SPlus and R Noncentral Chi-Square, F, and t Confidence Interval Estimation Scripts

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The files to which this documentation refers are SPlus script files:
Chiscript.SSC
Fscript.SSC
Nonct.SSC
Rknonct.SSC
All of these scripts use simple iterative routines to determine lower and upper limits on confidence intervals for the noncentrality parameters of the noncentral chi-square, F, and t distributions respectively. They also provide power analysis in the form of the smallest noncentrality parameter value that can be detected with a given power-level, given the appropriate degrees of freedom and significance-level.

Chiscript.SSC

The lower and upper confidence interval (CI) limits on the noncentrality parameter (ncp) for the noncentral chi-square distribution are computed by the functions "lochi" and hichi" respectively. Both functions take 3 arguments: observed chi-square value, degrees of freedom (df), and confidence level. The output provides the CI limit for the ncp and the area under the tail associated with it.

Example: $\chi^2(2) = 7.5$, confidence level = .95, two-sided CI:

```
> lochi(7.5,2,.95)
[1] 0.03349255 0.97499458
> hichi(7.5,2,.95)
[1] 20.76049805  0.02500663
```

If a one-sided CI is desired, then the confidence level argument for lof must be $1 - 2\alpha$ rather than $1 - \alpha$.
Example: $\chi^2(2) = 7.5$, confidence level = .95, one-sided CI:

```
> lochi(7.5,2,.90)
[1] 0.5396442 0.949998
```

The smallest noncentrality parameter value that can be detected with a given power-level, given the appropriate degrees of freedom and significance-level, is computed by "powchi" which takes df, alpha, and power level as its arguments. The output provides the ncp and beta (i.e., 1 – power).

Example: $\chi^2(2)$, alpha = .05, power = .85:

```
> powchi(2,.05,.85)
[1] 10.9231595  0.1500014
```

Fscript.SSC

The lower and upper confidence interval (CI) limits on the noncentrality parameter (ncp) for the noncentral F distribution are computed by the functions "lof" and hif" respectively. Both functions take 4 arguments: observed F-ratio, df1 (numerator), df2 (denominator), and confidence level. The output provides the CI limit for the ncp and the area under the tail associated with it.

Example: F(4, 75) = 3.5, confidence level = .95, two-sided CI:

```
> lof(3.5,4,75,.95)
[1] 0.7781436 0.9750039
> hif(3.5,4,75,.95)
[1] 29.72949219  0.02499965
```

If a one-sided CI is desired, then the confidence level argument for lof must be $1 - 2\alpha$ rather than $1 - \alpha$.

Example: F(4, 75) = 3.5, confidence level = .95, one-sided CI:

```
> lof(3.5,4,75,.90)
[1] 1.785889 0.950003
```

The smallest noncentrality parameter value that can be detected with a given power-level, given the appropriate degrees of freedom and significance-level, is computed by "powf" which takes df1, df2, alpha, and power level as its arguments. The output provides the ncp and beta (i.e., 1 – power).

Example: F(4, 75), alpha = .05, desired power = .85:

```
> powf(4,75,.05,.85)
[1] 14.2973528  0.1499988
```

Nonct.SSC and Rknonct.SSC

SPlus doesn't have a noncentral t cumulative distribution function calculator, although R does. Fortunately, a good one for SPlus is provided at
http://www2.active.ch/~krause.a/doc/statistics-in-pharma/code/bock2/index.html
and it is included in both of these scripts.

In Nonct.SSC, the lower and upper confidence interval (CI) limits on the noncentrality parameter (ncp) for the noncentral t distribution are computed by the functions "lot" and hit" respectively. Both functions take 4 arguments: observed t-statistic, df, and confidence level. The output provides the CI limit for the ncp and the area under the tail associated with it.

Example: t(98) = 1.5, confidence level = .95, two-sided CI:

```
> lot(1.5,98,.95)
[1] -0.4749756  0.9750024
> hit(1.5,98,.95)
[1] 3.467285 0.025005
```

The smallest noncentrality parameter value that can be detected with a given power-level, given the appropriate degrees of freedom and significance-level, is computed by "powt" which takes df, alpha, and power level as its arguments. The output provides the ncp and beta (i.e., 1 – power).

Example: t(98), alpha = .05, power = .85:

```
> powt(98,.05,.85)
[1] 2.7000174 0.1499964
```

Note that while the lot function will accurately report a negative lower limit, it does not handle a negative observed t-statistic. There are at least two ways to do this. One is to use the absolute value of the observed t and, for a negative t, reverse the order and sign of the lower and upper limits. Another is to use Rknonct.SSC, SPlus code adapted from Nonct.SSC by Joe

Rausch & Ken Kelley, University of Notre Dame, (JRausch@nd.edu & KKelley@nd.edu). Rknonct.SSC outputs lower and upper CI limits for the ncp via the conf.limits.nct function, which will handle either a positive or negative observed t.

Example: t(98) = 1.5, confidence level = .95, two-sided CI:

```
> conf.limits.nct(1.5,98,.95)
       Lower.Limit Prob.Low.Limit Upper.Limit Prob.Up.Limit
Values   -0.474934          0.975    3.467371    0.02499999
```

Example: t(98) = -1.5, confidence level = .95, two-sided CI:

```
> conf.limits.nct(-1.5,98,.95)
       Lower.Limit Prob.Low.Limit Upper.Limit Prob.Up.Limit
Values   -3.467371          0.975    0.474934    0.02499999
```