Admissible Multinomial Trial - IUT design Example

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Multinomial Trial Design with Different Output Options

In the following example, we provide four design methods for multinomial trial: Minimax (minimize the maximum sample size), Optimal (minimize the expected sample size), Admissible (minimize the Bayesian risk) and Maxpower (maximize the exact power level).

```
source(file="powfun_IUT.r")
source(file="searchfun_IUT_adm.r")
library(clinfun)
```

Single-stage

It should be noted that single-stage design only allows Minimax and Maxpower output methods.

```
# Minimax
IUT.design(method = "s1", s2.rej = 18, t2.rej = 12, n = 80, s2.rej.delta = 1,
    t2.rej.delta = 1, n.delta = 1, p0.s = 0.15, p0.t = 0.25, p1.s = 0.3, p1.t = 0.1,
    output = "minimax")
```

```
##   p0.s p0.t p1.s p1.t s.rej t.rej  N  Error Power
## 2 0.15 0.25  0.3  0.1    18    11 79 0.0430 0.857
## 3 0.15 0.25  0.3  0.1    19    11 79 0.0228 0.825
## 5 0.15 0.25  0.3  0.1    18    12 79 0.0430 0.896
## 6 0.15 0.25  0.3  0.1    19    12 79 0.0254 0.862
## 8 0.15 0.25  0.3  0.1    18    13 79 0.0477 0.919
## 9 0.15 0.25  0.3  0.1    19    13 79 0.0477 0.882
##    user  system elapsed
##    0.52    0.00    0.51
```

```
# Maxpower
IUT.design(method = "s1", s2.rej = 18, t2.rej = 12, n = 80, s2.rej.delta = 1,
    t2.rej.delta = 1, n.delta = 1, p0.s = 0.15, p0.t = 0.25, p1.s = 0.3, p1.t = 0.1,
    output = "maxpower")
```

```
##    p0.s p0.t p1.s p1.t s.rej t.rej  N Error Power
## 17 0.15 0.25  0.3  0.1    18    13 80 0.048 0.924
##    user  system elapsed
##    0.48    0.01    0.50
```

Two-stage

```r
# Minimax
IUT.design(method = "s2.sf", s1.rej = 10, t1.rej = 3, s1.acc = 8, t1.acc = 5,
    s2.rej = 18, t2.rej = 12, n1 = 40, n2 = 40, n1.delta = 1, n2.delta = 1,
    s1.rej.delta = 1, t1.rej.delta = 1, s2.rej.delta = 1, t2.rej.delta = 1,
    p0.s = 0.15, p0.t = 0.25, p1.s = 0.3, p1.t = 0.1, output = "minimax")
```

```
##    p0.s p0.t p1.s p1.t s1.rej t1.rej s1.acc t1.acc s2.rej t2.rej N1 N2
## 18 0.15 0.25  0.3  0.1     11      4      8      5     18     11 39 39
## 45 0.15 0.25  0.3  0.1     11      4      8      5     18     12 39 39
## 54 0.15 0.25  0.3  0.1     11      4      8      5     19     12 39 39
## 72 0.15 0.25  0.3  0.1     11      4      8      5     18     13 39 39
## 81 0.15 0.25  0.3  0.1     11      4      8      5     19     13 39 39
##     Error Power   PET   EN
## 18 0.0398 0.857 0.995 39.2
## 45 0.0398 0.869 0.995 39.2
## 54 0.0325 0.850 0.995 39.2
## 72 0.0398 0.874 0.995 39.2
## 81 0.0364 0.855 0.995 39.2
##    user  system elapsed
##  551.21    0.05  555.52
```

```r
# Optimal
IUT.design(method = "s2.sf", s1.rej = 10, t1.rej = 3, s1.acc = 8, t1.acc = 5,
    s2.rej = 18, t2.rej = 12, n1 = 40, n2 = 40, n1.delta = 1, n2.delta = 1,
    s1.rej.delta = 1, t1.rej.delta = 1, s2.rej.delta = 1, t2.rej.delta = 1,
    p0.s = 0.15, p0.t = 0.25, p1.s = 0.3, p1.t = 0.1, output = "optimal")
```

```
##     p0.s p0.t p1.s p1.t s1.rej t1.rej s1.acc t1.acc s2.rej t2.rej N1 N2
## 18  0.15 0.25  0.3  0.1     11      4      8      5     18     11 39 39
## 45  0.15 0.25  0.3  0.1     11      4      8      5     18     12 39 39
## 54  0.15 0.25  0.3  0.1     11      4      8      5     19     12 39 39
## 72  0.15 0.25  0.3  0.1     11      4      8      5     18     13 39 39
## 81  0.15 0.25  0.3  0.1     11      4      8      5     19     13 39 39
## 99  0.15 0.25  0.3  0.1     11      4      8      5     18     11 40 39
## 126 0.15 0.25  0.3  0.1     11      4      8      5     18     12 40 39
## 135 0.15 0.25  0.3  0.1     11      4      8      5     19     12 40 39
## 153 0.15 0.25  0.3  0.1     11      4      8      5     18     13 40 39
## 162 0.15 0.25  0.3  0.1     11      4      8      5     19     13 40 39
## 189 0.15 0.25  0.3  0.1     11      4      8      5     19     11 41 39
## 216 0.15 0.25  0.3  0.1     11      4      8      5     19     12 41 39
## 243 0.15 0.25  0.3  0.1     11      4      8      5     19     13 41 39
## 261 0.15 0.25  0.3  0.1     11      4      8      5     18     11 39 40
## 288 0.15 0.25  0.3  0.1     11      4      8      5     18     12 39 40
## 297 0.15 0.25  0.3  0.1     11      4      8      5     19     12 39 40
## 315 0.15 0.25  0.3  0.1     11      4      8      5     18     13 39 40
## 324 0.15 0.25  0.3  0.1     11      4      8      5     19     13 39 40
## 342 0.15 0.25  0.3  0.1     11      4      8      5     18     11 40 40
## 369 0.15 0.25  0.3  0.1     11      4      8      5     18     12 40 40
## 378 0.15 0.25  0.3  0.1     11      4      8      5     19     12 40 40
## 396 0.15 0.25  0.3  0.1     11      4      8      5     18     13 40 40
## 405 0.15 0.25  0.3  0.1     11      4      8      5     19     13 40 40
## 432 0.15 0.25  0.3  0.1     11      4      8      5     19     11 41 40
```

```
## 459 0.15 0.25  0.3  0.1     11      4      8      5     19     12 41 40
## 486 0.15 0.25  0.3  0.1     11      4      8      5     19     13 41 40
## 504 0.15 0.25  0.3  0.1     11      4      8      5     18     11 39 41
## 531 0.15 0.25  0.3  0.1     11      4      8      5     18     12 39 41
## 540 0.15 0.25  0.3  0.1     11      4      8      5     19     12 39 41
## 558 0.15 0.25  0.3  0.1     11      4      8      5     18     13 39 41
## 567 0.15 0.25  0.3  0.1     11      4      8      5     19     13 39 41
## 594 0.15 0.25  0.3  0.1     11      4      8      5     19     11 40 41
## 621 0.15 0.25  0.3  0.1     11      4      8      5     19     12 40 41
## 648 0.15 0.25  0.3  0.1     11      4      8      5     19     13 40 41
## 675 0.15 0.25  0.3  0.1     11      4      8      5     19     11 41 41
## 702 0.15 0.25  0.3  0.1     11      4      8      5     19     12 41 41
## 729 0.15 0.25  0.3  0.1     11      4      8      5     19     13 41 41
##      Error Power   PET   EN
## 18  0.0398 0.857 0.995 39.2
## 45  0.0398 0.869 0.995 39.2
## 54  0.0325 0.850 0.995 39.2
## 72  0.0398 0.874 0.995 39.2
## 81  0.0364 0.855 0.995 39.2
## 99  0.0464 0.863 0.995 39.2
## 126 0.0464 0.876 0.995 39.2
## 135 0.0383 0.859 0.995 39.2
## 153 0.0464 0.881 0.995 39.2
## 162 0.0383 0.863 0.995 39.2
## 189 0.0448 0.851 0.995 39.2
## 216 0.0448 0.863 0.995 39.2
## 243 0.0448 0.868 0.995 39.2
## 261 0.0414 0.858 0.995 39.2
## 288 0.0414 0.871 0.995 39.2
## 297 0.0336 0.855 0.995 39.2
## 315 0.0414 0.877 0.995 39.2
## 324 0.0350 0.860 0.995 39.2
## 342 0.0483 0.864 0.995 39.2
## 369 0.0483 0.877 0.995 39.2
## 378 0.0396 0.863 0.995 39.2
## 396 0.0483 0.883 0.995 39.2
## 405 0.0396 0.868 0.995 39.2
## 432 0.0462 0.852 0.995 39.2
## 459 0.0462 0.866 0.995 39.2
## 486 0.0462 0.872 0.995 39.2
## 504 0.0432 0.858 0.995 39.2
## 531 0.0432 0.873 0.995 39.2
## 540 0.0348 0.859 0.995 39.2
## 558 0.0432 0.879 0.995 39.2
## 567 0.0348 0.865 0.995 39.2
## 594 0.0409 0.851 0.995 39.2
## 621 0.0409 0.866 0.995 39.2
## 648 0.0409 0.872 0.995 39.2
## 675 0.0476 0.853 0.995 39.2
## 702 0.0476 0.869 0.995 39.2
## 729 0.0476 0.875 0.995 39.2
##    user  system elapsed
##  537.19    0.06  538.38
```

```r
# Admissible
IUT.design(method = "s2.sf", s1.rej = 10, t1.rej = 3, s1.acc = 8, t1.acc = 5,
    s2.rej = 18, t2.rej = 12, n1 = 40, n2 = 40, n1.delta = 1, n2.delta = 1,
    s1.rej.delta = 1, t1.rej.delta = 1, s2.rej.delta = 1, t2.rej.delta = 1,
    p0.s = 0.15, p0.t = 0.25, p1.s = 0.3, p1.t = 0.1, output = "admissible")
```

```
##    p0.s p0.t p1.s p1.t s1.rej t1.rej s1.acc t1.acc s2.rej t2.rej N1 N2
## 18 0.15 0.25  0.3  0.1     11      4      8      5     18     11 39 39
##     Error Power   PET   EN
## 18 0.0398 0.857 0.995 39.2
##    user  system elapsed
##  575.27    0.03  581.64
```

```r
# Maxpower
IUT.design(method = "s2.sf", s1.rej = 10, t1.rej = 3, s1.acc = 8, t1.acc = 5,
    s2.rej = 18, t2.rej = 12, n1 = 40, n2 = 40, n1.delta = 1, n2.delta = 1,
    s1.rej.delta = 1, t1.rej.delta = 1, s2.rej.delta = 1, t2.rej.delta = 1,
    p0.s = 0.15, p0.t = 0.25, p1.s = 0.3, p1.t = 0.1, output = "maxpower")
```

```
##     p0.s p0.t p1.s p1.t s1.rej t1.rej s1.acc t1.acc s2.rej t2.rej N1 N2
## 396 0.15 0.25  0.3  0.1     11      4      8      5     18     13 40 40
##      Error Power   PET   EN
## 396 0.0483 0.883 0.995 39.2
##    user  system elapsed
##  550.38    0.00  552.17
```

Two-stage early terminate with futility only

```r
# Minimax
suppressWarnings(IUT.design(method = "s2.f", s1.acc = 7, t1.acc = 5, s2.rej = 17,
    t2.rej = 13, n1 = 41, n2 = 41, s1.acc.delta = 0, t1.acc.delta = 0, s2.rej.delta = 0,
    t2.rej.delta = 0, p0.s = 0.15, p0.t = 0.25, p1.s = 0.3, p1.t = 0.1, output = "minimax"))
```

```
## Error in IUT.design(method = "s2.f", s1.acc = 7, t1.acc = 5, s2.rej = 17, :   No feasible solution fo
##  Increase maximum sample size.  Current nmax value = 82.
```

```r
# Optimal
suppressWarnings(IUT.design(method = "s2.f", s1.acc = 7, t1.acc = 5, s2.rej = 17,
    t2.rej = 13, n1 = 41, n2 = 41, s1.acc.delta = 0, t1.acc.delta = 0, s2.rej.delta = 0,
    t2.rej.delta = 0, p0.s = 0.15, p0.t = 0.25, p1.s = 0.3, p1.t = 0.1, output = "optimal"))
```

```
## Error in IUT.design(method = "s2.f", s1.acc = 7, t1.acc = 5, s2.rej = 17, :   No feasible solution fo
##  Increase maximum sample size.  Current nmax value = 82.
```

```r
# Admissible
suppressWarnings(IUT.design(method = "s2.f", s1.acc = 7, t1.acc = 5, s2.rej = 17,
    t2.rej = 13, n1 = 41, n2 = 41, s1.acc.delta = 0, t1.acc.delta = 0, s2.rej.delta = 0,
    t2.rej.delta = 0, p0.s = 0.15, p0.t = 0.25, p1.s = 0.3, p1.t = 0.1, output = "admissible"))
```

```
## Error in IUT.design(method = "s2.f", s1.acc = 7, t1.acc = 5, s2.rej = 17, :   No feasible solution fo
##  Increase maximum sample size.  Current nmax value = 82.
```

```r
# Maxpower
suppressWarnings(IUT.design(method = "s2.f", s1.acc = 7, t1.acc = 5, s2.rej = 17,
    t2.rej = 13, n1 = 41, n2 = 41, s1.acc.delta = 0, t1.acc.delta = 0, s2.rej.delta = 0,
    t2.rej.delta = 0, p0.s = 0.15, p0.t = 0.25, p1.s = 0.3, p1.t = 0.1, output = "maxpower"))
```

```
## Error in IUT.design(method = "s2.f", s1.acc = 7, t1.acc = 5, s2.rej = 17, :   No feasible solution fo
##  Increase maximum sample size.  Current nmax value = 82.
```