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
## FA2  -2.358e-01   0.257258 -0.9167714
## FA3   9.843e-01   0.473689  2.0779440
## FA4   1.447e+00   0.413619  3.4993461
## FA5   1.157e-01   0.541963  0.2135295
## FA6   1.561e+00   0.398315  3.9182682
## H     5.193e-01   0.159581  3.2541555
## NP2  -1.174e+00   0.229627 -5.1115744
## NP3  -1.835e+00   0.256696 -7.1485927
## AGR   5.048e-05   0.058765  0.0008591
## TA   -1.324e-02   0.009972 -1.3279510
## RS2  -3.474e-01   0.195210 -1.7793778
## DWH2 -4.074e-01   0.319198 -1.2764647
## DS2  -4.644e-01   0.224283 -2.0705912
##
## Intercepts:
##     Value   Std. Error t value
## 1|2 -1.8900  0.9131    -2.0699
## 2|3 -0.6228  0.9104    -0.6840
## 3|4  0.4384  0.9074     0.4832
## 4|5  1.4839  0.9095     1.6316
## 5|6  2.3720  0.9211     2.5751
## 6|7  3.9593  0.9750     4.0607
##
## Residual Deviance: 1182.68
## AIC: 1220.68
```

```
##              Value  Std. Error       t value p value
## FA2  -2.358465e-01 0.257257639 -0.9167714164  0.3593
## FA3   9.842997e-01 0.473689254  2.0779439604  0.0377
## FA4   1.447397e+00 0.413619261  3.4993461337  0.0005
## FA5   1.157251e-01 0.541963059  0.2135295287  0.8309
## FA6   1.560704e+00 0.398314871  3.9182681903  0.0001
## H     5.193013e-01 0.159580977  3.2541555084  0.0011
## NP2  -1.173758e+00 0.229627459 -5.1115743669  0.0000
## NP3  -1.835016e+00 0.256696126 -7.1485927346  0.0000
## AGR   5.048386e-05 0.058764538  0.0008590872  0.9993
## TA   -1.324217e-02 0.009971879 -1.3279510250  0.1842
## RS2  -3.473524e-01 0.195210037 -1.7793778362  0.0752
## DWH2 -4.074449e-01 0.319197927 -1.2764646768  0.2018
## DS2  -4.643984e-01 0.224283001 -2.0705911841  0.0384
## 1|2  -1.889970e+00 0.913076824 -2.0698912030  0.0385
## 2|3  -6.227850e-01 0.910446270 -0.6840436516  0.4939
## 3|4   4.384399e-01 0.907366420  0.4832005141  0.6290
## 4|5   1.483884e+00 0.909474008  1.6315853150  0.1028
## 5|6   2.372045e+00 0.921149753  2.5750918065  0.0100
## 6|7   3.959253e+00 0.975013007  4.0607183223  0.0000
```

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
## FA2  -2.358e-01   0.257257 -0.9167501
## FA3   9.843e-01   0.473689  2.0779710
## FA4   1.447e+00   0.413620  3.4993642
## FA5   1.157e-01   0.541963  0.2135247
## FA6   1.561e+00   0.398315  3.9182688
## H     5.193e-01   0.159581  3.2541582
## NP1   1.835e+00   0.256696  7.1486226
## NP2   6.613e-01   0.241296  2.7404439
## AGR   5.038e-05   0.058764  0.0008573
## TA   -1.324e-02   0.009972 -1.3279491
## RS2  -3.474e-01   0.195210 -1.7793827
## DWH2 -4.074e-01   0.319198 -1.2764666
## DS2  -4.644e-01   0.224283 -2.0705937
##
## Intercepts:
##     Value   Std. Error t value
## 1|2 -0.0549  0.9085    -0.0605
## 2|3  1.2122  0.9119     1.3293
## 3|4  2.2735  0.9148     2.4851
## 4|5  3.3189  0.9215     3.6017
## 5|6  4.2071  0.9362     4.4938
## 6|7  5.7943  0.9938     5.8304
##
## Residual Deviance: 1182.68
## AIC: 1220.68
```

```
##              Value  Std. Error       t value p value
## FA2  -2.358407e-01 0.257257345 -0.9167500822  0.3593
## FA3   9.843119e-01 0.473688921  2.0779710460  0.0377
## FA4   1.447405e+00 0.413619542  3.4993642120  0.0005
## FA5   1.157224e-01 0.541962709  0.2135247382  0.8309
## FA6   1.560705e+00 0.398314939  3.9182688478  0.0001
## H     5.193013e-01 0.159580842  3.2541582383  0.0011
## NP1   1.835023e+00 0.256695975  7.1486225889  0.0000
## NP2   6.612592e-01 0.241296384  2.7404438621  0.0061
## AGR   5.037969e-05 0.058764472  0.0008573154  0.9993
## TA   -1.324214e-02 0.009971872 -1.3279491178  0.1842
## RS2  -3.473531e-01 0.195209871 -1.7793826561  0.0752
## DWH2 -4.074454e-01 0.319197857 -1.2764665983  0.2018
## DS2  -4.643986e-01 0.224282838 -2.0705936904  0.0384
## 1|2  -5.493155e-02 0.908538516 -0.0604614459  0.9518
## 2|3   1.212222e+00 0.911913702  1.3293170259  0.1837
## 3|4   2.273453e+00 0.914815812  2.4851483986  0.0129
## 4|5   3.318901e+00 0.921481118  3.6017030194  0.0003
## 5|6   4.207066e+00 0.936196227  4.4937866890  0.0000
## 6|7   5.794289e+00 0.993806335  5.8304001570  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
## FA2  -2.358e-01   0.257258 -0.9167710
## FA3   9.843e-01   0.473690  2.0778770
## FA4   1.447e+00   0.413619  3.4993492
## FA5   1.157e-01   0.541963  0.2135237
## FA6   1.561e+00   0.398315  3.9182679
## H     5.193e-01   0.159581  3.2541674
## NP3  -1.835e+00   0.256696 -7.1486163
## NP2  -1.174e+00   0.229628 -5.1116005
## AGR   5.049e-05   0.058765  0.0008593
## TA   -1.324e-02   0.009972 -1.3279556
## RS2  -3.474e-01   0.195210 -1.7794169
## DWH1  4.074e-01   0.319198  1.2764070
## DS2  -4.644e-01   0.224283 -2.0705785
##
## Intercepts:
##     Value   Std. Error t value
## 1|2 -1.4825  0.8983    -1.6503
## 2|3 -0.2153  0.8964    -0.2402
## 3|4  0.8459  0.8954     0.9446
## 4|5  1.8913  0.8997     2.1022
## 5|6  2.7795  0.9112     3.0504
## 6|7  4.3667  0.9693     4.5050
##
## Residual Deviance: 1182.68
## AIC: 1220.68

##              Value Std. Error       t value p value
## FA2  -2.358464e-01 0.25725766 -0.9167709586  0.3593
## FA3   9.842690e-01 0.47368974  2.0778770320  0.0377
## FA4   1.447398e+00 0.41361929  3.4993492481  0.0005
## FA5   1.157220e-01 0.54196347  0.2135236909  0.8309
## FA6   1.560705e+00 0.39831497  3.9182678728  0.0001
## H     5.193035e-01 0.15958106  3.2541674149  0.0011
## NP3  -1.835023e+00 0.25669621 -7.1486163019  0.0000
## NP2  -1.173764e+00 0.22962758 -5.1116004573  0.0000
## AGR   5.049423e-05 0.05876455  0.0008592635  0.9993
## TA   -1.324221e-02 0.00997188 -1.3279555928  0.1842
## RS2  -3.473601e-01 0.19521008 -1.7794168598  0.0752
## DWH1  4.074267e-01 0.31919813  1.2764069814  0.2018
## DS2  -4.643956e-01 0.22428303 -2.0705784942  0.0384
## 1|2  -1.482532e+00 0.89834883 -1.6502852110  0.0989
## 2|3  -2.153488e-01 0.89644235 -0.2402260872  0.8102
## 3|4   8.458822e-01 0.89544527  0.9446498211  0.3448
## 4|5   1.891325e+00 0.89967078  2.1022416321  0.0355
## 5|6   2.779486e+00 0.91118234  3.0504169580  0.0023
## 6|7   4.366690e+00 0.96929539  4.5050147986  0.0000
```

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
## FA2  -2.358e-01   0.257257 -0.9167501
## FA3   9.843e-01   0.473689  2.0779710
## FA4   1.447e+00   0.413620  3.4993642
## FA5   1.157e-01   0.541963  0.2135247
## FA6   1.561e+00   0.398315  3.9182688
## H     5.193e-01   0.159581  3.2541582
## NP1   1.835e+00   0.256696  7.1486226
## NP2   6.613e-01   0.241296  2.7404439
## AGR   5.038e-05   0.058764  0.0008573
## TA   -1.324e-02   0.009972 -1.3279491
## RS2  -3.474e-01   0.195210 -1.7793827
## DWH2 -4.074e-01   0.319198 -1.2764666
## DS2  -4.644e-01   0.224283 -2.0705937
##
## Intercepts:
##     Value   Std. Error t value
## 1|2 -0.0549  0.9085    -0.0605
## 2|3  1.2122  0.9119     1.3293
## 3|4  2.2735  0.9148     2.4851
## 4|5  3.3189  0.9215     3.6017
## 5|6  4.2071  0.9362     4.4938
## 6|7  5.7943  0.9938     5.8304
##
## Residual Deviance: 1182.68
## AIC: 1220.68
```

```
##              Value  Std. Error       t value p value
## FA2  -2.358407e-01 0.257257345 -0.9167500822  0.3593
## FA3   9.843119e-01 0.473688921  2.0779710460  0.0377
## FA4   1.447405e+00 0.413619542  3.4993642120  0.0005
## FA5   1.157224e-01 0.541962709  0.2135247382  0.8309
## FA6   1.560705e+00 0.398314939  3.9182688478  0.0001
## H     5.193013e-01 0.159580842  3.2541582383  0.0011
## NP1   1.835023e+00 0.256695975  7.1486225889  0.0000
## NP2   6.612592e-01 0.241296384  2.7404438621  0.0061
## AGR   5.037969e-05 0.058764472  0.0008573154  0.9993
## TA   -1.324214e-02 0.009971872 -1.3279491178  0.1842
## RS2  -3.473531e-01 0.195209871 -1.7793826561  0.0752
## DWH2 -4.074454e-01 0.319197857 -1.2764665983  0.2018
## DS2  -4.643986e-01 0.224282838 -2.0705936904  0.0384
## 1|2  -5.493155e-02 0.908538516 -0.0604614459  0.9518
## 2|3   1.212222e+00 0.911913702  1.3293170259  0.1837
## 3|4   2.273453e+00 0.914815812  2.4851483986  0.0129
## 4|5   3.318901e+00 0.921481118  3.6017030194  0.0003
## 5|6   4.207066e+00 0.936196227  4.4937866890  0.0000
## 6|7   5.794289e+00 0.993806335  5.8304001570  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 -0.386246    0.29441 -1.3119
## Rank2  0.118230    0.30233  0.3911
## NASA   0.003953    0.01790  0.2208
## TA    -0.023823    0.01475 -1.6150
## EM     0.029778    0.02429  1.2262
## H      0.460752    0.19096  2.4128
## NP1    1.805548    0.26611  6.7850
## NP2    0.614014    0.24554  2.5007
## FA2   -0.240627    0.25886 -0.9296
## FA3    1.029019    0.48216  2.1342
## FA4    1.423594    0.41635  3.4192
## FA5    0.062537    0.54589  0.1146
## FA6    1.493164    0.40388  3.6970
## DWH2  -0.368744    0.31967 -1.1535
## DS2   -0.448282    0.23583 -1.9009
## T2     0.257677    0.20038  1.2859
##
## Intercepts:
##     Value   Std. Error t value
## 1|2  0.2534  0.8231     0.3078
## 2|3  1.5360  0.8278     1.8555
## 3|4  2.6049  0.8319     3.1315
## 4|5  3.6499  0.8399     4.3457
## 5|6  4.5326  0.8559     5.2959
## 6|7  6.1355  0.9228     6.6491
##
## Residual Deviance: 1178.701
## AIC: 1222.701
```

```
##              Value Std. Error    t value p value
## Rank1 -0.386245575 0.29441438 -1.3119114  0.1896
## Rank2  0.118230194 0.30232635  0.3910681  0.6957
## NASA   0.003952767 0.01789954  0.2208306  0.8252
## TA    -0.023822703 0.01475078 -1.6150131  0.1063
## EM     0.029777789 0.02428510  1.2261754  0.2201
## H      0.460752051 0.19095780  2.4128475  0.0158
## NP1    1.805547526 0.26610795  6.7850191  0.0000
## NP2    0.614013801 0.24553561  2.5007118  0.0124
## FA2   -0.240627024 0.25886317 -0.9295529  0.3526
## FA3    1.029018768 0.48216296  2.1341722  0.0328
## FA4    1.423593819 0.41634692  3.4192491  0.0006
## FA5    0.062536966 0.54588646  0.1145604  0.9088
## FA6    1.493164495 0.40388207  3.6970309  0.0002
## DWH2  -0.368743557 0.31966883 -1.1535174  0.2487
## DS2   -0.448282381 0.23582505 -1.9009107  0.0573
## T2     0.257677343 0.20038329  1.2859223  0.1985
```

```
## 1|2    0.253365520 0.82314282  0.3078026  0.7582
## 2|3    1.535951155 0.82778284  1.8555001  0.0635
## 3|4    2.604931177 0.83185169  3.1314851  0.0017
## 4|5    3.649947600 0.83989806  4.3457031  0.0000
## 5|6    4.532618728 0.85587971  5.2958595  0.0000
## 6|7    6.135500594 0.92275074  6.6491419  0.0000
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