

This page explains how to compute limits using the method described in *Limits and Confidence Intervals in the Presence of Nuisance Parameters*.using the Fortran routines provided.

There are 5 files needed:

RLClimits.for is the main program

pmle.for finds limits using the unbounded likelihood method

f0pmle.for finds limits using the bounded likelihood method

fun.for calculates the profile likelihood function for the various models

qnorm.for calculates the quantiles of a normal distribution.

Currently our method can handle 7 different situations:

model=1: Background - Poisson, Efficiency - Binomial

model=2: Background - Poisson, Efficiency - Gaussian

model=3: Background - Gaussian, Efficiency - Gaussian

model=4: Background - Poisson, Efficiency - known

model=5: Background - Gaussian, Efficiency - known

model=6: Background - known, Efficiency - Binomial

model=7: Background - known, Efficiency - Gaussian

To calculate limits you have to make an ASCII file called setup.dat with the following format:

```
model method
cl x y z tau m
```

where (if model=1)

model is as describe above

method is 1 for bounded likelihood, 2 for unbounded likelihood

cl is the desired confidence level for the limits (for example 0.9 for 90% limits)

x is the number of events in the signal region

y is the number of events in the background region

z is the number of events in the Monte Carlo that survive the cuts (for estimation of the efficiency)

tau is the relative size of the background region to the signal region (so that y/tau is the estimated number of background events in the signal region.

m is the number of events used in the MC for the estimation of the efficiency (so that z/m is the estimated efficiency).

This is for mode=1. For the other models the first line is also model method but the other lines are

if model=1: cl x y z tau m

if model=2: cl x y z tau  $\sigma_e$

if model=3: cl x y z  $\sigma_b$   $\sigma_e$

if model=4: cl x y tau e

if model=5: cl x y z  $\sigma_b$  e

```

if model=6: cl x z m b
if model=7: cl x z  $\sigma_e$  b

```

Note that you can compute as many limits as you want in one run, but only for one combination of model and method.

Example: here is a sample setup.dat:

```

3 1
0.9 10 2.3 0.9 0.7 0.1
0.99 0 2.3 0.9 0.7 0.1
0.9 10 2.3 0.1 0.7 0.1

```

The limits are written to the file out.dat. Here is the file corresponding to the setup.dat above:

```

3.4821992    16.0042152    4.1504421
0.0000000    2.2944343     7.3456864
-99.00000    -99.00000     -99.00000

```

where each line is lower limit upper limit sensitivity

Note that for cases where no limits can be found the output is -99 -99 -99

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