Whats' beyond Concerto: An introduction to the R package *catR*

Session 3:

CAT application(s) with an item bank of dichotomously scored items

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Outline:

1. Item bank

2. CAT settings

3. *catR* application

4. Output

1. Item bank

24 items calibrated under a Rasch model with scaling constant D equal to 1.195

To load the item bank in R:

1. Load *catR* package in R:

```
R> require(catR)
```

2. Set a working directory wherein all files are stored:

```
R> setwd("C:/Users/David/Desktop/")
```

3. Load the item bank:

```
R> bank <- read.table("IQ.txt", header = TRUE)
```

4. Convert the bank in a matrix:

```
R > bank <- as.matrix(bank)
```

1. Item bank

A few remarks about R language:

1. Both directory paths and file names must be surrounded by double quotes `"..."`

2. File name must be specified with its extension (`.txt`)

3. Update your directory path accordingly!

4. `bank` is just a name, up to you to modify it

5. `header = TRUE` sets the first row of the data file as the column names

6. `as.matrix` converts a data frame (i.e. format of the item bank once loaded in R) in a matrix
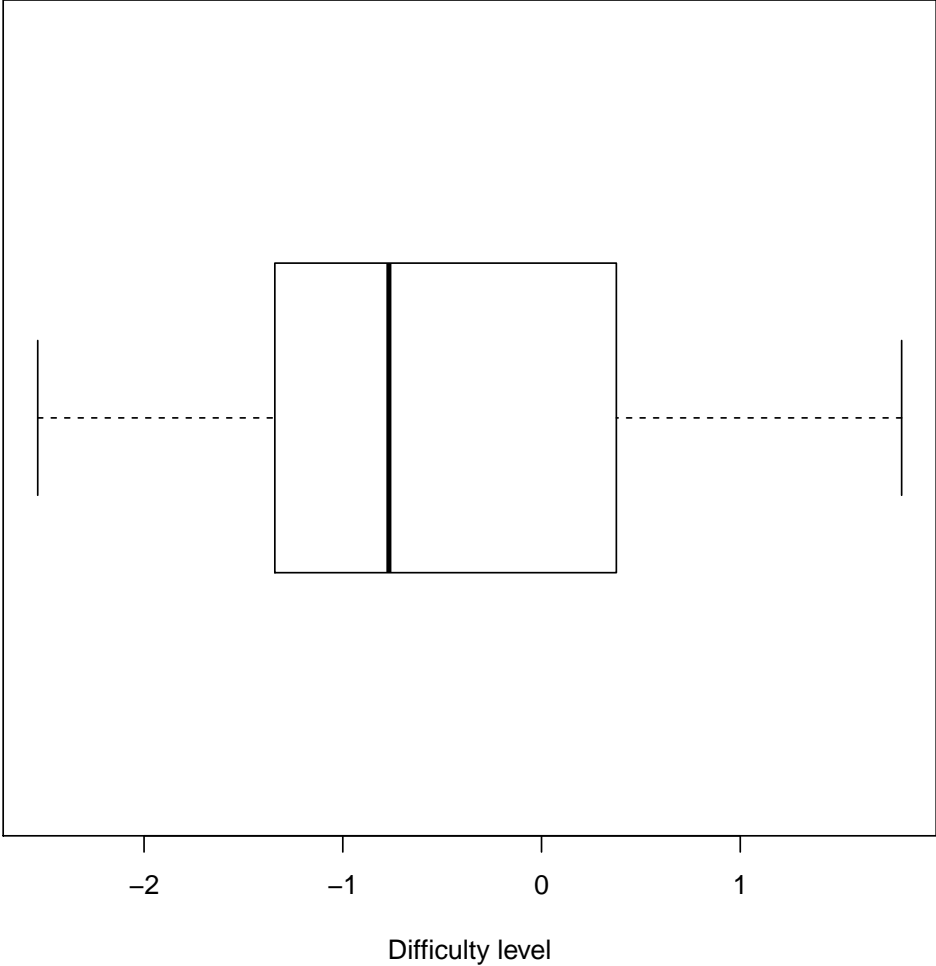
1. Item bank

To see the item bank as stored in R:

R > bank
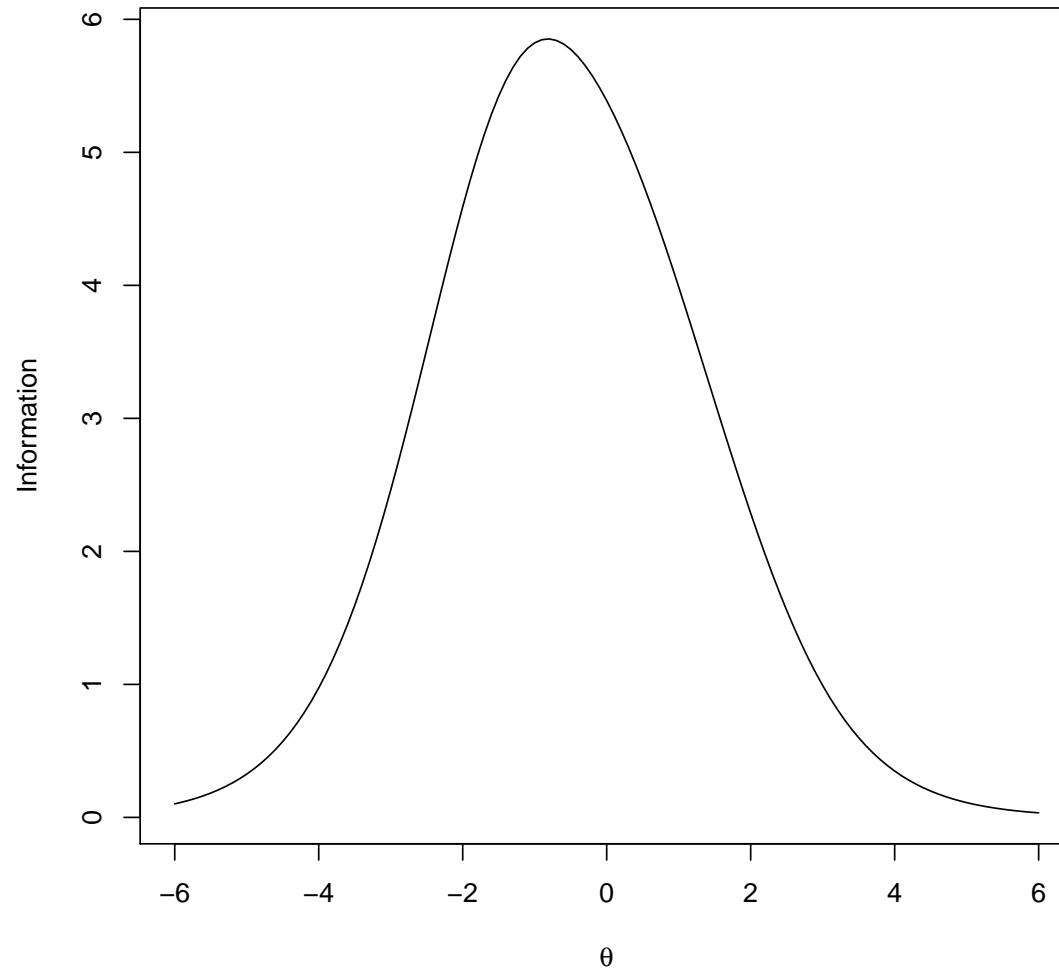
which returns

```
          a        b c d
[1,]  1.195 -1.732 0 1
[2,]  1.195 -1.020 0 1
[3,]  1.195 -2.100 0 1
[4,]  1.195 -2.535 0 1
[5,]  1.195 -1.258 0 1
[6,]  1.195 -1.172 0 1
         .        .   . .
         .        .   . .
         .        .   . .
```

1. Item bank

Difficulty level

1. Item bank

2. CAT settings

The following CAT design will be considered:

- Random generation of one CAT response pattern for true proficiency level $\theta = 0$

- Two starting items, selected as being most informative for proficiency levels $\theta = -1$ and $\theta = 1$

- Next item selection by maximum (Fisher) information (MFI)

- Ad-interim proficiency estimation by EAP with standard normal prior (default)

- Stopping rule: after 10 items

- Final proficiency estimation by ML

3. *catR* application

To implement this design in *catR*:

- All options of each step (starting, test, stopping, final) must be provided as lists

- Elements of a list have specific names and allowed values

- All elements have by-default values (so specify only interesting elements)

- For details on these lists and elements, see the help file of `randomCAT` function

3. *catR* application

The starting list is set as follows:

```
R > startList <- list(nrItems = 2, theta = 0,
                      halfRange = 1)
```

Explanations:

- `nrItems` sets the number of initial items (by default 1)

- `theta` sets the center of the range of starting proficiency levels

- `halfRange` sets the half-range of the interval of starting proficiency levels

- As another example, setting `nrItems = 3`, `theta = 1` and `halfRange = 0.5` yields the starting proficiencies (0.5, 1, 1.5)

3. *catR* application

The testing list is set as follows:

```
R > testList <- list(method = "EAP", itemSelect
                           = "MFI")
```

Explanations:

- **method** sets the ad-interim proficiency estimator (by default "BM")

- **itemSelect** sets the method for next item selection

- **"MFI"** is the acronym for **maximum Fisher information** (default method)

3. *catR* application

The stopping list is set as follows:

```
R > stopList <- list(rule = "length", thr = 10)
```

Explanations:

- **rule** sets the stopping rule, **"length"** is the default value
- **thr** sets the numerical value related to the stopping rule

3. *catR* application

The final list is set as follows:

```
R > finalList <- list(method = "ML")
```

Explanations:

- Basically, only the final proficiency estimator is required
- Specified through `method` argument

Note: `startList`, `testList`, `stopList`, `finalList` are just names of variables in R!

3. *catR* application

Now, to set the CAT, make use of the `randomCAT` function:

```
R > res <- randomCAT(theta = 0, itemBank = bank,
       start = startList, test = testList, stop =
              stopList, final = finalList)
```

Explanations:

- `res` is a variable name in R to store the output
- `theta` sets the true proficiency level (used to generate CAT responses)
- `itemBank` specifies the item bank (stored in `bank` object, see above)
- `start`, `test`, `stop` and `final` set the four corresponding lists

4. Output

Let's have a look at the R session and output...

4. Output

To see the output in an optimized fashion:

```
R > res
```

To see the output as is:

```
R > str(res)
```

To display the trace line of ad-interim proficiency estimates:

```
R > plot(res)
```

Many graphical options available (see help files)