

# betaDelta: Staging

Ivan Jacob Agaloos Pesigan

## 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 df      p    0.05%   0.5%   2.5%  97.5%  99.5%
#> NARTIC  0.4951 0.0759 6.5272 42 0.000   0.2268 0.2905 0.3421 0.6482 0.6998
#> PCTGRT  0.3915 0.0770 5.0824 42 0.000   0.1190 0.1837 0.2360 0.5469 0.5993
#> PCTSUPP 0.2632 0.0747 3.5224 42 0.001  -0.0011 0.0616 0.1124 0.4141 0.4649
#>      99.95%
#> NARTIC  0.7635
#> PCTGRT  0.6640
#> PCTSUPP 0.5276

summary(adf)

#> Call:
#> BetaDelta(object = object, type = "adf")
#>
#> Standardized regression slopes with ADF standard errors:
#>      est      se      t df      p    0.05%   0.5%   2.5%  97.5%  99.5%
#> NARTIC  0.4951 0.0674 7.3490 42 0.0000   0.2568 0.3134 0.3592 0.6311 0.6769
#> PCTGRT  0.3915 0.0710 5.5164 42 0.0000   0.1404 0.2000 0.2483 0.5347 0.5830
#> PCTSUPP 0.2632 0.0769 3.4231 42 0.0014  -0.0088 0.0558 0.1081 0.4184 0.4707
#>      99.95%
#> NARTIC  0.7335
#> PCTGRT  0.6426
#> PCTSUPP 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      z      p  0.05%   0.5%   2.5%  97.5%
#> NARTIC-PCTGRT  0.1037 0.1357 0.7640 0.4449 -0.3428 -0.2458 -0.1623 0.3696
#> NARTIC-PCTSUPP 0.2319 0.1252 1.8524 0.0640 -0.1800 -0.0906 -0.0135 0.4773
#> PCTGRT-PCTSUPP 0.1282 0.1227 1.0451 0.2960 -0.2755 -0.1878 -0.1123 0.3688
#>      99.5% 99.95%
#> NARTIC-PCTGRT  0.4531 0.5501
#> NARTIC-PCTSUPP 0.5544 0.6438
#> PCTGRT-PCTSUPP 0.4443 0.5320

summary(adf)

#> Call:
#> DiffBetaDelta(object = std_adf)
#>
#> Difference between standardized regression coefficients with ADF standard errors:
#>      est      se      z      p  0.05%   0.5%   2.5%  97.5%
#> NARTIC-PCTGRT  0.1037 0.1212 0.8555 0.3923 -0.2950 -0.2084 -0.1338 0.3411
#> NARTIC-PCTSUPP 0.2319 0.1181 1.9642 0.0495 -0.1566 -0.0722  0.0005 0.4633
#> PCTGRT-PCTSUPP 0.1282 0.1215 1.0555 0.2912 -0.2716 -0.1847 -0.1099 0.3664
#>      99.5% 99.95%
#> NARTIC-PCTGRT  0.4158 0.5024
#> NARTIC-PCTSUPP 0.5360 0.6204
#> PCTGRT-PCTSUPP 0.4412 0.5281

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  -0.16226855  0.3695814
#> NARTIC-PCTSUPP -0.01346652  0.4772614
#> PCTGRT-PCTSUPP -0.11226950  0.3687516

confint(adf)

#>          2.5%      97.5%
#> NARTIC-PCTGRT  -0.1338262589  0.3411391
#> NARTIC-PCTSUPP  0.0004975295  0.4632974
#> PCTGRT-PCTSUPP -0.1099011119  0.3663832

```

## References

R Core Team. (2023). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. Vienna, Austria. <https://www.R-project.org/>