Ordinal Logistic Regression or Proportional Odds Logistic Regression

Model with NP1 as reference

```
## Call:
## polr(formula = SR ~ FA + H + NP + AGR + TA + RS + DWH + DS, data = lm_DF,
##     Hess = TRUE)
##
## Coefficients:
##           Value Std. Error    t value
## FA1  -1.561e+00   0.398315 -3.9183174
## FA2  -1.797e+00   0.447391 -4.0156439
## FA3  -5.764e-01   0.588183 -0.9800153
## FA4  -1.133e-01   0.542854 -0.2087420
## FA5  -1.445e+00   0.652541 -2.2144407
## H     5.193e-01   0.159581  3.2541640
## NP2  -1.174e+00   0.229627 -5.1115925
## NP3  -1.835e+00   0.256696 -7.1486214
## AGR   5.079e-05   0.058765  0.0008643
## TA   -1.324e-02   0.009972 -1.3279489
## RS2  -3.474e-01   0.195210 -1.7793809
## DWH2 -4.074e-01   0.319198 -1.2764563
## DS2  -4.644e-01   0.224283 -2.0705957
##
## Intercepts:
##     Value   Std. Error t value
## 1|2 -3.4507  0.9938    -3.4721
## 2|3 -2.1835  0.9871    -2.2120
## 3|4 -1.1223  0.9802    -1.1449
## 4|5 -0.0768  0.9783    -0.0785
## 5|6  0.8113  0.9849     0.8238
## 6|7  2.3986  1.0265     2.3367
##
## Residual Deviance: 1182.68
## AIC: 1220.68
```

```
##              Value  Std. Error      t value p value
## FA1  -1.560725e+00 0.398315019 -3.918317429  0.0001
## FA2  -1.796564e+00 0.447391180 -4.015643938  0.0001
## FA3  -5.764288e-01 0.588183438 -0.980015312  0.3271
## FA4  -1.133164e-01 0.542853836 -0.208742025  0.8346
## FA5  -1.445014e+00 0.652541380 -2.214440747  0.0268
## H     5.193025e-01 0.159580926  3.254163986  0.0011
## NP2  -1.173762e+00 0.229627403 -5.111592473  0.0000
## NP3  -1.835023e+00 0.256696107 -7.148621442  0.0000
## AGR   5.079234e-05 0.058764505  0.000864337  0.9993
## TA   -1.324214e-02 0.009971876 -1.327948933  0.1842
## RS2  -3.473529e-01 0.195209961 -1.779380864  0.0752
## DWH2 -4.074423e-01 0.319197963 -1.276456316  0.2018
## DS2  -4.643993e-01 0.224282932 -2.070595699  0.0384
## 1|2  -3.450674e+00 0.993823483 -3.472119892  0.0005
## 2|3  -2.183509e+00 0.987139168 -2.211956176  0.0270
## 3|4  -1.122280e+00 0.980228794 -1.144915930  0.2522
## 4|5  -7.683324e-02 0.978346612 -0.078533760  0.9374
## 5|6   8.113319e-01 0.984851430  0.823811516  0.4100
## 6|7   2.398550e+00 1.026454365  2.336733661  0.0195
```

Model with NP3 as reference

```
## Call:
## polr(formula = SR ~ FA + H + NP + AGR + TA + RS + DWH + DS, data = lm_DF,
##     Hess = TRUE)
##
## Coefficients:
##           Value Std. Error    t value
## FA1  -1.561e+00   0.398315 -3.9182348
## FA2  -1.797e+00   0.447392 -4.0155512
## FA3  -5.764e-01   0.588184 -0.9799169
## FA4  -1.133e-01   0.542855 -0.2086376
## FA5  -1.445e+00   0.652543 -2.2144933
## H     5.193e-01   0.159581  3.2540864
## NP1   1.835e+00   0.256696  7.1486072
## NP2   6.613e-01   0.241297  2.7405204
## AGR   4.446e-05   0.058765  0.0007565
## TA   -1.324e-02   0.009972 -1.3280815
## RS2  -3.474e-01   0.195210 -1.7793834
## DWH2 -4.074e-01   0.319199 -1.2764574
## DS2  -4.644e-01   0.224283 -2.0705858
##
## Intercepts:
##     Value   Std. Error t value
## 1|2 -1.6158  0.9790    -1.6504
## 2|3 -0.3486  0.9778    -0.3565
## 3|4  0.7126  0.9765     0.7298
## 4|5  1.7581  0.9789     1.7960
## 5|6  2.6463  0.9884     2.6773
## 6|7  4.2335  1.0342     4.0933
##
## Residual Deviance: 1182.68
## AIC: 1220.68

##              Value  Std. Error      t value p value
## FA1  -1.5606935796 0.398315485 -3.918234758  0.0001
## FA2  -1.7965239687 0.447391627 -4.015551164  0.0001
## FA3  -0.5763718347 0.588184385 -0.979916926  0.3271
## FA4  -0.1132599822 0.542855074 -0.208637604  0.8347
## FA5  -1.4450525527 0.652543200 -2.214493313  0.0268
## H     0.5192906171 0.159581078  3.254086413  0.0011
## NP1   1.8350216390 0.256696388  7.148607153  0.0000
## NP2   0.6612785501 0.241296711  2.740520362  0.0061
## AGR   0.0000444578 0.058764554  0.000756541  0.9994
## TA   -0.0132434832 0.009971891 -1.328081479  0.1842
## RS2  -0.3473537964 0.195210207 -1.779383374  0.0752
## DWH2 -0.4074433315 0.319198542 -1.276457369  0.2018
## DS2  -0.4643976698 0.224283225 -2.070585840  0.0384
## 1|2  -1.6157744093 0.979014028 -1.650409864  0.0989
## 2|3  -0.3486073521 0.977838466 -0.356508119  0.7215
## 3|4   0.7126491828 0.976459145  0.729830005  0.4655
## 4|5   1.7580893178 0.978874936  1.796030579  0.0725
## 5|6   2.6462615692 0.988396906  2.677326843  0.0074
## 6|7   4.2334708031 1.034242375  4.093306275  0.0000
```

Model with all variables NP1, DWH2 and DS1 as reference

```
## Call:
## polr(formula = SR ~ FA + H + NP + AGR + TA + RS + DWH + DS, data = lm_DF,
##     Hess = TRUE)
##
## Coefficients:
##          Value Std. Error   t value
## FA1  -1.560908   0.398316 -3.918769
## FA2  -1.796712   0.447392 -4.015969
## FA3  -0.576785   0.588186 -0.980618
## FA4  -0.113492   0.542853 -0.209067
## FA5  -1.445357   0.652548 -2.214945
## H     0.519364   0.159582  3.254536
## NP3  -1.835028   0.256697 -7.148613
## NP2  -1.173739   0.229628 -5.111481
## AGR   0.000065   0.058765  0.001106
## TA   -0.013240   0.009972 -1.327686
## RS2  -0.347335   0.195211 -1.779282
## DWH1  0.407480   0.319199  1.276572
## DS2  -0.464389   0.224284 -2.070542
##
## Intercepts:
##     Value   Std. Error t value
## 1|2 -3.0430  0.9929    -3.0649
## 2|3 -1.7758  0.9869    -1.7994
## 3|4 -0.7145  0.9819    -0.7277
## 4|5  0.3309  0.9819     0.3370
## 5|6  1.2191  0.9881     1.2337
## 6|7  2.8063  1.0331     2.7164
##
## Residual Deviance: 1182.68
## AIC: 1220.68

##              Value  Std. Error      t value p value
## FA1  -1.560908e+00 0.398315863 -3.918768817  0.0001
## FA2  -1.796712e+00 0.447391861 -4.015969131  0.0001
## FA3  -5.767852e-01 0.588185719 -0.980617511  0.3268
## FA4  -1.134925e-01 0.542853303 -0.209066539  0.8344
## FA5  -1.445357e+00 0.652547728 -2.214944815  0.0268
## H     5.193640e-01 0.159581596  3.254535534  0.0011
## NP3  -1.835028e+00 0.256697078 -7.148613012  0.0000
## NP2  -1.173739e+00 0.229628035 -5.111480583  0.0000
## AGR   6.500072e-05 0.058764744  0.001106118  0.9991
## TA   -1.323956e-02 0.009971902 -1.327686409  0.1843
## RS2  -3.473346e-01 0.195210501 -1.779282423  0.0752
## DWH1  4.074803e-01 0.319198872  1.276571807  0.2018
## DS2  -4.643888e-01 0.224283745 -2.070541542  0.0384
## 1|2  -3.042987e+00 0.992856310 -3.064881727  0.0022
## 2|3  -1.775786e+00 0.986862765 -1.799425701  0.0720
## 3|4  -7.145408e-01 0.981893714 -0.727717050  0.4668
## 4|5   3.308927e-01 0.981929398  0.336982142  0.7361
## 5|6   1.219068e+00 0.988143434  1.233695753  0.2173
## 6|7   2.806258e+00 1.033076673  2.716408265  0.0066
```

Model with all variables, NP3, DWH1 and DS1 as reference

```
## Call:
## polr(formula = SR ~ FA + H + NP + AGR + TA + RS + DWH + DS, data = lm_DF,
##     Hess = TRUE)
##
## Coefficients:
##           Value Std. Error    t value
## FA1  -1.561e+00   0.398315 -3.9182348
## FA2  -1.797e+00   0.447392 -4.0155512
## FA3  -5.764e-01   0.588184 -0.9799169
## FA4  -1.133e-01   0.542855 -0.2086376
## FA5  -1.445e+00   0.652543 -2.2144933
## H     5.193e-01   0.159581  3.2540864
## NP1   1.835e+00   0.256696  7.1486072
## NP2   6.613e-01   0.241297  2.7405204
## AGR   4.446e-05   0.058765  0.0007565
## TA   -1.324e-02   0.009972 -1.3280815
## RS2  -3.474e-01   0.195210 -1.7793834
## DWH2 -4.074e-01   0.319199 -1.2764574
## DS2  -4.644e-01   0.224283 -2.0705858
##
## Intercepts:
##     Value   Std. Error t value
## 1|2 -1.6158  0.9790    -1.6504
## 2|3 -0.3486  0.9778    -0.3565
## 3|4  0.7126  0.9765     0.7298
## 4|5  1.7581  0.9789     1.7960
## 5|6  2.6463  0.9884     2.6773
## 6|7  4.2335  1.0342     4.0933
##
## Residual Deviance: 1182.68
## AIC: 1220.68

##              Value  Std. Error      t value p value
## FA1  -1.5606935796 0.398315485 -3.918234758  0.0001
## FA2  -1.7965239687 0.447391627 -4.015551164  0.0001
## FA3  -0.5763718347 0.588184385 -0.979916926  0.3271
## FA4  -0.1132599822 0.542855074 -0.208637604  0.8347
## FA5  -1.4450525527 0.652543200 -2.214493313  0.0268
## H     0.5192906171 0.159581078  3.254086413  0.0011
## NP1   1.8350216390 0.256696388  7.148607153  0.0000
## NP2   0.6612785501 0.241296711  2.740520362  0.0061
## AGR   0.0000444578 0.058764554  0.000756541  0.9994
## TA   -0.0132434832 0.009971891 -1.328081479  0.1842
## RS2  -0.3473537964 0.195210207 -1.779383374  0.0752
## DWH2 -0.4074433315 0.319198542 -1.276457369  0.2018
## DS2  -0.4643976698 0.224283225 -2.070585840  0.0384
## 1|2  -1.6157744093 0.979014028 -1.650409864  0.0989
## 2|3  -0.3486073521 0.977838466 -0.356508119  0.7215
## 3|4   0.7126491828 0.976459145  0.729830005  0.4655
## 4|5   1.7580893178 0.978874936  1.796030579  0.0725
## 5|6   2.6462615692 0.988396906  2.677326843  0.0074
## 6|7   4.2334708031 1.034242375  4.093306275  0.0000
```

Model with all variables, NP3, DWH1 and DS1 as reference(New Model)

```
## Call:
## polr(formula = SR ~ Rank + NASA + TA + EM + H + NP + FA + DWH +
##     DS + T, data = lm_DF, Hess = TRUE)
##
## Coefficients:
##           Value Std. Error t value
## Rank1 -0.386249    0.29441 -1.3119
## Rank2  0.118220    0.30233  0.3910
## NASA   0.003953    0.01790  0.2209
## TA    -0.023822    0.01475 -1.6150
## EM     0.029779    0.02429  1.2262
## H      0.460768    0.19096  2.4129
## NP1    1.805562    0.26611  6.7851
## NP2    0.614030    0.24554  2.5008
## FA1   -1.493162    0.40388 -3.6970
## FA2   -1.733793    0.45352 -3.8230
## FA3   -0.464133    0.59967 -0.7740
## FA4   -0.069584    0.54802 -0.1270
## FA5   -1.430636    0.65966 -2.1688
## DWH2  -0.368726    0.31967 -1.1535
## DS2   -0.448294    0.23583 -1.9010
## T2     0.257691    0.20038  1.2860
##
## Intercepts:
##     Value   Std. Error t value
## 1|2 -1.2397  0.8946    -1.3858
## 2|3  0.0429  0.8945     0.0480
## 3|4  1.1119  0.8942     1.2435
## 4|5  2.1569  0.8977     2.4026
## 5|6  3.0396  0.9079     3.3479
## 6|7  4.6424  0.9608     4.8317
##
## Residual Deviance: 1178.701
## AIC: 1222.701
```

```
##              Value Std. Error     t value p value
## Rank1 -0.386249325 0.29441428 -1.31192458  0.1895
## Rank2  0.118219704 0.30232624  0.39103356  0.6958
## NASA   0.003953345 0.01789954  0.22086297  0.8252
## TA    -0.023822422 0.01475077 -1.61499513  0.1063
## EM     0.029778712 0.02428508  1.22621425  0.2201
## H      0.460767551 0.19095773  2.41292962  0.0158
## NP1    1.805562117 0.26610804  6.78507162  0.0000
## NP2    0.614030497 0.24553565  2.50077945  0.0124
## FA1   -1.493162439 0.40388202 -3.69702627  0.0002
## FA2   -1.733792683 0.45351661 -3.82299706  0.0001
## FA3   -0.464133352 0.59966787 -0.77398403  0.4389
## FA4   -0.069584469 0.54802465 -0.12697325  0.8990
## FA5   -1.430636307 0.65965784 -2.16875512  0.0301
## DWH2  -0.368725543 0.31966861 -1.15346186  0.2487
## DS2   -0.448294330 0.23582502 -1.90096173  0.0573
## T2     0.257691299 0.20038318  1.28599267  0.1984
```

```
## 1|2   -1.239681289 0.89455450 -1.38580857  0.1658
## 2|3    0.042894671 0.89450055  0.04795377  0.9618
## 3|4    1.111873188 0.89417778  1.24345876  0.2137
## 4|5    2.156889260 0.89774992  2.40255022  0.0163
## 5|6    3.039558758 0.90789929  3.34790301  0.0008
## 6|7    4.642437870 0.96082259  4.83173263  0.0000
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