betaSandwich: Methods

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1 HC

```
object <- lm(rating ~ ., data = attitude)
```

```
out <- BetaHC(object, type = "hc5")
str(out)

#> List of 7
#>  $ call: language BetaHC(object = object, type = "hc5")
#>  $ type: chr "hc5"
#>  $ beta: Named num [1:6] 0.6707 -0.0734 0.3089 0.0698 0.0312 ...
#>   ..- attr(*, "names")= chr [1:6] "complaints" "privileges" "learning" "raises" ...
#>  $ vcov: num [1:6, 1:6] 0.01524 -0.00825 -0.00842 -0.00806 0.00172 ...
#>   ..- attr(*, "dimnames")=List of 2
#>   .. ..$ : chr [1:6] "complaints" "privileges" "learning" "raises" ...
#>   .. ..$ : chr [1:6] "complaints" "privileges" "learning" "raises" ...
#>  $ n   : int 30
#>  $ p   : num 6
#>  $ df  : int 23
#>  - attr(*, "class")= chr [1:2] "betaSandwich" "list"

BetaHC(object, type = "hc5")

#> Call:
#> BetaHC(object = object, type = "hc5")
#>
#> Standardized regression slopes with HC5 standard errors:
#>                 est     se       t         p   0.05%    0.5%      2.5%  97.5%
#> complaints  0.67073 0.1235  5.4324 1.606e-05  0.2055  0.3241  0.415315 0.9261
#> privileges -0.07343 0.1252 -0.5866 5.632e-01 -0.5450 -0.4248 -0.332371 0.1855
#> learning    0.30887 0.1520  2.0314 5.393e-02 -0.2640 -0.1180 -0.005669 0.6234
#> raises      0.06981 0.1446  0.4829 6.337e-01 -0.4749 -0.3360 -0.229256 0.3689
#> critical    0.03120 0.1396  0.2236 8.251e-01 -0.4946 -0.3606 -0.257488 0.3199
#> advance    -0.18346 0.1439 -1.2747 2.151e-01 -0.7257 -0.5875 -0.481192 0.1143
#>             99.5% 99.95%
```

```
#> complaints 1.0173 1.1359
#> privileges 0.2780 0.3982
#> learning   0.7357 0.8817
#> raises     0.4757 0.6145
#> critical   0.4230 0.5570
#> advance    0.2206 0.3588
```

print

```
print(out)

#> Call:
#> BetaHC(object = object, type = "hc5")
#>
#> Standardized regression slopes with HC5 standard errors:
#>                 est     se       t         p   0.05%    0.5%      2.5%  97.5%
#> complaints  0.67073 0.1235  5.4324 1.606e-05  0.2055  0.3241  0.415315 0.9261
#> privileges -0.07343 0.1252 -0.5866 5.632e-01 -0.5450 -0.4248 -0.332371 0.1855
#> learning    0.30887 0.1520  2.0314 5.393e-02 -0.2640 -0.1180 -0.005669 0.6234
#> raises      0.06981 0.1446  0.4829 6.337e-01 -0.4749 -0.3360 -0.229256 0.3689
#> critical    0.03120 0.1396  0.2236 8.251e-01 -0.4946 -0.3606 -0.257488 0.3199
#> advance    -0.18346 0.1439 -1.2747 2.151e-01 -0.7257 -0.5875 -0.481192 0.1143
#>              99.5% 99.95%
#> complaints 1.0173 1.1359
#> privileges 0.2780 0.3982
#> learning   0.7357 0.8817
#> raises     0.4757 0.6145
#> critical   0.4230 0.5570
#> advance    0.2206 0.3588
```

coef

```
coef(out)

#>  complaints  privileges    learning      raises    critical     advance
#>  0.67072520 -0.07342743  0.30887024  0.06981172  0.03119975 -0.18346445
```

vcov

```
vcov(out)
```

```
#>              complaints    privileges      learning       raises     critical
#> complaints  0.015243986 -0.0082499463 -0.0084200245 -0.008062176  0.001722769
#> privileges -0.008249946  0.0156686628 -0.0003037232  0.003678245 -0.003141913
#> learning   -0.008420025 -0.0003037232  0.0231191966 -0.007071968  0.003042060
#> raises     -0.008062176  0.0036782449 -0.0070719680  0.020900736 -0.007179183
#> critical    0.001722769 -0.0031419128  0.0030420602 -0.007179183  0.019475155
#> advance     0.007239867 -0.0062729483 -0.0057375001 -0.009474551  0.001256892
#>                 advance
#> complaints  0.007239867
#> privileges -0.006272948
#> learning   -0.005737500
#> raises     -0.009474551
#> critical    0.001256892
#> advance     0.020713919
```

confint

```
confint(out, level = 0.95)

#>                    2.5%     97.5%
#> complaints  0.415315214 0.9261352
#> privileges -0.332370670 0.1855158
#> learning   -0.005669106 0.6234096
#> raises     -0.229255912 0.3688793
#> critical   -0.257488482 0.3198880
#> advance    -0.481192497 0.1142636
```

summary

```
summary(out)

#> Call:
#> BetaHC(object = object, type = "hc5")
#>
#> Standardized regression slopes with HC5 standard errors:
#>                    est        se          t            p      0.05%       0.5%
#> complaints  0.67072520 0.1234665  5.4324453 1.606024e-05  0.2055494  0.3241132
#> privileges -0.07342743 0.1251745 -0.5866004 5.631859e-01 -0.5450383 -0.4248344
#> learning    0.30887024 0.1520500  2.0313731 5.392855e-02 -0.2639973 -0.1179851
#> raises      0.06981172 0.1445709  0.4828892 6.337390e-01 -0.4748774 -0.3360472
#> critical    0.03119975 0.1395534  0.2235685 8.250669e-01 -0.4945854 -0.3605735
#> advance    -0.18346445 0.1439233 -1.2747376 2.151303e-01 -0.7257138 -0.5875055
#>                    2.5%     97.5%     99.5%    99.95%
```

```
#> complaints  0.415315214 0.9261352 1.0173372 1.1359010
#> privileges -0.332370670 0.1855158 0.2779795 0.3981835
#> learning   -0.005669106 0.6234096 0.7357256 0.8817378
#> raises     -0.229255912 0.3688793 0.4756707 0.6145008
#> critical   -0.257488482 0.3198880 0.4229730 0.5569849
#> advance    -0.481192497 0.1142636 0.2205766 0.3587849
```

2 Multivariate Normal

```
object <- lm(rating ~ ., data = attitude)
```

```
out <- BetaN(object)
str(out)

#> List of 7
#>  $ call: language BetaN(object = object)
#>  $ type: chr "mvn"
#>  $ beta: Named num [1:6] 0.6707 -0.0734 0.3089 0.0698 0.0312 ...
#>   ..- attr(*, "names")= chr [1:6] "complaints" "privileges" "learning" "raises" ...
#>  $ vcov: num [1:6, 1:6] 0.020531 -0.006381 -0.009324 -0.013812 -0.000242 ...
#>   ..- attr(*, "dimnames")=List of 2
#>   .. ..$ : chr [1:6] "complaints" "privileges" "learning" "raises" ...
#>   .. ..$ : chr [1:6] "complaints" "privileges" "learning" "raises" ...
#>  $ n   : int 30
#>  $ p   : num 6
#>  $ df  : int 23
#>  - attr(*, "class")= chr [1:2] "betaSandwich" "list"

BetaN(object)

#> Call:
#> BetaN(object = object)
#>
#> Standardized regression slopes with MVN standard errors:
#>                 est     se       t         p   0.05%     0.5%     2.5%   97.5%
#> complaints  0.67073 0.1433  4.6810 0.0001031  0.1309  0.26847  0.37431 0.96714
#> privileges -0.07343 0.1197 -0.6136 0.5455017 -0.5243 -0.40937 -0.32098 0.17412
#> learning    0.30887 0.1431  2.1580 0.0416048 -0.2304 -0.09293  0.01279 0.60495
#> raises      0.06981 0.1657  0.4213 0.6774348 -0.5545 -0.39536 -0.27296 0.41259
#> critical    0.03120 0.1047  0.2980 0.7683711 -0.3632 -0.26271 -0.18538 0.24778
#> advance    -0.18346 0.1338 -1.3717 0.1834027 -0.6874 -0.55896 -0.46015 0.09323
#>             99.5% 99.95%
#> complaints 1.0730 1.2106
```

```
#> privileges 0.2625 0.3774
#> learning   0.7107 0.8481
#> raises     0.5350 0.6941
#> critical   0.3251 0.4256
#> advance    0.1920 0.3205
```

print

```
print(out)

#> Call:
#> BetaN(object = object)
#>
#> Standardized regression slopes with MVN standard errors:
#>                 est     se       t         p   0.05%     0.5%     2.5%   97.5%
#> complaints  0.67073 0.1433  4.6810 0.0001031  0.1309  0.26847  0.37431 0.96714
#> privileges -0.07343 0.1197 -0.6136 0.5455017 -0.5243 -0.40937 -0.32098 0.17412
#> learning    0.30887 0.1431  2.1580 0.0416048 -0.2304 -0.09293  0.01279 0.60495
#> raises      0.06981 0.1657  0.4213 0.6774348 -0.5545 -0.39536 -0.27296 0.41259
#> critical    0.03120 0.1047  0.2980 0.7683711 -0.3632 -0.26271 -0.18538 0.24778
#> advance    -0.18346 0.1338 -1.3717 0.1834027 -0.6874 -0.55896 -0.46015 0.09323
#>             99.5% 99.95%
#> complaints 1.0730 1.2106
#> privileges 0.2625 0.3774
#> learning   0.7107 0.8481
#> raises     0.5350 0.6941
#> critical   0.3251 0.4256
#> advance    0.1920 0.3205
```

coef

```
coef(out)

#>  complaints  privileges    learning      raises    critical     advance
#>  0.67072520 -0.07342743  0.30887024  0.06981172  0.03119975 -0.18346445
```

vcov

```
vcov(out)
```

```
#>               complaints    privileges     learning       raises      critical
#> complaints  0.0205314876 -0.0063811296 -0.009324286 -0.013811718 -0.0002422133
#> privileges -0.0063811296  0.0143201460 -0.002170471  0.001552377 -0.0002768442
#> learning   -0.0093242861 -0.0021704714  0.020484826 -0.004998152  0.0028372586
#> raises     -0.0138117179  0.0015523774 -0.004998152  0.027456049 -0.0048713593
#> critical   -0.0002422133 -0.0002768442  0.002837259 -0.004871359  0.0109607636
#> advance     0.0096650976 -0.0029432354 -0.006326814 -0.009305030 -0.0017608366
#>                 advance
#> complaints  0.009665098
#> privileges -0.002943235
#> learning   -0.006326814
#> raises     -0.009305030
#> critical   -0.001760837
#> advance     0.017890011
```

confint

```
confint(out, level = 0.95)

#>                   2.5%      97.5%
#> complaints  0.37431113 0.96713928
#> privileges -0.32097709 0.17412223
#> learning    0.01279319 0.60494730
#> raises     -0.27296210 0.41258553
#> critical   -0.18537560 0.24777510
#> advance    -0.46015474 0.09322584
```

summary

```
summary(out)

#> Call:
#> BetaN(object = object)
#>
#> Standardized regression slopes with MVN standard errors:
#>                    est        se          t            p      0.05%        0.5%
#> complaints  0.67072520 0.1432881  4.6809545 0.0001030949  0.1308690  0.26846733
#> privileges -0.07342743 0.1196668 -0.6135989 0.5455016623 -0.5242873 -0.40937234
#> learning    0.30887024 0.1431252  2.1580422 0.0416047589 -0.2303721 -0.09293027
#> raises      0.06981172 0.1656987  0.4213173 0.6774347660 -0.5544790 -0.39536008
#> critical    0.03119975 0.1046937  0.2980099 0.7683710623 -0.3632469 -0.26271051
#> advance    -0.18346445 0.1337535 -1.3716605 0.1834027121 -0.6873979 -0.55895555
#>                   2.5%      97.5%     99.5%    99.95%
```

```
#> complaints  0.37431113 0.96713928 1.0729831 1.2105814
#> privileges -0.32097709 0.17412223 0.2625175 0.3774325
#> learning    0.01279319 0.60494730 0.7106708 0.8481126
#> raises     -0.27296210 0.41258553 0.5349835 0.6941025
#> critical   -0.18537560 0.24777510 0.3251100 0.4256464
#> advance    -0.46015474 0.09322584 0.1920266 0.3204690
```

References

Dudgeon, P. (2017). Some improvements in confidence intervals for standardized regression coefficients. *Psychometrika*, *82*(4), 928–951. https://doi.org/10.1007/s11336-017-9563-z

R Core Team. (2022). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. Vienna, Austria. https://www.R-project.org/