```
$Single.Stage.Equal.Alpha.Allocation.Design
$Single.Stage.Equal.Alpha.Allocation.Design$design.parameters
$Single.Stage.Equal.Alpha.Allocation.Design$design.parameters$cumulative.sample.sizes.and.c
alendar.time.per.stage
  Stage  C1  C2  A1  A2 Analysis.Time.In.Years
1     1 250 250 250 250                      5

$Single.Stage.Equal.Alpha.Allocation.Design$design.parameters$alpha.allocation
  Stage Subpop.1 Subpop.2
1     1    0.025    0.025

$Single.Stage.Equal.Alpha.Allocation.Design$design.parameters$futility.boundaries
  Stage Subpop.1 Subpop.2
1     1       NA       NA


$Single.Stage.Equal.Alpha.Allocation.Design$design.performance
$Single.Stage.Equal.Alpha.Allocation.Design$design.performance$Power
  Scenario Power.H01 Power.H02 Prob.Reject.All.False.Null.Hypotheses
1        1    0.8648    0.8583                                0.7615
2        2    0.8047        NA                                0.8047
3        3        NA    0.7971                                0.7971
4        4        NA        NA                                    NA

$Single.Stage.Equal.Alpha.Allocation.Design$design.performance$Type.1.Error
  Scenario Type.I.Error.H01 Type.I.Error.H02 Familywise.Type.I.Error
1        1               NA               NA                     NA
2        2               NA           0.0458                 0.0458
3        3           0.0455               NA                 0.0455
4        4           0.0241           0.0273                 0.0492

$Single.Stage.Equal.Alpha.Allocation.Design$design.performance$Expected.Sample.Size
                            Scenario expected.sample.size
1                                  1                1000
2                                  2                1000
3                                  3                1000
4                                  4                1000
5 Weighted.Combination.Over.Scenarios                1000

$Single.Stage.Equal.Alpha.Allocation.Design$design.performance$Expected.Duration
                            Scenario expected.duration
1                                  1                 4
2                                  2                 4
3                                  3                 4
4                                  4                 4
5 Weighted.Combination.Over.Scenarios                 4

$Single.Stage.Equal.Alpha.Allocation.Design$design.performance$Distribution.of.sample.size.
and.duration.per.scenario
  scenario C1 C2 A1 A2 sample.size duration frequency proportion
1        1  1  1  1  1        1000        4     10000          1
2        2  1  1  1  1        1000        4     10000          1
3        3  1  1  1  1        1000        4     10000          1
4        4  1  1  1  1        1000        4     10000          1
```

```
$Single.Stage.Optimized.Alpha.Allocation.Design
$Single.Stage.Optimized.Alpha.Allocation.Design$design.parameters
$Single.Stage.Optimized.Alpha.Allocation.Design$design.parameters$cumulative.sample.sizes.a
nd.calendar.time.per.stage
  Stage  C1  C2  A1  A2 Analysis.Time.In.Years
1     1 250 250 250 250                     5

$Single.Stage.Optimized.Alpha.Allocation.Design$design.parameters$alpha.allocation
  Stage Subpop.1 Subpop.2
1     1   0.0253   0.0247

$Single.Stage.Optimized.Alpha.Allocation.Design$design.parameters$futility.boundaries
  Stage Subpop.1 Subpop.2
1     1       NA       NA


$Single.Stage.Optimized.Alpha.Allocation.Design$design.performance
$Single.Stage.Optimized.Alpha.Allocation.Design$design.performance$Power
  Scenario Power.H01 Power.H02 Prob.Reject.All.False.Null.Hypotheses
1        1    0.8608    0.8537                                0.7565
2        2    0.8030        NA                                0.8030
3        3        NA    0.7961                                0.7961
4        4        NA        NA                                    NA

$Single.Stage.Optimized.Alpha.Allocation.Design$design.performance$Type.1.Error
  Scenario Type.I.Error.H01 Type.I.Error.H02 Familywise.Type.I.Error
1        1               NA               NA                      NA
2        2               NA           0.0458                  0.0458
3        3           0.0494               NA                  0.0494
4        4           0.0256           0.0244                  0.0486

$Single.Stage.Optimized.Alpha.Allocation.Design$design.performance$Expected.Sample.Size
                            Scenario expected.sample.size
1                                  1                1000
2                                  2                1000
3                                  3                1000
4                                  4                1000
5 Weighted.Combination.Over.Scenarios                1000

$Single.Stage.Optimized.Alpha.Allocation.Design$design.performance$Expected.Duration
                            Scenario expected.duration
1                                  1                 4
2                                  2                 4
3                                  3                 4
4                                  4                 4
5 Weighted.Combination.Over.Scenarios                 4

$Single.Stage.Optimized.Alpha.Allocation.Design$design.performance$Distribution.of.sample.s
ize.and.duration.per.scenario
  scenario C1 C2 A1 A2 sample.size duration frequency proportion
1        1  1  1  1  1        1000        4     10000          1
2        2  1  1  1  1        1000        4     10000          1
3        3  1  1  1  1        1000        4     10000          1
4        4  1  1  1  1        1000        4     10000          1
```

```
$Two.Stage.Group.Sequential.Design
$Two.Stage.Group.Sequential.Design$design.parameters
$Two.Stage.Group.Sequential.Design$design.parameters$cumulative.sample.sizes.and.calendar.t
ime.per.stage
  Stage  C1  C2  A1  A2 Analysis.Time.In.Years
1     1 250 250 250 250                    4.6
2     2 250 250 250 250                    5.0

$Two.Stage.Group.Sequential.Design$design.parameters$alpha.allocation
  Stage Subpop.1 Subpop.2
1     1   0.0157   0.0093
2     2   0.0089   0.0161

$Two.Stage.Group.Sequential.Design$design.parameters$futility.boundaries
  Stage Subpop.1 Subpop.2
1     1  -4.0206  -0.9036
2     2       NA       NA


$Two.Stage.Group.Sequential.Design$design.performance
$Two.Stage.Group.Sequential.Design$design.performance$Power
  Scenario Power.H01 Power.H02 Prob.Reject.All.False.Null.Hypotheses
1        1    0.8646    0.8592                                0.7644
2        2    0.7903        NA                                0.7903
3        3        NA    0.8051                                0.8051
4        4        NA        NA                                    NA

$Two.Stage.Group.Sequential.Design$design.performance$Type.1.Error
  Scenario Type.I.Error.H01 Type.I.Error.H02 Familywise.Type.I.Error
1        1               NA               NA                     NA
2        2               NA           0.0459                 0.0459
3        3           0.0468               NA                 0.0468
4        4           0.0255           0.0263                 0.0495

$Two.Stage.Group.Sequential.Design$design.performance$Expected.Sample.Size
                            Scenario expected.sample.size
1                                  1                1000
2                                  2                1000
3                                  3                1000
4                                  4                1000
5 Weighted.Combination.Over.Scenarios                1000

$Two.Stage.Group.Sequential.Design$design.performance$Expected.Duration
                            Scenario expected.duration
1                                  1                4
2                                  2                4
3                                  3                4
4                                  4                4
5 Weighted.Combination.Over.Scenarios                4

$Two.Stage.Group.Sequential.Design$design.performance$Distribution.of.sample.size.and.durat
ion.per.scenario
   scenario C1 C2 A1 A2 sample.size duration frequency proportion
1         1  1  1  1  1        1000        4      4288     0.4288
```

```
2         1  1  2  1  2        1000        4        NA         NA
3         1  2  1  2  1        1000        4        NA         NA
4         1  2  2  2  2        1000        4      5712     0.5712
5         2  1  1  1  1        1000        4      1343     0.1343
6         2  1  2  1  2        1000        4        NA         NA
7         2  2  1  2  1        1000        4        NA         NA
8         2  2  2  2  2        1000        4      8657     0.8657
9         3  1  1  1  1        1000        4        90     0.0090
10        3  1  2  1  2        1000        4        NA         NA
11        3  2  1  2  1        1000        4        NA         NA
12        3  2  2  2  2        1000        4      9910     0.9910
13        4  1  1  1  1        1000        4        30     0.0030
14        4  1  2  1  2        1000        4        NA         NA
15        4  2  1  2  1        1000        4        NA         NA
16        4  2  2  2  2        1000        4      9970     0.9970



$Two.Stage.Equal.Alpha.Allocation.Design
$Two.Stage.Equal.Alpha.Allocation.Design$design.parameters
$Two.Stage.Equal.Alpha.Allocation.Design$design.parameters$cumulative.sample.sizes.and.cale
ndar.time.per.stage
  Stage  C1  C2  A1  A2 Analysis.Time.In.Years
1     1 187 187 187 187                      3
2     2 250 250 250 250                      5

$Two.Stage.Equal.Alpha.Allocation.Design$design.parameters$alpha.allocation
  Stage Subpop.1 Subpop.2
1     1   0.0125   0.0125
2     2   0.0125   0.0125

$Two.Stage.Equal.Alpha.Allocation.Design$design.parameters$futility.boundaries
  Stage Subpop.1 Subpop.2
1     1       -3       -3
2     2       NA       NA


$Two.Stage.Equal.Alpha.Allocation.Design$design.performance
$Two.Stage.Equal.Alpha.Allocation.Design$design.performance$Power
  Scenario Power.H01 Power.H02 Prob.Reject.All.False.Null.Hypotheses
1        1    0.8390    0.8387                                0.7346
2        2    0.7682        NA                                0.7682
3        3        NA    0.7649                                0.7649
4        4        NA        NA                                    NA

$Two.Stage.Equal.Alpha.Allocation.Design$design.performance$Type.1.Error
  Scenario Type.I.Error.H01 Type.I.Error.H02 Familywise.Type.I.Error
1        1               NA               NA                      NA
2        2               NA           0.0420                  0.0420
3        3           0.0399               NA                  0.0399
4        4           0.0235           0.0234                  0.0459

$Two.Stage.Equal.Alpha.Allocation.Design$design.performance$Expected.Sample.Size
                            Scenario expected.sample.size
1                                  1                  902
2                                  2                  949
```

```
3                                    3                 948
4                                    4                 997
5 Weighted.Combination.Over.Scenarios                  949

$Two.Stage.Equal.Alpha.Allocation.Design$design.performance$Expected.Duration
                              Scenario expected.duration
1                                    1             3.85
2                                    2             4.00
3                                    3             3.99
4                                    4             4.00
5 Weighted.Combination.Over.Scenarios              3.96

$Two.Stage.Equal.Alpha.Allocation.Design$design.performance$Distribution.of.sample.size.and
.duration.per.scenario
   scenario C1 C2 A1 A2 sample.size duration frequency proportion
1         1  1  1  1  1         748    2.992      1469     0.1469
2         1  1  2  1  2         874    4.000      2444     0.2444
3         1  2  1  2  1         874    4.000      2382     0.2382
4         1  2  2  2  2        1000    4.000      3705     0.3705
5         2  1  1  1  1         748    2.992        49     0.0049
6         2  1  2  1  2         874    4.000      3875     0.3875
7         2  2  1  2  1         874    4.000        89     0.0089
8         2  2  2  2  2        1000    4.000      5987     0.5987
9         3  1  1  1  1         748    2.992        58     0.0058
10        3  1  2  1  2         874    4.000        83     0.0083
11        3  2  1  2  1         874    4.000      3889     0.3889
12        3  2  2  2  2        1000    4.000      5970     0.5970
13        4  1  1  1  1         748    2.992         2     0.0002
14        4  1  2  1  2         874    4.000       131     0.0131
15        4  2  1  2  1         874    4.000       133     0.0133
16        4  2  2  2  2        1000    4.000      9734     0.9734



$Two.Stage.Optimized.Alpha.Allocation.Design
$Two.Stage.Optimized.Alpha.Allocation.Design$design.parameters
$Two.Stage.Optimized.Alpha.Allocation.Design$design.parameters$cumulative.sample.sizes.and.
calendar.time.per.stage
  Stage  C1  C2  A1  A2 Analysis.Time.In.Years
1     1 250 250 250 250                    4.6
2     2 250 250 250 250                    5.0

$Two.Stage.Optimized.Alpha.Allocation.Design$design.parameters$alpha.allocation
  Stage Subpop.1 Subpop.2
1     1   0.0124   0.0213
2     2   0.0120   0.0044

$Two.Stage.Optimized.Alpha.Allocation.Design$design.parameters$futility.boundaries
  Stage Subpop.1 Subpop.2
1     1  -3.2636  -3.1129
2     2       NA       NA


$Two.Stage.Optimized.Alpha.Allocation.Design$design.performance
$Two.Stage.Optimized.Alpha.Allocation.Design$design.performance$Power
  Scenario Power.HO1 Power.HO2 Prob.Reject.All.False.Null.Hypotheses
```

```
1        1    0.8586    0.8634                                0.7644
2        2    0.7962        NA                                0.7962
3        3        NA    0.7895                                0.7895
4        4        NA        NA                                    NA

$Two.Stage.Optimized.Alpha.Allocation.Design$design.performance$Type.1.Error
  Scenario Type.I.Error.H01 Type.I.Error.H02 Familywise.Type.I.Error
1        1               NA               NA                      NA
2        2               NA           0.0458                  0.0458
3        3           0.0443               NA                  0.0443
4        4           0.0253           0.0259                  0.0495

$Two.Stage.Optimized.Alpha.Allocation.Design$design.performance$Expected.Sample.Size
                            Scenario expected.sample.size
1                                  1                1000
2                                  2                1000
3                                  3                1000
4                                  4                1000
5 Weighted.Combination.Over.Scenarios                1000

$Two.Stage.Optimized.Alpha.Allocation.Design$design.performance$Expected.Duration
                            Scenario expected.duration
1                                  1                4
2                                  2                4
3                                  3                4
4                                  4                4
5 Weighted.Combination.Over.Scenarios                4

$Two.Stage.Optimized.Alpha.Allocation.Design$design.performance$Distribution.of.sample.size
.and.duration.per.scenario
   scenario C1 C2 A1 A2 sample.size duration frequency proportion
1         1  1  1  1  1        1000        4      4897     0.4897
2         1  1  2  1  2        1000        4      1720     0.1720
3         1  2  1  2  1        1000        4      2515     0.2515
4         1  2  2  2  2        1000        4       868     0.0868
5         2  1  1  1  1        1000        4       148     0.0148
6         2  1  2  1  2        1000        4      6421     0.6421
7         2  2  1  2  1        1000        4        73     0.0073
8         2  2  2  2  2        1000        4      3358     0.3358
9         3  1  1  1  1        1000        4        92     0.0092
10        3  1  2  1  2        1000        4        30     0.0030
11        3  2  1  2  1        1000        4      7209     0.7209
12        3  2  2  2  2        1000        4      2669     0.2669
13        4  1  1  1  1        1000        4         1     0.0001
14        4  1  2  1  2        1000        4       128     0.0128
15        4  2  1  2  1        1000        4       210     0.0210
16        4  2  2  2  2        1000        4      9661     0.9661
```

Minimum power difference (obtained - desired) for each Design

Design	*Scenario*	*Minimum difference in power (obtained - desired)*
Single.Stage.Equal.Alpha.Allocation.Design	1	-0.0385
Single.Stage.Optimized.Alpha.Allocation.Design	1	-0.0435
Two.Stage.Group.Sequential.Design	1	-0.0356
Two.Stage.Equal.Alpha.Allocation.Design	1	-0.0654
Two.Stage.Optimized.Alpha.Allocation.Design	1	-0.0356