# Online Supplement 2

## Description of R Functions with Examples

*Instructions*: A single R function from the R Code file (in Online Supplement 1) can be copied and pasted at the > prompt. Type the name of the function with the required arguments in parentheses. If using R Studio, the entire R Code file can be copied into the command pane and converted to an R script file. After clicking the Source tab, all of the functions will be available at the > prompt.

### rep_mean2(alpha, m11, m12, sd11, sd12, n11, n12, m21, m22, sd21, sd22, n21, n22)

Computes confidence intervals for a 2-group mean difference in the original and follow-up studies, the difference in mean differences, and the average of the mean differences. Equal variances within and between studies is not assumed.

Arguments

```
alpha:  alpha level for 1-alpha confidence
m11:    sample mean for group 1 in original study
m12:    sample mean for group 2 in original study
m21:    sample mean for group 1 in follow-up study
m22:    sample mean for group 2 in follow-up study
sd11:   sample SD for group 1 in original study
sd12:   sample SD for group 2 in original study
sd21:   sample SD for group 1 in follow-up study
sd22:   sample SD for group 2 in follow-up study
n11:    sample size for group 1 in original study
n12:    sample size for group 2 in original study
n21:    sample size for group 1 in follow-up study
n22:    sample size for group 2 in follow-up study
```

Example

The original study used a 2-group design to compare the proactive behavior of junior (J) and senior (S) employees and was replicated in a follow-up study. The sample means and standard deviations are given below.

| Study | Group | Sample mean | Sample SD | Sample size |
|---|---|---|---|---|
| Original | J | 16.2 | 4.15 | 20 |
| | S | 10.5 | 3.94 | 20 |
| Follow-up | J | 14.8 | 5.02 | 50 |
| | S | 11.0 | 4.37 | 50 |

**rep_mean2(.05, 16.2, 10.5, 4.15, 3.94, 20, 20, 14.8, 11.0, 5.02, 4.37, 50, 50)**

```
            Estimate        SE       df        t            p        LL       UL
Original:       5.70 1.2795722 37.89799 4.454614 7.204765e-05  3.109413 8.290587
Follow-up:      3.80 0.9412470 96.17416 4.037197 1.086938e-04  1.931683 5.668317
Difference:     1.90 1.5884744 80.69691 1.196116 2.351539e-01 -1.260746 5.060746
Average:        4.75 0.7942372 80.69691 5.980581 5.799874e-08  3.169627 6.330373
```

## rep_mean_ps(alpha, m11, m12, sd11, sd12, cor1, n1, m21, m22, sd21, sd22, cor2, n2)

Computes confidence intervals for a paired-samples mean difference in original and follow-up studies, the difference in mean differences, and the average of the mean differences (equal variances within and between studies is not assumed).

Arguments

```
alpha: alpha level for 1-alpha confidence
m11:    sample mean for group 1 in original study
m12:    sample mean for group 2 in original study
m21:    sample mean for group 1 in follow-up study
m22:    sample mean for group 2 in follow-up study
sd11:   sample SD for group 1 in original study
sd12:   sample SD for group 2 in original study
sd21:   sample SD for group 1 in follow-up study
sd22:   sample SD for group 2 in follow-up study
n1:     sample size in original study
n2:     sample size in follow-up study
cor1:   sample correlation of paired observations in original study
cor2:   sample correlation of paired observations in follow-up study
```

Example

The original study used a (pre-post) paired-samples design to assess change in reported work-life balance before and 6 months after a workshop. The study was replicated in a similar organization. The sample means, standard deviations, and pre-post correlations are given below.

| Study | Condition | Sample mean | Sample SD | Sample correlation | Sample size |
|---|---|---|---|---|---|
| Original | Pre | 86.22 | 14.89 | .765 | 25 |
| | Post | 70.93 | 12.32 | | |
| Follow-up | Pre | 84.81 | 15.68 | .702 | 75 |
| | Post | 76.24 | 16.95 | | |

**rep_mean_ps(.05, 86.22, 70.93, 14.89, 12.32, .765, 20, 84.81, 77.24, 15.68, 16.95, .702, 75)**

```
            Estimate       SE        t       df            p        LL       UL
Original:      15.29 2.154344 7.097288 19.00000 9.457592e-07 10.780906 19.79909
Follow-up:      7.57 1.460664 5.182575 74.00000 1.831197e-06  4.659564 10.48044
Difference:     7.72 2.602832 2.966000 38.40002 5.166213e-03  2.452643 12.98736
Average:       11.43 1.301416 8.782740 38.40002 1.010232e-10  8.796322 14.06368
```

### rep_stdmean2(alpha, m11, m12, sd11, sd12, n11, n12, m21, m22, sd21, sd22, n21, n22)

Computes confidence intervals for a 2-group standardized mean difference in original and follow-up studies, the difference in standardized mean differences, and the average of standardized mean differences (equal variances within and between studies is not assumed).

Arguments

```
alpha: alpha level for 1-alpha confidence
m11:    sample mean for group 1 in original study
m12:    sample mean for group 2 in original study
m21:    sample mean for group 1 in follow-up study
m22:    sample mean for group 2 in follow-up study
sd11:   sample SD for group 1 in original study
sd12:   sample SD for group 2 in original study
sd21:   sample SD for group 1 in follow-up study
sd22:   sample SD for group 2 in follow-up study
n11:    sample size for group 1 in original study
n12:    sample size for group 2 in original study
n21:    sample size for group 1 in follow-up study
n22:    sample size for group 2 in follow-up study
```

Example

The original study used a 2-group design to compare the team innovation behavior of introverted (I) and extroverted (E) employees and was replicated in a follow-up study. The sample means and standard deviations are given below.

| Study | Group | Sample mean | Sample SD | Sample size |
|---|---|---|---|---|
| Original | I | 21.2 | 5.15 | 40 |
| | E | 15.5 | 4.94 | 40 |
| Follow-up | I | 19.8 | 6.02 | 80 |
| | E | 16.0 | 5.37 | 80 |

**rep_stdmean2(.05, 21.2, 15.5, 5.15, 4.94, 40, 40, 19.8, 16.0, 6.02, 5.37, 80, 80)**

```
             Estimate        SE         LL        UL
Original:   1.1295869 0.2438760  0.6515988 1.6075750
Follow-up:  0.6661681 0.1635206  0.3456735 0.9866627
Difference: 0.4634188 0.2936230 -0.1120718 1.0389094
Average:    0.8908457 0.1468115  0.6031004 1.1785910
```

## rep_stdmean_ps(alpha, m11, m12, sd11, sd12, cor1, n1, m21, m22, sd21, sd22, cor2, n2)

Computes confidence intervals for a paired-samples standardized mean difference in original and follow-up studies, the difference in standardized mean differences, and the average of standardized mean differences (equal variances within and between studies is not assumed).

Arguments

```
alpha: alpha level for 1-alpha confidence
m11:    sample mean for group 1 in original study
m12:    sample mean for group 2 in original study
m21:    sample mean for group 1 in follow-up study
m22:    sample mean for group 2 in follow-up study
sd11:   sample SD for group 1 in original study
sd12:   sample SD for group 2 in original study
sd21:   sample SD for group 1 in follow-up study
sd22:   sample SD for group 2 in follow-up study
n1:     sample size in original study
n2:     sample size in follow-up study
cor1:   sample correlation of paired observations in original study
cor2:   sample correlation of paired observations in follow-up study
```

Example

The original study used a longitudinal paired-samples design to assess a 1-year change in mean burnout of service workers. The study was replicated in a similar organization. The sample means, standard deviations, and pre-post correlations are given below.

| Study | Condition | Sample mean | Sample SD | Sample correlation | Sample size |
|---|---|---|---|---|---|
| Original | Pre | 86.22 | 14.89 | .765 | 25 |
| | Post | 70.93 | 12.32 | | |
| Follow-up | Pre | 84.81 | 15.68 | .702 | 75 |
| | Post | 76.24 | 16.95 | | |

**rep_stdmean_ps(.05, 86.22, 70.93, 14.89, 12.32, .765, 20, 84.81, 77.24, 15.68, 16.95, .702, 75)**

```
             Estimate         SE        LL        UL
Orginal:    1.1188719 0.22915553 0.6697353 1.5680085
Follow-up:  0.4636392 0.09590506 0.2756687 0.6516096
Difference: 0.6552328 0.24841505 0.1683482 1.1421173
Average:    0.7747629 0.12420752 0.5313206 1.0182052
```

## rep_cor(alpha, cor1, cor2, n1, n2, s)

Computes a confidence interval for a Pearson correlation or partial correlation in original and follow-up studies, the difference in correlations, and the average of correlations.

Arguments

```
alpha: alpha value for 1-alpha confidence
cor1:  sample Pearson correlation between y and x in original study
cor2:  sample Pearson correlation between y and x in follow-up study
n1:    sample size in original study
n2:    sample size in follow-up study
s:     number of control variables in each study
```

Example

The original study estimated a Pearson correlation between job security and positive affect in a sample of tech-industry employees ($r$ = .438, $n_1$ = 100). The study was replicated in a similar company ($r$ = .360, $n_2$ = 300).

**rep_cor(.05, .438, .360, 100, 300, 0)**

```
            Estimate         SE         z            p         LL        UL
Original:      0.438 0.10153462 4.8232475 5.179657e-06  0.2643218 0.5841620
Follow-up:     0.360 0.05802589 6.6611803 1.309317e-10  0.2572462 0.4547041
Difference:    0.078 0.09635344 0.7941078 4.271327e-01 -0.1198206 0.2566663
Average:       0.399 0.04817672 7.2395968 4.500844e-13  0.3090387 0.4818845
```

Note

The test statistics (in column labeled z) are t-statistics for the individual studies and are z-statistics for the difference and average.

## rep_general(alpha, est1, se1, est2, se2)

Computes approximate confidence intervals for a general effect size parameter for original and follow-up studies, the difference across studies, and the average across studies.

Arguments

```
Arguments:
alpha:  alpha level for 1-alpha confidence
est1:   estimate from original study
se1:    standard error of estimate from original study
est2:   estimate from follow-up study
se2:    standard error of estimate from follow-up study
```

Example

A standardized estimate of the indirect effect of 6-month change in initiative on 6-month change in emotional engagement (mediated by 6-month change in mood) was 0.652 with a standard error of 0.214. The estimate of this indirect effect was .748 with a standard error of 0.106 in a follow-up study.

**rep_general(.05, .652, .214, .748, .106)**

```
            Estimate        SE          z            p         LL        UL
Original:      0.652 0.2140000  3.0467290 2.313462e-03  0.2325677 1.0714323
Follow-up:     0.748 0.1060000  7.0566038 1.706191e-12  0.5402438 0.9557562
Difference:   -0.096 0.2388137 -0.4019869 6.876936e-01 -0.5640663 0.3720663
Average:       0.700 0.1194069  5.8623094 4.564735e-09  0.4659668 0.9340332
```

Note

This function can be used for any effect-size parameter for which large-sample approximate confidence intervals are typically computed (e.g., SEM path coefficient, SEM indirect effect, factor correlation, factor loading, log-odds ratio, nominal and ordinal measures of association, measures of agreement, slope coefficient in multilevel model).

### ci_mean_lc(alpha, m, sd, n, c)

Computes confidence interval and test statistic for a linear contrast of population means in k independent samples (equal variances is not assumed).

Arguments

```
alpha: alpha level for 1-alpha confidence
m:     kx1 vector of sample means
sd:    kx1 vector of sample standard deviations
n:     kx1 vector of sample sizes
c:     kx1 vector of contrast coefficients
```

Example

A 2x2 (gender by training method) between-subjects factorial design was used in an original study and was replicated in a follow-up study. The sample means and standard deviations are given below.

| Study | Condition | Sample mean | Sample SD | Sample size |
|---|---|---|---|---|
| Original | M-T1 | 22.41 | 5.57 | 20 |
| | F-T1 | 24.32 | 5.46 | 20 |
| | M-T2 | 17.47 | 5.06 | 20 |
| | F-T2 | 18.94 | 4.80 | 20 |
| Follow-up | M-T1 | 21.88 | 6.10 | 40 |
| | F-T1 | 23.10 | 5.17 | 40 |
| | M-T2 | 20.13 | 5.89 | 40 |
| | F-T2 | 19.97 | 5.25 | 40 |

```
m = c(22.41, 24.32, 17.47, 18.94, 21.88, 23.10, 20.13, 19.97)
sd = c(5.57, 5.46, 5.06, 4.80, 6.10, 5.17, 5.89, 5.25)
n = c(20, 20, 20, 20, 40, 40, 40, 40)
c = c(.5, .5, -.5, -.5, 0, 0, 0, 0)         # main effect of training in original study
ci_mean_lc(.05, m, sd, n, c)

     Estimate      SE        t       df      p-value       LL       UL
[1,]     5.16 1.16983 4.410899 74.96949 3.391107e-05 2.829564 7.490436


c = c(0, 0, 0, 0, .5, .5, -.5, -.5)         # main effect of training in follow-up study
ci_mean_lc(.05, m, sd, n, c)

     Estimate        SE       t       df     p-value        LL       UL
[1,]     2.44 0.8880931 2.74746 152.8874 0.006728163 0.6854816 4.194518


c = c(.5, .5, -.5, -.5, -.5, -.5, .5, .5)   # difference in training main effect between studies
ci_mean_lc(.05, m, sd, n, c)

     Estimate       SE        t       df    p-value         LL       UL
[1,]     2.72 1.468745 1.851922 160.1939 0.06587761 -0.1805992 5.620599
```

### ci_odds(alpha, p1, p2, n1, n2)

Computes adjusted Wald confidence interval for a population log-odds ratio and a population odds ratio.

Arguments

```
alpha:  alpha level for 1-alpha confidence
p1:     sample proportion in group 1
p2:     sample proportion in group 2
n1:     group 1 sample size
n2:     group 2 sample size
```

Example

The proportion of employees who indicate they are looking for another job was estimated in a 2-group (service vs manufacturing) design. The study was replicated in a similar organization. The sample proportions are given below.

| Study | Group | Sample proportion | Sample size |
|---|---|---|---|
| Original | S | .212 | 200 |
| | M | .143 | 150 |
| Follow-up | S | .235 | 300 |
| | M | .101 | 300 |

**ci_odds(.05, .212, .143, 200, 150)**

```
                 Estimate        SE          LL       UL
Log-odds Ratio: 0.4670769 0.2879968 -0.09738648 1.031540
Odds Ratio:     1.5953240 0.4594482  0.90720532 2.805383
```

**ci_odds(.05, .235, .101, 300, 300)**

```
                 Estimate        SE       LL       UL
Log-odds Ratio: 0.9962483 0.2336682 0.538267 1.454230
Odds Ratio:     2.7081028 0.6327975 1.713036 4.281184
```

**rep_general(.05, .467, .288, .996, .2337)**

```
            Estimate        SE         z            p          LL        UL
Original:     0.4670 0.2880000  1.621528 1.049045e-01 -0.09746963 1.0314696
Follow-up:    0.9960 0.2337000  4.261874 2.027196e-05  0.53795642 1.4540436
Difference:  -0.5290 0.3708904 -1.426297 1.537825e-01 -1.25593183 0.1979318
Average:      0.7315 0.1854452  3.944562 7.994613e-05  0.36803409 1.0949659
```

Note

The results from the ci_odds function can be used in the rep_general function as illustrated above. When analyzing log-odds ratios using the rep_general function, the estimate and confidence interval for the Average can be exponentiated to give an estimate of the average population odds ratio and its confidence interval.

### ci_prop_lc(alpha, p, n, c)

Computes adjusted Wald confidence interval for a linear contrast of population proportions in k independent samples.

Arguments

alpha: alpha level for 1-alpha confidence
p: kx1 vector of sample proportions
n: kx1 vector of sample sizes
c: kx1 vector of contrast coefficients

Example

The proportion of male and female employees who report a positive work environment were estimated in a 2-group design. The study was replicated in a similar organization. The sample proportions are given below.

| Study | Group | Sample proportion | Sample size |
|---|---|---|---|
| Original | M | .622 | 100 |
| | F | .451 | 105 |
| Follow-up | M | .683 | 250 |
| | F | .501 | 250 |

```
p = c(.622, .451, .683, .501)
n = c(100, 105, 250, 250)
c = c(1, -1, 0, 0)                              # gender difference in original study
ci_prop_lc(.05, p, n, c)

     Estimate         SE         LL        UL
[1,]    0.171 0.06801151 0.03439185 0.3009921


c = c(0, 0, 1, -1)                              # gender difference in follow-up study
ci_prop_lc(.05, p, n, c)

     Estimate         SE         LL        UL
[1,]    0.182 0.04305033 0.09617845 0.2649327


c = c(1, -1, -1, 1)                             # difference in gender difference between studies
ci_prop_lc(.05, p, n, c)

     Estimate        SE         LL        UL
[1,]   -0.011 0.0807881 -0.1702868 0.1463967
```

## ci_general_lc(alpha, est, se, c)

Computes Wald confidence interval for a linear contrast of population parameters (general) in k independent samples.

Arguments

```
alpha:  alpha level for 1-alpha confidence
est:    kx1 vector of sample parameter estimates
se:     kx1 vector of standard errors
c:      kx1 vector of contrast coefficients
```

Example

Means on a leadership questionnaire were estimated in a 2x2 mixed design. The between-subject factor levels were Supervisor (S) and Manager (M), and the within-subject factor levels were two vignettes of two hypothetical supervisors. The study was replicated in a similar organization. The estimated mean differences of the within-subjects factor for each between-subject factor are given below.

| Study | Between-subjects condition | Estimate of within-subjects difference | Standard error |
|---|---|---|---|
| Original | S | 19.43 | 3.55 |
| | M | 10.26 | 3.89 |
| Follow-up | S | 16.68 | 1.32 |
| | M | 9.02 | 1.86 |

```
est = c(19.43, 10.26, 16.68, 9.02)
se = c(3.55, 3.89, 1.32, 1.86)
c = c(.5, -.5, .5, -.5)              # average two-way interaction effect
ci_general_lc(.05, est, se, c)

     Estimate       SE        z     p-value       LL       UL
[1,]    8.415 2.869521 2.932545 0.003361958 2.790842 14.03916


c = c(.5, 0, .5, 0)                  # average simple main effect of Vignette at Supervisor
ci_general_lc(.05, est, se, c)

     Estimate       SE        z p-value       LL       UL
[1,]   18.055 1.893733 9.534079       0 14.34335 21.76665

c = c(0, .5, 0, .5)                  # average simple main effect of Vignette at Manager
ci_general_lc(.05, est, se, c)

     Estimate       SE        z     p-value       LL      UL
[1,]     9.64 2.155905 4.471441 7.76944e-06 5.414504 13.8655
```

Note

This function should be used only with sample sizes that are large enough for the sampling distribution of each parameter to have an approximate normal distribution.

## size_ci_mean_lc(alpha, var, w, c)

Computes the sample size per group required to estimate a linear contrast of population means with desired precision in a k-group follow-up study.

Arguments

```
alpha: alpha level for 1-alpha confidence
var:   planning value of average within-group variance
w:     desired confidence interval width in follow-up study
c:     kx1 vector of contrast coefficients
```

Example

The original study estimated the mean innovation in two groups and the average within-group variance was 5.67. A 95% interval for a difference in population means is planned in a follow-up study, and the desired width of the confidence interval is 1.0. The required sample size per group in the follow-up study is 176.

```
c = c(1, -1)
size_ci_mean_lc(.05, 5.67, 1.0, c)

    [,1]
[1,]   176
```

Note

A linear contrast can specify a difference (as in the above example) as well as a main effect, interaction effect, or simple main effect in a factorial design.

### size_ci_stdmean2(alpha, d, w, r)

Computes the sample size per group required to estimate a population standardized mean difference with desired precision in a 2-group follow-up study.

Arguments

alpha: alpha level for 1-alpha confidence
d: planning value of standardized mean difference
w: desired confidence interval width in follow-up study
r: desired n2/n1 ratio

Example

The original study estimated the mean innovation in two groups and the standardized mean difference was 0.48. A 95% interval for a difference in standardized population means is planned in a follow-up study (with equal sample sizes per group), and the desired width of the confidence interval is 0.4. The required sample size per group in the follow-up study is 198.

```
size_ci_stdmean2(.05, .48, .4, 1)

[1] 198
```

### size_ci_stdmean_ps(alpha, d, cor, w)

Computes the sample size required to estimate a population standardized mean difference with desired precision in a paired-samples follow-up study.

Arguments

alpha: alpha level for 1-alpha confidence
d: planning value of standardized mean difference
cor: planning value of correlation
w: desired confidence interval width in follow-up study

Example

A 95% interval for a standardized difference in population means is planned in a pretest-posttest study of change in negative affect after a change in job assignment. The desired width of the confidence interval is .3. The standardized mean difference in the original study was .752. The correlation between the paired observations in the original study was .811. The required sample size in the follow-up study is 105.

```
size_ci_stdmean_ps(.05, .752, .811, .3)

[1] 105
```

### size_ci_prop_lc(alpha, p, w, c)

Computes the sample size per group required to estimate a linear contrast of population proportions with desired precision in a k-group follow-up study.

Arguments

alpha: alpha level for 1-alpha confidence
p: kx1 vector of proportion planning values
w: desired confidence interval width in follow-up study
c: kx1 vector of contrast coefficients

Example

A 95% interval for a difference in population proportion of employees receiving more than a 3% raise is planned in a follow-up 2-group (service department vs marketing department) study. The desired width of the confidence interval is .2. The proportions in the original study were .251 and .425. The required sample size per group in the follow-up study is 167.

```
p = c(.251, .425)
c = c(1, -1)
size_ci_prop_lc(.05, p, .2, c)
```

```
    [,1]
[1,]  167
```

Note

Each proportion from the original study could be set to .5 to give a conservatively large sample size requirement.

### size_ci_cor(alpha, cor, w, s)

Computes the sample size required to estimate a Pearson correlation or a partial correlation with desired precision.

Arguments

alpha: alpha value for 1-alpha confidence
cor: planning value of correlation
w: desired confidence interval width in follow-up study
s: number of control variables

Example

A 95% interval for a Pearson correlation between punitive supervision and burnout is planned in a follow-up study. The desired width of the confidence interval is .2. The Pearson correlation in the original study was .425. The required sample size in the follow-up study is 260.

```
size_ci_cor(.05, .425, .2, 0)
```

```
[1] 260
```

Note

Instead of using the sample correlation value from the original study, a lower 1-sided 80% confidence limit computed from the original study could be used as the correlation planning value to obtain a conservatively large sample size.

### size_ci_slope(alpha, n1, se1, w)

Computes sample size required to estimate a slope coefficient (for any type of statistical model) with desired precision in a follow-up study.

Arguments

```
alpha: alpha value for 1-alpha confidence
n1:    sample size in original study
se1:   standard error for slope in original study
w:     desired confidence interval width in follow-up study
```

Example

The original study used a sample size of 100 to estimate the slope coefficient for proactive behavior in a multiple regression model with anxiety as the response variable and punitive supervision as a control variable. The standard error for the proactive behavior slope was 1.025. The desired width of the confidence interval for the proactive behavior slope in the follow-up study is 2.5. The required sample size in the follow-up study is 259.

**size_ci_slope(.05, 100, 1.025, 2.5)**

```
[1] 259
```

Note

This formula can be used for any type of statistical model (linear regression, logistic, ordinal logistic, multilevel, SEM, etc.)

### size_test_mean_lc(alpha, var, pow, es, c)

Computes the sample size per group required to perform a directional two-sided test of a linear contrast of population means with desired power in a k-group follow-up study (to test directional replication or non-replication).

<u>Arguments</u>

```
alpha: alpha level for test
var:   planning value of average within-group variance
pow:   desired power of test in follow-up study
es:    planning value of linear contrast of means (effect size)
c:     kx1 vector of contrast coefficients
```

<u>Example</u>

A directional test of a main effect of one factor in a 2x2 factorial design (gender by training method) is planned in a follow-up study. The desired power of the test is .95 and an alpha level of .05 will be used. The average within-group variance in the original study was 5.67. A population main effect of .7 is believed to be the smallest value that would have any practical or scientific value. The required sample size per group in the follow-up study is 151.

```
c = c(.5, .5, -.5, -.5)
size_test_mean_lc(.05, 5.67, .95, .7, c)

    [,1]
[1,]   151
```

<u>Note</u>

Using a minimally interesting effect size could require a very large sample size. The effect size could also be set to the anticipated effect size in the follow-up study rather than a minimally interesting effect size.

### size_test_prop_lc(alpha, p, pow, es, c)

Computes sample size per group required to perform a directional two-sided test of a linear contrast of proportions with desired power in a k-group follow-up study (for test of directional replication or non-replication).

Arguments

```
alpha:  alpha level for 1-alpha confidence
p:      kx1 vector of proportion planning values
pow:    desired power of test in follow-up study
es:     effect size
c:      kx1 vector of contrast coefficients
```

Example

A test of equal population proportions is planned in a follow-up 2-group (service department vs marketing department) study. The response variable is dichotomous (receive or not receive more than a 3% raise). The desired power of the test is .90 and an alpha level of .05 will be used. The proportions in the original study were .251 and .425. A .1 difference in population proportions is believed to be the smallest difference that would have any practical or scientific value. The required sample size per group in the follow-up study is 455.

```
p = c(.251, .425)
c = c(1, -1)
size_test_prop_lc(.05, p, .9, .1, c)

     [,1]
[1,]  455
```

Note

Using a minimally interesting effect size could require a very large sample size. The effect size could also be set to the anticipated effect size in the follow-up study rather than a minimally interesting effect size

### size_test_cor(alpha, cor, b, pow, s)

Computes sample size required to perform a directional two-sided test of a Pearson correlation or partial correlation with desired power in a follow-up study (for test of directional replication or non-replication).

Arguments

```
alpha: alpha value for test
cor:   planning value of correlation
b:     hypothesized value of correlation
pow:   desired power of test in follow-up study
s:     number of control variables
```

Example

A test of a population Pearson correlation equal to 0 is planned in a follow-up study. The desired power of the test is .90 and an alpha level of .05 will be used. A correlation of .2 is believed to be the smallest value that would have any practical or scientific value. The required sample size in the follow-up study is 259.

**size_test_cor(.05, .2, 0, .90, 0)**

```
[1] 259
```

### size_ci_diff(alpha, n1, se1, w)

Computes sample size in the follow-up study required to estimate the difference in original and follow-up parameters with desired precision.

Arguments

```
alpha: alpha value for 1-alpha confidence
n1:    sample size in original study
se1:   standard error in original study
w:     desired confidence interval width for difference in original
       and follow-up parameters (must be greater than the CI width
       in the original study)
```

Example

A confidence interval for the difference in an SEM slope coefficient (IV = individual job performance and DV = team innovation) between the original and follow-up studies is planned. The 95% confidence interval width in the original study was 12.82. The sample size in the original study was 150 and the standard error of the slope was 3.27. The desired 95% confidence interval width for the difference in population slopes is 15.0.

**size_ci_diff(.05, 150, 3.27, 15.0)**

```
[1] 407
```

Note

The desired CI width for the difference must be greater than the CI width in the original study for a given alpha level. With alpha = .05, the CI width in the original study will be about 4 times the value of se1 and w should be set to a number greater than this value.