

## A Level students' Comparative Judgement Analysis

```
## Rows: 900
## Columns: 5
## $ judgeName <chr> "583191-583182-57469173@x.xx", "583191-583182-57469173@x.xx"~
## $ timeTaken <int> 56096, 44472, 26649, 19878, 21206, 62010, 17249, 34803, 5725~
## $ chosen <int> 302, 405, 302, 104, 105, 104, 103, 106, 102, 104, 401, 301, ~
## $ notChosen <int> 403, 402, 103, 403, 405, 103, 101, 406, 101, 103, 301, 404, ~
## $ createdAt <chr> "27/03/2020 11:19", "27/03/2020 11:20", "27/03/2020 11:20", ~
```

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] 60
```

```
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
## [26] 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
```

```
Number of scripts =
```

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

```
List of number of judgements per script =
```

```
## [1] 108 110 110 110 110 111 112 112 112 113 113 115 115 116 116 117
```

### Fit to Bradley Terry model.

```
###SSR=
```

```
## [1] 0.89
```

```
###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> 113, 111, 112, 116, 115, 110, 108, 116, 113, 110, 112, 117,~
## $ theta <dbl> -1.25427141, 1.04654217, 0.53360219, 0.19394255, -0.1432577~
## $ se.theta <dbl> 0.2338477, 0.2239272, 0.2028937, 0.1947772, 0.1957016, 0.20~
## $ infit <dbl> 0.9480442, 1.0086530, 1.0184042, 1.0520912, 0.9952827, 0.97~
```

```
###Judge misfits
```

```
Number of misfits=
```

```

## [1] 0
Misfit threshold (3 SDs above mean) =
## [1] 0.7370851
Table of misfits (shows '0 rows' if na)
## [1] judgeName total      average
## <0 rows> (or 0-length row.names)

###Script misfits
Number of misfits=
## [1] 0
Misfit threshold (3 SDs above mean) =
## [1] 1.158446
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] 0.795
Mean Pearson =
## [1] 0.79
List of actual correlations =
## [1] 0.537 0.547 0.551 0.570 0.576 0.578 0.579 0.580 0.593 0.599 0.607 0.611
## [13] 0.613 0.613 0.614 0.615 0.615 0.615 0.616 0.616 0.617 0.617 0.620 0.622
## [25] 0.623 0.628 0.630 0.630 0.634 0.634 0.634 0.634 0.636 0.638 0.638 0.639 0.642
## [37] 0.646 0.646 0.646 0.647 0.647 0.647 0.648 0.652 0.656 0.658 0.659 0.659
## [49] 0.661 0.661 0.661 0.663 0.663 0.664 0.665 0.666 0.668 0.669 0.670 0.672
## [61] 0.674 0.674 0.678 0.679 0.679 0.680 0.680 0.681 0.681 0.682 0.682 0.683
## [73] 0.684 0.684 0.684 0.685 0.685 0.685 0.686 0.686 0.688 0.689 0.690 0.690
## [85] 0.690 0.691 0.691 0.691 0.692 0.692 0.692 0.693 0.693 0.694 0.694 0.694
## [97] 0.696 0.696 0.697 0.697 0.697 0.697 0.698 0.698 0.698 0.698 0.698 0.698
## [109] 0.698 0.699 0.699 0.699 0.700 0.700 0.700 0.700 0.700 0.701 0.701 0.701
## [121] 0.701 0.701 0.702 0.702 0.702 0.704 0.704 0.705 0.706 0.706 0.706 0.706
## [133] 0.707 0.707 0.707 0.708 0.708 0.708 0.708 0.708 0.709 0.709 0.709 0.709
## [145] 0.709 0.710 0.711 0.711 0.711 0.712 0.712 0.712 0.712 0.712 0.713 0.713
## [157] 0.713 0.714 0.714 0.715 0.716 0.716 0.716 0.717 0.717 0.717 0.718 0.718
## [169] 0.719 0.719 0.719 0.719 0.720 0.721 0.721 0.721 0.721 0.721 0.722 0.722
## [181] 0.723 0.724 0.725 0.725 0.725 0.725 0.725 0.725 0.725 0.726 0.726 0.726
## [193] 0.727 0.727 0.727 0.728 0.728 0.728 0.728 0.728 0.728 0.729 0.729 0.730
## [205] 0.730 0.730 0.731 0.731 0.731 0.731 0.732 0.732 0.733 0.733 0.733 0.733
## [217] 0.734 0.734 0.734 0.734 0.734 0.735 0.735 0.735 0.735 0.736 0.736 0.736
## [229] 0.738 0.738 0.739 0.739 0.739 0.739 0.740 0.740 0.740 0.740 0.740 0.740
## [241] 0.741 0.741 0.742 0.742 0.743 0.743 0.743 0.743 0.743 0.743 0.743 0.744
## [253] 0.745 0.745 0.745 0.746 0.746 0.746 0.747 0.747 0.747 0.747 0.747 0.747

```

## [265] 0.748 0.748 0.748 0.748 0.749 0.749 0.749 0.749 0.749 0.750 0.750 0.750  
## [277] 0.750 0.750 0.751 0.751 0.751 0.751 0.751 0.751 0.751 0.752 0.752 0.752  
## [289] 0.752 0.752 0.752 0.753 0.753 0.753 0.753 0.753 0.753 0.754 0.754 0.754  
## [301] 0.754 0.755 0.755 0.755 0.755 0.755 0.755 0.755 0.756 0.756 0.757 0.757  
## [313] 0.757 0.757 0.757 0.758 0.758 0.758 0.758 0.758 0.758 0.759 0.759 0.759  
## [325] 0.759 0.759 0.760 0.760 0.760 0.760 0.760 0.760 0.760 0.761 0.761 0.761  
## [337] 0.761 0.761 0.761 0.761 0.761 0.762 0.762 0.762 0.763 0.763 0.763 0.763  
## [349] 0.763 0.764 0.764 0.764 0.764 0.765 0.765 0.765 0.765 0.765 0.765 0.766  
## [361] 0.766 0.766 0.767 0.767 0.768 0.768 0.768 0.768 0.769 0.769 0.769 0.769  
## [373] 0.770 0.770 0.770 0.770 0.770 0.771 0.771 0.771 0.771 0.772 0.772 0.772  
## [385] 0.773 0.773 0.773 0.773 0.773 0.773 0.773 0.774 0.774 0.774 0.774 0.775  
## [397] 0.775 0.775 0.775 0.775 0.775 0.775 0.775 0.776 0.776 0.776 0.777 0.777  
## [409] 0.777 0.777 0.777 0.777 0.778 0.778 0.778 0.778 0.780 0.780 0.780 0.780  
## [421] 0.781 0.781 0.781 0.781 0.781 0.781 0.781 0.781 0.781 0.781 0.781 0.782  
## [433] 0.782 0.782 0.782 0.783 0.783 0.783 0.784 0.784 0.784 0.784 0.785 0.785  
## [445] 0.785 0.785 0.786 0.786 0.786 0.786 0.786 0.786 0.787 0.787 0.787 0.787  
## [457] 0.787 0.788 0.788 0.788 0.788 0.789 0.789 0.789 0.790 0.790 0.790 0.790  
## [469] 0.790 0.790 0.790 0.791 0.791 0.791 0.791 0.791 0.791 0.792 0.792 0.792  
## [481] 0.792 0.792 0.792 0.792 0.792 0.792 0.792 0.793 0.793 0.793 0.793 0.793  
## [493] 0.793 0.794 0.794 0.794 0.794 0.794 0.795 0.795 0.795 0.795 0.795 0.796  
## [505] 0.796 0.796 0.797 0.797 0.797 0.797 0.797 0.797 0.797 0.797 0.797 0.797  
## [517] 0.797 0.798 0.798 0.798 0.798 0.799 0.799 0.799 0.799 0.799 0.799 0.800  
## [529] 0.800 0.800 0.800 0.800 0.800 0.800 0.800 0.800 0.801 0.802 0.802 0.802  
## [541] 0.803 0.803 0.803 0.803 0.803 0.803 0.803 0.803 0.804 0.804 0.804 0.804  
## [553] 0.804 0.804 0.804 0.805 0.805 0.805 0.805 0.805 0.805 0.806 0.806 0.806  
## [565] 0.806 0.806 0.806 0.806 0.807 0.807 0.807 0.807 0.807 0.807 0.808 0.808  
## [577] 0.809 0.809 0.809 0.810 0.810 0.810 0.810 0.811 0.811 0.811 0.812 0.812  
## [589] 0.812 0.812 0.812 0.812 0.812 0.813 0.813 0.813 0.813 0.813 0.813 0.813  
## [601] 0.813 0.813 0.813 0.813 0.814 0.814 0.814 0.814 0.814 0.814 0.815 0.815  
## [613] 0.815 0.815 0.815 0.815 0.815 0.816 0.816 0.816 0.816 0.816 0.817 0.817  
## [625] 0.818 0.818 0.818 0.818 0.818 0.818 0.818 0.818 0.818 0.819 0.819 0.819  
## [637] 0.820 0.820 0.820 0.820 0.820 0.821 0.821 0.821 0.822 0.822 0.822 0.822  
## [649] 0.822 0.823 0.823 0.823 0.823 0.823 0.824 0.824 0.824 0.824 0.825 0.825  
## [661] 0.825 0.825 0.826 0.826 0.826 0.826 0.827 0.827 0.827 0.827 0.827 0.827  
## [673] 0.828 0.828 0.828 0.828 0.828 0.828 0.829 0.829 0.829 0.830 0.830 0.830  
## [685] 0.831 0.831 0.831 0.831 0.831 0.831 0.831 0.831 0.831 0.831 0.831 0.832  
## [697] 0.832 0.832 0.833 0.833 0.834 0.834 0.834 0.834 0.834 0.834 0.834 0.834  
## [709] 0.835 0.835 0.835 0.835 0.835 0.835 0.835 0.835 0.835 0.836 0.837 0.837  
## [721] 0.837 0.837 0.837 0.837 0.838 0.838 0.838 0.838 0.838 0.838 0.839 0.839  
## [733] 0.840 0.840 0.840 0.840 0.841 0.841 0.841 0.841 0.842 0.842 0.842 0.843  
## [745] 0.843 0.843 0.843 0.843 0.844 0.844 0.844 0.844 0.844 0.844 0.845 0.845  
## [757] 0.845 0.845 0.845 0.846 0.846 0.846 0.846 0.846 0.846 0.847 0.847 0.847  
## [769] 0.848 0.848 0.849 0.849 0.849 0.849 0.850 0.850 0.850 0.850 0.851 0.851  
## [781] 0.851 0.852 0.852 0.852 0.852 0.852 0.853 0.853 0.853 0.854 0.854 0.854  
## [793] 0.854 0.854 0.854 0.855 0.855 0.855 0.855 0.855 0.855 0.855 0.855 0.855  
## [805] 0.855 0.855 0.855 0.856 0.856 0.856 0.856 0.857 0.857 0.857 0.858 0.858  
## [817] 0.858 0.858 0.858 0.859 0.859 0.859 0.859 0.859 0.859 0.860 0.860 0.860  
## [829] 0.860 0.861 0.861 0.861 0.862 0.862 0.862 0.862 0.862 0.862 0.862 0.862  
## [841] 0.862 0.863 0.863 0.863 0.863 0.863 0.864 0.864 0.864 0.864 0.864 0.864  
## [853] 0.865 0.865 0.865 0.866 0.866 0.867 0.867 0.867 0.867 0.867 0.867 0.867  
## [865] 0.868 0.869 0.869 0.870 0.870 0.870 0.870 0.871 0.871 0.871 0.871 0.871  
## [877] 0.871 0.872 0.872 0.872 0.873 0.873 0.874 0.874 0.874 0.875 0.875 0.876  
## [889] 0.876 0.876 0.877 0.877 0.877 0.878 0.878 0.878 0.878 0.878 0.878 0.878  
## [901] 0.878 0.879 0.879 0.879 0.879 0.880 0.880 0.880 0.881 0.881 0.882 0.882

```
## [913] 0.882 0.883 0.883 0.883 0.883 0.883 0.884 0.884 0.884 0.885 0.885 0.885
## [925] 0.886 0.886 0.887 0.887 0.888 0.888 0.888 0.889 0.890 0.890 0.891 0.891
## [937] 0.891 0.891 0.892 0.892 0.893 0.893 0.893 0.894 0.894 0.894 0.895 0.897
## [949] 0.897 0.897 0.897 0.898 0.898 0.898 0.899 0.900 0.900 0.901 0.901 0.901
## [961] 0.902 0.902 0.903 0.904 0.904 0.905 0.906 0.907 0.908 0.910 0.910 0.910
## [973] 0.911 0.911 0.912 0.912 0.913 0.914 0.916 0.918 0.918 0.919 0.920 0.920
## [985] 0.922 0.923 0.927 0.927 0.928 0.932 0.934 0.936 0.937 0.946 0.947 0.948
## [997] 0.949 0.949 0.949 0.959
```

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=0.2051507
## **** Iteration 2 | Maximum parameter change=0.01325
## **** Iteration 3 | Maximum parameter change=0.0012142
## **** Iteration 4 | Maximum parameter change=0.0001137
## **** Iteration 5 | Maximum parameter change=1.31e-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 13:56:27
## Time difference of 0.02730989 secs
## Computation Time: 0.02730989
##
##
## 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 = 5
## Number of individuals = 16
## Number of pairwise comparisons = 900
## -----
## 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 -0.0507 0.6195 -1.2543 1.0465
## -----
## MLE reliability (separation reliability)
## MLE Rel=0.8896
## Separation index=3.009
## -----
## Individual effects parameters
##   individual id Ntot N1 ND NO   score propscore   theta se.theta outfit infit
## 1           101  1  113 24  0 89 24.1726   0.2139 -1.2543  0.2338 0.8795 0.9480
## 2           102  2  111 83  0 28 82.8514   0.7464  1.0465  0.2239 1.0021 1.0087
```

## 3	103	3	112	70	0	42	69.9250	0.6243	0.5336	0.2029	1.0056	1.0184
## 4	104	4	116	66	0	50	65.9586	0.5686	0.1939	0.1948	1.0623	1.0521
## 5	105	5	115	53	0	62	53.0235	0.4611	-0.1433	0.1957	0.9941	0.9953
## 6	106	6	110	73	0	37	72.9018	0.6627	0.6781	0.2094	0.9657	0.9734
## 7	107	7	108	51	0	57	51.0167	0.4724	-0.1851	0.2003	1.0409	1.0363
## 8	301	8	116	59	0	57	58.9948	0.5086	-0.0383	0.1942	1.0495	1.0463
## 9	302	9	113	71	0	42	70.9230	0.6276	0.4374	0.2039	0.9448	0.9682
## 10	401	10	110	34	0	76	34.1145	0.3101	-0.6625	0.2137	0.9290	0.9345
## 11	402	11	112	40	0	72	40.0857	0.3579	-0.5511	0.2043	0.9730	0.9647
## 12	403	12	117	56	0	61	56.0128	0.4787	-0.0632	0.1931	1.0835	1.0748
## 13	404	13	112	61	0	51	60.9732	0.5444	0.1917	0.1990	0.8739	0.8829
## 14	405	14	110	75	0	35	74.8909	0.6808	0.7937	0.2108	0.9221	0.9665
## 15	406	15	115	51	0	64	51.0339	0.4438	-0.1985	0.1951	1.0469	1.0458
## 16	407	16	110	33	0	77	33.1200	0.3011	-0.7788	0.2143	1.0533	1.0600
## NULL												