# Undergraduates' Comparative Judgement Analysis

```
## Rows: 3,210
## Columns: 6
## $ Judge                <int> 234567, 234567, 234567, 234567, 234567, 234567, 2~
## $ Candidate.Chosen     <int> 301, 107, 103, 102, 404, 405, 107, 103, 106, 401,~
## $ Candidate.Not.Chosen <int> 101, 101, 402, 107, 102, 402, 403, 102, 401, 104,~
## $ Time.Taken           <dbl> 4.9, 6.0, 7.9, 8.7, 9.7, 10.7, 13.4, 13.4, 17.8, ~
## $ Internal             <lgl> TRUE, TRUE, TRUE, TRUE, TRUE, TRUE, TRUE, TRUE, T~
## $ Date.Created         <chr> "15/02/2019 10:43", "15/02/2019 10:42", "15/02/20~
```

Here it is worth noting that there were actually 220 judges who made 15 comparisons, however, 6 of these judges had asterixes in their data row in R

#Number of judges =

```
## [1] 214
```

List of number of judgements per judge =

```
##   [1] 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15
##  [26] 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15
##  [51] 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15
##  [76] 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15
## [101] 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15
## [126] 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15
## [151] 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15
## [176] 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15 15
## [201] 15 15 15 15 15 15 15 15 15 15 15 15 15 15
```

Number of scripts =

```
## [1] 16
```

List of number of judgements per script =

```
##  [1] 399 400 400 400 400 400 400 401 401 401 402 402 403 403 404 404
```

## Fit to Bradley Terry model.

###SSR=

```
## [1] 0.92
```

###Summary of parameter estimates

Codes:

individual = filename ('script')

Ntot = number of judgements

theta = the parameter estimate

```
## Rows: 16
## Columns: 5
## $ individual <dbl> 101, 102, 103, 104, 105, 106, 107, 301, 302, 401, 402, 403,~
```

```
## $ Ntot       <dbl> 400, 401, 401, 400, 403, 399, 402, 402, 403, 400, 400, 400,~
## $ theta      <dbl> -0.379084354, 0.637388240, 0.605933138, -0.238972160, -0.07~
## $ se.theta   <dbl> 0.1033011, 0.1065991, 0.1061936, 0.1021830, 0.1011143, 0.10~
## $ infit      <dbl> 1.0240825, 1.0059496, 1.0163122, 1.0127568, 1.0136805, 1.00~
```

###Judge misfits

Number of misfits=

```
## [1] 0
```

Misfit threshold (3 SDs above mean) =

```
## [1] 0.6430521
```

Table of misfits (shows '0 rows' if na)

```
## [1] Judge   total   average
## <0 rows> (or 0-length row.names)
```

###Script misfits

Number of misfits=

```
## [1] 0
```

Misfit threshold (3 SDs above mean) =

```
## [1] 1.042191
```

Table of misfits (shows '0 rows' if na)

```
## [1] candidate wms
## <0 rows> (or 0-length row.names)
```

###Inter-rater reliability

Number of iterations =

```
## [1] 1000
```

Median Pearson =

```
## [1] 0.832
```

Mean Pearson =

```
## [1] 0.827
```

List of actual correlations =

```
##    [1] 0.525 0.608 0.615 0.616 0.629 0.631 0.648 0.648 0.651 0.652 0.657 0.666
##   [13] 0.669 0.670 0.672 0.675 0.676 0.677 0.677 0.678 0.679 0.679 0.682 0.682
##   [25] 0.684 0.689 0.691 0.693 0.695 0.697 0.697 0.699 0.704 0.704 0.704 0.707
##   [37] 0.707 0.708 0.709 0.709 0.710 0.710 0.710 0.712 0.713 0.715 0.717 0.718
##   [49] 0.718 0.718 0.718 0.723 0.723 0.723 0.723 0.724 0.724 0.725 0.726 0.729
##   [61] 0.730 0.730 0.731 0.732 0.732 0.732 0.732 0.733 0.733 0.734 0.734 0.734
##   [73] 0.734 0.735 0.737 0.738 0.738 0.738 0.738 0.739 0.741 0.741 0.741 0.741
##   [85] 0.742 0.742 0.743 0.743 0.744 0.744 0.744 0.745 0.746 0.747 0.747 0.748
##   [97] 0.748 0.748 0.748 0.749 0.751 0.751 0.751 0.752 0.752 0.752 0.752 0.752
##  [109] 0.752 0.752 0.752 0.752 0.753 0.753 0.753 0.753 0.754 0.754 0.754 0.754
##  [121] 0.755 0.755 0.755 0.755 0.756 0.756 0.756 0.757 0.757 0.757 0.758 0.758
##  [133] 0.758 0.758 0.759 0.759 0.759 0.759 0.761 0.761 0.761 0.762 0.762 0.762
##  [145] 0.762 0.763 0.763 0.763 0.763 0.763 0.764 0.764 0.765 0.765 0.765 0.765
##  [157] 0.765 0.767 0.767 0.767 0.768 0.768 0.768 0.768 0.768 0.769 0.769 0.769
```

```
##  [169] 0.770 0.770 0.770 0.772 0.772 0.773 0.773 0.773 0.774 0.774 0.774 0.774
##  [181] 0.774 0.774 0.774 0.774 0.775 0.775 0.776 0.776 0.776 0.776 0.776 0.776
##  [193] 0.777 0.777 0.778 0.779 0.779 0.779 0.779 0.779 0.780 0.780 0.780 0.780
##  [205] 0.780 0.780 0.780 0.780 0.780 0.781 0.781 0.781 0.781 0.782 0.782 0.782
##  [217] 0.782 0.782 0.782 0.783 0.783 0.784 0.784 0.784 0.784 0.784 0.785 0.785
##  [229] 0.785 0.785 0.785 0.786 0.786 0.786 0.786 0.786 0.787 0.787 0.787 0.787
##  [241] 0.787 0.787 0.788 0.788 0.788 0.788 0.788 0.788 0.788 0.789 0.789 0.789
##  [253] 0.789 0.790 0.790 0.790 0.790 0.790 0.791 0.791 0.791 0.791 0.792 0.792
##  [265] 0.792 0.792 0.792 0.792 0.793 0.793 0.793 0.793 0.793 0.793 0.794 0.794
##  [277] 0.794 0.794 0.794 0.795 0.796 0.796 0.796 0.796 0.797 0.797 0.797 0.798
##  [289] 0.798 0.798 0.798 0.798 0.798 0.798 0.799 0.799 0.799 0.799 0.799 0.800
##  [301] 0.800 0.800 0.800 0.801 0.801 0.801 0.801 0.802 0.802 0.802 0.802 0.802
##  [313] 0.802 0.802 0.803 0.803 0.803 0.803 0.803 0.804 0.804 0.804 0.804 0.804
##  [325] 0.804 0.804 0.805 0.805 0.805 0.805 0.806 0.806 0.806 0.806 0.806 0.806
##  [337] 0.806 0.806 0.806 0.806 0.806 0.807 0.807 0.807 0.808 0.808 0.808 0.808
##  [349] 0.808 0.808 0.809 0.809 0.809 0.809 0.810 0.810 0.810 0.811 0.811 0.811
##  [361] 0.811 0.811 0.811 0.812 0.812 0.812 0.812 0.812 0.812 0.812 0.812 0.812
##  [373] 0.813 0.813 0.813 0.813 0.813 0.813 0.814 0.814 0.814 0.814 0.814 0.815
##  [385] 0.815 0.815 0.815 0.815 0.815 0.815 0.815 0.816 0.816 0.816 0.816 0.816
##  [397] 0.816 0.817 0.817 0.817 0.817 0.817 0.817 0.817 0.818 0.818 0.818 0.818
##  [409] 0.818 0.818 0.818 0.819 0.819 0.819 0.819 0.819 0.819 0.820 0.820 0.820
##  [421] 0.820 0.820 0.820 0.820 0.821 0.821 0.822 0.822 0.822 0.822 0.822 0.822
##  [433] 0.822 0.822 0.822 0.823 0.823 0.823 0.823 0.823 0.823 0.823 0.824 0.824
##  [445] 0.824 0.824 0.824 0.825 0.825 0.825 0.825 0.825 0.825 0.825 0.825 0.826
##  [457] 0.826 0.826 0.826 0.826 0.826 0.826 0.826 0.827 0.827 0.827 0.827 0.827
##  [469] 0.827 0.827 0.828 0.828 0.828 0.828 0.828 0.828 0.828 0.828 0.828 0.828
##  [481] 0.828 0.828 0.829 0.829 0.829 0.829 0.829 0.829 0.830 0.830 0.830 0.830
##  [493] 0.831 0.831 0.831 0.831 0.832 0.832 0.832 0.832 0.832 0.833 0.833 0.834
##  [505] 0.834 0.834 0.834 0.834 0.835 0.835 0.835 0.835 0.835 0.835 0.835 0.836
##  [517] 0.836 0.836 0.836 0.836 0.837 0.837 0.837 0.837 0.837 0.837 0.837 0.837
##  [529] 0.838 0.838 0.839 0.839 0.839 0.840 0.840 0.840 0.840 0.840 0.841 0.841
##  [541] 0.841 0.841 0.841 0.841 0.841 0.841 0.841 0.842 0.842 0.842 0.842 0.842
##  [553] 0.842 0.842 0.842 0.843 0.843 0.843 0.843 0.843 0.843 0.843 0.843 0.843
##  [565] 0.843 0.843 0.843 0.843 0.844 0.844 0.844 0.844 0.844 0.844 0.844 0.845
##  [577] 0.845 0.845 0.846 0.846 0.846 0.846 0.846 0.846 0.846 0.846 0.846 0.846
##  [589] 0.846 0.847 0.847 0.847 0.847 0.847 0.847 0.848 0.848 0.848 0.848 0.848
##  [601] 0.848 0.849 0.849 0.849 0.849 0.849 0.849 0.849 0.850 0.850 0.850 0.850
##  [613] 0.850 0.850 0.850 0.851 0.851 0.851 0.851 0.851 0.852 0.852 0.852 0.852
##  [625] 0.852 0.852 0.852 0.852 0.852 0.852 0.852 0.853 0.853 0.853 0.853 0.853
##  [637] 0.853 0.854 0.854 0.854 0.854 0.854 0.854 0.854 0.854 0.855 0.855 0.855
##  [649] 0.856 0.856 0.856 0.856 0.856 0.856 0.856 0.856 0.857 0.857 0.857 0.857
##  [661] 0.857 0.857 0.857 0.858 0.858 0.858 0.858 0.858 0.858 0.858 0.858 0.858
##  [673] 0.859 0.859 0.859 0.859 0.860 0.860 0.860 0.861 0.861 0.861 0.861 0.861
##  [685] 0.861 0.861 0.861 0.861 0.861 0.861 0.862 0.862 0.862 0.862 0.862 0.862
##  [697] 0.862 0.863 0.863 0.863 0.863 0.863 0.863 0.863 0.863 0.863 0.863 0.863
##  [709] 0.864 0.864 0.864 0.864 0.864 0.865 0.865 0.865 0.866 0.866 0.866 0.866
##  [721] 0.867 0.867 0.867 0.867 0.867 0.867 0.868 0.868 0.868 0.868 0.868 0.868
##  [733] 0.868 0.868 0.868 0.869 0.869 0.869 0.869 0.869 0.869 0.869 0.869 0.870
##  [745] 0.870 0.870 0.870 0.870 0.870 0.870 0.870 0.871 0.871 0.871 0.871 0.871
##  [757] 0.871 0.871 0.872 0.872 0.872 0.872 0.872 0.872 0.872 0.872 0.873 0.873
##  [769] 0.873 0.873 0.873 0.873 0.873 0.873 0.873 0.873 0.874 0.874 0.874 0.875
##  [781] 0.875 0.875 0.875 0.875 0.875 0.876 0.876 0.876 0.876 0.876 0.876 0.876
##  [793] 0.877 0.877 0.877 0.877 0.878 0.878 0.878 0.878 0.878 0.878 0.879 0.879
##  [805] 0.879 0.879 0.879 0.880 0.880 0.880 0.880 0.880 0.881 0.881 0.881 0.881
```

```
##  [817] 0.882 0.882 0.882 0.882 0.883 0.883 0.883 0.883 0.883 0.883 0.883 0.883
##  [829] 0.883 0.883 0.883 0.883 0.884 0.884 0.884 0.885 0.885 0.885 0.885 0.886
##  [841] 0.886 0.886 0.887 0.887 0.887 0.887 0.888 0.888 0.888 0.888 0.889 0.889
##  [853] 0.890 0.890 0.890 0.890 0.891 0.891 0.891 0.892 0.892 0.892 0.893 0.893
##  [865] 0.893 0.893 0.893 0.893 0.894 0.894 0.894 0.895 0.895 0.895 0.895 0.895
##  [877] 0.895 0.895 0.895 0.895 0.896 0.896 0.896 0.896 0.897 0.897 0.897 0.897
##  [889] 0.898 0.898 0.898 0.898 0.898 0.899 0.899 0.899 0.899 0.899 0.900 0.900
##  [901] 0.900 0.901 0.901 0.901 0.902 0.902 0.902 0.902 0.903 0.903 0.903 0.903
##  [913] 0.903 0.904 0.904 0.904 0.904 0.904 0.904 0.904 0.905 0.905 0.905 0.905
##  [925] 0.905 0.905 0.905 0.906 0.906 0.907 0.907 0.908 0.908 0.908 0.908 0.909
##  [937] 0.909 0.909 0.909 0.910 0.910 0.910 0.911 0.913 0.913 0.913 0.913 0.913
##  [949] 0.913 0.913 0.914 0.914 0.915 0.915 0.915 0.915 0.915 0.916 0.916 0.916
##  [961] 0.918 0.918 0.918 0.918 0.918 0.919 0.920 0.920 0.922 0.923 0.923 0.924
##  [973] 0.924 0.925 0.925 0.926 0.926 0.926 0.927 0.928 0.928 0.928 0.930 0.930
##  [985] 0.930 0.935 0.936 0.936 0.942 0.942 0.943 0.944 0.946 0.948 0.948 0.951
##  [997] 0.952 0.955 0.957 0.959
```

Code to randomly choose two groups of 30 to calculate inter-rater reliability (From Prof. Matthew Inglis)

Adjusted Mean Pearson:

```
## [1] 0.551537
```

The code from NMM marking website:

```
## Loading required package: ggplot2
```

```
## Warning: package 'ggplot2' was built under R version 4.0.5
```

```
## **** Iteration 1 | Maximum parameter change=0.0967943
## **** Iteration 2 | Maximum parameter change=0.0027408
## **** Iteration 3 | Maximum parameter change=0.0001897
## **** Iteration 4 | Maximum parameter change=1.71e-05
```

```
## ------------------------------------------------------------
## sirt 3.9-4 (2020-02-17 12:57:09)
## R version 4.0.4 (2021-02-15) x86_64, mingw32 | nodename=DESKTOP-SNFUENT | login=betha
## Date of Analysis: 2022-05-28 14:24:15
## Time difference of 0.02898693 secs
## Computation Time: 0.02898693
##
##
## Call:
## btm(data = df, ignore.ties = TRUE, fix.eta = 0, maxiter = 400,
##     eps = 0.3)
##
## Bradley-Terry Model with Ties and Home Advantage Parameters
## ------------------------------------------------------------
## Number of iterations = 4
## Number of individuals = 16
## Number of pairwise comparisons = 3210
## ------------------------------------------------------------
## Ties and Home advantage parameters
##   parlabel   par est se
## 1     Ties delta -99 NA
## 2     Home   eta   0 NA
## ------------------------------------------------------------
## Summary of individual effects parameters
```

```
##   M  median    SD     min    max
## 1 0 -0.1118 0.357 -0.4373 0.6374
## ------------------------------------------------------------
## MLE reliability (separation reliability)
## MLE Rel=0.9169
## Separation index=3.468
## ------------------------------------------------------------
## Individual effects parameters
##    individual id Ntot  N1 ND  N0    score propscore   theta se.theta outfit
## 1         101  1  400 161  0 239 161.0585    0.4026 -0.3791   0.1033 1.0259
## 2         102  2  401 264  0 137 263.9050    0.6581  0.6374   0.1066 1.0074
## 3         103  3  401 261  0 140 260.9095    0.6506  0.6059   0.1062 1.0200
## 4         104  4  400 176  0 224 176.0360    0.4401 -0.2390   0.1022 1.0145
## 5         105  5  403 195  0 208 195.0097    0.4839 -0.0790   0.1011 1.0142
## 6         106  6  399 249  0 150 248.9256    0.6239  0.4668   0.1047 1.0097
## 7         107  7  402 232  0 170 231.9537    0.5770  0.2873   0.1024 0.9803
## 8         301  8  402 187  0 215 187.0209    0.4652 -0.1489   0.1015 0.9936
## 9         302  9  403 172  0 231 172.0439    0.4269 -0.2623   0.1022 0.9941
## 10        401 10  400 195  0 205 195.0075    0.4875 -0.0543   0.1016 1.0032
## 11        402 11  400 171  0 229 171.0435    0.4276 -0.2882   0.1025 0.9858
## 12        403 12  400 197  0 203 197.0045    0.4925 -0.0098   0.1017 0.9711
## 13        404 13  401 164  0 237 164.0546    0.4091 -0.3246   0.1031 0.9956
## 14        405 14  404 242  0 162 241.9406    0.5989  0.3694   0.1030 0.9832
## 15        406 15  404 189  0 215 189.0193    0.4679 -0.1445   0.1011 1.0052
## 16        407 16  400 155  0 245 155.0675    0.3877 -0.4373   0.1039 1.0032
##     infit
## 1  1.0241
## 2  1.0059
## 3  1.0163
## 4  1.0128
## 5  1.0137
## 6  1.0085
## 7  0.9799
## 8  0.9927
## 9  0.9961
## 10 1.0030
## 11 0.9876
## 12 0.9721
## 13 0.9939
## 14 0.9844
## 15 1.0037
## 16 1.0001
## NULL
```