

Online Supplement to **Point and interval estimates for a standardized mean**

difference in paired-sample designs using a pooled standard deviation by Douglas A. Fitts

Table S1. Calculated sample sizes for a 90% paired-pooled confidence interval (CI) having an average fixed full width of ω in standard deviation units. The sample size n assumes a noncentral t distribution with known population correlation ρ . Simulations with these parameters for 90% using the Pearson correlation r instead of ρ required about 1 extra subject. δ is the population standardized effect size.

δ	ρ	ω					
		0.25	0.4	0.6	0.8	1	1.2
0	0	347	136	61	34	22	16
0.2	0	349	136	61	34	22	16
0.4	0	354	138	62	35	23	16
0.6	0	362	142	63	36	23	16
0.8	0	375	147	65	37	24	17
1	0	390	153	68	39	25	18
0	0.2	278	109	49	28	18	13
0.2	0.2	279	109	49	28	18	13
0.4	0.2	285	112	50	28	18	13
0.6	0.2	294	115	51	29	19	13
0.8	0.2	306	120	54	30	20	14
1	0.2	323	126	57	32	21	15
0	0.4	208	82	37	21	13	10
0.2	0.4	210	82	37	21	14	10
0.4	0.4	216	85	38	22	14	10
0.6	0.4	226	89	40	23	15	10
0.8	0.4	241	94	42	24	16	11
1	0.4	259	101	45	26	17	12
0	0.6	139	55	25	14	9	7
0.2	0.6	141	56	25	14	9	7
0.4	0.6	148	58	26	15	10	7
0.6	0.6	160	63	28	16	11	8
0.8	0.6	177	70	31	18	12	8
1	0.6	198	78	35	20	13	9
0	0.8	70	28	13	7	5	4
0.2	0.8	73	29	13	8	5	4
0.4	0.8	81	32	15	8	6	4
0.6	0.8	96	38	17	10	7	5
0.8	0.8	116	46	21	12	8	6
1	0.8	141	56	25	15	10	7

Table S2. Calculated sample sizes for a 95% paired-pooled CI having an average fixed width of ω . See comments in Table S1. The n assumes a noncentral t distribution with known ρ . Simulations with these parameters for 95% using r instead ρ required about 2 extra subjects.

δ	ρ	ω					
		0.25	0.4	0.6	0.8	1	1.2
0	0	492	193	86	49	31	22
0.2	0	495	194	86	49	31	22
0.4	0	502	196	88	49	32	22
0.6	0	514	201	90	51	33	23
0.8	0	532	208	93	52	34	24
1	0	554	217	97	55	35	25
0	0.2	394	154	69	39	25	18
0.2	0.2	396	155	69	39	25	18
0.4	0.2	404	158	71	40	26	18
0.6	0.2	417	163	73	41	27	19
0.8	0.2	435	170	76	43	28	19
1	0.2	458	179	80	45	29	20
0	0.4	296	116	52	29	19	13
0.2	0.4	298	117	52	30	19	13
0.4	0.4	307	120	54	30	20	14
0.6	0.4	321	126	56	32	21	14
0.8	0.4	341	134	60	34	22	15
1	0.4	367	144	64	36	24	17
0	0.6	197	77	35	20	13	9
0.2	0.6	201	79	35	20	13	9
0.4	0.6	211	83	37	21	14	10
0.6	0.6	227	89	40	23	15	10
0.8	0.6	251	98	44	25	16	12
1	0.6	281	110	49	28	18	13
0	0.8	99	39	18	10	7	5
0.2	0.8	103	41	18	11	7	5
0.4	0.8	115	45	20	12	8	6
0.6	0.8	135	53	24	14	9	7
0.8	0.8	164	64	29	17	11	8
1	0.8	200	79	35	20	13	10

Table S3. Calculated sample sizes for a 99% paired-pooled CI having an average fixed width of ω . See comments in Table S1. The n assumes a noncentral t distribution with known ρ . Simulations with these parameters for 99% using r instead of ρ required about 3 extra subjects.

δ	ρ	ω					
		0.25	0.4	0.6	0.8	1	1.2
0	0	850	332	148	83	54	37
0.2	0	854	334	149	84	54	38
0.4	0	867	339	151	85	55	38
0.6	0	888	347	155	87	56	39
0.8	0	918	359	160	90	58	40
1	0	956	374	166	94	60	42
0	0.2	680	266	118	67	43	30
0.2	0.2	684	268	119	67	43	30
0.4	0.2	698	273	122	69	44	31
0.6	0.2	720	281	125	71	45	32
0.8	0.2	751	294	131	74	47	33
1	0.2	790	309	138	78	50	35
0	0.4	510	200	89	50	32	23
0.2	0.4	515	201	90	51	33	23
0.4	0.4	530	207	92	52	34	24
0.6	0.4	554	217	97	55	35	25
0.8	0.4	589	230	103	58	37	26
1	0.4	633	248	111	62	40	28
0	0.6	340	133	59	34	22	15
0.2	0.6	346	135	60	34	22	16
0.4	0.6	363	142	64	36	23	16
0.6	0.6	392	154	69	39	25	18
0.8	0.6	433	169	76	43	28	19
1	0.6	485	190	85	48	31	22
0	0.8	170	67	30	17	11	8
0.2	0.8	177	70	31	18	12	8
0.4	0.8	198	78	35	20	13	9
0.6	0.8	233	92	41	23	15	11
0.8	0.8	282	111	50	28	18	13
1	0.8	ND	135	61	34	22	16

Documentation of the variability of the simulations with identical parameters.

Figure 9 illustrates the variability in coverage produced by 10 independent identical runs of 50,000 iterations. These were 95% paired-pooled noncentral t CIs using independent samples from $n = 10$ through 100. The mean M_M and standard deviation S_M of the 10 means were used to construct two-tailed 95% central t CIs ($M_M \pm (S_M)(t_{v=9})$) at each n for the observed CI (top and middle) and the fixed-width CI (bottom) at ω values of 0.4 and 0.8 with $\delta = 0.4$ and $\rho = .4$. The protocol [$\omega = 0.8$; $\delta = 0.4$; $\rho = .4$] in green is a multiple replication of the simulation plotted in Figure 3, row 3, for $\rho = .4$. The mean of the means is therefore based on 500,000 experiments. The scaling on the ordinate is the same as in Figure 3 (the bottom panel is stretched vertically with the same scaling to accommodate the new data for $\omega = 0.4$).

Most of the means from Figure 3, row 3 for $\delta = 0.4$ on the left for the observed CI, fall within these limits in Figure 9. These results cannot rule out differences according to δ and ρ with the observed CI, but if such differences exist (Cousineau & Goulet-Pelletier, 2021, Figure B7), they are small and within the bounds of normal variability of the present method. For example, I reran the simulations [$\omega = 0.8$; $\delta = 0.4$; $\rho = .0, .2, .4, .6, \text{ and } .8$] and [$\omega = 0.8$; $\delta = 0.0, 0.2, 0.4, 0.6, 0.8, 1.0$; $\rho = .4$] with 1,000,000 iterations to discover potential differences in the coverage of the observed CI attributable to ρ or δ with these specific parameters. With these tests at these parameters, the maximum difference in coverage of the observed CI between any two values of ρ was 0.0015 and the maximum difference between any two values of δ was 0.0013. Both are within the normal variability of the method with 50,000 iterations according to Figure 9.

This fixed-CI method was used to identify sample sizes for CIs in Tables S1 to S3. If we look up the recommended n for Figure 9 [$\omega = 0.8$; $\delta = 0.4$; $\rho = .4$] in Table S2, the calculated

value was 30 and the value for using r instead of ρ was $30 + 2 = 32$. In the independent simulations in Figure 9, the mean sample size determined from the 10 simulations for these parameters was 31 in 3 of 10 and 32 in 7 of 10 simulations for an average of $n = 31.7$. These sample size estimations are highly stable.

Figure 9. Illustration of the variability of independent samples with identical parameters and 50,000 iterations. Means and 95% central t CIs of coverages of 10 independent simulations of 95% paired-pooled noncentral t CIs with identical δ and ρ parameters with sample sizes varying from 10 to 100 with ω either 0.4 (dark red) or 0.8 (green). Compare to Figure 3 at the same scale.

