Appendix G

Emission Factor Uncertainty Ratios Based on the Difference of Means

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Emission Factor Uncertainty Ratios Based on the Difference of Means

This statistical approach is designed to account for the uncertainty induced by three sources of variability: (1) the skewness of the distribution of emissions data, (2) the number of tests comprising the emissions factor, and (3) the number of emissions units for which emissions are being estimated. In this approach, three hypothetical log-normally distributed populations, each comprised of 10,000 data points are generated. The three populations have a population mean of 1.0 and standard deviations of 0.5, 1.0, and 2.0, respectively. The approach is to sample each of these populations to develop separate data sets; one data set to replicate emissions factors ("calculated" emissions factor values) and the other to represent actual emissions from the emissions units. The results are compared to determine how well the calculated emissions factors represent the actual emissions of the emissions units; the calculated emissions factor value is subtracted from the actual emissions unit value. The sampling that simulates emissions factor emissions units is replicated 9 times to represent 9 different facilities having from 1 to 9 similar emissions units. The sampling that simulates the development of the calculated emissions factor values is replicated 20 times to represent emissions factors developed from 1 to 20 tests (i.e., n = 1 to 20).

Each hypothetical population consists of a sample of size 10,000 values drawn with replacement from a log-normal distribution with mean 1 and standard deviation equal to 0.5, 1.0, or 2.0. This sample represents 10,000 repetitions of "actual emissions" since they are drawn from the hypothetical population of emissions. This process is repeated nine times; each of the nine resulting populations represent 10,000 emissions from one of the nine different emissions units. The distribution corresponding to the first emissions unit represents a facility with only one emissions unit, and the 10,000 values are actual emissions based on a sample of size 1. The first two emissions units (population distributions) represent a facility with two emissions units, therefore actual emissions are based on samples of size 2, one value from each emissions unit. Following the same reasoning, all of the nine emissions units (population distributions) represent a facility with nine emissions units, that will generate actual emissions based on samples of size 9. The result consists of nine sampling distributions, where sampling distribution I, with I =1,...,9, represents the sampling distribution of the emissions factor based on I emissions units.

Another 20 samples of size 10,000 are selected with replacement from the standardized population. Then, in the same way, sampling distributions of means are calculated using 1 to 20 emissions tests. Each of these 20 sampling distributions is referred to as the calculated emissions factor developed from 1 to 20 tests.

Next, all combinations of differences between the 9 sampling distributions representing emissions units and the 20 sampling distributions representing calculated emissions factors are calculated. Differences of two sampling distributions will result in a sampling distribution of differences of means (averages). Tables reporting the percentiles of all sampling distributions of differences are reported. The adjustment for the emissions factor is defined as 1+ (difference). Tables G-1 through G-3 present selected percentiles of the distribution of the differences of means for hypothetical populations with a standard deviation of 0.5, 1.0, and 2.0, respectively.

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TABLE G-1. SELECTED PERCENTILES OF DISTRIBUTION OF DIFFERENCE IN MEANS BY NUMBER OF TESTS AND SOURCES
HYPOTHETICAL POPULATION WITH RSD OF 0.5

25th Percentile

Sources estimated \ EF data	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	-0.39	-0.38	-0.36	-0.36	-0.35	-0.35	-0.35	-0.36	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35	-0.35
2	-0.33	-0.30	-0.29	-0.28	-0.27	-0.27	-0.26	-0.26	-0.27	-0.26	-0.26	-0.26	-0.26	-0.26	-0.26	-0.25	-0.25	-0.25	-0.25	-0.25
3	-0.30	-0.27	-0.25	-0.25	-0.24	-0.23	-0.23	-0.23	-0.23	-0.23	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22	-0.21	-0.21	-0.21	-0.21
4	-0.28	-0.24	-0.23	-0.23	-0.22	-0.21	-0.21	-0.21	-0.21	-0.20	-0.20	-0.20	-0.20	-0.20	-0.19	-0.19	-0.19	-0.19	-0.19	-0.19
5	-0.27	-0.24	-0.22	-0.21	-0.21	-0.20	-0.20	-0.19	-0.19	-0.19	-0.19	-0.18	-0.18	-0.18	-0.18	-0.18	-0.18	-0.17	-0.17	-0.17
6	-0.27	-0.23	-0.22	-0.20	-0.20	-0.19	-0.19	-0.18	-0.18	-0.18	-0.17	-0.17	-0.17	-0.17	-0.17	-0.16	-0.16	-0.16	-0.16	-0.16
7	-0.26	-0.22	-0.21	-0.19	-0.19	-0.18	-0.18	-0.17	-0.17	-0.17	-0.16	-0.16	-0.16	-0.16	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15
8	-0.26	-0.22	-0.20	-0.19	-0.18	-0.17	-0.17	-0.16	-0.16	-0.16	-0.16	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15	-0.14	-0.14
9	-0.25	-0.21	-0.20	-0.18	-0.17	-0.17	-0.16	-0.16	-0.16	-0.16	-0.15	-0.15	-0.15	-0.14	-0.14	-0.14	-0.14	-0.14	-0.14	-0.14

50th Percentile

Sources estimated \ EF data	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.01	-0.04	-0.06	-0.07	-0.07	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.08	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09
2	0.06	0.01	-0.01	-0.02	-0.02	-0.03	-0.03	-0.03	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04
3	0.07	0.02	0.01	0.00	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02	-0.02	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03	-0.03
4	0.08	0.03	0.02	0.01	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
5	0.08	0.03	0.02	0.01	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02
6	0.08	0.03	0.02	0.02	0.01	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02	-0.02	-0.01	-0.01	-0.01
7	0.09	0.04	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
8	0.09	0.05	0.03	0.02	0.01	0.01	0.01	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
9	0.09	0.05	0.03	0.02	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01

75th Percentile

Sources estimated \ EF data	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.42	0.34	0.32	0.30	0.29	0.29	0.28	0.28	0.28	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
2	0.40	0.32	0.28	0.27	0.26	0.24	0.24	0.24	0.23	0.23	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.21	0.21	0.21
3	0.38	0.29	0.26	0.24	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.20	0.20	0.19	0.19	0.19	0.19	0.19	0.19	0.19
4	0.38	0.28	0.25	0.23	0.22	0.21	0.20	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.18	0.17	0.17	0.17	0.17	0.17
5	0.37	0.28	0.24	0.22	0.21	0.20	0.19	0.19	0.18	0.18	0.17	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16
6	0.37	0.27	0.23	0.21	0.20	0.19	0.18	0.18	0.17	0.17	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.15	0.15
7	0.37	0.27	0.23	0.21	0.20	0.19	0.17	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14
8	0.37	0.27	0.23	0.21	0.19	0.18	0.17	0.17	0.16	0.16	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.14	0.14	0.13
9	0.37	0.27	0.23	0.20	0.19	0.18	0.17	0.17	0.16	0.16	0.15	0.15	0.14	0.14	0.14	0.14	0.14	0.13	0.13	0.13

TABLE G-1 (continued). SELECTED PERCENTILES OF DISTRIBUTION OF DIFFERENCE IN MEANS BY NUMBER OF TESTS AND SOURCES
HYPOTHETICAL POPULATION WITH RSD OF 0.5

80th Percentile

	EF data																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1		0.45	0.42	0.41	0.40	0.39	0.39	0.39	0.39	0.38	0.38	0.38	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Sources 2	0.48	0.40	0.37	0.35	0.33	0.32	0.31	0.31	0.30	0.30	0.29	0.29	0.29	0.29	0.29	0.29	0.28	0.29	0.29	0.28
estimated 3	0.46	0.37	0.32	0.31	0.29	0.29	0.28	0.27	0.27	0.26	0.26	0.26	0.26	0.25	0.25	0.25	0.25	0.25	0.25	0.24
4	0.45	0.35	0.31	0.29	0.27	0.26	0.26	0.25	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.22
5	0.44	0.33	0.29	0.27	0.26	0.25	0.24	0.23	0.23	0.22	0.22	0.22	0.21	0.21	0.21	0.21	0.20	0.20	0.20	0.20
6	0.44	0.33	0.29	0.26	0.25	0.24	0.22	0.22	0.22	0.21	0.21	0.21	0.20	0.20	0.20	0.19	0.19	0.19	0.19	0.19
7	0.43	0.33	0.28	0.26	0.24	0.23	0.22	0.22	0.21	0.20	0.20	0.20	0.19	0.19	0.19	0.19	0.19	0.18	0.18	0.18
8	0.43	0.32	0.28	0.25	0.24	0.23	0.21	0.21	0.20	0.20	0.19	0.19	0.18	0.18	0.18	0.18	0.18	0.18	0.17	0.17
9	0.43	0.32	0.27	0.25	0.23	0.22	0.21	0.21	0.20	0.19	0.19	0.19	0.18	0.18	0.18	0.18	0.17	0.17	0.17	0.17

90th Percentile

	EF data																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.87	0.79	0.75	0.73	0.72	0.71	0.70	0.71	0.70	0.70	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.68	0.68
Sources 2	0.71	0.63	0.58	0.57	0.55	0.54	0.53	0.52	0.51	0.51	0.51	0.51	0.50	0.51	0.50	0.50	0.50	0.49	0.50	0.49
estimated 3	0.64	0.55	0.50	0.48	0.47	0.46	0.45	0.44	0.44	0.43	0.42	0.42	0.42	0.42	0.42	0.41	0.41	0.41	0.42	0.41
4	0.62	0.51	0.47	0.44	0.43	0.42	0.40	0.40	0.39	0.39	0.38	0.38	0.38	0.38	0.37	0.37	0.37	0.37	0.36	0.36
5	0.60	0.49	0.45	0.42	0.40	0.38	0.37	0.37	0.36	0.36	0.35	0.35	0.35	0.34	0.34	0.34	0.34	0.33	0.33	0.33
6	0.59	0.48	0.43	0.40	0.38	0.37	0.36	0.35	0.34	0.34	0.33	0.33	0.32	0.32	0.32	0.32	0.31	0.31	0.31	0.30
7	0.58	0.47	0.42	0.39	0.37	0.35	0.34	0.33	0.33	0.32	0.32	0.31	0.31	0.30	0.30	0.30	0.30	0.29	0.29	0.29
8	0.58	0.46	0.40	0.38	0.36	0.34	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.29	0.29	0.28	0.28	0.28	0.28	0.27
9	0.57	0.45	0.39	0.37	0.35	0.33	0.32	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.27	0.27	0.27	0.27	0.27	0.26

95th Percentile

	EF data																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1.18	1.11	1.07	1.05	1.04	1.03	1.01	1.00	1.00	0.99	1.00	1.00	0.99	0.99	1.00	0.99	0.99	0.99	0.99	0.99
Sources 2	0.92	0.83	0.78	0.76	0.75	0.75	0.74	0.73	0.73	0.72	0.72	0.72	0.71	0.71	0.71	0.70	0.70	0.71	0.71	0.71
estimated 3	0.82	0.72	0.67	0.64	0.63	0.61	0.60	0.59	0.59	0.59	0.57	0.58	0.57	0.58	0.57	0.56	0.56	0.57	0.56	0.56
4	0.77	0.66	0.61	0.58	0.56	0.54	0.54	0.53	0.52	0.52	0.51	0.51	0.50	0.50	0.50	0.50	0.50	0.50	0.49	0.49
5	0.73	0.63	0.57	0.55	0.53	0.51	0.50	0.49	0.48	0.47	0.47	0.46	0.46	0.46	0.45	0.45	0.45	0.45	0.44	0.44
6	0.71	0.61	0.54	0.51	0.50	0.48	0.46	0.46	0.45	0.44	0.44	0.43	0.43	0.43	0.43	0.42	0.42	0.42	0.41	0.41
7	0.70	0.59	0.53	0.49	0.47	0.46	0.45	0.44	0.43	0.42	0.42	0.41	0.41	0.41	0.40	0.40	0.40	0.40	0.39	0.39
8	0.68	0.57	0.51	0.48	0.46	0.44	0.43	0.41	0.41	0.40	0.39	0.40	0.39	0.39	0.38	0.38	0.37	0.37	0.37	0.37
9	0.67	0.56	0.50	0.47	0.44	0.42	0.41	0.40	0.39	0.39	0.38	0.38	0.37	0.37	0.36	0.36	0.35	0.35	0.34	0.34

99th Percentile

	EF data																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1.95	1.86	1.83	1.79	1.78	1.77	1.76	1.76	1.74	1.75	1.77	1.77	1.79	1.79	1.78	1.77	1.77	1.77	1.77	1.78
Sources 2	1.37	1.30	1.24	1.20	1.22	1.20	1.19	1.16	1.17	1.16	1.17	1.15	1.16	1.15	1.16	1.15	1.15	1.15	1.15	1.15
estimated 3	1.17	1.08	1.01	0.98	0.95	0.95	0.94	0.93	0.94	0.93	0.92	0.90	0.91	0.91	0.91	0.90	0.90	0.89	0.90	0.90
4	1.09	0.98	0.91	0.87	0.85	0.83	0.82	0.80	0.81	0.80	0.81	0.80	0.80	0.79	0.79	0.79	0.78	0.78	0.77	0.77
5	1.02	0.91	0.83	0.79	0.78	0.75	0.74	0.73	0.73	0.72	0.72	0.70	0.70	0.70	0.70	0.69	0.68	0.68	0.68	0.68
6	0.96	0.85	0.78	0.73	0.72	0.70	0.69	0.68	0.68	0.67	0.65	0.66	0.65	0.64	0.64	0.64	0.64	0.63	0.63	0.63
7	0.93	0.82	0.76	0.72	0.69	0.67	0.66	0.65	0.65	0.63	0.63	0.62	0.61	0.61	0.60	0.59	0.59	0.59	0.59	0.59
8	0.91	0.79	0.74	0.69	0.66	0.64	0.63	0.60	0.60	0.60	0.59	0.58	0.57	0.57	0.56	0.55	0.55	0.55	0.55	0.55
9	0.89	0.77	0.70	0.66	0.63	0.61	0.60	0.58	0.58	0.56	0.56	0.56	0.54	0.53	0.53	0.52	0.52	0.52	0.52	0.52

TABLE G-2. SELECTED PERCENTILES OF DISTRIBUTION OF DIFFERENCE IN MEANS BY NUMBER OF TESTS AND SOURCES
HYPOTHETICAL POPULATION WITH RSD OF 1.0

25th Percentile

Sources estimated	EF data 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	-0.54	-0.58	-0.59	-0.60	-0.61	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.59
2	-0.43	-0.48	-0.48	-0.48	-0.48	-0.48	-0.47	-0.47	-0.47	-0.48	-0.47	-0.47	-0.47	-0.47	-0.47	-0.47	-0.47	-0.47	-0.47	-0.47
3	-0.39	-0.42	-0.41	-0.42	-0.42	-0.41	-0.41	-0.41	-0.41	-0.41	-0.40	-0.40	-0.40	-0.40	-0.40	-0.40	-0.40	-0.40	-0.40	-0.40
4	-0.37	-0.37	-0.38	-0.38	-0.39	-0.38	-0.38	-0.37	-0.37	-0.37	-0.37	-0.37	-0.37	-0.37	-0.37	-0.36	-0.37	-0.36	-0.36	-0.36
5	-0.34	-0.36	-0.35	-0.35	-0.36	-0.35	-0.35	-0.35	-0.35	-0.35	-0.34	-0.34	-0.34	-0.34	-0.34	-0.34	-0.34	-0.34	-0.33	-0.33
6	-0.33	-0.34	-0.34	-0.33	-0.34	-0.33	-0.33	-0.33	-0.33	-0.33	-0.32	-0.32	-0.32	-0.31	-0.32	-0.31	-0.31	-0.31	-0.31	-0.31
7	-0.56	-0.60	-0.60	-0.60	-0.61	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.61	-0.61
8	-0.56	-0.59	-0.59	-0.59	-0.60	-0.60	-0.60	-0.60	-0.59	-0.59	-0.59	-0.59	-0.59	-0.60	-0.59	-0.59	-0.60	-0.59	-0.59	-0.59
9	-0.54	-0.59	-0.59	-0.60	-0.60	-0.61	-0.61	-0.61	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60	-0.60

50th Percentile

Sources estimated	EF data 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	-0.01	-0.10	-0.15	-0.18	-0.20	-0.20	-0.22	-0.23	-0.23	-0.24	-0.24	-0.24	-0.25	-0.26	-0.26	-0.26	-0.27	-0.26	-0.26	-0.27
2	0.10	0.00	-0.04	-0.07	-0.09	-0.11	-0.11	-0.12	-0.12	-0.13	-0.14	-0.14	-0.14	-0.15	-0.15	-0.15	-0.15	-0.15	-0.16	-0.16
3	0.14	0.03	0.00	-0.03	-0.05	-0.06	-0.07	-0.07	-0.08	-0.09	-0.09	-0.10	-0.10	-0.10	-0.11	-0.11	-0.11	-0.11	-0.11	-0.11
4	0.16	0.06	0.02	0.00	-0.02	-0.03	-0.04	-0.05	-0.05	-0.07	-0.07	-0.07	-0.08	-0.08	-0.08	-0.09	-0.09	-0.09	-0.09	-0.09
5	0.19	0.09	0.05	0.02	0.00	-0.01	-0.02	-0.02	-0.04	-0.04	-0.05	-0.06	-0.06	-0.06	-0.06	-0.07	-0.07	-0.07	-0.07	-0.07
6	0.19	0.09	0.06	0.03	0.01	0.00	-0.01	-0.01	-0.02	-0.04	-0.04	-0.04	-0.04	-0.05	-0.05	-0.05	-0.05	-0.06	-0.06	-0.06
7	0.00	-0.12	-0.16	-0.19	-0.21	-0.22	-0.23	-0.24	-0.25	-0.25	-0.26	-0.26	-0.26	-0.26	-0.27	-0.27	-0.27	-0.27	-0.28	-0.28
8	0.00	-0.11	-0.15	-0.17	-0.19	-0.20	-0.21	-0.22	-0.23	-0.24	-0.24	-0.24	-0.25	-0.25	-0.25	-0.25	-0.25	-0.26	-0.26	-0.26
9	-0.01	-0.10	-0.16	-0.18	-0.20	-0.21	-0.21	-0.23	-0.23	-0.24	-0.24	-0.25	-0.25	-0.26	-0.26	-0.26	-0.27	-0.27	-0.27	-0.27

75th Percentile

Sources estimated	EF data 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.54	0.42	0.39	0.36	0.34	0.32	0.32	0.31	0.30	0.29	0.28	0.28	0.27	0.27	0.27	0.27	0.27	0.27	0.26	0.26
2	0.57	0.47	0.42	0.39	0.37	0.36	0.34	0.33	0.32	0.31	0.31	0.30	0.30	0.29	0.29	0.28	0.28	0.28	0.28	0.28
3	0.57	0.47	0.42	0.39	0.36	0.35	0.33	0.32	0.31	0.30	0.30	0.28	0.28	0.28	0.27	0.27	0.27	0.26	0.26	0.26
4	0.57	0.47	0.42	0.39	0.36	0.34	0.32	0.32	0.31	0.29	0.29	0.29	0.28	0.28	0.27	0.27	0.26	0.26	0.26	0.25
5	0.58	0.46	0.41	0.38	0.35	0.33	0.32	0.31	0.30	0.29	0.29	0.28	0.28	0.27	0.26	0.26	0.26	0.25	0.25	0.25
6	0.58	0.46	0.41	0.37	0.35	0.33	0.31	0.30	0.29	0.28	0.28	0.27	0.27	0.26	0.26	0.25	0.25	0.25	0.24	0.24
7	0.53	0.44	0.38	0.35	0.33	0.31	0.30	0.29	0.28	0.28	0.27	0.26	0.26	0.25	0.25	0.25	0.24	0.24	0.24	0.24
8	0.55	0.44	0.39	0.36	0.34	0.33	0.32	0.32	0.31	0.30	0.30	0.29	0.28	0.27	0.27	0.27	0.27	0.26	0.26	0.26
9	0.54	0.44	0.39	0.36	0.34	0.34	0.32	0.32	0.31	0.30	0.30	0.30	0.29	0.29	0.29	0.29	0.29	0.28	0.28	0.28

TABLE G-2 (continued). SELECTED PERCENTILES OF DISTRIBUTION OF DIFFERENCE IN MEANS BY NUMBER OF TESTS AND SOURCES
HYPOTHETICAL POPULATION WITH RSD OF 1.0

80th Percentile

Sources estimated	EF data 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.71	0.60	0.57	0.53	0.51	0.51	0.49	0.49	0.48	0.48	0.46	0.46	0.46	0.46	0.45	0.44	0.45	0.45	0.46	0.45
2	0.71	0.61	0.56	0.53	0.51	0.50	0.48	0.47	0.46	0.45	0.45	0.44	0.44	0.44	0.43	0.43	0.44	0.43	0.42	0.42
3	0.69	0.58	0.53	0.50	0.48	0.46	0.45	0.44	0.43	0.42	0.41	0.40	0.40	0.39	0.38	0.38	0.38	0.38	0.37	0.37
4	0.68	0.57	0.53	0.50	0.47	0.45	0.44	0.42	0.42	0.41	0.40	0.40	0.39	0.38	0.38	0.37	0.37	0.37	0.37	0.36
5	0.68	0.56	0.50	0.48	0.45	0.43	0.41	0.40	0.40	0.39	0.38	0.37	0.37	0.36	0.35	0.35	0.35	0.35	0.34	0.34
6	0.67	0.55	0.50	0.46	0.43	0.42	0.40	0.39	0.38	0.36	0.36	0.35	0.35	0.34	0.33	0.33	0.33	0.33	0.32	0.32
7	0.69	0.61	0.56	0.53	0.50	0.48	0.48	0.48	0.46	0.46	0.45	0.44	0.44	0.43	0.43	0.43	0.43	0.43	0.43	0.43
8	0.72	0.61	0.56	0.53	0.51	0.51	0.50	0.49	0.48	0.48	0.47	0.47	0.47	0.46	0.45	0.45	0.44	0.44	0.44	0.44
9	0.73	0.63	0.58	0.55	0.53	0.52	0.50	0.50	0.49	0.49	0.48	0.48	0.48	0.47	0.47	0.47	0.47	0.46	0.47	0.47

90th Percentile

Sources estimated	EF data 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1.33	1.25	1.21	1.20	1.16	1.15	1.12	1.10	1.09	1.08	1.09	1.08	1.08	1.07	1.07	1.06	1.07	1.06	1.06	1.06
2	1.14	1.05	1.00	0.98	0.96	0.94	0.93	0.92	0.91	0.89	0.89	0.88	0.88	0.87	0.87	0.87	0.86	0.85	0.85	0.85
3	1.07	0.95	0.90	0.87	0.84	0.83	0.81	0.80	0.79	0.78	0.78	0.77	0.77	0.77	0.76	0.76	0.76	0.76	0.76	0.76
4	1.01	0.88	0.82	0.79	0.76	0.76	0.74	0.73	0.72	0.72	0.71	0.70	0.69	0.69	0.68	0.67	0.67	0.67	0.66	0.66
5	0.96	0.84	0.78	0.74	0.71	0.70	0.68	0.66	0.66	0.66	0.65	0.64	0.64	0.63	0.62	0.62	0.62	0.61	0.61	0.60
6	0.92	0.81	0.76	0.71	0.68	0.66	0.65	0.63	0.62	0.61	0.60	0.59	0.59	0.58	0.58	0.57	0.57	0.56	0.55	0.56
7	1.32	1.21	1.20	1.18	1.16	1.15	1.13	1.13	1.12	1.11	1.11	1.10	1.09	1.08	1.09	1.08	1.07	1.07	1.07	1.07
8	1.32	1.20	1.18	1.15	1.13	1.11	1.11	1.10	1.10	1.08	1.08	1.07	1.06	1.06	1.05	1.05	1.05	1.06	1.05	1.05
9	1.36	1.27	1.23	1.20	1.20	1.18	1.17	1.17	1.14	1.13	1.12	1.12	1.11	1.11	1.11	1.11	1.10	1.10	1.10	1.10

95th Percentile

Sources estimated	EF data 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	2.05	1.96	1.94	1.92	1.89	1.88	1.87	1.87	1.86	1.85	1.85	1.86	1.86	1.85	1.84	1.84	1.85	1.85	1.83	1.83
2	1.64	1.53	1.48	1.47	1.44	1.43	1.42	1.39	1.39	1.39	1.39	1.39	1.38	1.38	1.37	1.37	1.36	1.36	1.36	1.35
3	1.43	1.32	1.24	1.23	1.21	1.19	1.18	1.17	1.15	1.14	1.14	1.13	1.12	1.11	1.10	1.11	1.11	1.10	1.10	1.10
4	1.30	1.18	1.12	1.08	1.06	1.05	1.02	1.01	1.01	1.00	0.98	0.98	0.98	0.97	0.97	0.96	0.96	0.96	0.96	0.96
5	1.23	1.11	1.05	1.03	0.99	0.98	0.95	0.93	0.92	0.91	0.90	0.90	0.89	0.89	0.89	0.88	0.88	0.87	0.86	0.86
6	1.17	1.06	0.98	0.95	0.94	0.91	0.89	0.89	0.87	0.86	0.85	0.85	0.83	0.83	0.82	0.82	0.81	0.81	0.80	0.80
7	2.04	1.98	1.95	1.93	1.92	1.92	1.89	1.90	1.90	1.90	1.89	1.88	1.89	1.88	1.88	1.89	1.86	1.87	1.87	1.87
8	1.98	1.87	1.83	1.83	1.79	1.79	1.79	1.77	1.77	1.76	1.75	1.75	1.75	1.74	1.74	1.72	1.72	1.71	1.71	1.70
9	2.01	1.95	1.92	1.90	1.88	1.88	1.86	1.86	1.84	1.84	1.82	1.82	1.81	1.82	1.81	1.81	1.80	1.80	1.81	1.81

99th Percentile

Sources estimated	EF data 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	4.19	4.04	4.05	4.10	3.95	4.03	4.03	4.08	4.05	4.06	4.05	4.03	4.04	4.06	4.05	4.08	4.07	4.06	4.06	4.05
2	3.03	2.87	2.84	2.84	2.84	2.83	2.84	2.78	2.73	2.72	2.72	2.72	2.72	2.72	2.70	2.69	2.67	2.68	2.70	2.72
3	2.39	2.28	2.22	2.20	2.18	2.18	2.18	2.17	2.12	2.12	2.13	2.12	2.12	2.14	2.12	2.14	2.15	2.12	2.09	2.09
4	2.06	1.98	1.91	1.89	1.85	1.85	1.82	1.84	1.82	1.80	1.79	1.77	1.79	1.80	1.79	1.79	1.73	1.75	1.75	1.76
5	1.91	1.77	1.70	1.65	1.63	1.65	1.65	1.67	1.65	1.64	1.63	1.62	1.59	1.60	1.60	1.59	1.58	1.57	1.57	1.56
6	1.76	1.62	1.58	1.56	1.48	1.48	1.48	1.50	1.48	1.49	1.48	1.45	1.46	1.47	1.45	1.44	1.43	1.44	1.42	1.42
7	4.30	4.20	4.22	4.13	4.14	4.14	4.06	4.02	4.09	4.04	4.07	4.03	4.01	4.01	3.99	3.99	3.98	3.99	4.02	3.98
8	4.10	3.88	3.85	3.89	3.90	3.88	3.89	3.85	3.86	3.87	3.86	3.81	3.83	3.86	3.86	3.82	3.82	3.84	3.85	3.87
9	4.17	4.09	4.07	4.07	4.05	4.03	4.02	3.99	3.99	3.97	3.97	3.96	3.95	3.92	3.93	3.93	3.96	3.99	3.95	3.97

TABLE G-3. SELECTED PERCENTILES OF DISTRIBUTION OF DIFFERENCE IN MEANS BY NUMBER OF TESTS AND SOURCES
HYPOTHETICAL POPULATION WITH RSD OF 2.0

25th Percentile

Sources estimated \ EF data	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	-0.55	-0.68	-0.71	-0.74	-0.76	-0.77	-0.77	-0.76	-0.77	-0.78	-0.78	-0.78	-0.78	-0.79	-0.79	-0.79	-0.79	-0.79	-0.80	-0.80
2	-0.45	-0.56	-0.60	-0.64	-0.65	-0.65	-0.65	-0.65	-0.66	-0.67	-0.67	-0.68	-0.68	-0.67	-0.67	-0.68	-0.68	-0.68	-0.68	-0.68
3	-0.38	-0.48	-0.52	-0.56	-0.58	-0.58	-0.59	-0.58	-0.59	-0.59	-0.59	-0.60	-0.60	-0.60	-0.60	-0.61	-0.61	-0.61	-0.61	-0.61
4	-0.33	-0.42	-0.49	-0.51	-0.54	-0.54	-0.54	-0.54	-0.55	-0.56	-0.55	-0.56	-0.55	-0.56	-0.56	-0.56	-0.56	-0.56	-0.56	-0.56
5	-0.29	-0.40	-0.45	-0.48	-0.51	-0.51	-0.51	-0.50	-0.51	-0.52	-0.51	-0.52	-0.53	-0.52	-0.52	-0.52	-0.52	-0.52	-0.52	-0.52
6	-0.26	-0.37	-0.43	-0.46	-0.49	-0.48	-0.48	-0.48	-0.49	-0.49	-0.49	-0.50	-0.49	-0.50	-0.50	-0.50	-0.50	-0.49	-0.49	-0.49
7	-0.25	-0.36	-0.40	-0.44	-0.46	-0.47	-0.47	-0.46	-0.46	-0.47	-0.46	-0.47	-0.47	-0.47	-0.47	-0.47	-0.47	-0.47	-0.47	-0.47
8	-0.24	-0.35	-0.39	-0.42	-0.44	-0.44	-0.45	-0.44	-0.45	-0.45	-0.44	-0.44	-0.44	-0.45	-0.45	-0.45	-0.45	-0.45	-0.45	-0.45
9	-0.23	-0.33	-0.37	-0.41	-0.43	-0.42	-0.43	-0.43	-0.43	-0.44	-0.43	-0.43	-0.43	-0.43	-0.43	-0.43	-0.44	-0.44	-0.44	-0.44

50th Percentile

Sources estimated \ EF data	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.00	-0.11	-0.18	-0.23	-0.26	-0.30	-0.32	-0.33	-0.35	-0.36	-0.37	-0.39	-0.40	-0.40	-0.41	-0.42	-0.42	-0.42	-0.42	-0.43
2	0.10	-0.01	-0.07	-0.12	-0.15	-0.17	-0.20	-0.21	-0.23	-0.25	-0.25	-0.26	-0.26	-0.27	-0.28	-0.28	-0.29	-0.30	-0.30	-0.31
3	0.18	0.07	0.00	-0.04	-0.08	-0.10	-0.12	-0.13	-0.16	-0.17	-0.18	-0.18	-0.19	-0.20	-0.21	-0.21	-0.22	-0.22	-0.22	-0.22
4	0.23	0.11	0.04	0.00	-0.02	-0.05	-0.08	-0.09	-0.11	-0.13	-0.14	-0.14	-0.15	-0.15	-0.16	-0.17	-0.17	-0.18	-0.18	-0.18
5	0.26	0.14	0.08	0.04	0.00	-0.02	-0.04	-0.05	-0.07	-0.08	-0.09	-0.10	-0.11	-0.12	-0.12	-0.13	-0.13	-0.14	-0.14	-0.15
6	0.29	0.17	0.10	0.06	0.03	0.00	-0.02	-0.03	-0.05	-0.06	-0.07	-0.07	-0.08	-0.09	-0.10	-0.10	-0.11	-0.11	-0.12	-0.12
7	0.31	0.19	0.13	0.08	0.05	0.02	0.00	-0.01	-0.02	-0.04	-0.05	-0.06	-0.07	-0.08	-0.08	-0.09	-0.09	-0.09	-0.09	-0.10
8	0.32	0.21	0.14	0.09	0.06	0.04	0.02	0.01	-0.01	-0.03	-0.04	-0.05	-0.05	-0.06	-0.07	-0.07	-0.08	-0.07	-0.08	-0.08
9	0.33	0.22	0.15	0.11	0.07	0.05	0.04	0.02	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.05	-0.06	-0.06	-0.06	-0.07	-0.07

75th Percentile

Sources estimated \ EF data	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.53	0.43	0.37	0.34	0.30	0.27	0.25	0.23	0.22	0.20	0.20	0.19	0.19	0.18	0.17	0.16	0.15	0.15	0.14	0.14
2	0.65	0.53	0.46	0.42	0.40	0.37	0.35	0.32	0.31	0.31	0.30	0.30	0.28	0.28	0.27	0.27	0.26	0.26	0.25	0.25
3	0.70	0.59	0.54	0.48	0.45	0.43	0.41	0.39	0.38	0.37	0.35	0.35	0.34	0.33	0.32	0.32	0.31	0.31	0.31	0.30
4	0.72	0.61	0.56	0.50	0.47	0.45	0.44	0.42	0.41	0.39	0.38	0.37	0.36	0.36	0.34	0.34	0.34	0.33	0.32	0.32
5	0.73	0.63	0.58	0.53	0.50	0.46	0.44	0.42	0.41	0.40	0.39	0.38	0.37	0.36	0.35	0.35	0.34	0.34	0.33	0.33
6	0.75	0.64	0.59	0.54	0.51	0.47	0.45	0.44	0.42	0.41	0.40	0.40	0.39	0.37	0.36	0.36	0.36	0.35	0.35	0.34
7	0.77	0.65	0.60	0.54	0.51	0.48	0.46	0.45	0.43	0.42	0.41	0.40	0.39	0.38	0.38	0.37	0.37	0.36	0.35	0.35
8	0.77	0.66	0.60	0.55	0.52	0.48	0.46	0.44	0.43	0.42	0.40	0.39	0.39	0.38	0.38	0.37	0.36	0.36	0.35	0.34
9	0.78	0.66	0.60	0.55	0.52	0.48	0.46	0.45	0.42	0.41	0.41	0.39	0.38	0.37	0.37	0.37	0.36	0.35	0.35	0.34

TABLE G-3 (continued). SELECTED PERCENTILES OF DISTRIBUTION OF DIFFERENCE IN MEANS BY NUMBER OF TESTS AND SOURCES
HYPOTHETICAL POPULATION WITH RSD OF 2.0

80th Percentile

Sources estimated	EF data 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0.75	0.64	0.59	0.54	0.51	0.49	0.47	0.46	0.44	0.43	0.43	0.43	0.41	0.40	0.40	0.40	0.39	0.38	0.38	0.39
2	0.84	0.74	0.68	0.62	0.60	0.58	0.56	0.54	0.52	0.52	0.50	0.49	0.48	0.47	0.47	0.46	0.45	0.45	0.44	0.44
3	0.87	0.76	0.70	0.66	0.63	0.60	0.58	0.57	0.55	0.53	0.53	0.52	0.51	0.50	0.49	0.49	0.48	0.48	0.48	0.47
4	0.88	0.77	0.72	0.67	0.65	0.62	0.59	0.58	0.57	0.55	0.55	0.54	0.53	0.52	0.51	0.51	0.50	0.49	0.49	0.49
5	0.88	0.77	0.73	0.69	0.65	0.62	0.59	0.58	0.56	0.56	0.54	0.54	0.53	0.52	0.51	0.50	0.50	0.49	0.48	0.48
6	0.90	0.79	0.74	0.69	0.66	0.62	0.60	0.58	0.57	0.55	0.55	0.54	0.53	0.52	0.52	0.51	0.50	0.50	0.49	0.49
7	0.91	0.80	0.73	0.69	0.65	0.62	0.59	0.58	0.57	0.56	0.54	0.53	0.53	0.52	0.52	0.51	0.51	0.50	0.49	0.49
8	0.90	0.79	0.73	0.68	0.64	0.62	0.59	0.57	0.56	0.55	0.54	0.53	0.51	0.51	0.50	0.49	0.49	0.48	0.48	0.48
9	0.91	0.78	0.73	0.67	0.64	0.61	0.59	0.57	0.55	0.54	0.53	0.52	0.52	0.50	0.49	0.48	0.48	0.48	0.47	0.46

90th Percentile

Sources estimated	EF data 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	1.65	1.54	1.47	1.44	1.43	1.39	1.38	1.36	1.35	1.34	1.34	1.33	1.30	1.31	1.30	1.29	1.29	1.29	1.28	1.29
2	1.56	1.43	1.40	1.38	1.36	1.32	1.31	1.28	1.28	1.26	1.26	1.25	1.24	1.23	1.22	1.22	1.24	1.22	1.21	1.20
3	1.50	1.37	1.33	1.29	1.27	1.23	1.21	1.21	1.20	1.20	1.17	1.16	1.16	1.14	1.15	1.15	1.15	1.15	1.14	1.14
4	1.44	1.34	1.30	1.22	1.19	1.16	1.15	1.13	1.12	1.12	1.12	1.12	1.11	1.11	1.11	1.11	1.08	1.06	1.06	1.06
5	1.44	1.32	1.25	1.21	1.18	1.15	1.13	1.11	1.10	1.08	1.07	1.06	1.06	1.06	1.05	1.05	1.04	1.04	1.04	1.04
6	1.39	1.27	1.21	1.18	1.13	1.10	1.08	1.06	1.05	1.05	1.04	1.03	1.04	1.03	1.02	1.01	1.00	0.99	0.99	0.98
7	1.36	1.24	1.19	1.14	1.10	1.06	1.04	1.03	1.01	1.00	1.00	1.00	0.98	0.97	0.96	0.95	0.95	0.95	0.94	0.94
8	1.32	1.21	1.16	1.10	1.07	1.03	1.00	0.99	0.98	0.96	0.96	0.95	0.95	0.94	0.92	0.93	0.92	0.91	0.91	0.91
9	1.29	1.17	1.11	1.08	1.04	1.00	0.97	0.95	0.94	0.93	0.92	0.91	0.90	0.90	0.89	0.89	0.88	0.87	0.87	0.87

95th Percentile

Sources estimated	EF data 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	2.93	2.80	2.78	2.73	2.69	2.68	2.67	2.66	2.66	2.63	2.62	2.61	2.59	2.60	2.60	2.61	2.62	2.60	2.59	2.60
2	2.53	2.42	2.36	2.33	2.28	2.26	2.23	2.24	2.24	2.22	2.22	2.22	2.23	2.23	2.22	2.22	2.22	2.22	2.21	2.21
3	2.34	2.21	2.17	2.11	2.06	2.05	2.03	1.99	2.01	1.98	1.99	1.97	1.97	1.98	1.99	2.00	1.96	1.96	1.97	1.96
4	2.17	2.03	1.99	1.96	1.91	1.86	1.86	1.83	1.82	1.83	1.84	1.82	1.82	1.81	1.79	1.80	1.81	1.80	1.78	1.79
5	2.08	1.94	1.91	1.89	1.86	1.80	1.78	1.75	1.74	1.72	1.72	1.72	1.72	1.72	1.70	1.71	1.71	1.70	1.71	1.72
6	1.95	1.82	1.79	1.75	1.72	1.67	1.66	1.62	1.61	1.59	1.60	1.60	1.59	1.59	1.56	1.57	1.56	1.55	1.54	1.55
7	1.85	1.75	1.70	1.65	1.58	1.56	1.55	1.53	1.53	1.51	1.49	1.50	1.48	1.48	1.47	1.47	1.46	1.45	1.46	1.44
8	1.80	1.66	1.62	1.56	1.53	1.48	1.46	1.45	1.44	1.46	1.43	1.42	1.42	1.41	1.39	1.38	1.37	1.36	1.35	1.34
9	1.72	1.61	1.57	1.52	1.47	1.41	1.40	1.38	1.38	1.38	1.35	1.36	1.34	1.34	1.31	1.31	1.30	1.29	1.28	1.28

99th Percentile

Sources estimated	EF data 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	8.19	7.98	8.02	7.88	7.89	7.97	7.91	7.90	7.91	7.71	7.79	7.79	7.72	7.72	7.81	7.86	7.78	7.82	7.80	7.84
2	6.17	5.83	5.92	5.98	5.96	5.83	5.73	5.81	5.79	5.82	5.76	5.77	5.77	5.74	5.77	5.79	5.80	5.82	5.80	5.82
3	4.89	4.79	4.71	4.73	4.69	4.59	4.66	4.58	4.58	4.55	4.52	4.52	4.55	4.59	4.57	4.59	4.60	4.62	4.59	4.60
4	4.20	4.17	4.00	3.99	3.99	3.93	3.95	3.98	3.91	3.93	3.98	3.91	3.92	3.93	3.88	3.91	3.90	3.90	3.93	3.93
5	3.81	3.83	3.69	3.76	3.66	3.61	3.68	3.60	3.60	3.59	3.59	3.59	3.55	3.55	3.59	3.62	3.64	3.64	3.57	3.58
6	3.47	3.39	3.38	3.33	3.34	3.25	3.21	3.15	3.15	3.19	3.19	3.23	3.20	3.23	3.21	3.18	3.20	3.17	3.17	3.18
7	3.31	3.23	3.22	3.16	3.07	3.03	3.05	3.08	3.03	3.07	3.12	3.09	3.05	3.07	3.08	3.09	3.10	3.03	3.01	3.01
8	3.04	3.05	2.98	2.93	2.88	2.82	2.83	2.82	2.82	2.78	2.80	2.79	2.82	2.82	2.84	2.83	2.82	2.81	2.81	2.77
9	2.99	2.89	2.83	2.76	2.75	2.70	2.65	2.65	2.69	2.66	2.64	2.63	2.65	2.66	2.68	2.69	2.68	2.65	2.59	2.62