betaMC: Methods

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```
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
```

```
set.seed(42)
out <- BetaMC(object)
str(out)

#> List of 9
#>  $ call        : language BetaMC(object = object)
#>  $ lm          :List of 12
#>   ..$ coefficients : Named num [1:4] 10.3592 0.0842 0.216 0.1126
#>   .. ..- attr(*, "names")= chr [1:4] "(Intercept)" "NARTIC" "PCTGRT" "PCTSUPP"
#>   ..$ residuals    : Named num [1:46] -3.068 -0.688 2.675 2.052 4.039 ...
#>   .. ..- attr(*, "names")= chr [1:46] "1" "2" "3" "4" ...
#>   ..$ effects      : Named num [1:46] -187.4 51.49 27.59 -16.11 4.51 ...
#>   .. ..- attr(*, "names")= chr [1:46] "(Intercept)" "NARTIC" "PCTGRT" "PCTSUPP" ...
#>   ..$ rank         : int 4
#>   ..$ fitted.values: Named num [1:46] 15.1 23.7 26.3 33.9 40 ...
#>   .. ..- attr(*, "names")= chr [1:46] "1" "2" "3" "4" ...
#>   ..$ assign       : int [1:4] 0 1 2 3
#>   ..$ qr           :List of 5
#>   .. ..$ qr   : num [1:46, 1:4] -6.782 0.147 0.147 0.147 0.147 ...
#>   .. .. ..- attr(*, "dimnames")=List of 2
#>   .. .. .. ..$ : chr [1:46] "1" "2" "3" "4" ...
#>   .. .. .. ..$ : chr [1:4] "(Intercept)" "NARTIC" "PCTGRT" "PCTSUPP"
#>   .. .. ..- attr(*, "assign")= int [1:4] 0 1 2 3
#>   .. ..$ qraux: num [1:4] 1.15 1.04 1.06 1.09
#>   .. ..$ pivot: int [1:4] 1 2 3 4
#>   .. ..$ tol  : num 1e-07
#>   .. ..$ rank : int 4
#>   .. ..- attr(*, "class")= chr "qr"
#>   ..$ df.residual  : int 42
#>   ..$ xlevels      : Named list()
#>   ..$ call         : language lm(formula = QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = nas1982)
#>   ..$ terms        :Classes 'terms', 'formula'  language QUALITY ~ NARTIC + PCTGRT + PCTSUPP
#>   .. .. ..- attr(*, "variables")= language list(QUALITY, NARTIC, PCTGRT, PCTSUPP)
```

```
#>   .. .. ..- attr(*, "factors")= int [1:4, 1:3] 0 1 0 0 0 0 1 0 0 0 ...
#>   .. .. .. ..- attr(*, "dimnames")=List of 2
#>   .. .. .. .. ..$ : chr [1:4] "QUALITY" "NARTIC" "PCTGRT" "PCTSUPP"
#>   .. .. .. .. ..$ : chr [1:3] "NARTIC" "PCTGRT" "PCTSUPP"
#>   .. .. ..- attr(*, "term.labels")= chr [1:3] "NARTIC" "PCTGRT" "PCTSUPP"
#>   .. .. ..- attr(*, "order")= int [1:3] 1 1 1
#>   .. .. ..- attr(*, "intercept")= int 1
#>   .. .. ..- attr(*, "response")= int 1
#>   .. .. ..- attr(*, ".Environment")=<environment: 0x55a30e49d4b8>
#>   .. .. ..- attr(*, "predvars")= language list(QUALITY, NARTIC, PCTGRT, PCTSUPP)
#>   .. .. ..- attr(*, "dataClasses")= Named chr [1:4] "numeric" "numeric" "numeric" "numeric"
#>   .. .. .. ..- attr(*, "names")= chr [1:4] "QUALITY" "NARTIC" "PCTGRT" "PCTSUPP"
#>   ..$ model        :'data.frame': 46 obs. of  4 variables:
#>   .. ..$ QUALITY: int [1:46] 12 23 29 36 44 21 40 42 24 30 ...
#>   .. ..$ NARTIC : int [1:46] 14 61 68 49 130 65 79 187 32 50 ...
#>   .. ..$ PCTGRT : int [1:46] 8 3 13 63 53 29 35 40 19 8 ...
#>   .. ..$ PCTSUPP: int [1:46] 16 67 66 52 64 59 81 65 87 43 ...
#>   .. ..- attr(*, "terms")=Classes 'terms', 'formula'  language QUALITY ~ NARTIC + PCTGRT + PCTSUP
#>   .. .. .. ..- attr(*, "variables")= language list(QUALITY, NARTIC, PCTGRT, PCTSUPP)
#>   .. .. .. ..- attr(*, "factors")= int [1:4, 1:3] 0 1 0 0 0 0 1 0 0 0 ...
#>   .. .. .. .. ..- attr(*, "dimnames")=List of 2
#>   .. .. .. .. .. ..$ : chr [1:4] "QUALITY" "NARTIC" "PCTGRT" "PCTSUPP"
#>   .. .. .. .. .. ..$ : chr [1:3] "NARTIC" "PCTGRT" "PCTSUPP"
#>   .. .. .. ..- attr(*, "term.labels")= chr [1:3] "NARTIC" "PCTGRT" "PCTSUPP"
#>   .. .. .. ..- attr(*, "order")= int [1:3] 1 1 1
#>   .. .. .. ..- attr(*, "intercept")= int 1
#>   .. .. .. ..- attr(*, "response")= int 1
#>   .. .. .. ..- attr(*, ".Environment")=<environment: 0x55a30e49d4b8>
#>   .. .. .. ..- attr(*, "predvars")= language list(QUALITY, NARTIC, PCTGRT, PCTSUPP)
#>   .. .. .. ..- attr(*, "dataClasses")= Named chr [1:4] "numeric" "numeric" "numeric" "numeric"
#>   .. .. .. .. ..- attr(*, "names")= chr [1:4] "QUALITY" "NARTIC" "PCTGRT" "PCTSUPP"
#>   ..- attr(*, "class")= chr "lm"
#>  $ type        : chr "hc3"
#>  $ beta        : Named num [1:3] 0.495 0.391 0.263
#>   ..- attr(*, "names")= chr [1:3] "NARTIC" "PCTGRT" "PCTSUPP"
#>  $ vcov        : num [1:3, 1:3] 0.00655 -0.00359 -0.00202 -0.00359 0.00674 ...
#>   ..- attr(*, "dimnames")=List of 2
#>   .. ..$ : chr [1:3] "NARTIC" "PCTGRT" "PCTSUPP"
#>   .. ..$ : chr [1:3] "NARTIC" "PCTGRT" "PCTSUPP"
#>  $ thetahatstar: num [1:20000, 1:3] 0.399 0.575 0.313 0.439 0.653 ...
#>   ..- attr(*, "dimnames")=List of 2
#>   .. ..$ : NULL
#>   .. ..$ : chr [1:3] "NARTIC" "PCTGRT" "PCTSUPP"
#>  $ n           : int 46
#>  $ p           : num 3
```

```
#>  $ df          : int 42
#>  - attr(*, "class")= chr [1:2] "betamc" "list"

set.seed(42)
BetaMC(object)

#> Call:
#> BetaMC(object = object)
#>
#> Standardized regression slopes.
#>  HC3 sampling variance-covariance matrix:
#>            est     se     R   0.05%   0.5%   2.5%  97.5%  99.5% 99.95%
#> NARTIC  0.4951 0.0810 20000  0.1762 0.2710 0.3212 0.6362 0.6820 0.7242
#> PCTGRT  0.3915 0.0821 20000  0.0900 0.1644 0.2189 0.5426 0.5873 0.6291
#> PCTSUPP 0.2632 0.0856 20000 -0.0387 0.0246 0.0867 0.4232 0.4749 0.5311
```

print

```
print(out)

#> Call:
#> BetaMC(object = object)
#>
#> Standardized regression slopes.
#>  HC3 sampling variance-covariance matrix:
#>            est     se     R   0.05%   0.5%   2.5%  97.5%  99.5% 99.95%
#> NARTIC  0.4951 0.0810 20000  0.1762 0.2710 0.3212 0.6362 0.6820 0.7242
#> PCTGRT  0.3915 0.0821 20000  0.0900 0.1644 0.2189 0.5426 0.5873 0.6291
#> PCTSUPP 0.2632 0.0856 20000 -0.0387 0.0246 0.0867 0.4232 0.4749 0.5311
```

coef

```
coef(out)

#>    NARTIC    PCTGRT   PCTSUPP
#> 0.4951451 0.3914887 0.2632477
```

vcov

```
vcov(out)
```

```
#>               NARTIC       PCTGRT      PCTSUPP
#> NARTIC   0.006553462 -0.003590805 -0.002023911
#> PCTGRT  -0.003590805  0.006742652 -0.002298333
#> PCTSUPP -0.002023911 -0.002298333  0.007330253
```

confint

```
confint(out, level = 0.95)

#>               2.5%     97.5%
#> NARTIC  0.32119527 0.6362478
#> PCTGRT  0.21888204 0.5425632
#> PCTSUPP 0.08665619 0.4232492
```

summary

```
summary(out)

#> Call:
#> BetaMC(object = object)
#>
#> Standardized regression slopes.
#>  HC3 sampling variance-covariance matrix:
#>            est     se     R   0.05%   0.5%   2.5%  97.5%  99.5% 99.95%
#> NARTIC  0.4951 0.0810 20000  0.1762 0.2710 0.3212 0.6362 0.6820 0.7242
#> PCTGRT  0.3915 0.0821 20000  0.0900 0.1644 0.2189 0.5426 0.5873 0.6291
#> PCTSUPP 0.2632 0.0856 20000 -0.0387 0.0246 0.0867 0.4232 0.4749 0.5311
```

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

Preacher, K. J., & Selig, J. P. (2012). Advantages of Monte Carlo confidence intervals for indirect effects. *Communication Methods and Measures*, *6*(2), 77–98. https://doi.org/10.1080/19312458.2012.679848

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