



**Note:** Overlap in the CI's of the top panel will reflect CI's for Cohen's d, in the bottom panel, that include zero. Exceeding the statistical significance threshold for an observed p-value ( $P_{obs} < .05$ ) occurs when the top panel CI's do not overlap and the bottom panel Cohen's d CI's do not include zero. See below for R script that produces these plots.

```

# Page 1

# Independent groups "inferential confidence intervals" and
# "Cohen's d" confidence intervals
#
# References:
#
# 1) "Evaluating statistical difference, equivalence,
# and indeterminacy using inferential confidence intervals,
# an integrated alternative method of conducting
# null hypothesis statistical tests" (Tyron, W., 2001,
# Psychological Methods, Dec. Vol. 6(4):371-86 -
# http://www.unt.edu/rss/tryonICI.pdf )
#
# 2) "A primer on the understanding, use, and calculation of confidence
# intervals that are based on central and noncentral distributions"
# (Cumming, G. & Finch, S, 2001, Educational and
# Psychological Measurement, 61, 532-574 -
# http://www.unt.edu/rss/PrimerOnUseOfNoncentralIntervals.pdf )
#

# Create simulated data set with 2 independent groups
# and 4 outcome variables (DVs); 10 obs per group

# Sample sizes

n1<-10
n2<-10

# Standard Deviations per group for four outcome variables(depvars)

stdevAdepVar1<-2
stdevAdepVar2<-2
stdevAdepVar3<-2
stdevAdepVar4<-2

stdevBdepVar1<-2
stdevBdepVar2<-2
stdevBdepVar3<-2
stdevBdepVar4<-2

# Means per group for three depvars

meanAdepVar1<-10
meanAdepVar2<-7
meanAdepVar3<-8
meanAdepVar4<-4

meanBdepVar1<-12
meanBdepVar2<-9
meanBdepVar3<-11
meanBdepVar4<-5

# Grouping indicator (group1 -> "a" group2 -> "b")

group<-c(rep("a",n1), rep("b", n2))

# Simulate dep vars for groups: e.g. mean (meanAdepVar) with error
# added (stdevAdepVar)

depVar1<-c(meanAdepVar1 + rnorm(n1, 0, stdevAdepVar1),
           meanBdepVar1 + rnorm(n2, 0, stdevBdepVar1))

depVar2<-c(meanAdepVar2 + rnorm(n1, 0, stdevAdepVar2),
           meanBdepVar2 + rnorm(n2, 0, stdevBdepVar2))

depVar3<-c(meanAdepVar3 + rnorm(n1, 0, stdevAdepVar3),
           meanBdepVar3 + rnorm(n2, 0, stdevBdepVar3))

depVar4<-c(meanAdepVar4 + rnorm(n1, 0, stdevAdepVar4),
           meanBdepVar4 + rnorm(n2, 0, stdevBdepVar4))

```

```

# Page 2

# high and low endpoints on y-axis for inferential CI's
low.ici<-3
high.ici<-15

# high and low endpoints on y-axis for Cohen d CI's
low.cohen.d<-(-1)
high.cohen.d<-(4)

Dataset<-data.frame(group, cbind(depVar1, depVar2, depVar3, depVar4))
Dataset

attach(Dataset)
Dataset

data2<-split(Dataset, group)

data2A<-data.frame(data2$a)
data2B<-data.frame(data2$b)

dvsA<-(data2A[,2:5])
dvsB<-(data2B[,2:5])

dvsA
dvsB

# Noting means, stdev, and n of the two groups

meansA<-mean(dvsA)
meansB<-mean(dvsB)

meansA
meansB

sdA<-sd(dvsA)
sdB<-sd(dvsB)

sdA
sdB

# Calculating the std errors to be used in the reduction term

sderrA<-sdA/sqrt(n1)
sderrB<-sdB/sqrt(n2)

# Calculating the reduction term and the reduced t-critical
# value, and finally the margin of error

redterm<-sqrt(sderrA^2 +sderrB^2)/(sderrA+sderrB)
tred<-1.96*redterm

margerrA<-tred*sderrA
margerrB<-tred*sderrB

# "plotCI" is a function from package "gplots"
# Note: xaxt="n" is actually from the "par"
# function, and suppress x-axis labeling

library(gplots)

# Create X-axis labels

OutcomeVariableNames<-c("v1", "v2", "v3", "v4")
xlabel<- "Outcome Variables"

par(mfrow=c(2,1))

plotCI(meansA, uiw=margerrA, col="black", gap=0, type="p", barcol="red",
       xaxt="n", xlim=c(1,4), ylim=c(low.ici,high.ici), xlab=xlabel,
       ylab="Group Mean 95% Inferential CI's")

```

```

# Page 3
axis(1, 1:4, OutcomeVariableNames)

# Cohen's d interval plots

# Cohen's ds, upper and lower limits obtained from smd function in MBESS package
library(MBESS)

depVarIndex<-1

smdDepVar1<- smd(Mean.2=meansA[depVarIndex], Mean.1=meansB[depVarIndex],
                 s.2=sdA[depVarIndex], s.1=sdB[depVarIndex], n.1=n1, n.2=n2)

dv1.ci<-ci.smd(smd=smdDepVar1, n.1=n1, n.2=n2, conf.level=1-.05)

depVarIndex<-2
smdDepVar2<- smd(Mean.2=meansA[depVarIndex], Mean.1=meansB[depVarIndex],
                 s.2=sdA[depVarIndex], s.1=sdB[depVarIndex], n.1=n1, n.2=n2)

dv2.ci<-ci.smd(smd=smdDepVar2, n.1=n1, n.2=n2, conf.level=1-.05)

depVarIndex<-3
smdDepVar3<- smd(Mean.2=meansA[depVarIndex], Mean.1=meansB[depVarIndex],
                 s.2=sdA[depVarIndex], s.1=sdB[depVarIndex], n.1=n1, n.2=n2)

dv3.ci<-ci.smd(smd=smdDepVar3, n.1=n1, n.2=n2, conf.level=1-.05)

depVarIndex<-4
smdDepVar4<- smd(Mean.2=meansA[depVarIndex], Mean.1=meansB[depVarIndex],
                 s.2=sdA[depVarIndex], s.1=sdB[depVarIndex], n.1=n1, n.2=n2)

dv4.ci<-ci.smd(smd=smdDepVar4, n.1=n1, n.2=n2, conf.level=1-.05)

Cohen.d<-c(dv1.ci$smd, dv2.ci$smd, dv3.ci$smd, dv4.ci$smd)

dlow<-c(dv1.ci$Lower.Conf.Limit.smd, dv2.ci$Lower.Conf.Limit.smd,
        dv3.ci$Lower.Conf.Limit.smd, dv4.ci$Lower.Conf.Limit.smd)

dupp<-c(dv1.ci$Upper.Conf.Limit.smd, dv2.ci$Upper.Conf.Limit.smd,
        dv3.ci$Upper.Conf.Limit.smd, dv4.ci$Upper.Conf.Limit.smd)

# Cohen's d interval plots
library(gplots)

# Create X-axis labels
OutcomeVariableNames<-c("v1", "v2", "v3", "v4")
xlabel<- "Outcome Variables"

plotCI(Cohen.d, ui=dupp, li=dlow, col="black",
       barcol="red", xaxt="n", xlim=c(1,4),
       ylim=c(low.cohen.d,high.cohen.d), xlab=xlabel, ylab="Cohen's d 95% CI's")

axis(1, 1:4, OutcomeVariableNames)

abline(h=0, lty=2)

```