Estimation of sectoral priorities: Borda Count & Plackett-Luce model

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Contents

Ratings and rankings account for the majority of data generated in the course of rapid key informant needs assessments during humanitarian emergencies. Using this information to develop consolidated need prioritisation comes with challenges.

Practically speaking, the method presented here can be used for dataset that includes questions such as

> what's your first need? *(select_one among different options)*
>
> what's your second need? *(select_one among different options)*
>
> what's your third need? *(select_one among different options)*

This tutorial is based on the publication Priorities and preferences in humanitarian needs assessments -Their measurement by rating and ranking methods and the article Modelling rankings in R: the PlackettLuce package .

Humanitarian needs assessments seek to establish priorities for action and preferences of those whom the action will affect. Assessment teams collect data meant to capture the severity of problems and the situational aspects that matter in the evaluation of response options. Needs assessments establish priorities whereas **response plans seek viable compromises between priorities** and the means to address them.

When samples of stakeholders, such as key informants or relief workers, state priorities or preferences, the information chiefly produces **ratings or rankings** and such data are ordinal. In summarizing them, we need to avoid operations that require metric variables (such as the arithmetic mean) wich does not account for compensability; yet we will seek methods that produce aggregates with metric qualities (such as Borda counts) as these have a higher information value and offer greater flexibility for subsequent prioritisation analyses.

When aggregating rating and ranking data and about the interpretation of the resulting measures of priority and preference, two distinctions are fundamental:

- The first concerns **statistical independence**: Ratings (such as of the severity of unmet needs invarious sectors), though cognitively interdependent among items, statistically are independent. Rankings reflect an order among items and are dependent in both respects.For the analysis, both types have pros and cons; they contribute the most when used in tandem. This can happen during data collection – by asking both rating and ranking questions – and/or in the analysis – such as by ranking aggregate measures from ratings.
- Second, certain measures characterize **cases** (units like geographical areas, communities,camps, eventually households and individuals), while others express **relationships with items** (formally: options,

aspects, attributes, indicators; substantively: sectors, agencies,problems, etc.). Methods suitable to compare Case A vs. Case B as well as Item X vs. Y are few; most of those based on ordinal data work only in one or the other way, not both.

0.1 Problem statement

The simple visualisation of 3 variable `Need1`, `Need2`, `Need3` does not allow to clear visualise priorities between needs. Borda count can be used to consolidate ranks. Though it implicitly makes a strong assumptions by implicitely accepting that respondents are aware that they exercise voting.

The Plackett-Luce model of rankings overcomes analysis barrier linked to the analysis of ranked preferences and priorities:

- It produces a true ratio-level measure of the strength of preferences from full or partial choices.
- It tests for differences between items follow from confidence intervals; so that such difference can be extended for groups within a given item.

The Plackett-Luce model supplies a stronger measure. It is ratio level. Moreover, it is basedon more intuitive behavioral assumptions than the Borda count.

In this tutorial, we will present code to implement quickly those 2 methods.

0.2 Loading packages & Function

```
## This function will retrieve the packae if they are not yet installed.
using <- function(...) {
    libs <- unlist(list(...))
    req <- unlist(lapply(libs,require,character.only = TRUE))
    need <- libs[req == FALSE]
    if (length(need) > 0) {
        install.packages(need)
        lapply(need,require,character.only = TRUE)
    }
}

## Getting all necessary package
using("foreign", "PlackettLuce", "tidyverse", "qvcalc","kableExtra","stargazer","NLP",
                     "ggthemes", "ggrepel", "GGally", "bbplot","ggpubr",'grid','gridExtra', 'forcat', '
```

```
## [[1]]
## [1] FALSE
```

```
rm(using)

# This small function is used to have nicely left align text within charts produced with ggplot2
left_align <- function(plot_name, pieces){
  grob <- ggplot2::ggplotGrob(plot_name)
  n <- length(pieces)
  grob$layout$l[grob$layout$name %in% pieces] <- 2
  return(grob)
}

## Fonction to calculate borda count
AvgRank <- function(BallotMatrix){
```

```r
    Ballots <- as.matrix(BallotMatrix[, -1], mode = "numeric")
    Num_Candidates <- dim(Ballots)[1]
    Names <- BallotMatrix[, 1]
    Ballots[is.na(Ballots)] <- Num_Candidates + 1 #Treat blanks as one worse than min
    MeanRanks <- rowMeans(Ballots)
    Rankings <- data.frame(Names, MeanRanks)
    Rankings <- Rankings[order(rank(Rankings[, 2], ties.method = "random")), ] #Ties handled through ra
    Rankings <- data.frame(Rankings, seq_along(Rankings[, 1]))
    names(Rankings) <- c("Items", "Average Rank", "Position")
    return(Rankings)
}


## Some ggplot2 style
kobo_unhcr_style_scatter <- function() {
    font <- "Arial"
    ggplot2::theme(

      #This sets the font, size, type and colour of text for the chart's title
      plot.title = ggplot2::element_text(family = font, size = 12, face = "bold", color = "#222222"),

      #This sets the font, size, type and colour of text for the chart's subtitle,  as well as setting
      plot.subtitle = ggplot2::element_text(family = font, size = 11, margin = ggplot2::margin(9,0,9,0))
      plot.caption = ggplot2::element_blank(),

      #This sets the position and alignment of the legend, removes a title and backround for it and set
      legend.position = "top",
      legend.text.align = 0,
      legend.background = ggplot2::element_blank(),
      legend.title = ggplot2::element_blank(),
      legend.key = ggplot2::element_blank(),
      legend.text = ggplot2::element_text(family = font, size = 9, color = "#222222"),

      #This sets the text font, size and colour for the axis text, as well as setting the margins and r
      axis.title = ggplot2::element_text(family = font, size = 11, color = "#222222"),
      axis.text = ggplot2::element_text(family = font, size = 10, color = "#222222"),
      #axis.text.x = ggplot2::element_text(margin = ggplot2::margin(5, b = 9)),
      axis.ticks = ggplot2::element_blank(),
      axis.line = ggplot2::element_blank(),

      #This removes all minor gridlines and adds major y gridlines. In many cases you will want to chan
      panel.grid.minor = ggplot2::element_blank(),
      panel.grid.major.x = ggplot2::element_line(color = "#cbcbcb"),
      panel.grid.major.y = ggplot2::element_line(color = "#cbcbcb"),

      #This sets the panel background as blank, removing the standard grey ggplot background colour fro
      panel.background = ggplot2::element_blank(),

      #This sets the panel background for facet-wrapped plots to white, removing the standard grey ggpl
      strip.background = ggplot2::element_rect(fill = "white"),
      strip.text = ggplot2::element_text(size  = 11,  hjust = 0)
    )
  }
```

Table 1: Data Overview

block_id	population	priority1	priority3	priority3.1
CXB-001-001	40	Food assistance	Job opportunities	Job opportunities
CXB-005-001	129	Cooking fuel and firewood	Education for children	Education for children
CXB-006-001	221	Food assistance	Healthcare	Healthcare
CXB-007-001	130	Food assistance	Education for children	Education for children
CXB-008-001	112	Food assistance	Healthcare	Healthcare
CXB-009-001	54	Cooking fuel and firewood	Shelter	Shelter
CXB-010-001	230	Food assistance	Healthcare	Healthcare
CXB-013-001	106	Food assistance	Sanitation	Sanitation
CXB-014-001	570	Cooking fuel and firewood	Job opportunities	Job opportunities
CXB-016-001	67	Sanitation	Healthcare	Healthcare

0.3 Dataset

The data used in the this tutorial comes from NPM Site Assessment Round 11, 2018 - for the Rohingya refugee camps in Bangladesh.

```
data_csv <- read.csv(file = "181227_2027AB_NPM11_Priorities_PlackettLuce.csv", header = T, sep = ",")

# Structure of the data:
#str(data_csv)
```

When loaded in R, all non-numeric data columns are read as factors when loading csv because of argument `default.stringsAsFactors()`.

The model-fitting function in PlackettLuce, requires data in the form of rankings, with the rank (1st, 2nd, 3rd, . . .) for each item. Therefore transformation is required for the data in their orginal stage as we can see below.

```
used_var <- as.character(names(data_csv))[grepl("l_",as.character(names(data_csv)))]

 kable( data_csv[1:10 , c("block_id","population","priority1","priority3","priority3") ],
       caption = "Data Overview") %>%
        kable_styling(bootstrap_options = c("striped", "bordered", "condensed", "responsive"), font_size
```

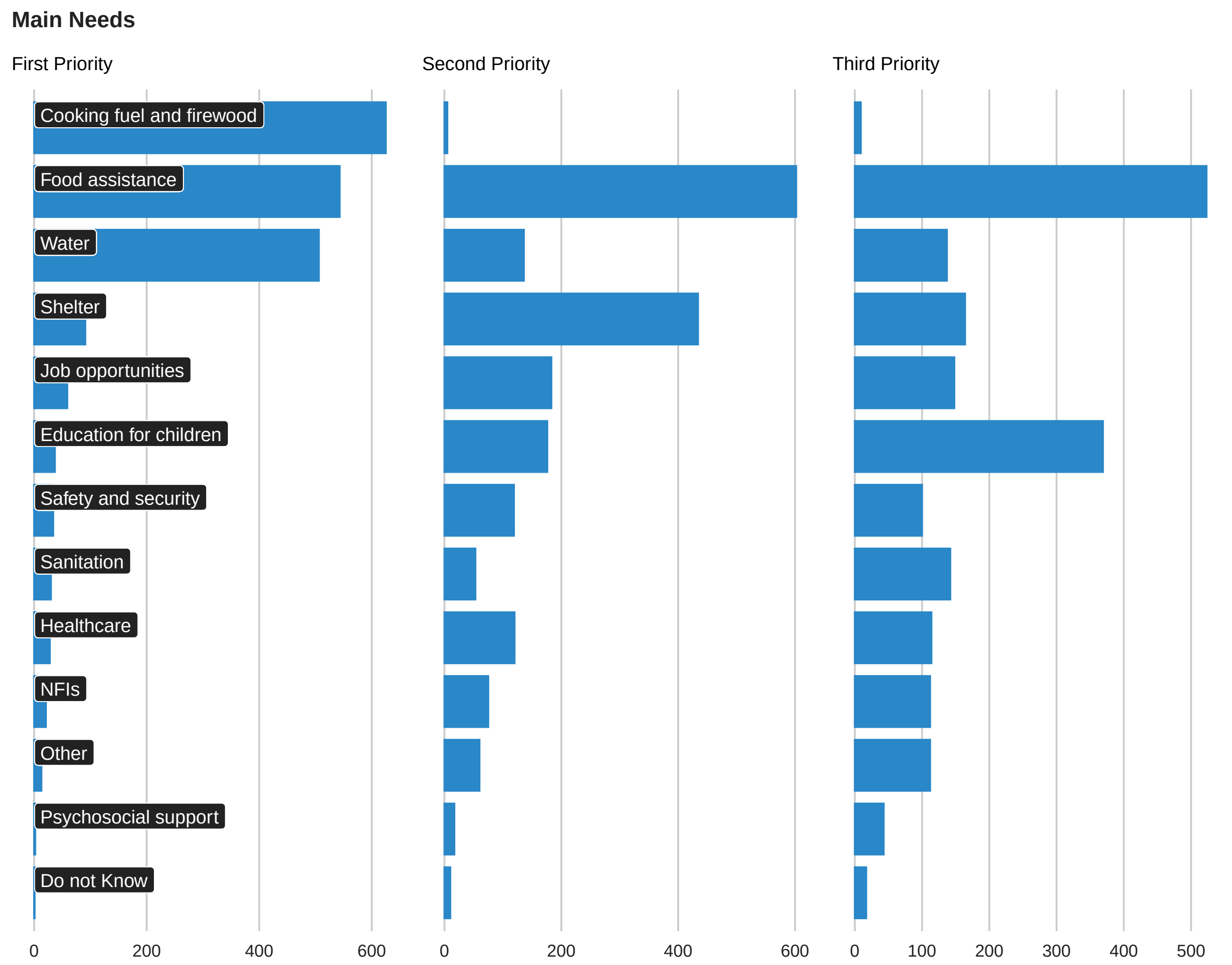
We can visualise this all together. We fist need to sort all the 3 needs based on frequency of the first need using `forcat` package. Note that factor level are inverted as the bar chard will be then flipped.

```
data_csv$priority1 <- factor(data_csv$priority1, levels =  levels(fct_rev(fct_infreq(data_csv$priority1)

data_csv$priority2 <- factor(data_csv$priority2, levels =  levels(fct_rev(fct_infreq(data_csv$priority1)

data_csv$priority3 <- factor(data_csv$priority3, levels =  levels(fct_rev(fct_infreq(data_csv$priority1)
```

```
plot1 <- ggplot(data = data_csv, aes( x = priority1)) +
  geom_bar(fill = "#2a87c8",colour = "#2a87c8", stat = "count", width = .8) +
  guides(fill = FALSE) +
  #geom_label(aes(label = ..count.., y = ..count..), stat = "count", fill = "#2a87c8", color = 'white')

  geom_label(aes(label = priority1, y = 1), hjust = 0, vjust=0,  fill = "#222222", color = 'white') +
  coord_flip() +
        xlab("Priority") +
        ylab("") +
       labs(title = "Main Needs",
```

```
        subtitle = "First Priority") +
      bbc_style() +
      theme( plot.title = element_text(size = 13),
         plot.subtitle = element_text(size = 11),
         plot.caption = element_text(size = 7, hjust = 1),
         axis.text = element_text(size = 10),
         axis.text.y = element_blank(),
         strip.text.x = element_text(size = 11),
         panel.grid.major.x = element_line(color = "#cbcbcb"),
         panel.grid.major.y = element_blank())

plot1 <- ggpubr::ggarrange(left_align(plot1, c("subtitle", "title", "caption")), ncol = 1, nrow = 1)


plot2 <-   ggplot(data = data_csv, aes( x = priority2)) +
    geom_bar(fill = "#2a87c8",colour = "#2a87c8", stat = "count", width = .8) +
    guides(fill = FALSE) +
   # geom_label(aes(label = ..count.., y = ..count..), stat = "count", fill = "#2a87c8", color = 'white
    coord_flip() +
    xlab("") +
    ylab("") +
     labs(title = "",
        subtitle = "Second Priority") +
      bbc_style() +
      theme( plot.title = element_text(size = 13),
         plot.subtitle = element_text(size = 11),
         plot.caption = element_text(size = 7, hjust = 1),
         axis.text = element_text(size = 10),
         axis.text.y = element_blank(),
         strip.text.x = element_text(size = 11),
         panel.grid.major.x = element_line(color = "#cbcbcb"),
         panel.grid.major.y = element_blank())

plot2 <- ggpubr::ggarrange(left_align(plot2, c("subtitle", "title")), ncol = 1, nrow = 1)

plot3 <-   ggplot(data = data_csv, aes( x = priority3)) +
    geom_bar(fill = "#2a87c8",colour = "#2a87c8", stat = "count", width = .8) +
    guides(fill = FALSE) +
    #geom_label(aes(label = ..count.., y = ..count..), stat = "count", fill = "#2a87c8", color = 'white
    coord_flip() +
    xlab("") +
    ylab("") +
     labs(title = "",
        subtitle = "Third Priority") +
      bbc_style() +
      theme( plot.title = element_text(size = 13),
         plot.subtitle = element_text(size = 11),
         plot.caption = element_text(size = 7, hjust = 1),
         axis.text = element_text(size = 10),
         axis.text.y = element_blank(),
         strip.text.x = element_text(size = 11),
         panel.grid.major.x = element_line(color = "#cbcbcb"),
         panel.grid.major.y = element_blank())
```

```r
plot3 <- ggpubr::ggarrange(left_align(plot3, c("subtitle", "title")), ncol = 1, nrow = 1)


grid.arrange( plot1, plot2, plot3,  ncol = 3)
```



The analysis will provide estimates for priorities among **10 areas of need** extracted from those 3 variables.

```r
    ## thanks to: https://stackoverflow.com/questions/44232180/list-to-dataframe
    # tosplitlist <- strsplit(as.character(data[ , id]), " ")
    # tosplitlist <- stats::setNames(tosplitlist, seq_along(tosplitlist))
    # tosplitlist2 <- utils::stack(tosplitlist)
    # tosplitframe <- reshape2::dcast(tosplitlist2, ind ~ values, value.var = "ind", fun.aggregate = le
```

Arguments to be used the Plackett-Luce model have been prefixed "l_" so that they can retrieved automatically.

0.4 Borda Count

```r
## transpose the data

vote <- t(data_csv[ , c(used_var)])
```

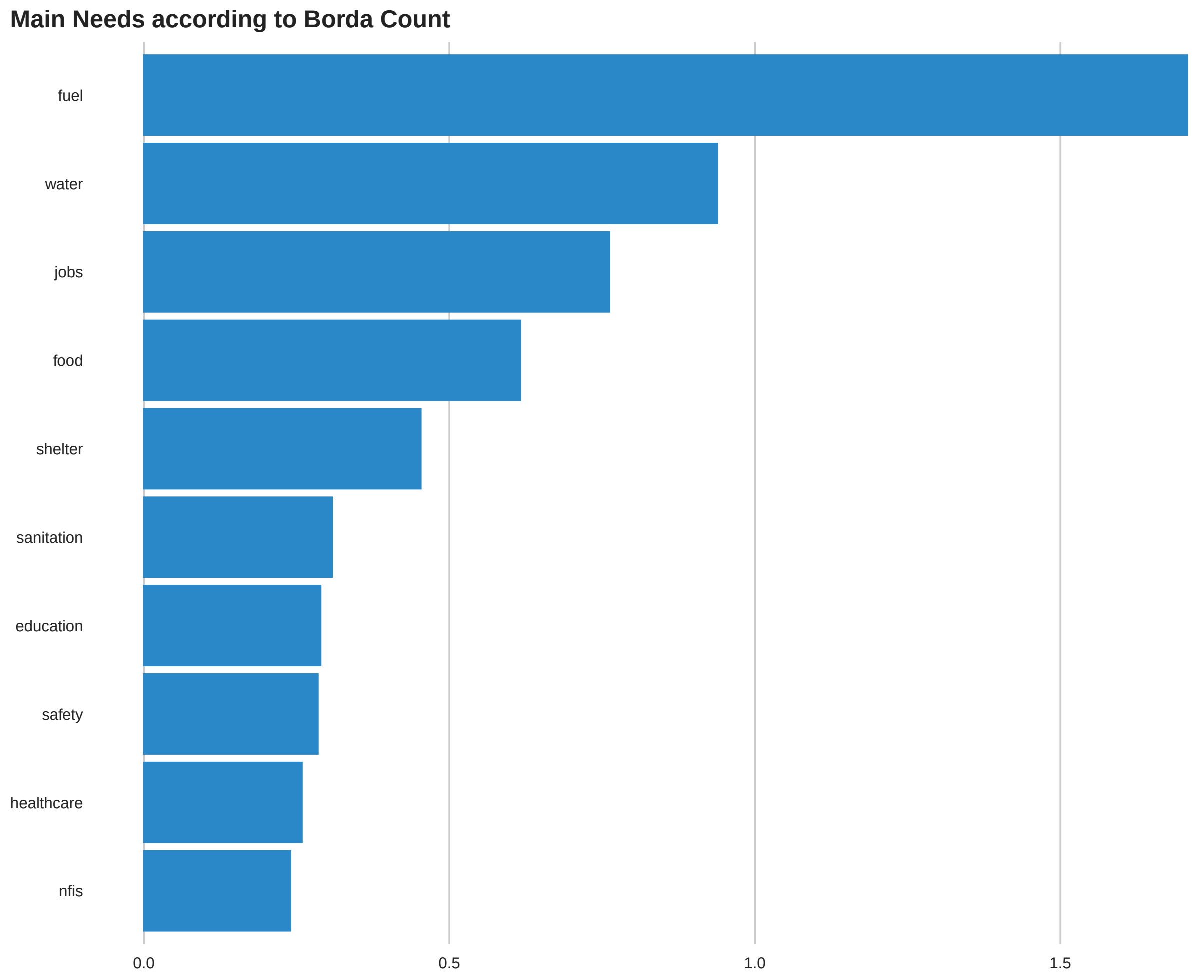
Table 2: Borda Count per sector

Items	Average Rank	Position
l_nfis	0.2398190	1
l_healthcare	0.2584213	2
l_safety	0.2845651	3
l_education	0.2890900	4
l_sanitation	0.3076923	5
l_shelter	0.4529915	6
l_food	0.6158874	7
l_jobs	0.7616893	8
l_water	0.9381599	9
l_fuel	1.7073906	10

```
borda <- AvgRank(vote)

borda$Items <- row.names(borda)
row.names(borda) <- NULL

kable( borda,
       caption = "Borda Count per sector") %>%
        kable_styling(bootstrap_options = c("striped", "bordered", "condensed", "responsive"), font_size
```

We can visualise this all together

```
borda$items <- gsub(pattern     = "l_",
                    replacement = "",
                    borda$Items)

plot1 <- ggplot(data = borda, aes( x = reorder( items, borda[ ,2]), ## Reordering country by Value
                         y = borda[ ,2])) +
  geom_bar(fill = "#2a87c8", colour = "#2a87c8",
           stat = "identity") +
  coord_flip() +
  scale_y_continuous( ) + ## Format axis number
  guides(fill = FALSE) +
  xlab("") +
  ylab("Priority average Rank") +
  labs(title = "Main Needs according to Borda Count") +
  bbc_style() +
  theme( plot.title = element_text(size = 14),
         plot.subtitle = element_text(size = 12),
         plot.caption = element_text(size = 7, hjust = 1),
         axis.text = element_text(size = 9),
         panel.grid.major.x = element_line(color = "#cbcbcb"),
         panel.grid.major.y = element_blank(),
         strip.text.x = element_text(size = 11))

ggpubr::ggarrange(left_align(plot1, c("subtitle", "title", "caption")), ncol = 1, nrow = 1)
```



0.5 Plackett-Luce Model

0.5.1 Generate the model

In the needs assessment context, we call the Plackett-Luce-"worth" coefficients "Intensities"; this terminology is arbitrary. Error messages below will apppear but are specific of this dataset and can be ignored.

```
data_csv %>%
  dplyr::select(starts_with("l_")) %>%
  PlackettLuce() -> intensities
```

```
## Recoded rankings that are not in dense form
```

```
## Rankings with only 1 item set to `NA`
```

```
#names(intensities)
# Summary of intensities:
# "ref = NULL" sets the mean of all intensities as the reference value.
# Else the first item would be the reference, with its coefficent constrained to 0.

Plackett_Luce_est <- summary(intensities, ref = NULL)
```

Table 3: Model estimation

	items_num	items	Estimate	Std..Error	z.value	Pr...z..
l_fuel	1	fuel	0.4082170	0.0421095	9.6941844	0.0000000
l_education	2	education	-0.0512509	0.0961501	-0.5330300	0.5940128
l_food	3	food	1.4559099	0.0650167	22.3928506	0.0000000
l_healthcare	4	healthcare	-0.5058790	0.1115519	-4.5349226	0.0000058
l_jobs	5	jobs	-0.7408503	0.0723857	-10.2347628	0.0000000
l_nfis	6	nfis	-0.7515089	0.1207942	-6.2213973	0.0000000
l_safety	7	safety	-0.7563186	0.1154639	-6.5502617	0.0000000
l_sanitation	8	sanitation	-0.1708777	0.0958493	-1.7827746	0.0746230
l_shelter	9	shelter	0.0692724	0.0765627	0.9047796	0.3655822
l_water	10	water	1.0432861	0.0533651	19.5499757	0.0000000

```
Plackett_Luce_est
```

```
## Call: PlackettLuce(rankings = .)
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## l_fuel        0.40822    0.04211   9.694  < 2e-16 ***
## l_education  -0.05125    0.09615  -0.533   0.5940
## l_food        1.45591    0.06502  22.393  < 2e-16 ***
## l_healthcare -0.50588    0.11155  -4.535 5.76e-06 ***
## l_jobs       -0.74085    0.07239 -10.235  < 2e-16 ***
## l_nfis       -0.75151    0.12079  -6.221 4.93e-10 ***
## l_safety     -0.75632    0.11546  -6.550 5.74e-11 ***
## l_sanitation -0.17088    0.09585  -1.783   0.0746 .
## l_shelter     0.06927    0.07656   0.905   0.3656
## l_water       1.04329    0.05337  19.550  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual deviance:  5912.8 on 5729 degrees of freedom
## AIC:  5930.8
## Number of iterations: 17
```

0.5.2 Preparations for confidence intervals

First, we prepare a table for export, stripping the prefix "l_". We ensure items will be listed in the sequence of the arguments, not alphabetically.

```
Plackett_Luce_est$coefficients %>%
  gsub(pattern     = "l_",
       replacement = "",
       x           = row.names(.)) %>%
  factor(x = ., levels = .) -> items
data.frame(items_num = as.integer(items),
           items     = items,
           Plackett_Luce_est$coefficients) -> Plackett_Luce_est_z.values

kable(Plackett_Luce_est_z.values, caption = "Model estimation") %>%
           kable_styling(bootstrap_options = c("striped", "bordered", "condensed", "responsive"), font_s
```

```r
# ==========================================================================
# Export output: if needed
# --------------------------------------------------------------------------
# write.csv(x         = Plackett_Luce_est_z.values,
#           file      = paste0(path.output, "/", "Plackett_Luce_coef_table.csv"),
#           row.names = F)
```

In order to obtain confidence intervals, quasi-variances of the coefficients are needed:

```r
qv <- qvcalc(intensities, ref = NULL)
summary(qv)
```

```
## Model call:  PlackettLuce(rankings = .)
##                     estimate         SE    quasiSE    quasiVar
##      l_fuel        0.40821699 0.04210947 0.03288481 0.001081411
##      l_education  -0.05125089 0.09615010 0.10275089 0.010557745
##      l_food        1.45590988 0.06501673 0.06142255 0.003772729
##      l_healthcare -0.50587901 0.11155185 0.12108662 0.014661971
##      l_jobs       -0.74085027 0.07238568 0.07490996 0.005611502
##      l_nfis       -0.75150887 0.12079423 0.13156000 0.017308034
##      l_safety     -0.75631864 0.11546388 0.12518339 0.015670881
##      l_sanitation -0.17087771 0.09584931 0.10267997 0.010543176
##      l_shelter     0.06927241 0.07656274 0.07906022 0.006250518
##      l_water       1.04328611 0.05336508 0.04693406 0.002202806
## Worst relative errors in SEs of simple contrasts (%):  -2.9 6.4
## Worst relative errors over *all* contrasts (%):  -11.3 7.8
```

```r
#plot(qv, xlab = "Needs Priorities", ylab = "Worth (log)", main = NULL)
```

We strips prefix "l_" in preparation for export and ensure that items will be listed in the sequence of the arguments, not alphabetically.

```r
qv$qvframe %>%
  gsub(pattern     = "l_",
       replacement = "",
       x           = row.names(.)) %>%
  factor(x = ., levels = .) -> items
```

Now we computes additional columns needed for 95%-CIs and exponentiate coefficent and CI bound estimates, in accordance with Plackett-Luce Model.

```r
qv$qvframe %>% # qv table ...
  data.frame(items_num = as.integer(items),
             items     = items,
             .) %>%
  mutate(quasiSD   = sqrt(quasiVar),
         quasiLCI = estimate - quasiSD * qnorm(0.975, 0, 1),
         quasiUCI = estimate + quasiSD * qnorm(0.975, 0, 1),
         expLCI   = exp(quasiLCI),
         expEst   = exp(estimate),
         expUCI   = exp(quasiUCI)) -> qv_estim_CI

## Sort based on preference level
qv_estim_CI <- qv_estim_CI[ order(-  qv_estim_CI$expEst), ]
qv_estim_CI$items <- reorder(qv_estim_CI$items, qv_estim_CI$expEst)
```

Table 4: Model Confidence Interval

	items_num	items	estimate	SE	quasiSE	quasiVar	quasiSD	quasiLCI	quasiUCI	expL
3	3	food	1.4559099	0.0650167	0.0614225	0.0037727	0.0614225	1.3355239	1.5762959	3.80198
10	10	water	1.0432861	0.0533651	0.0469341	0.0022028	0.0469341	0.9512970	1.1352752	2.58906
1	1	fuel	0.4082170	0.0421095	0.0328848	0.0010814	0.0328848	0.3437639	0.4726700	1.41024
9	9	shelter	0.0692724	0.0765627	0.0790602	0.0062505	0.0790602	-0.0856828	0.2242276	0.91788
2	2	education	-0.0512509	0.0961501	0.1027509	0.0105577	0.1027509	-0.2526389	0.1501372	0.77674
8	8	sanitation	-0.1708777	0.0958493	0.1026800	0.0105432	0.1026800	-0.3721268	0.0303713	0.68926
4	4	healthcare	-0.5058790	0.1115519	0.1210866	0.0146620	0.1210866	-0.7432044	-0.2685536	0.47558
5	5	jobs	-0.7408503	0.0723857	0.0749100	0.0056115	0.0749100	-0.8876711	-0.5940294	0.41161
6	6	nfis	-0.7515089	0.1207942	0.1315600	0.0173080	0.1315600	-1.0093617	-0.4936560	0.36445
7	7	safety	-0.7563186	0.1154639	0.1251834	0.0156709	0.1251834	-1.0016736	-0.5109637	0.36726

```
kable(qv_estim_CI, caption = "Model Confidence Interval") %>%
           kable_styling(bootstrap_options = c("striped", "bordered", "condensed", "responsive"), font_s
```

```
#str(qv_estim_CI)
# ========================================================================
# Export output:
# ------------------------------------------------------------------------
# write.csv(x         = qv_estim_CI,
#           file      = paste0(path.output, "/", "Plackett_Luce_estimates_CI.csv"),
#           row.names = F)
```

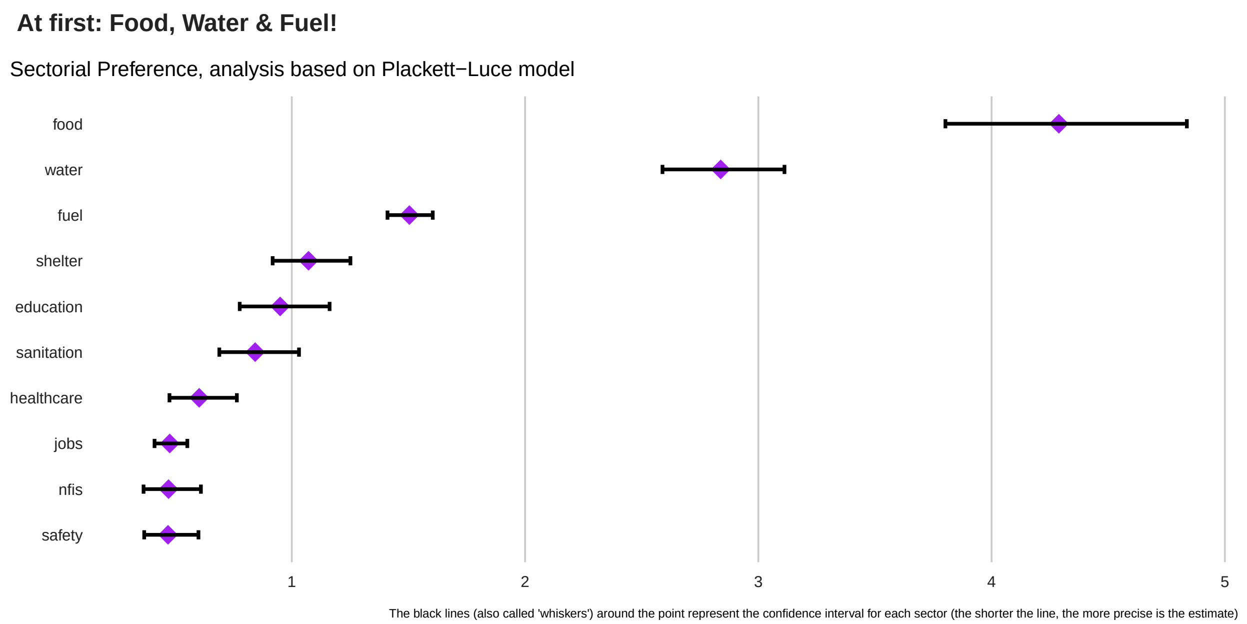
0.5.3 Visualise Results

In order to visualise the results together with the confidence interval, the best type visual is called a *Forest plot*.

There's a default plot in PlackettLuce package but we can also use ggplot2.

```
plot1 <- ggplot(data = qv_estim_CI,
             aes( x = items,
                  y = expEst,
                  ymin = expLCI,
                  ymax = expUCI)) +
      # geom_pointrange(color = "purple", shape = 18,  size = 2) +

        geom_point(color = "purple", shape = 18,  size = 5) +
        geom_errorbar(aes(xmax = expLCI, xmin = expLCI), height = 1, color = "black", width = 0.2, size

        #geom_hline(yintercept = 1, lty = 2) +  # add a dotted line at x=1 after flip
        coord_flip() +  # flip coordinates (puts labels on y axis)
        xlab("Preference Level") +
        ylab("") +
        labs(title = " At first: Food, Water & Fuel!",
                 subtitle =  "Sectorial Preference, analysis based on Plackett-Luce model",
                 caption = "The black lines (also called 'whiskers') around the point represent the con
          bbc_style() +
            theme( plot.title = element_text(size = 14),
                   plot.subtitle = element_text(size = 12),
                   plot.caption = element_text(size = 7, hjust = 1),
```

```
                    axis.text = element_text(size = 9),
                    panel.grid.major.x = element_line(color = "#cbcbcb"),
                    panel.grid.major.y = element_blank(),
                    strip.text.x = element_text(size = 11))

ggpubr::ggarrange(left_align(plot1, c("subtitle", "title", "caption")), ncol = 1, nrow = 1)
```



0.6 Compare Borda Count & Plackett-Luce Model

Plackett-Luce does not score observed ranks mechanically, as Borda does. Rather, it considers the tendency for items to be at the higher end of the observed ranks and then extrapolates that information into simulated rankings of the unobserved ranks.

The Borda count is indifferent to the unobserved rank orders. It is uninformative in this regard.

We can compare the 2 method with the chart below:

Note the usage of ggrepel to avoid having overlaping labels.

```
compare <- merge(x = qv_estim_CI, y = borda, by = "items")

# plot1 <- ggplot(data = compare, aes(x = compare[ ,14], y = expEst)) +
# geom_point(shape = 1) + # Use hollow circles # geom_smooth() + # Add a loess
# smoothed fit curve with confidence region geom_label_repel(aes(label = items),
# size = 5) + xlab('Preference Level - Borda') + ylab('Preference Level -
# Plackett-Luce') + labs(title = 'Comparing Needs Prioritisation', subtitle =
# 'Food or Fuel? It depends on how you count it...') + kobo_unhcr_style_scatter()
# + theme( plot.title = element_text(size = 14), plot.subtitle =
# element_text(size = 12), plot.caption = element_text(size = 7, hjust = 1),
# axis.text = element_text(size = 9), panel.grid.major.x = element_line(color =
# '#cbcbcb'), panel.grid.major.y = element_line(color = '#cbcbcb'), strip.text.x
# = element_text(size = 11)) ggpubr::ggarrange(left_align(plot1, c('subtitle',
# 'title')), ncol = 1, nrow = 1)
```

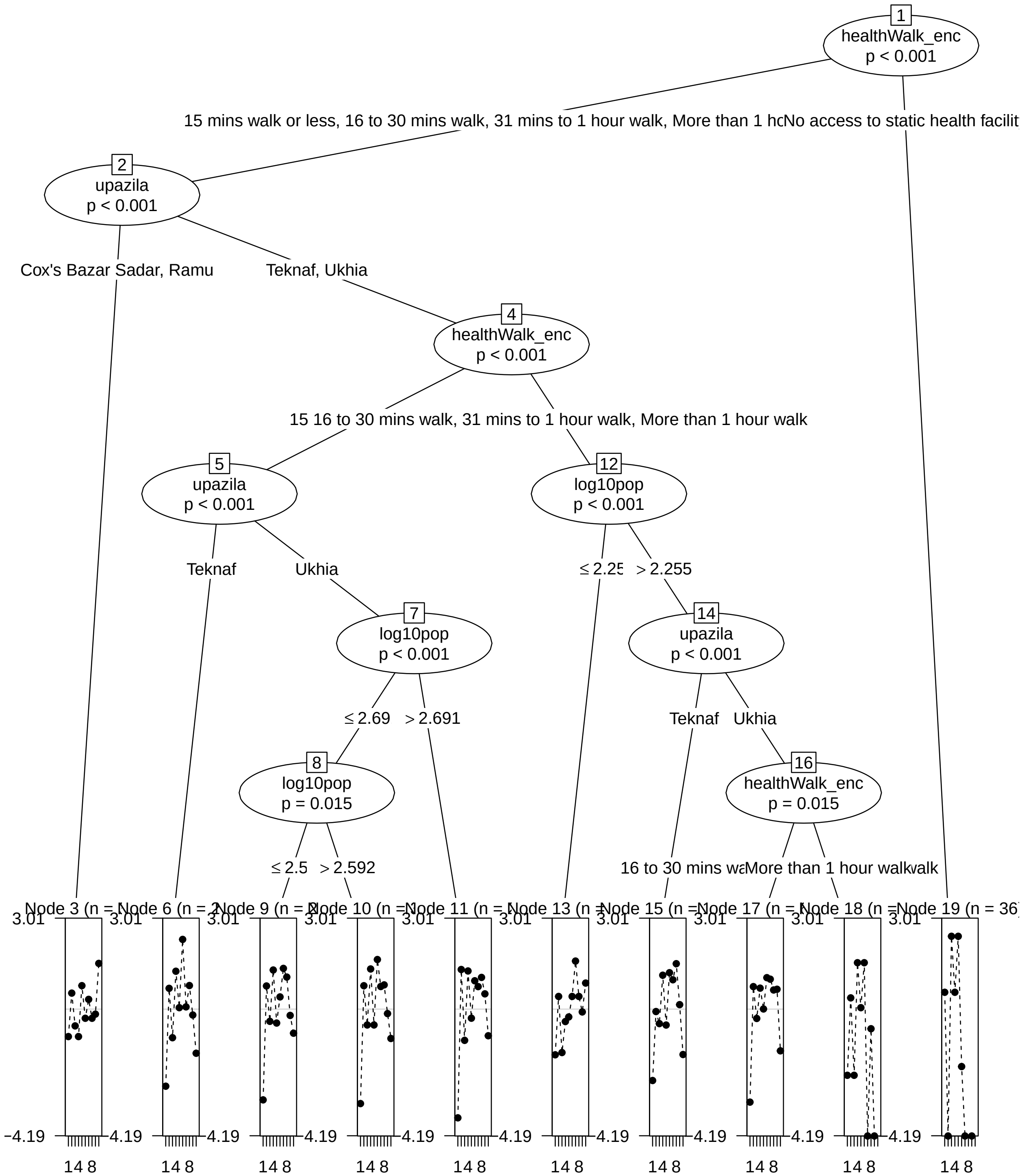
0.7 Can we identify differences within preferences?

In the dataset, there are variables define groups among which sectoral needs priorities may differ significantly. For instance, we have 4 sub-districts with refugee settlements (`upazila`), a continuous population size variable for the 1,990 camp blocks (`log10pop`) (logarithmic), and the distance from the nearest health care facility (`healthWalk_enc`, with five levels) as a marginalization indicator. These

Rashtree Visualisation are designed to identify significant differences within preferences.

We first need to format the data so that it can be consumed by the algorithm

```
covariate <- data_csv[, c("upazila", "log10pop", "healthWalk_enc")]

resp <- as.matrix(data_csv[, used_var])

## Rashtree accepts only 0 or 1 - so everything above 0 shalle be replaced by 1
for (i in 1:nrow(resp)) {
    for (j in 1:ncol(resp)) if (resp[i, j] > 0)
        resp[i, j] = 1
}
## resp will be a matrix variable used in the model
covariate$resp <- resp

# To exclude rows where all observed item responses are either 0 or 1, we select
# only the subsetof cases for which the proportion of correct item responses is
# strictly between 0 and 1 forfuther analysis.
covariate <- subset(covariate, rowMeans(resp, na.rm = TRUE) > 0 & rowMeans(resp,
    na.rm = TRUE) < 1)

## Compute the rashtree
raschtree <- raschtree(resp ~ upazila + log10pop + healthWalk_enc, data = covariate)

## and plotting it...
plot(raschtree)
```



1
healthWalk_enc
p < 0.001
15 mins walk or less, 16 to 30 mins walk, 31 mins to 1 hour walk, More than 1 hc
No access to static health facilit
2
upazila
p < 0.001
Cox's Bazar Sadar, Ramu
Teknaf, Ukhia
4
healthWalk_enc
p < 0.001
15 16 to 30 mins walk, 31 mins to 1 hour walk, More than 1 hour walk
5
upazila
p < 0.001
Teknaf
Ukhia
12
log10pop
p < 0.001
≤ 2.25
> 2.255
7
log10pop
p < 0.001
≤ 2.69
> 2.691
14
upazila
p < 0.001
Teknaf
Ukhia
8
log10pop
p = 0.015
≤ 2.5
> 2.592
16
healthWalk_enc
p = 0.015
16 to 30 mins wa
More than 1 hour walk
walk
Node 3 (n =
Node 6 (n = 2
Node 9 (n = 2
Node 10 (n =
Node 11 (n =
Node 13 (n =
Node 15 (n =
Node 17 (n =
Node 18 (n =
Node 19 (n = 36
3.01
−4.19
14 8