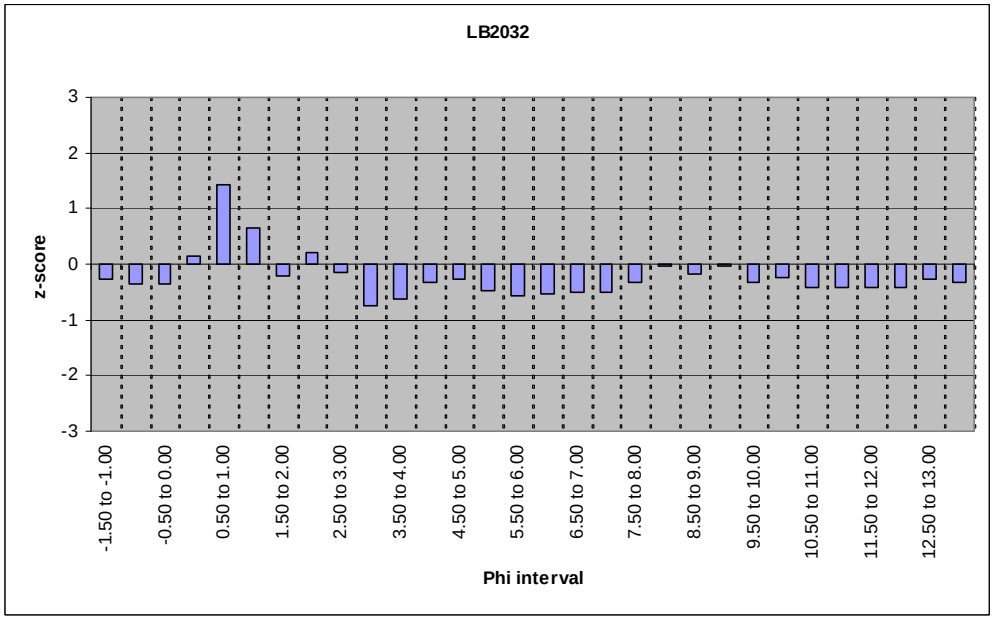

LB2021
z-score
3
2
1
0
-1
-2
-3
-1.50 to -1.00
-0.50 to 0.00
0.50 to 1.00
1.50 to 2.00
2.50 to 3.00
3.50 to 4.00
4.50 to 5.00
5.50 to 6.00
6.50 to 7.00
7.50 to 8.00
8.50 to 9.00
9.50 to 10.00
10.50 to 11.00
11.50 to 12.00
12.50 to 13.00
Phi interval

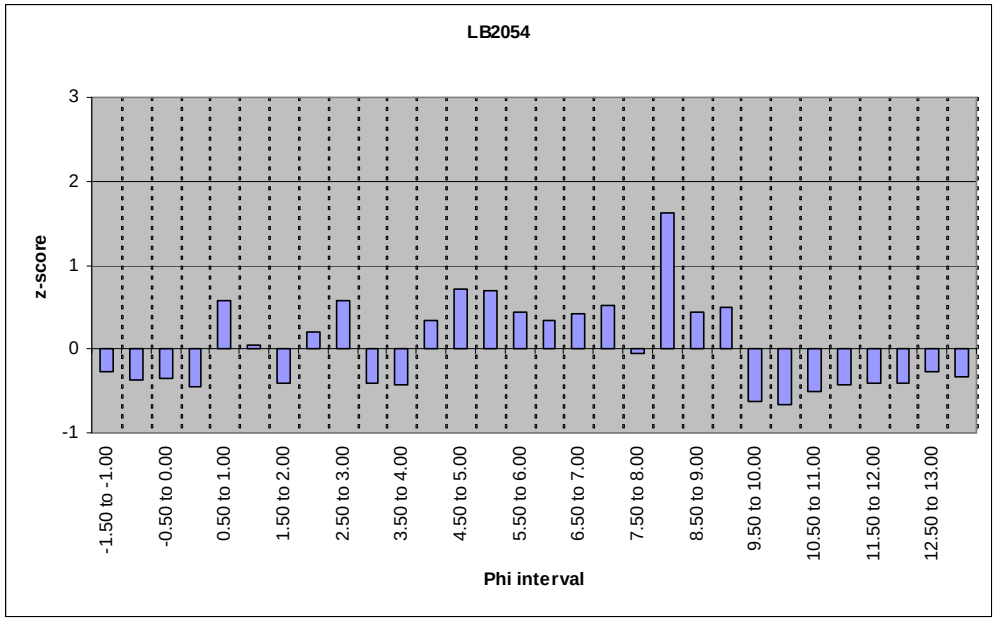

LB2022
z-score
3
2
1
0
-1
-2
-3
-1.50 to -1.00
-0.50 to 0.00
0.50 to 1.00
1.50 to 2.00
2.50 to 3.00
3.50 to 4.00
4.50 to 5.00
5.50 to 6.00
6.50 to 7.00
7.50 to 8.00
8.50 to 9.00
9.50 to 10.00
10.50 to 11.00
11.50 to 12.00
12.50 to 13.00
Phi interval


LB2027
z-score
4
3
2
1
0
-1
-2
-3
-1.50 to -1.00
-0.50 to 0.00
0.50 to 1.00
1.50 to 2.00
2.50 to 3.00
3.50 to 4.00
4.50 to 5.00
5.50 to 6.00
6.50 to 7.00
7.50 to 8.00
8.50 to 9.00
9.50 to 10.00
10.50 to 11.00
11.50 to 12.00
12.50 to 13.00
Phi interval


LB2029
z-score
3
2
1
0
-1
-2
-3
-1.50 to -1.00
-0.50 to 0.00
0.50 to 1.00
1.50 to 2.00
2.50 to 3.00
3.50 to 4.00
4.50 to 5.00
5.50 to 6.00
6.50 to 7.00
7.50 to 8.00
8.50 to 9.00
9.50 to 10.00
10.50 to 11.00
11.50 to 12.00
12.50 to 13.00
Phi interval


LB2031
z-score
3
2
1
0
-1
-2
-1.50 to -1.00
-0.50 to 0.00
0.50 to 1.00
1.50 to 2.00
2.50 to 3.00
3.50 to 4.00
4.50 to 5.00
5.50 to 6.00
6.50 to 7.00
7.50 to 8.00
8.50 to 9.00
9.50 to 10.00
10.50 to 11.00
11.50 to 12.00
12.50 to 13.00
Phi interval


LB2032
z-score
3
2
1
0
-1
-2
-3
-1.50 to -1.00
-0.50 to 0.00
0.50 to 1.00
1.50 to 2.00
2.50 to 3.00
3.50 to 4.00
4.50 to 5.00
5.50 to 6.00
6.50 to 7.00
7.50 to 8.00
8.50 to 9.00
9.50 to 10.00
10.50 to 11.00
11.50 to 12.00
12.50 to 13.00
Phi interval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z-score
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2
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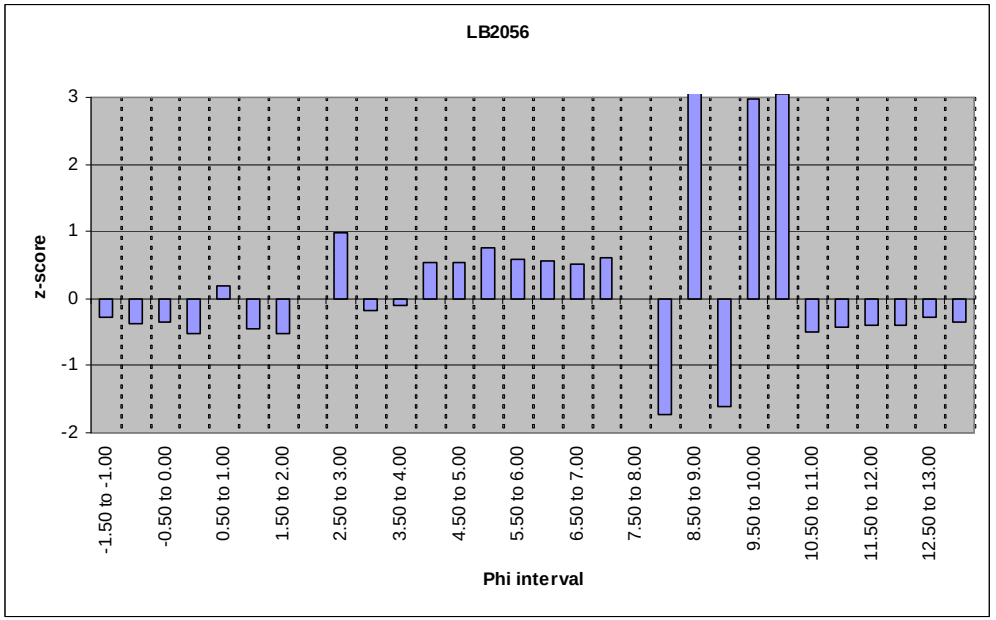
0
-1
-1.50 to -1.00
-0.50 to 0.00
0.50 to 1.00
1.50 to 2.00
2.50 to 3.00
3.50 to 4.00
4.50 to 5.00
5.50 to 6.00
6.50 to 7.00
7.50 to 8.00
8.50 to 9.00
9.50 to 10.00
10.50 to 11.00
11.50 to 12.00
12.50 to 13.00
Phi interval


LB2056
z-score
3
2
1
0
-1
-2
-1.50 to -1.00
-0.50 to 0.00
0.50 to 1.00
1.50 to 2.00
2.50 to 3.00
3.50 to 4.00
4.50 to 5.00
5.50 to 6.00
6.50 to 7.00
7.50 to 8.00
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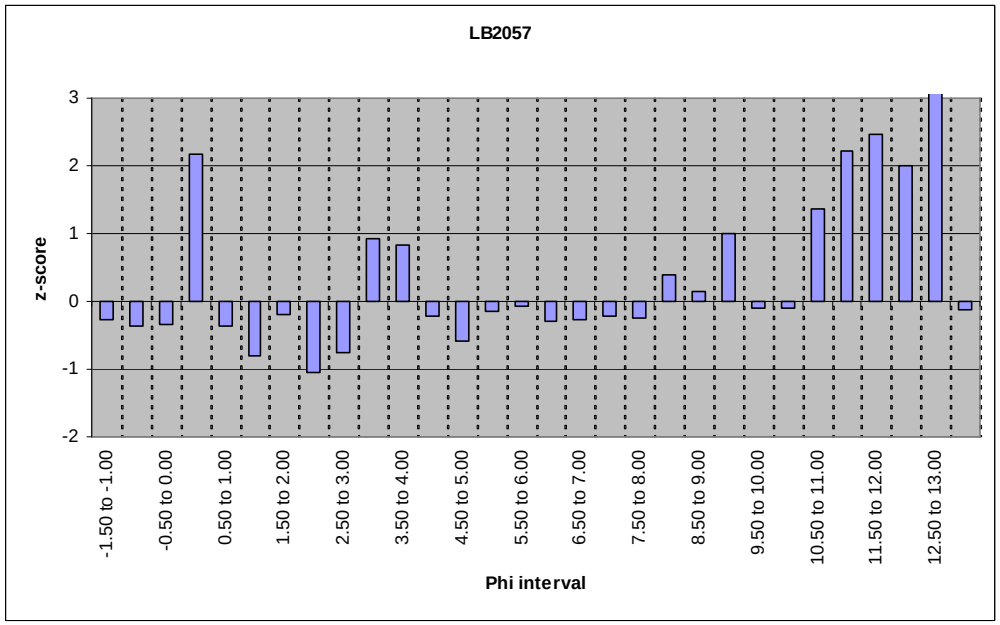
10.50 to 11.00
11.50 to 12.00
12.50 to 13.00
Phi interval


LB2057
z-score
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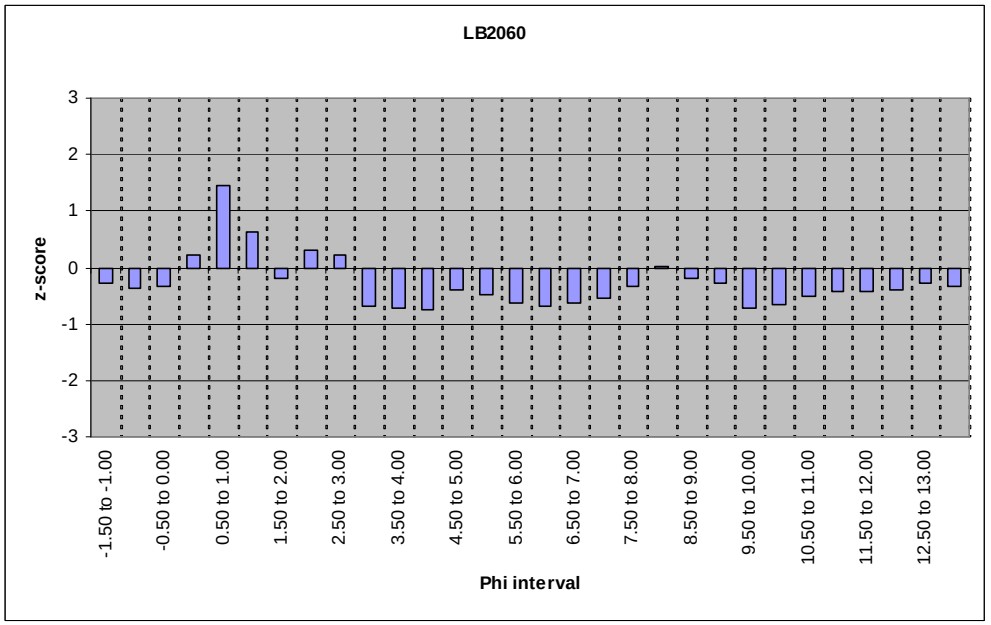
2
1
0
-1
-2
-1.50 to -1.00
-0.50 to 0.00
0.50 to 1.00
1.50 to 2.00
2.50 to 3.00
3.50 to 4.00
4.50 to 5.00
5.50 to 6.00
6.50 to 7.00
7.50 to 8.00
8.50 to 9.00
9.50 to 10.00
10.50 to 11.00
11.50 to 12.00
12.50 to 13.00
Phi interval


LB2060
z-score
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2
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0
-1
-2
-3
-1.50 to -1.00
-0.50 to 0.00
0.50 to 1.00
1.50 to 2.00
2.50 to 3.00
3.50 to 4.00
4.50 to 5.00
5.50 to 6.00
6.50 to 7.00
7.50 to 8.00
8.50 to 9.00
9.50 to 10.00
10.50 to 11.00
11.50 to 12.00
12.50 to 13.00
Phi interval