

betaDelta: Staging

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1 Standardized Slopes

```
df <- nas1982
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = df)
mvn <- BetaDelta(object, type = "mvn")
adf <- BetaDelta(object, type = "adf")
summary(mvn)

#> Call:
#> BetaDelta(object = object, type = "mvn")
#>
#> Standardized regression slopes with MVN standard errors:
#>      est      se      t      p  0.05%  0.5%  2.5% 97.5% 99.5% 99.95%
#> NARTIC  0.4951 0.0759 6.5272 0.000  0.2268 0.2905 0.3421 0.6482 0.6998 0.7635
#> PCTGRT  0.3915 0.0770 5.0824 0.000  0.1190 0.1837 0.2360 0.5469 0.5993 0.6640
#> PCTSUPP 0.2632 0.0747 3.5224 0.001 -0.0011 0.0616 0.1124 0.4141 0.4649 0.5276

summary(adf)

#> Call:
#> BetaDelta(object = object, type = "adf")
#>
#> Standardized regression slopes with ADF standard errors:
#>      est      se      t      p  0.05%  0.5%  2.5% 97.5% 99.5% 99.95%
#> NARTIC  0.4951 0.0674 7.3490 0.0000  0.2568 0.3134 0.3592 0.6311 0.6769 0.7335
#> PCTGRT  0.3915 0.0710 5.5164 0.0000  0.1404 0.2000 0.2483 0.5347 0.5830 0.6426
#> PCTSUPP 0.2632 0.0769 3.4231 0.0014 -0.0088 0.0558 0.1081 0.4184 0.4707 0.5353

coef(mvn)

#>      NARTIC      PCTGRT      PCTSUPP
#> 0.4951451 0.3914887 0.2632477

coef(adf)

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

```
vcov(mvn)

#>               NARTIC      PCTGRT      PCTSUPP
#> NARTIC    0.005754524 -0.003360334 -0.002166127
#> PCTGRT   -0.003360334  0.005933462 -0.001769723
#> PCTSUPP  -0.002166127 -0.001769723  0.005585256

vcov(adf)

#>               NARTIC      PCTGRT      PCTSUPP
#> NARTIC    0.004539472 -0.002552698 -0.001742698
#> PCTGRT   -0.002552698  0.005036538 -0.001906216
#> PCTSUPP  -0.001742698 -0.001906216  0.005914088

confint(mvn)

#>           2.5%      97.5%
#> NARTIC  0.3420563 0.6482339
#> PCTGRT  0.2360380 0.5469395
#> PCTSUPP 0.1124272 0.4140682

confint(adf)

#>           2.5%      97.5%
#> NARTIC  0.3591757 0.6311146
#> PCTGRT  0.2482683 0.5347091
#> PCTSUPP 0.1080509 0.4184444
```

2 Differences of Standardized Slopes

```
df <- nas1982
object <- lm(QUALITY ~ NARTIC + PCTGRT + PCTSUPP, data = df)
std_mvn <- BetaDelta(object, type = "mvn")
std_adf <- BetaDelta(object, type = "adf")
mvn <- DiffBetaDelta(std_mvn)
adf <- DiffBetaDelta(std_adf)
summary(mvn)

#> Call:
#> DiffBetaDelta(object = std_mvn)
#>
#> Difference between standardized regression coefficients with MVN standard errors:
#>           est      se      t      p  0.05%   0.5%   2.5%  97.5%
#> NARTIC-PCTGRT  0.1037 0.1357 0.7640 0.4491 -0.3763 -0.2624 -0.1702 0.3775
#> NARTIC-PCTSUPP 0.2319 0.1252 1.8524 0.0710 -0.2110 -0.1059 -0.0207 0.4845
```

```

#> PCTGRT-PCTSUPP 0.1282 0.1227 1.0451 0.3020 -0.3059 -0.2028 -0.1194 0.3759
#>          99.5% 99.95%
#> NARTIC-PCTGRT 0.4697 0.5837
#> NARTIC-PCTSUPP 0.5697 0.6748
#> PCTGRT-PCTSUPP 0.4593 0.5624

summary(adf)

#> Call:
#> DiffBetaDelta(object = std_adf)
#>
#> Difference between standardized regression coefficients with ADF standard errors:
#>      est      se      t      p 0.05% 0.5% 2.5% 97.5%
#> NARTIC-PCTGRT 0.1037 0.1212 0.8555 0.3971 -0.3250 -0.2233 -0.1409 0.3482
#> NARTIC-PCTSUPP 0.2319 0.1181 1.9642 0.0561 -0.1858 -0.0866 -0.0064 0.4702
#> PCTGRT-PCTSUPP 0.1282 0.1215 1.0555 0.2973 -0.3016 -0.1996 -0.1170 0.3734
#>      99.5% 99.95%
#> NARTIC-PCTGRT 0.4306 0.5323
#> NARTIC-PCTSUPP 0.5504 0.6496
#> PCTGRT-PCTSUPP 0.4561 0.5581

coef(mvn)

#> NARTIC-PCTGRT NARTIC-PCTSUPP PCTGRT-PCTSUPP
#>      0.1036564      0.2318974      0.1282410

coef(adf)

#> NARTIC-PCTGRT NARTIC-PCTSUPP PCTGRT-PCTSUPP
#>      0.1036564      0.2318974      0.1282410

vcov(mvn)

#>      NARTIC-PCTGRT NARTIC-PCTSUPP PCTGRT-PCTSUPP
#> NARTIC-PCTGRT      0.018408653      0.009511262     -0.008897391
#> NARTIC-PCTSUPP      0.009511262      0.015672035      0.006160773
#> PCTGRT-PCTSUPP     -0.008897391      0.006160773      0.015058164

vcov(adf)

#>      NARTIC-PCTGRT NARTIC-PCTSUPP PCTGRT-PCTSUPP
#> NARTIC-PCTGRT      0.014681407      0.006928651     -0.007752755
#> NARTIC-PCTSUPP      0.006928651      0.013938955      0.007010303
#> PCTGRT-PCTSUPP     -0.007752755      0.007010303      0.014763058

confint(mvn)

```

```
#>                2.5%      97.5%
#> NARTIC-PCTGRT  -0.17015387 0.3774667
#> NARTIC-PCTSUPP -0.02074216 0.4845371
#> PCTGRT-PCTSUPP -0.11940123 0.3758833

confint(adf)

#>                2.5%      97.5%
#> NARTIC-PCTGRT  -0.140868200 0.3481810
#> NARTIC-PCTSUPP -0.006364043 0.4701589
#> PCTGRT-PCTSUPP -0.116962608 0.3734447
```

References

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