MEER intervention survey - analysis of reliability and inter-item consistency of survey responses

Contents

Introduction

This R notebook checks for the reliability and inter-item consistency of survey responses for the MEER trial at the Epworth hospital.

The analysis focusses on the first seven questionnaire items reported in Table 2 of the paper ("Staff opinions on the MEER approach and its impact") as listed below:

- Q1: I have enjoyed the team-based discussions
- Q2: I like the process of reviewing the standards using the map-based graphical representations in the MEERQAT tool
- Q3: I have felt comfortable expressing my views and opinions in the team-based discussions
- Q4: I have found hearing the different perspectives amongst my colleagues to be worthwhile
- Q5: I have learnt new information about the national quality standards
- Q6: I have learnt new information about specific Epworth policies and protocols
- Q7: I have enjoyed the opportunity to reflect on my own clinical practice

The responses were collected in three surveys following the initial baseline survey, i.e. at 2.5 months (survey 2), 5 months (survey 3) and 10 months (survey 4) after the start of the MEER trial.

The responses for each survey question were based on a 5 point Likert scale, ranging from a least favourable (1) to a most favourable (5) response.

A single missing Likert rating for question 5 from a respondent was filled with the mode value (4) for question 5.

Load libraries

```
library("readxl")
library(psych)
library(ggplot2)
library(dplyr)
library(FSA)
library(lemon)
knit_print.data.frame <- lemon_print
```

Read in the data file for the questionairre Likert ratings

```
Data <- read.csv("Survey data BMJOQ Cronbach.csv")
headTail(Data)  # display head and tail of the data file
```

	pin	survey	Q1	Q2	Q3	Q4	Q5	Q6	Q7
1	7	S2	4	4	4	4	4	3	4
2	1011	S2	3	3	2	3	3	4	4
3	1062	S2	4	4	3	4	4	4	4
4	1012	S2	4	3	4	5	4	4	4
...	...	NA	...	...	...	...	...	...	...
95	1037	S4	5	5	5	5	4	4	5
96	2068	S4	5	3	4	4	4	4	5
97	1059	S4	5	5	5	5	5	5	5
98	1070	S4	5	4	5	4	5	4	5

Check the data

```
str(Data)
```

```
## 'data.frame':    98 obs. of  9 variables:
##  $ pin   : int  7 1011 1062 1012 2036 1028 2050 2104 1017 1020 ...
##  $ survey: Factor w/ 3 levels "S2","S3","S4": 1 1 1 1 1 1 1 1 1 1 ...
##  $ Q1    : num  4 3 4 4 4 4 4 4 4 4 ...
##  $ Q2    : num  4 3 4 3 4 4 3 4 4 4 ...
##  $ Q3    : num  4 2 3 4 5 4 4 4 4 4 ...
##  $ Q4    : num  4 3 4 5 5 5 4 4 4 4 ...
##  $ Q5    : num  4 3 4 4 4 4 4 4 4 4 ...
##  $ Q6    : num  3 4 4 4 4 5 4 4 4 4 ...
##  $ Q7    : num  4 4 4 4 4 5 4 4 4 4 ...
```

```
summary(Data)
```

```
##       pin       survey        Q1              Q2              Q3
##  Min.   :   7   S2:28   Min.   :3.000   Min.   :2.000   Min.   :2.000
##  1st Qu.:1036   S3:39   1st Qu.:4.000   1st Qu.:4.000   1st Qu.:4.000
##  Median :1079   S4:31   Median :4.000   Median :4.000   Median :4.000
##  Mean   :1408           Mean   :4.327   Mean   :4.102   Mean   :4.316
##  3rd Qu.:2030           3rd Qu.:5.000   3rd Qu.:5.000   3rd Qu.:5.000
##  Max.   :3035           Max.   :5.000   Max.   :5.000   Max.   :5.000
##        Q4              Q5              Q6              Q7
##  Min.   :3.0   Min.   :2.000   Min.   :2.000   Min.   :3.000
##  1st Qu.:4.0   1st Qu.:4.000   1st Qu.:4.000   1st Qu.:4.000
##  Median :5.0   Median :4.000   Median :4.000   Median :4.000
##  Mean   :4.5   Mean   :4.255   Mean   :4.235   Mean   :4.316
##  3rd Qu.:5.0   3rd Qu.:5.000   3rd Qu.:5.000   3rd Qu.:5.000
##  Max.   :5.0   Max.   :5.000   Max.   :5.000   Max.   :5.000
```

Get Likert rating counts

```
xtabs( ~ survey + Q1, data = Data)
```

```
##       Q1
## survey  3  4  5
##     S2  3 14 11
##     S3  3 24 12
##     S4  3 10 18
```

```
xtabs( ~ survey + Q2, data = Data)
```

```
##       Q2
## survey  2  3  4  5
##     S2  1  5 13  9
##     S3  1  6 22 10
##     S4  1  4 14 12
```

```
xtabs( ~ survey + Q3, data = Data)
```

```
##       Q3
## survey  2  3  4  5
##     S2  1  1 14 12
##     S3  0  3 23 13
##     S4  1  3 10 17
```

```
xtabs( ~ survey + Q4, data = Data)
```

```
##       Q4
## survey  3  4  5
##     S2  1 11 16
##     S3  0 21 18
##     S4  1 13 17
```

```
xtabs( ~ survey + Q5, data = Data)
```

```
##       Q5
## survey  2  3  4  5
##     S2  1  3 15  9
##     S3  0  2 25 12
##     S4  0  1 18 12
```

```
xtabs( ~ survey + Q6, data = Data)
```

```
##       Q6
## survey  2  3  4  5
##     S2  2  3 17  6
##     S3  0  1 24 14
##     S4  0  1 18 12
```

```
xtabs( ~ survey + Q7, data = Data)
```

```
##       Q7
## survey  3  4  5
##     S2  3 16  9
##     S3  2 25 12
##     S4  2 12 17
```

RELIABILITY AND INTER-ITEM CONSISTENCY ANALYSES

```
# For convenience, put just the question data into a separate dataframe, d
questions = c('Q1', 'Q2', 'Q3', 'Q4', 'Q5', 'Q6', 'Q7')
d <- Data[,questions]
```

Calculate average inter-item correlation

Calculate the average inter-item (i.e. inter-question) correlation for Q1-Q7 using the corrr package.

```
library(corrr)
d %>% correlate()
```

```
## # A tibble: 7 x 8
##   rowname     Q1     Q2     Q3     Q4     Q5     Q6     Q7
##   <chr>    <dbl>  <dbl>  <dbl>  <dbl>  <dbl>  <dbl>  <dbl>
## 1 Q1      NA      0.690  0.530  0.536  0.416  0.189  0.452
## 2 Q2       0.690 NA      0.402  0.471  0.360  0.161  0.354
## 3 Q3       0.530  0.402 NA      0.641  0.363  0.271  0.446
## 4 Q4       0.536  0.471  0.641 NA      0.418  0.342  0.458
## 5 Q5       0.416  0.360  0.363  0.418 NA      0.712  0.615
## 6 Q6       0.189  0.161  0.271  0.342  0.712 NA      0.635
## 7 Q7       0.452  0.354  0.446  0.458  0.615  0.635 NA
```

Obtain the average correlation of each item (question) with all others by computing the means for each column (excluding the `rowname` column):

```
inter_item <- d %>% correlate() %>% select(-rowname) %>% colMeans(na.rm = TRUE)
```

```
##
## Correlation method: 'pearson'
## Missing treated using: 'pairwise.complete.obs'
```

```
inter_item
```

```
##        Q1        Q2        Q3        Q4        Q5        Q6        Q7
## 0.4688252 0.4062839 0.4421260 0.4777339 0.4808158 0.3853014 0.4935205
```

We can see that `Q1`, `Q4`, `Q5` and `Q7` are more strongly correlated with the other items on average than `Q6`. However, most items correlate with the others in a reasonably restricted range around .4 to .5.

To obtain the overall average inter-item correlation, we calculate the `mean()` of these values:

```
mean(inter_item)
```

```
## [1] 0.4506581
```

Calculate Cronbach's alpha for questionnaire items

Cronbach's alpha is one of the most widely reported measures of internal consistency and shall be implemented using the `alpha()` function from the R psych package. This function takes a data frame where each column is a questionnaire item and each row is a survey respondent.

Cronbach's alpha will be checked for the following questionnaire groupings:

- All questions (`Q1` - `Q7`)
- Questions relating to team-based aspects of MEER (`Q1`, `Q3`, `Q4`)
- Questions relating to learning aspects of MEER (`Q5`, `Q6`, `Q7`)

Also, the consistency of Cronbach's alpha will be checked acrosss the three surveys: `S1` (2.5 months), `S2` (5 months) and `S3` (10 months).

Cronbach's alpha across all questionairre items

```
psych::alpha(d)$total$std.alpha
```

```
## [1] 0.8516875
```

Cronbach's alpha for *team based* items: `Q1`, `Q3`, `Q4`

```
dTB <- d[c('Q1','Q3','Q4')]
psych::alpha(dTB)$total$std.alpha
```

```
## [1] 0.7982847
```

Cronbach's alpha for *learning* items: `Q5`, `Q6`, `Q7`

```
dL <- d[c('Q5','Q6','Q7')]
psych::alpha(dL)$total$std.alpha
```

```
## [1] 0.8503299
```

Cronbach's alpha across all questionairre items, calculated separately for surveys 2, 3, 4

Survey 2

```
S2 <- Data[Data$survey == 'S2', questions]
psych::alpha(S2)$total$std.alpha
```

```
## [1] 0.8487798
```

Survey 3

```
S3 <- Data[Data$survey == 'S3', questions]
psych::alpha(S3)$total$std.alpha
```

```
## [1] 0.8363949
```

Survey 4

```
S4 <- Data[Data$survey == 'S4', questions]
psych::alpha(S4)$total$std.alpha
```

```
## [1] 0.8723361
```

CONCLUSIONS

Average inter-item correlations

The calculations on average inter-item correlation between the seven questionairre items (`Q1 - Q7`) showed that almost all items correlate with the others in a reasonably restricted range of 0.4 to 0.5, indicating good consistency in inter-item correlation.

Items `Q1`, `Q4`, `Q5` and `Q7` are more strongly correlated with the other items on average than `Q6`.

Cronbach alpha analyses

Rule of thumb guidelines for interpreting Cronbach alpha (α) for Likert scale questions are indicated in the table below:

Cronbach's alpha	Internal consistency
$\alpha \geq 0.9$	Excellent
$0.9 > \alpha \geq 0.8$	Good
$0.8 > \alpha \geq 0.7$	Acceptable
$0.7 > \alpha \geq 0.6$	Questionable
$0.6 > \alpha \geq 0.5$	Poor
$0.5 > \alpha$	Unacceptable

On this basis, the seven questionairre items showed good internal consistency ($\alpha = 0.85$) as a tool for assessing general approval of the MEER approach.

This good consistency was maintained when the Likert rating data was segregated for each survey ($\alpha = 0.85$ for survey 2, $\alpha = 0.84$ for survey 3, $\alpha = 0.87$ for survey 4), indicating that the questionnaire items were stable over time (2.5, 5, 10 months after trial commencement), and for different groups of respondents.

Cronbach alpha was also calculated for questionairre items subdivided by two smaller topic groups:

- Questions relating to respondents' experience of *team-based* aspects of MEER (`Q1`, `Q3`, `Q4`)
- Questions relating to respondents' experience of *learning* aspects of MEER (`Q5`, `Q6`, `Q7`)

The *learning* topic subgroup showed good internal consistency ($\alpha = 0.85$) and the *team-based* topic subgroup showed borderline good/acceptable internal consistency ($\alpha = 0.80$).

Overall, it is concluded that these analyses validate the survey questions as an appropriate tool for gauging the approval of respondents to the MEER approach.