IRT or Rasch – what can and cannot be done?

WORKSHOP

L R Pendrill[1], and the EMPIR NeuroMet 15HLT04 consortium

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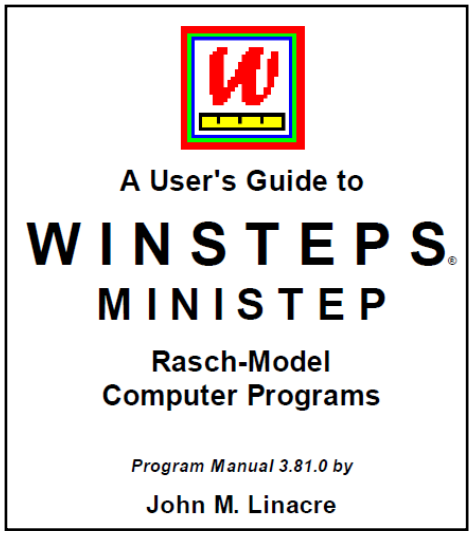
EXAM12

35 arthritis patients have been through rehabilitation therapy. Their admission to therapy and discharge from therapy measures are to be compared. They have been rated on the 13 mobility items of the Functional Independence Measure (FIM™).

Each item has seven levels.

At admission, the patients could not perform at the higher levels. At discharge, all patients had surpassed the lower levels (Data courtesy of C.V. Granger & B. Hamilton, ADS).

1	**0% Independent**
2	**25% Independent**
3	**50% Independent**
4	**75% Independent**
5	**Supervision**
6	**Device**
7	**Independent**



```
; This common control file is EXAM12.TXT
TITLE='GENERIC ARTHRITIS FIM CONTROL FILE'
ITEM1=9          ; Responses start in column 9
NI=13                    ; 13 mobility items
CODES=1234567            ; 7 level rating scale
CLFILE=*                 ; Defines the rating scale
1 0% Independent
2 25% Independent
3 50% Independent
4 75% Independent
5 Supervision
6 Device
7 Independent
*
@TIMEPOINT = $S7W1       ; the time-point code A=Admission, D=Discharge
PSUBTOTAL = @TIMEPOINT   ; subtotals by time-point
&END
A. EATING
B. GROOMING
C. BATHING
D. UPPER BODY DRESSING
E. LOWER BODY DRESSING
F. TOILETING
G. BLADDER
H. BOWEL
I. BED TRANSFER
J. TOILET TRANSFER
K. TUB, SHOWER
L. WALK/WHEELCHAIR
M. STAIRS
END NAMES
```

A User's Guide to

WINSTEPS®

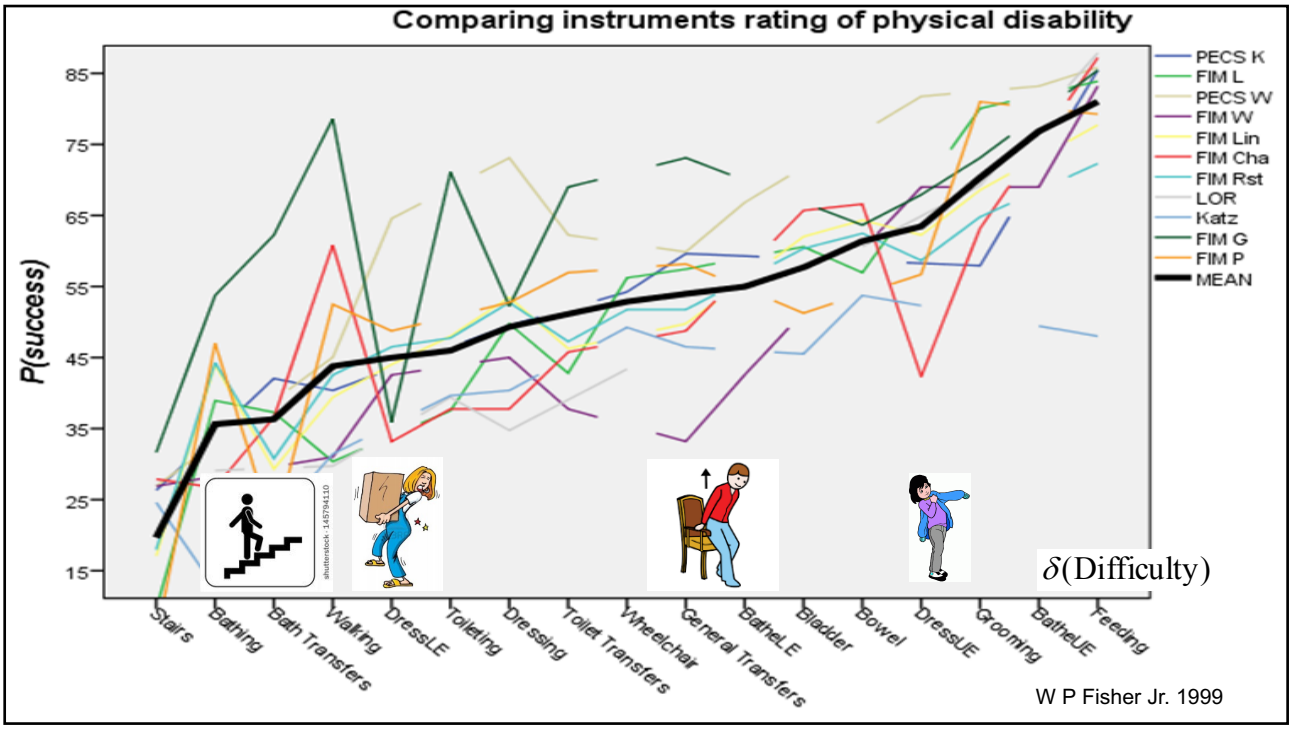
MINISTEP

Rasch-Model Computer Programs

Program Manual 3.81.0 by

John M. Linacre

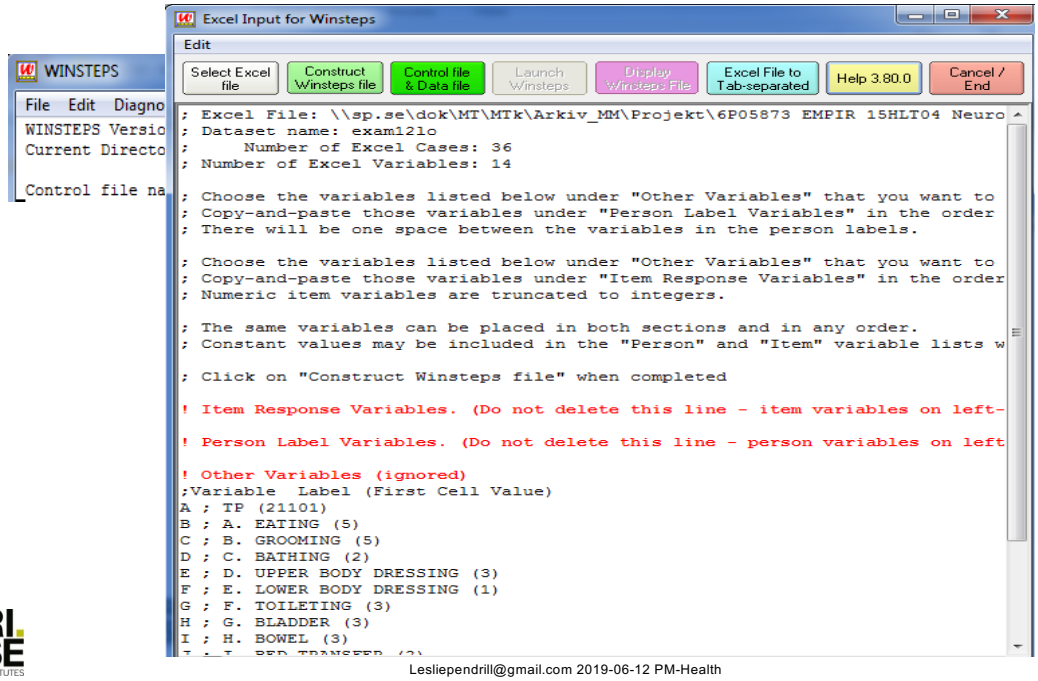
Lesliependrill@gmail.com 2019-06-12 PM-Health

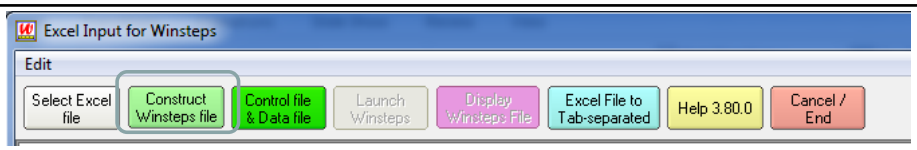


11.13 Example 12: Comparing high and low samples with rating scales

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	TP	A. EATING	B. GROOMING	C. BATHING	D. UPPER BODY DRESSING	E. LOWER BODY DRESSING	F. TOILETING	G. BLADDER	H. BOWEL	I. BED TRANSFER	J. TOILET TRANSFER	K. TUB, SHOWER	L. WALK/WHEELCHAIR	M. STAIRS
2	21101	5	5	2	3	1	3	3	3	2	2	1	2	1
3	21170	4	4	3	3	4	4	3	3	4	5	4	5	4
4	21174	4	4	4	4	3	4	4	4	3	4	1	4	1
5	21191	4	4	4	4	2	4	4	4	4	4	3	4	4
6	21243	4	2	2	1	1	2	2	2	1	1	1	1	1
7	21250	3	2	1	2	2	2	4	4	4	4	4	5	1
8	21266	4	4	3	4	2	3	5			4	3		

Score, x	
1	0% Independent
2	25% Independent
3	50% Independent
4	75% Independent
5	Supervision
6	Device
7	Independent






```
! Item Response Variables. (Do not delete this line - item variables on left-side if this line before "Person Label Variables")
B ; A. EATING (5)
C ; B. GROOMING (5)
D ; C. BATHING (2)
E ; D. UPPER BODY DRESSING (3)
F ; E. LOWER BODY DRESSING (1)
G ; F. TOILETING (3)
H ; G. BLADDER (3)
I ; H. BOWEL (3)
J ; I. BED TRANSFER (2)
K ; J. TOILET TRANSFER (2)
L ; K. TUB, SHOWER (1)
M ; L. WALK/WHEELCHAIR (2)
N ; M. STAIRS (1)
! Person Label Variables. (Do not delete this line - person variables on left-side if before "Item Response Variables")
A ; TP (21101)
! Other Variables (ignored)
;Variable  Label (First Cell Value)
```


Excel Input for Winsteps

Edit

Select Excel file | Construct Winsteps file | Control file & Data file | Launch Winsteps | Display Winsteps File | Excel File to Tab-separated | Help 3.80.0 | Cancel / End

NeuroMET

Exam12loe_new_190421.txt

File Edit Diagnosis Output Tables Output Files Batch Help Specification Plots Excel/RSSST Graphs Data Setup

```
WINSTEPS Version 3.91.2  Apr 22 2019  7:35
Current Directory: \\sp.se\dok\MT\MTk\Arkiv_MM\Projekt\6P05873 EMPIR 15HLT04 NeuroMet_2016\Presentations\2019\PM_Health_2019\workshop\exam12\

Name of control file:
\\sp.se\dok\MT\MTk\Arkiv_MM\Projekt\6P05873 EMPIR 15HLT04 NeuroMet_2016\Presentations\2019\PM_Health_2019\workshop\exam12\Exam12loe_new_190421.t

Report output file name (or press Enter for temporary file, Ctrl+O for Dialog Box):

Extra specifications (if any). Press Enter to analyze:
Boxnumber=no

 Calculating Fit Statistics
>=====================================<
Time for estimation: 0:0:0.205
Processing Table 0
\\sp.se\dok\MT\MTk\Arkiv_MM\Projekt\6P05873 EMPIR 15HLT04 NeuroMet_2016\Presen

  PERSON      35 INPUT      35 MEASURED              INFIT        OUTFIT
            TOTAL     COUNT     MEASURE  REALSE     IMNSQ   ZSTD  OMNSQ   ZSTD
  MEAN       38.2      13.0        -.18    .35      1.01    -.1   1.02     .0
  P.SD       10.1        .0         .99    .08       .56    1.4    .57    1.3
  REAL RMSE    .36 TRUE SD     .92  SEPARATION  2.54  PERSON RELIABILITY  .87

  ITEM      13 INPUT      13 MEASURED              INFIT        OUTFIT
            TOTAL     COUNT     MEASURE  REALSE     IMNSQ   ZSTD  OMNSQ   ZSTD
  MEAN      102.9      35.0         .00    .22      1.08    -.2   1.02    -.2
  P.SD       23.6        .0         .93    .07       .57    2.3    .53    2.0
  REAL RMSE    .24 TRUE SD     .90  SEPARATION  3.81  ITEM   RELIABILITY  .94
```

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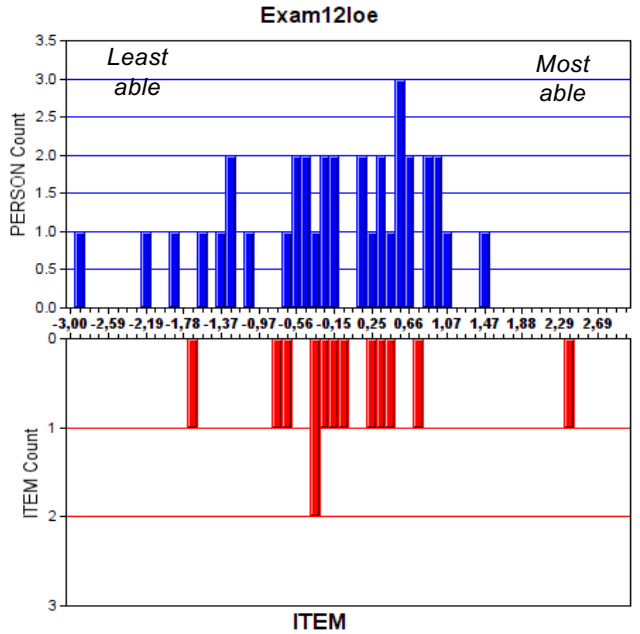
EMPIR EURAMET



PERSON STATISTICS: MEASURE ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEASUR-AL CORR.	PTMEASUR-AL EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	PERSON
19	54	13	1.43	.38	.91	.0	1.03	.2	.67	.65	46.2	49.1	21594
12	51	13	1.04	.34	.55	-1.1	.69	-.6	.59	.65	61.5	44.6	21385
2	50	13	.93	.34	1.65	1.4	1.92	1.8	-.13	.65	30.8	44.7	21170
8	50	13	.93	.34	1.55	1.3	1.84	1.7	.15	.65	69.2	44.7	21280
4	49	13	.82	.33	.97	.1	1.20	.6	.25	.65	76.9	43.7	21191
18	49	13	.82	.33	.80	-.4	.79	-.4	.82	.65	46.2	43.7	21540
13	48	13	.71	.32	.53	-1.3	.55	-1.1	.82	.65	53.8	42.7	21401
27	48	13	.71	.32	2.14	2.3	2.06	2.1	.61	.65	23.1	42.7	22214
20	47	13	.61	.31	1.28	.8	1.35	.9	.64	.65	61.5	43.9	21725
21	47	13	.61	.31	1.08	.3	.91	-.1	.71	.65	61.5	43.9	21761
33	47	13	.61	.31	1.38	1.0	1.21	.6	.81	.65	46.2	43.9	22573
15	45	13	.42	.30	.82	-.4	.84	-.3	.76	.64	38.5	43.8	21443
3	44	13	.33	.30	.50	-1.5	.46	-1.6	.76	.64	53.8	42.4	21174
7	44	13	.33	.30	.52	-1.5	.53	-1.3	.79	.64	61.5	42.4	21266
34	43	13	.24	.30	1.08	.3	1.01	.2	.69	.64	30.8	42.5	22618
16	42	13	.15	.29	2.13	2.5	2.10	2.3	.36	.63	23.1	39.9	21479
25	42	13	.15	.29	1.07	.3	1.12	.4	.67	.63	15.4	39.9	22080
6	38	13	-.18	.29	1.72	1.8	1.71	1.7	.34	.61	23.1	38.9	21250
29	38	13	-.18	.29	.79	-.5	.80	-.4	.74	.61	38.5	38.9	22250
23	37	13	-.26	.29	.44	-1.9	.42	-1.8	.80	.61	76.9	39.1	21883
26	37	13	-.26	.29	.38	-2.2	.48	-1.5	.76	.61	53.8	39.1	22186
11	36	13	-.34	.29	2.05	2.4	1.96	2.1	.33	.60	38.5	38.8	21360
10	35	13	-.43	.29	.44	-1.9	.42	-1.8	.80	.59	46.2	38.1	21349
28	35	13	-.43	.29	.49	-1.7	.51	-1.4	.83	.59	69.2	38.1	22246
1	33	13	-.59	.29	.55	-1.4	.55	-1.2	.81	.58	46.2	38.7	21101
9	33	13	-.59	.29	2.36	2.9	2.28	2.5	.32	.58	38.5	38.7	21308
35	32	13	-.68	.29	.98	.1	.89	-.1	.64	.57	30.8	38.7	22693
22	28	13	-1.03	.31	.23	-2.9	.24	-2.3	.77	.54	69.2	42.7	21842
30	26	13	-1.23	.32	.78	-.5	.67	-.6	.56	.52	61.5	43.0	22383
31	26	13	-1.23	.32	.50	-1.4	.45	-1.3	.65	.52	53.8	43.0	22394
32	25	13	-1.34	.33	.86	-.2	.69	-.5	.62	.51	53.8	44.9	22475
17	23	13	-1.57	.35	.64	-.8	.59	-.7	.66	.48	46.2	50.6	21488
5	21	13	-1.84	.38	.52	-1.1	.48	-.8	.64	.45	53.8	53.7	21243
24	19	13	-2.17	.43	1.51	1.0	1.35	.7	.38	.41	76.9	65.0	21943
14	16	13	-2.92	.59	1.11	.4	1.54	.8	-.06	.31	69.2	80.1	21413
MEAN	38.2	13.0	-.18	.32	1.01	-.1	1.02	.0			49.9	44.2	
P.SD	10.1	.0	.99	.06	.56	1.4	.57	1.3			16.5	8.0	

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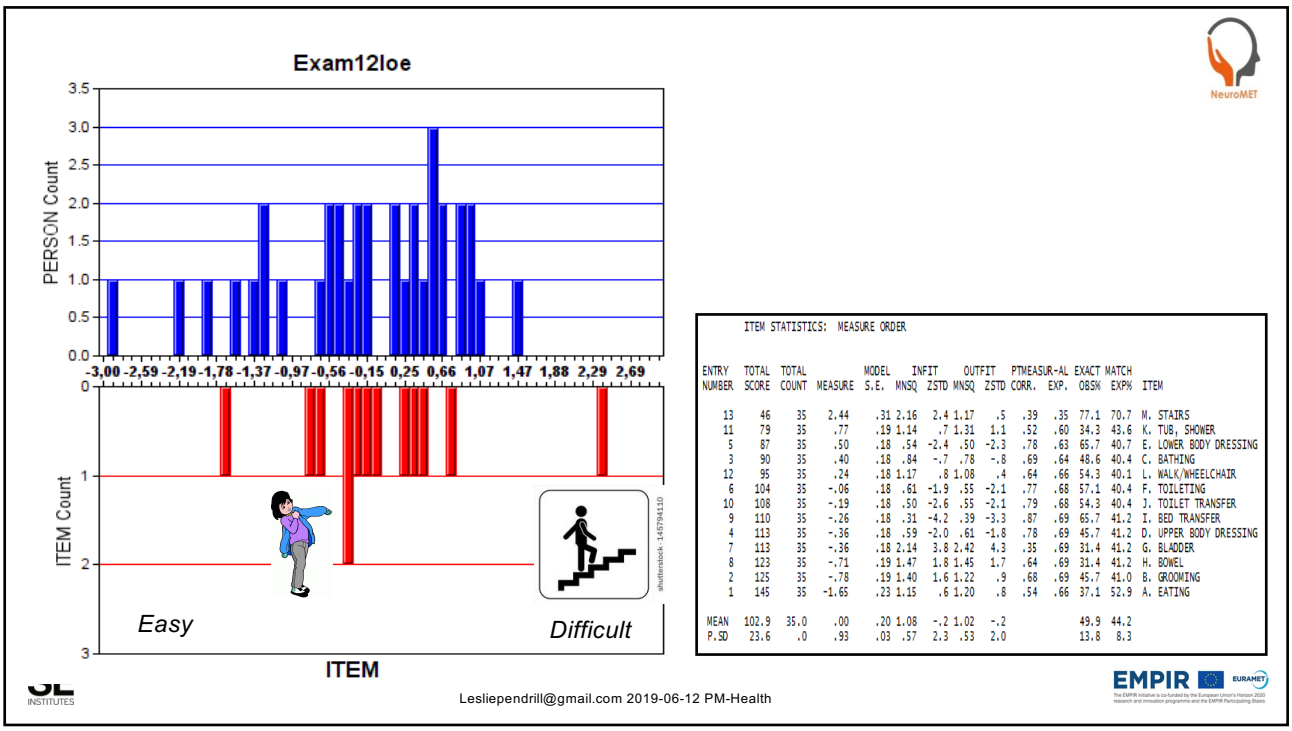

ITEM STATISTICS: MEASURE ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEASUR-AL CORR.	PTMEASUR-AL EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	ITEM
13	46	35	2.44	.31	2.16	2.4	1.17	.5	.39	.35	77.1	70.7	M. STAIRS
11	79	35	.77	.19	1.14	.7	1.31	1.1	.52	.60	34.3	43.6	K. TUB, SHOWER
5	87	35	.50	.18	.54	-2.4	.50	-2.3	.78	.63	65.7	40.7	E. LOWER BODY DRESSING
3	90	35	.40	.18	.84	-.7	.78	-.8	.69	.64	48.6	40.4	C. BATHING
12	95	35	.24	.18	1.17	.8	1.08	.4	.64	.66	54.3	40.1	L. WALK/WHEELCHAIR
6	104	35	-.06	.18	.61	-1.9	.55	-2.1	.77	.68	57.1	40.4	F. TOILETING
10	108	35	-.19	.18	.50	-2.6	.55	-2.1	.79	.68	54.3	40.4	J. TOILET TRANSFER
9	110	35	-.26	.18	.31	-4.2	.39	-3.3	.87	.69	65.7	41.2	I. BED TRANSFER
4	113	35	-.36	.18	.59	-2.0	.61	-1.8	.78	.69	45.7	41.2	D. UPPER BODY DRESSING
7	113	35	-.36	.18	2.14	3.8	2.42	4.3	.35	.69	31.4	41.2	G. BLADDER
8	123	35	-.71	.19	1.47	1.8	1.45	1.7	.64	.69	31.4	41.2	H. BOWEL
2	125	35	-.78	.19	1.40	1.6	1.22	.9	.68	.69	45.7	41.0	B. GROOMING
1	145	35	-1.65	.23	1.15	.6	1.20	.8	.54	.66	37.1	52.9	A. EATING
MEAN	102.9	35.0	.00	.20	1.08	-.2	1.02	-.2			49.9	44.2	
P.SD	23.6	.0	.93	.03	.57	2.3	.53	2.0			13.8	8.3	

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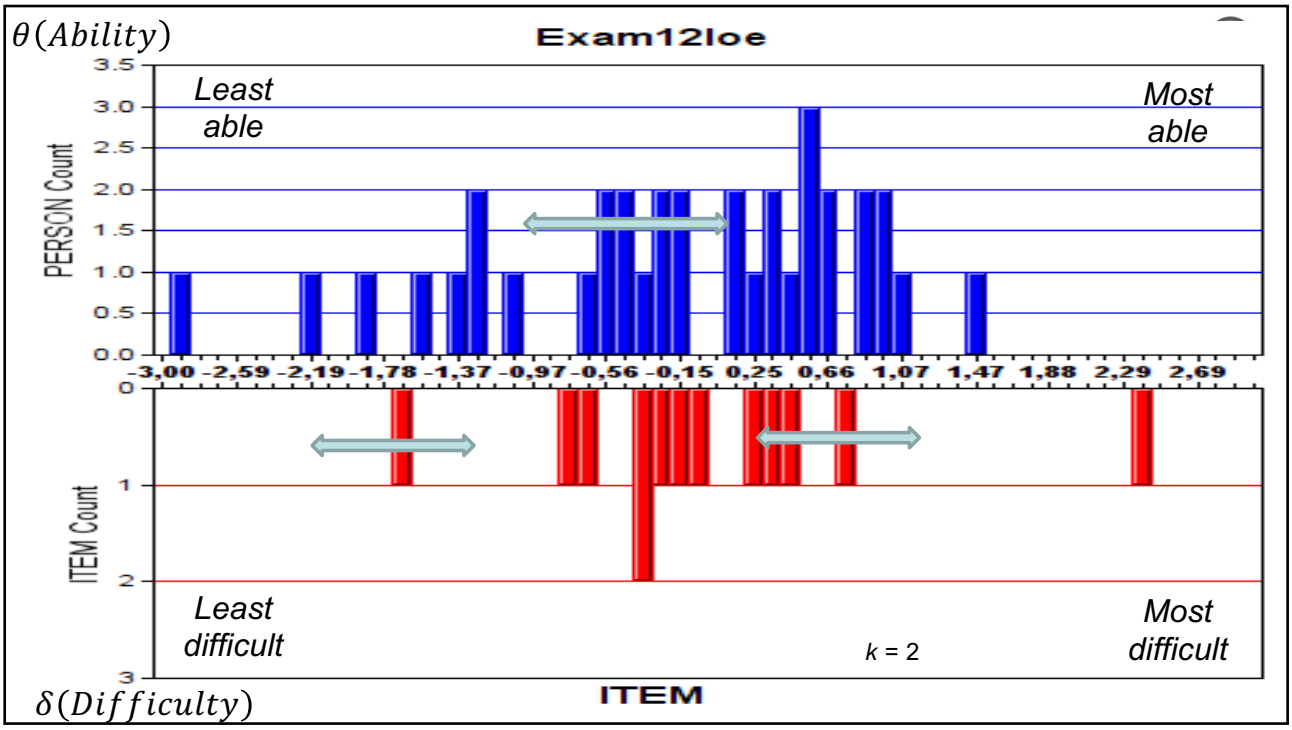

Exam12loe_new_190421.txt

File Edit Diagnosis Output Tables Output Files Batch Help Specification Plots Excel/RSSST Graphs Data Setup

13-042WS - Anteckningar

Arkiv Redigera Format Visa Hjälp

```
TABLE 13.1 \\sp.se\dok\MT\MTk\Arkiv_MM\Projekt\6 ZOU042WS.TXT1 Apr 22 2019  7:3516\Presenta
INPUT: 35 PERSON  13 ITEM  REPORTED: 35 PERSON  13 ITEM  5 CATS  WINSTEPS 3.91.2

PERSON: REAL SEP.: 2.54  REL.: .87 ... ITEM: REAL SEP.: 3.81  REL.: .94

         ITEM STATISTICS:  MEASURE ORDER


 ENTRY   TOTAL  TOTAL           MODEL    INFIT     OUTFIT   PTMEASUR-AL EXACT MATCH
 NUMBER  SCORE  COUNT  MEASURE  S.E.  MNSQ  ZSTD MNSQ  ZSTD CORR.  EXP.  OBS%  EXP%  ITEM

     13     46     35     2.44   .31 2.16   2.4 3.17   .5   .39   .35  77.1  70.7  M. STAIRS
     11     79     35      .77   .19 1.14    .7 1.31   1.1  .52   .60  34.3  43.6  K. TUB, SHOWER
      5     87     35      .50   .18  .54  -2.4  .50  -2.3  .78   .63  65.7  40.7  E. LOWER BODY DRESSING
      3     90     35      .40   .18  .84   -.7  .78   -.8  .69   .64  48.6  40.4  C. BATHING
     12     95     35      .24   .18 1.17    .8 1.08    .4  .64   .66  54.3  40.1  L. WALK/WHEELCHAIR
      6    104     35     -.06   .18  .61  -1.9  .55  -2.1  .77   .68  57.1  40.4  F. TOILETING
     10    108     35     -.19   .18  .50  -2.6  .55  -2.1  .79   .68  54.3  40.4  J. TOILET TRANSFER
      9    110     35     -.26   .18  .31  -4.2  .39  -3.3  .87   .69  65.7  41.2  I. BED TRANSFER
      4    113     35     -.36   .18  .59  -2.0  .61  -1.8  .78   .69  45.7  41.2  D. UPPER BODY DRESSING
      7    113     35     -.36   .18 2.14   3.8 2.42   4.3  .35   .69  31.4  41.2  G. BLADDER
      8    123     35     -.71   .19 1.47   1.8 1.45   1.7  .64   .69  31.4  41.2  H. BOWEL
      2    125     35     -.78   .19 1.40   1.6 1.22    .9  .68   .69  45.7  41.0  B. GROOMING
      1    145     35    -1.65   .23 1.15    .6 1.20    .8  .54   .66  37.1  52.9  A. EATING

  MEAN  102.9   35.0     .00   .20 1.08   -.2 1.02   -.2              49.9  44.2
  P.SD   23.6    .0     .93   .03  .57   2.3  .53   2.0              13.8   8.3
```

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34	22573	5	5	1
35	22618	4	4	3
36	22693	3	5	2
37	Mean	4,1	3,6	2,6
38	SD mea	0,2	0,2	0,2
39	TP	A. EATING	B. GROOMING	C. BATHING

Score, x	
1	**0% Independent**
2	**25% Independent**
3	**50% Independent**
4	**75% Independent**
5	**Supervision**
6	**Device**
7	**Independent**

`=AVERAGE(B2:B36)`

CTT mean of response *x*

$$\hat{x}_j = \frac{1}{N_{TP}} \cdot \sum_{i=1}^{N_{TP}} x_{i,j}$$

`=STDEV(B2:B36)/SQRT(COUNTA(B2:B36))`

u(CTT mean of response *x*)

$$u(\hat{x}_j) = \frac{1}{N_{TP} \cdot (N_{TP} - 1)} \cdot \sum_{i=1}^{N_{TP}} \left(x_{i,j} - \hat{x}_j{}^2\right)$$

$k = 1$

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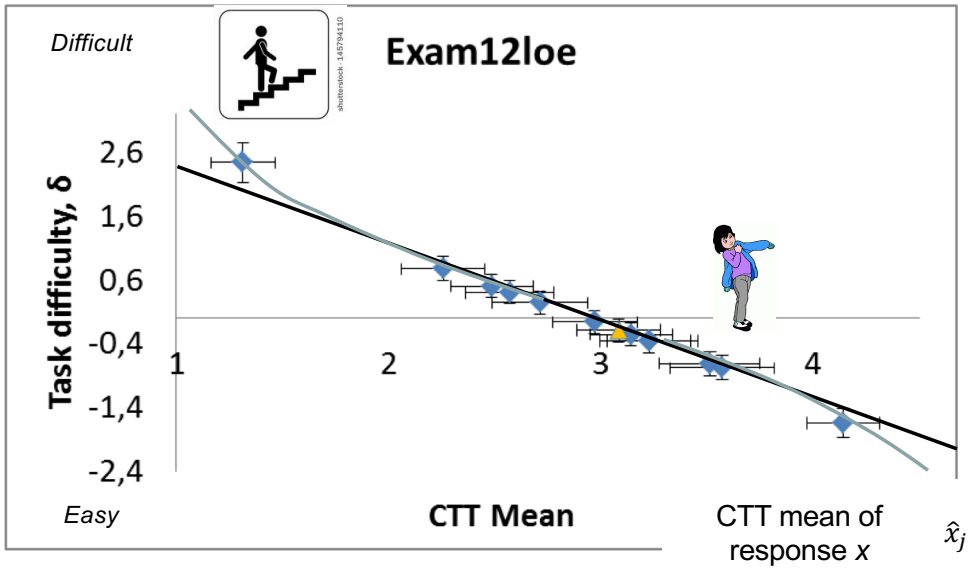


k = 1

CTT mean of response x

$$\hat{x}_j = \frac{1}{N_{TP}} \cdot \sum_{i=1}^{N_{TP}} x_{i,j}$$

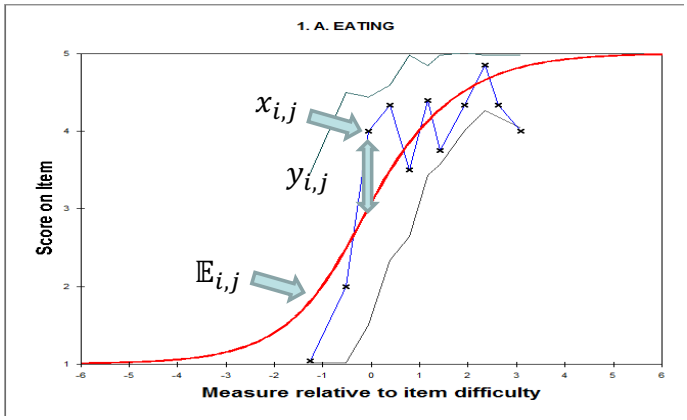
Score residual, y

$$y_{i,j} = x_{i,j} - \mathbb{E}_{i,j}$$

Expected mean, E, of response x

$$\mathbb{E}_{i,j} = \sum_{k=0}^{C_j} k \cdot q_{i,j,k}$$

$$q_{i,j,k} = \frac{e^{\sum_{c=0}^{k}(\theta_i - \delta_{j,c})}}{\sum_{k=0}^{C_j} e^{\sum_{c=0}^{k}(\theta_i - \delta_{j,c})}}$$



Graphs: Test Characteristic Curve

Exp+Empirical ICC

Score residual, *y* $y_{i,j} = x_{i,j} - \mathbb{E}_{i,j}$

Expected mean, *E*, of response *x*

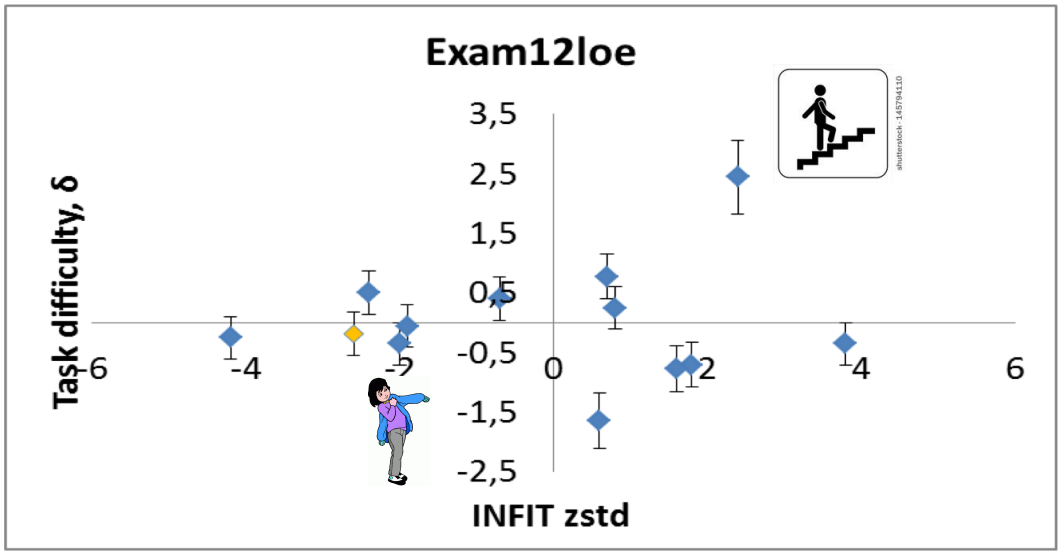
$$\mathbb{E}_{i,j} = \sum_{k=0}^{C_j} k \cdot q_{i,j,k} \qquad q_{i,j,k} = \frac{e^{\sum_{c=0}^{k}(\theta_i - \delta_{j,c})}}{\sum_{k=0}^{C_j} e^{\sum_{c=0}^{k}(\theta_i - \delta_{j,c})}}$$

$$X = \chi_j{}^2 = \sum_{i=1}^{N_{TP}} y_i{}^2$$

$$INFIT\_zstd\_WH = \frac{2 \cdot \left(\sqrt[3]{X} - \sqrt[3]{N_{TP} - \frac{2}{3}} \right)}{\sigma} \qquad \sigma = \frac{\sqrt{2}}{3 \cdot \sqrt[6]{N_{TP} - \frac{2}{3}}}$$

Molton: "Both statistics … require a lot of meditation and incense. For useful explanations, refer to: http://www.rasch.org/rmt/rmt162f.htm".

Physical disability



k = 2

Arkiv Redigera Format Visa Hjälp

```
TABLE 23.0 \\sp.se\dok\MT\MTk\Arkiv_MM\Projekt\6 ZOU042WS.TXT1 Apr 22 2019  7:3516\Presenta
INPUT: 35 PERSON  13 ITEM  REPORTED: 35 PERSON  13 ITEM  5 CATS  WINSTEPS 3.91.2


     Table of STANDARDIZED RESIDUAL variance in Eigenvalue units = ITEM information units
                                    Eigenvalue   Observed   Expected
Total raw variance in observations     =      31.4172 100.0%          100.0%
  Raw variance explained by measures   =      18.4172  58.6%           58.9%
    Raw variance explained by persons  =       7.0001  22.3%           22.4%
    Raw variance explained by items    =      11.4172  36.3%           36.5%
  Raw unexplained variance (total)     =      13.0000  41.4% 100.0%    41.1%
    Unexplned variance in 1st contrast =       3.2193  10.2%  24.8%
    Unexplned variance in 2nd contrast =       2.6462   8.4%  20.4%
    Unexplned variance in 3rd contrast =       1.3397   4.3%  10.3%
    Unexplned variance in 4th contrast =       1.2293   3.9%   9.5%
    Unexplned variance in 5th contrast =        .9564   3.0%   7.4%

       STANDARDIZED RESIDUAL VARIANCE SCREE PLOT

        VARIANCE COMPONENT SCREE PLOT

  100%   T
 V 63%
 A
      M
 R 40%          U
 I
 A 25%       I
 N
 C 16%        P
 E
   10%              1
 L                     2
 O  6%
 G
    4%                    3
 S                           4
 C  3%                         5
 A
 L  2%
 E
 D  1%

  0.5%

        TV MV PV IV UV U1 U2 U3 U4 U5
       VARIANCE COMPONENTS
```

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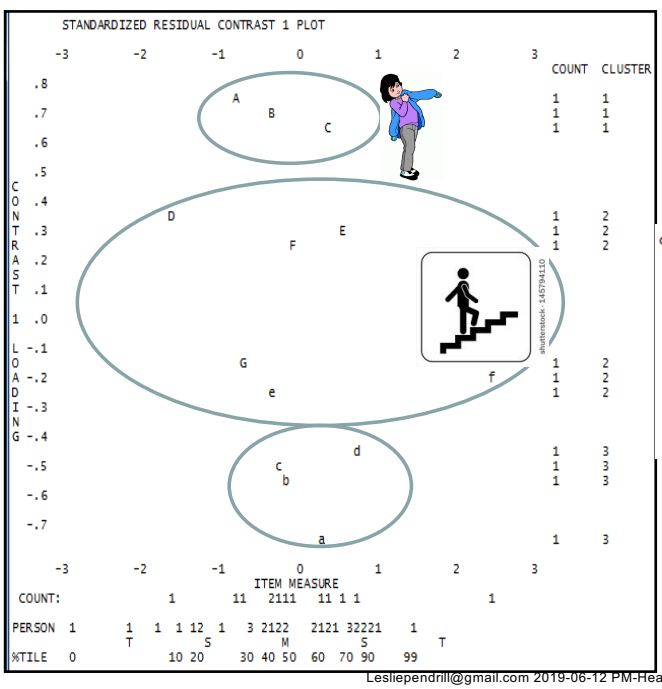

Physical disability

CON-TRAST	LOADING	MEASURE	INFIT MNSQ	OUTFIT MNSQ	ENTRY NUMBER	ITEM
1 1	.77	-.78	1.40	1.22	A 2	B. GROOMING
1 1	.72	-.36	.59	.61	B 4	D. UPPER BODY DRESSING
1 1	.63	.40	.84	.78	C 3	C. BATHING
1 2	.37	-1.65	1.15	1.20	D 1	A. EATING
1 2	.28	.50	.54	.50	E 5	E. LOWER BODY DRESSING
1 2	.25	-.06	.61	.55	F 6	F. TOILETING
1 3	-.74	.24	1.17	1.08	a 12	L. WALK/WHEELCHAIR
1 3	-.55	-.19	.50	.55	b 10	J. TOILET TRANSFER
1 3	-.52	-.26	.31	.39	c 9	I. BED TRANSFER
1 3	-.44	.77	1.14	1.31	d 11	K. TUB, SHOWER
1 2	-.24	-.36	2.14	2.42	e 7	G. BLADDER
1 2	-.20	2.44	2.16	1.17	f 13	M. STAIRS
1 2	-.16	-.71	1.47	1.45	G 8	H. BOWEL

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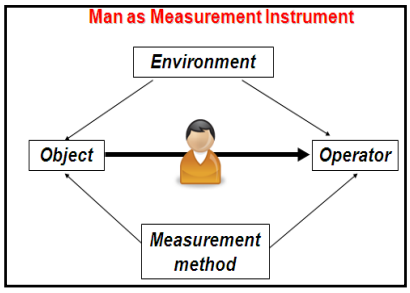
Physical disability

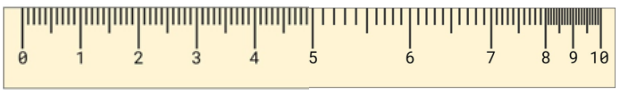
```
 Calculating Fit Statistics
>====================================<
Time for estimation: 0:0:0.205
Processing Table 0
\\sp.se\dok\MT\MTk\Arkiv_MM\Projekt\6P05873 EMPIR 15HLT04 NeuroMet_2016\Presen

  PERSON      35 INPUT      35 MEASURED              INFIT        OUTFIT
           TOTAL     COUNT     MEASURE  REALSE     IMNSQ   ZSTD  OMNSQ   ZSTD
  MEAN      38.2      13.0        -.18     .35      1.01    -.1   1.02     .0
  P.SD      10.1        .0         .99     .08       .56    1.4    .57    1.3
  REAL RMSE    .36 TRUE SD     .92  SEPARATION  2.54  PERSON RELIABILITY  .87

  ITEM      13 INPUT      13 MEASURED              INFIT        OUTFIT
           TOTAL     COUNT     MEASURE  REALSE     IMNSQ   ZSTD  OMNSQ   ZSTD
  MEAN     102.9      35.0         .00     .22      1.08    -.2   1.02    -.2
  P.SD      23.6        .0         .93     .07       .57    2.3    .53    2.0
  REAL RMSE    .24 TRUE SD     .90  SEPARATION  3.81  ITEM   RELIABILITY  .94
```

$$J.\ TOILET\ TRANSFER_{ACQUI} = 7 - J.\ TOILET\ TRANSFER$$

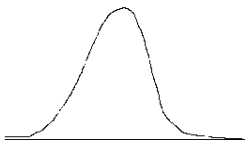
	K
	J. TOILET TRANSFER_ACQUI
	5
	2
	3
	3

```
PERSON      35 INPUT      35 MEASURED              INFIT        OUTFIT
         TOTAL     COUNT     MEASURE  REALSE     IMNSQ   ZSTD  OMNSQ   ZSTD
MEAN      39.1      13.0        -.87     .31      1.02    -.1   1.01    -.1
P.SD       8.4        .0         .64     .06       .52    1.4    .51    1.2
REAL RMSE    .32 TRUE SD     .56  SEPARATION  1.77  PERSON RELIABILITY  .76

ITEM      13 INPUT      13 MEASURED              INFIT        OUTFIT
         TOTAL     COUNT     MEASURE  REALSE     IMNSQ   ZSTD  OMNSQ   ZSTD
MEAN     105.2      35.0         .00     .20      1.08    -.3   1.01    -.5
P.SD      25.3        .0         .79     .08       .74    2.6    .70    2.4
REAL RMSE    .21 TRUE SD     .76  SEPARATION  3.55  ITEM   RELIABILITY  .93
```



$$\Delta\delta = \tau \cdot \delta; \tau < 0$$



Acquiescence

”Agreement regardless of item content

$$P_{success} = \frac{e^{\theta-\delta}}{1+e^{\theta-\delta}}$$

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Physical disability

ITEM STATISTICS: MEASURE ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEASUR-AL CORR.	PTMEASUR-AL EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	ITEM
13	46	35	2.44	.31	2.16	2.4	1.17	.5	.39	.35	77.1	70.7	M. STAIRS
11	79	35	.77	.19	1.14	.7	1.31	1.1	.52	.60	34.3	43.6	K. TUB, SHOWER
5	87	35	.50	.18	.54	-2.4	.50	-2.3	.78	.63	65.7	40.7	E. LOWER BODY DRESSING
3	90	35	.40	.18	.84	-.7	.78	-.8	.69	.64	48.6	40.4	C. BATHING
12	95	35	.24	.18	1.17	.8	1.08	.4	.64	.66	54.3	40.1	L. WALK/WHEELCHAIR
6	104	35	-.06	.18	.61	-1.9	.55	-2.1	.77	.68	57.1	40.4	F. TOILETING
10	108	35	-.19	.18	.50	-2.6	.55	-2.1	.79	.68	54.3	40.4	J. TOILET TRANSFER
9	110	35	-.26	.18	.31	-4.2	.30	-3.3	.87	.69	65.7	41.2	I. BED TRANSFER
4	113	35	-.36	.18	.59	-2.0					45.7	41.2	D. UPPER BODY DRESSING
7	113	35	-.36	.18	2.14	3.8					31.4	41.2	G. BLADDER
8	123	35	-.71	.19	1.47	1.8					31.4	41.2	H. BOWEL
2	125	35	-.78	.19	1.40	1.6					45.7	41.0	B. GROOMING
1	145	35	-1.65	.23	1.15	.6					37.1	52.9	A. EATING
MEAN	102.9	35.0	.00	.20	1.08	-.2	1.02	-.2			49.9	44.2	
P.SD	23.6	.0	.93	.03	.57	2.3	.53	2.0			13.8	8.3	

Difficult

Difficulty

Easy

ITEM STATISTICS: MEASURE ORDER

ENTRY NUMBER	TOTAL SCORE	TOTAL COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PTMEASUR-AL CORR.	PTMEASUR-AL EXP.	EXACT MATCH OBS%	EXACT MATCH EXP%	ITEM
13	46	35	2.08	.29	2.04	2.2	1.27	.7	.39	.28	82.9	71.7	M. STAIRS
11	79	35	.66	.17	.98	.0	1.02	.2	.48	.50	40.0	36.7	K. TUB, SHOWER
5	87	35	.44	.16	.52	-2.7	.50	-2.6	.76	.53	48.6	33.3	E. LOWER BODY DRESSING
3	90	35	.36	.16	.69	-1.6	.64	-1.7	.70	.54	51.4	33.6	C. BATHING
12	95	35	.23	.16	1.02	.2	.98	.0	.59	.55	34.3	32.6	L. WALK/WHEELCHAIR
6	104	35	.00	.16	.47	-3.1	.45	-3.1	.79	.57	62.9	34.4	F. TOILETING
9	110	35	-.15	.16	.36	-4.0	.37	-3.7	.83	.57	57.1	35.1	I. BED TRANSFER
4	113	35	-.23	.16	.46	-3.1	.47	-2.9	.79	.57	54.3	35.0	D. UPPER BODY DRESSING
7	113	35	-.23	.16	1.46	1.9	1.50	2.0	.40	.57	28.6	35.0	G. BLADDER
8	123	35	-.50	.17	1.05	.3	1.02	.2	.67	.57	31.4	34.2	H. BOWEL
2	125	35	-.55	.17	1.04	.3	.94	-.2	.71	.57	37.1	34.8	B. GROOMING
10	137	35	-.91	.18	3.11	5.8	3.14	5.6	-.70	.55	14.3	38.5	J. TOILET TRANSFER_ACQUI
1	145	35	-1.18	.19	.81	-.7	.78	-.8	.53	.53	40.0	44.3	A. EATING
MEAN	105.2	35.0	.00	.18	1.08	-.3	1.01	-.5			44.8	38.4	
P.SD	25.3	.0	.79	.03	.74	2.6	.70	2.4			16.8	10.0	

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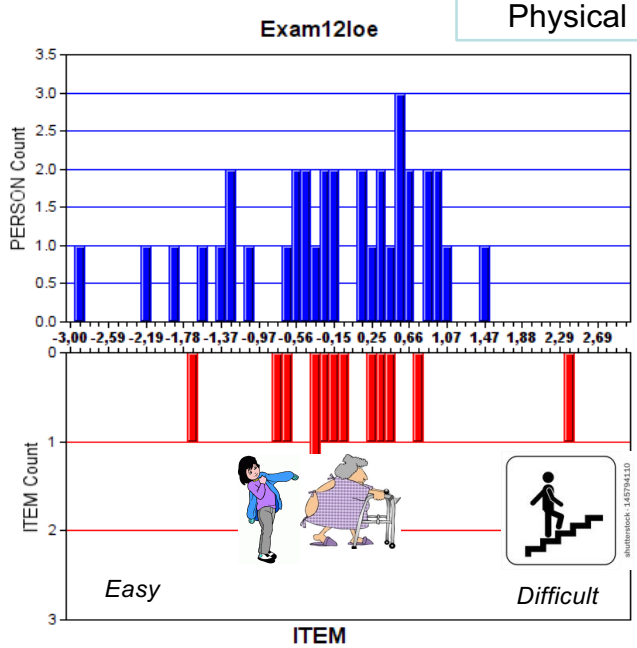
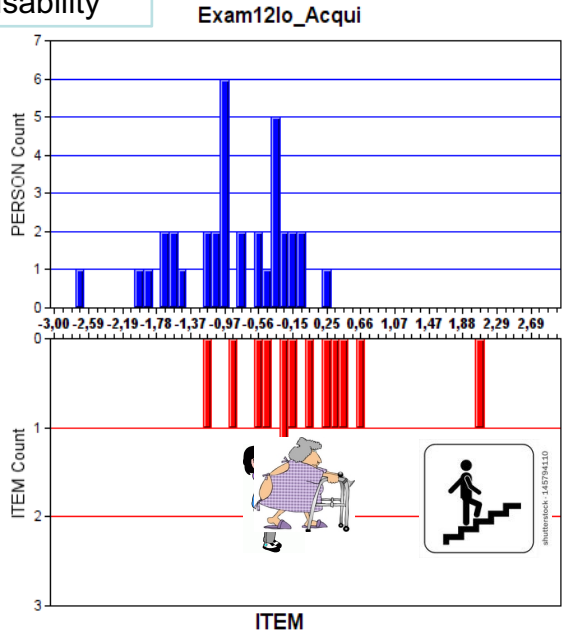
Physical disability





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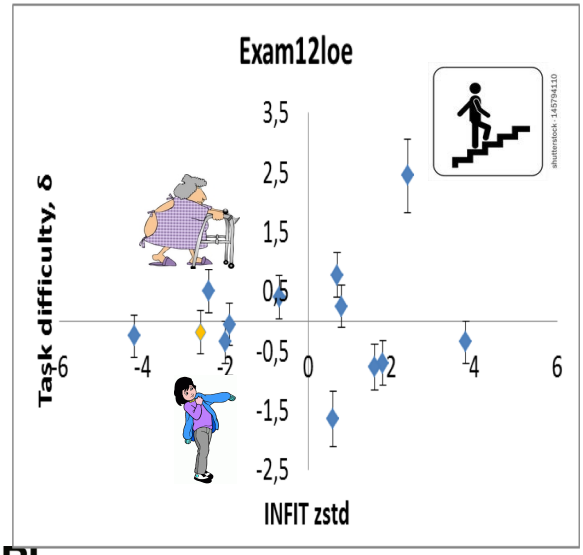
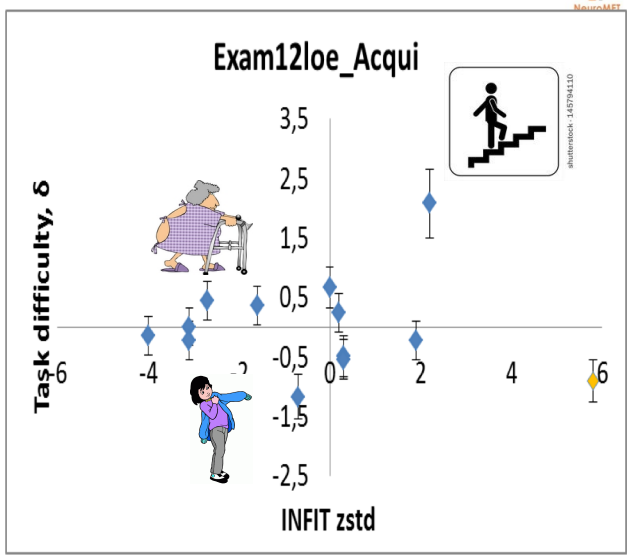
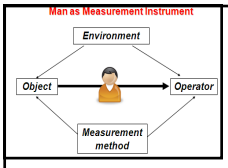
Physical disability





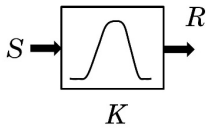
$k = 2$



Response

$$P_{success} = \frac{e^{\theta-\delta}}{1+e^{\theta-\delta}}$$

Sensitivity



$$K = \frac{\partial P_{success}}{\partial \delta} = \frac{e^{2\cdot(\theta-\delta)}}{(1+e^{(\theta-\delta)})^2} - \frac{e^{(\theta-\delta)}}{1+e^{(\theta-\delta)}}$$

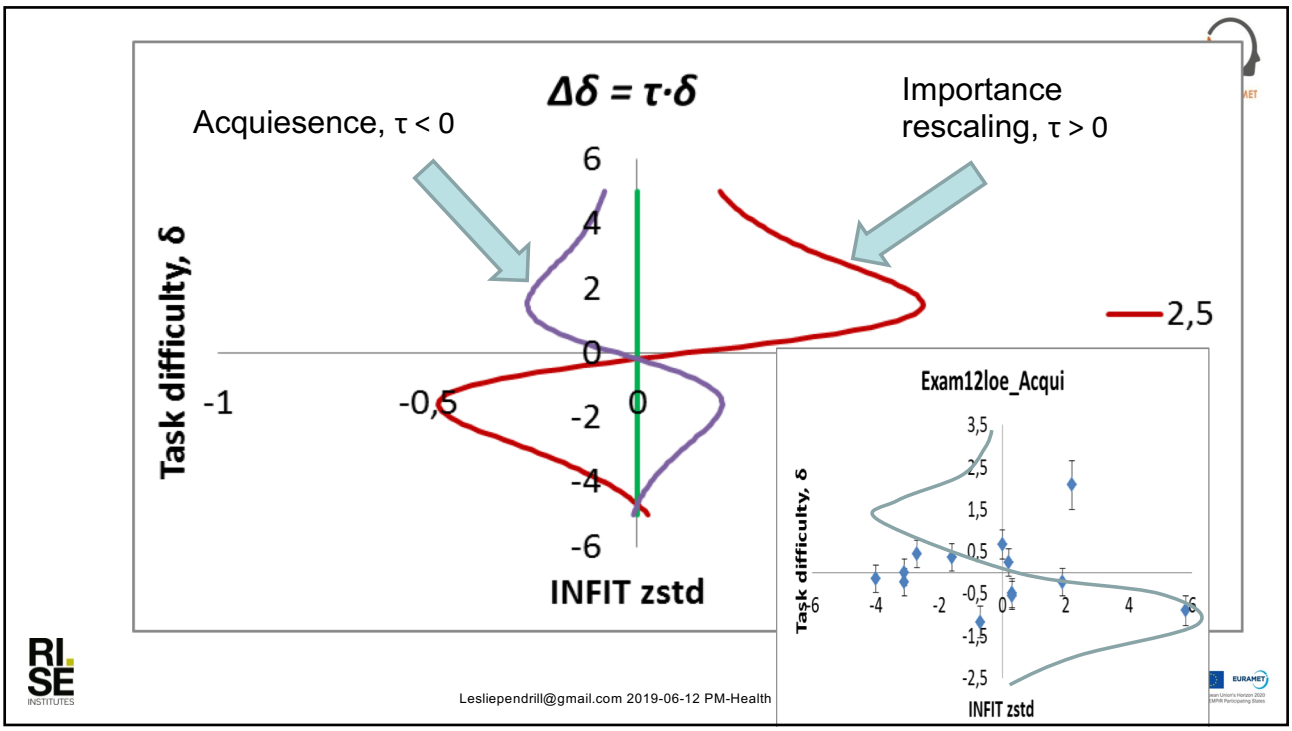
Fit residual $y_{i,j} = x_{i,j} - \mathbb{E}_{i,j}$

$$X = {\chi_j}^2 = \sum_{i=1}^{N_{TP}} {y_{i,j}}^2$$

$${\chi'_{j,\delta}}^2 = \left(\chi_j - \frac{\partial P_{success}}{\partial \delta}\cdot\partial\delta\right)^2 = {\chi_j}^2 - 2\cdot\frac{\partial P_{success}}{\partial \delta}\cdot\partial\delta\cdot\chi_j + \left(\frac{\partial P_{success}}{\partial \delta}\cdot\partial\delta\right)^2$$

Changed stimulus

$$Infit\_zstd\_WH = \frac{2\cdot\left(\sqrt[3]{X} - \sqrt[3]{N_{TP} - \frac{2}{3}}\right)}{\sigma}$$


Δδ = τ·δ
Acquiesence, τ < 0
Importance rescaling, τ > 0
Task difficulty, δ
INFIT zstd
2,5
Exam12loe_Acqui
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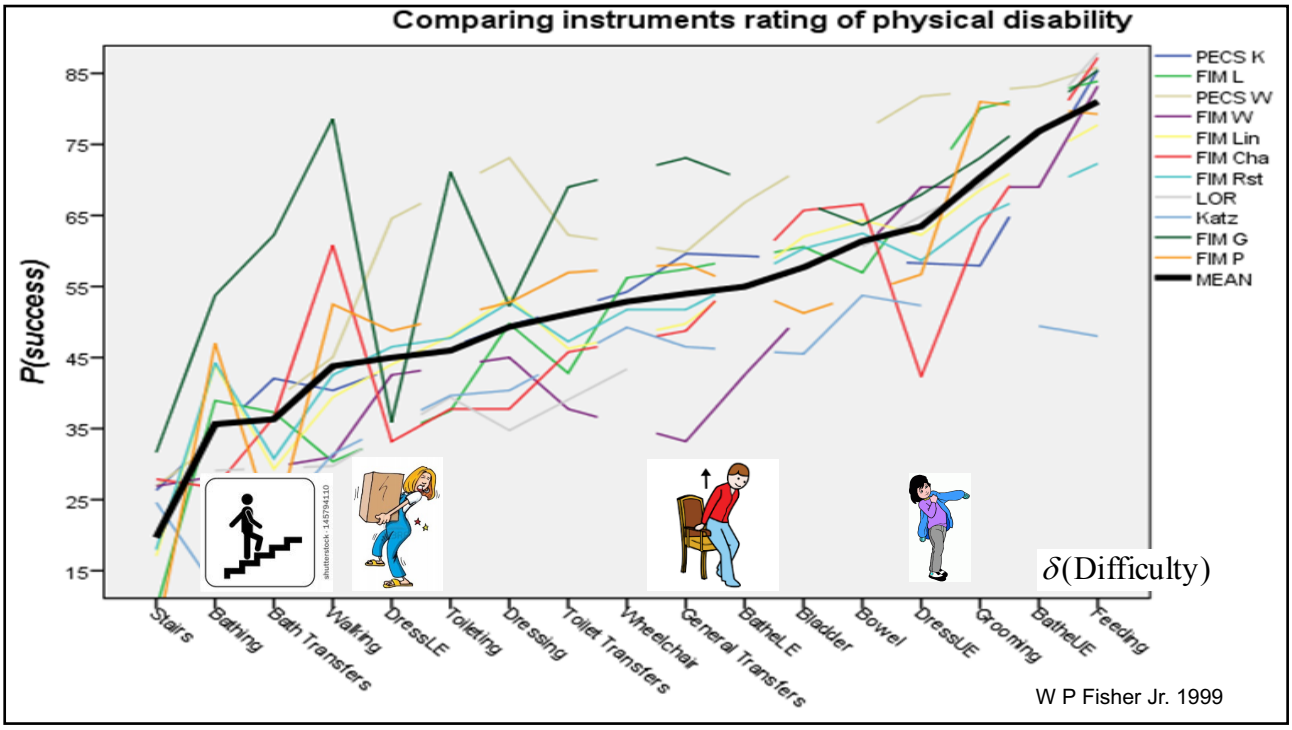
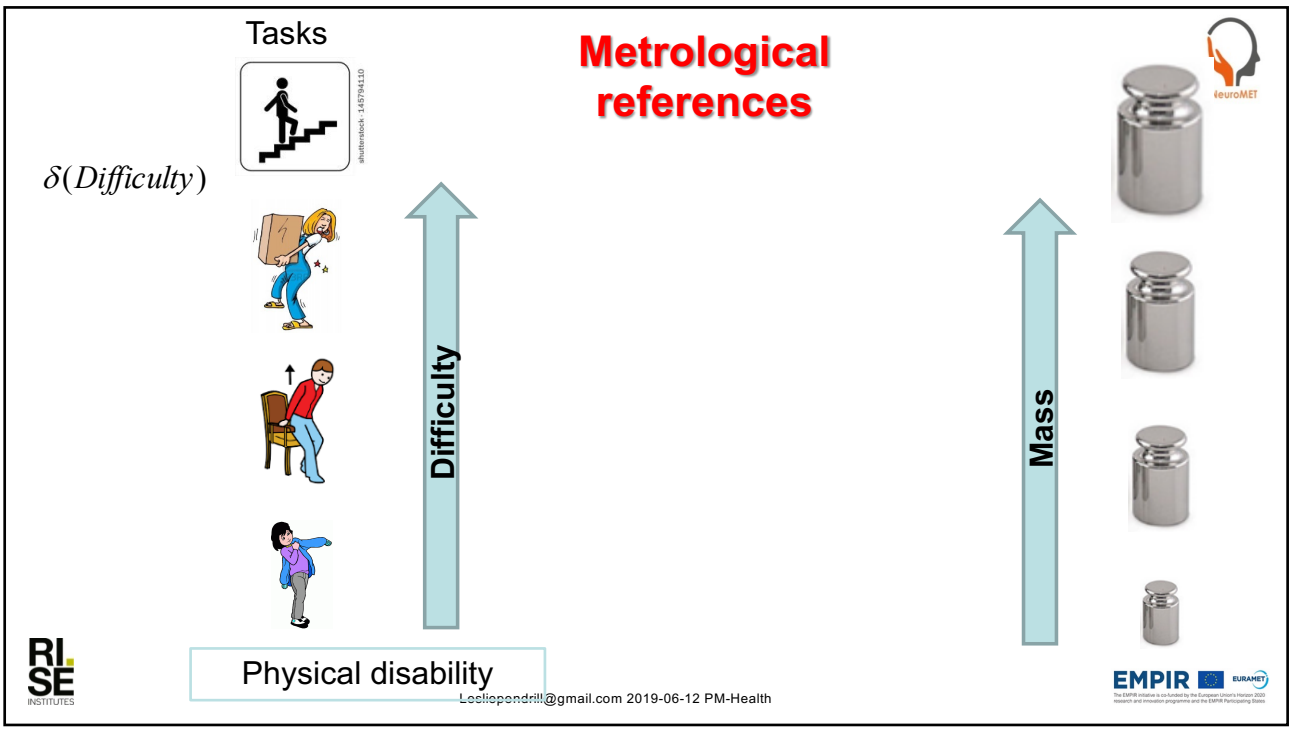

Comparing instruments rating of physical disability
P(success)
PECS K
FIM L
PECS W
FIM W
FIM Lin
FIM Cha
FIM Rst
LOR
Katz
FIM G
FIM P
MEAN
Stairs
Bathing
Bath Transfers
Walking
DressLE
Toileting
Dressing
Toilet Transfers
Wheelchair
General Transfers
BatheLE
Bladder
Bowel
DressUE
Grooming
BatheUE
Feeding
δ(Difficulty)
W P Fisher Jr. 1999



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- William P. Fisher, Jr., Ph.D., Research Associate, BEAR Center, Graduate School of Education, University of California, Berkeley, CA (USA) & Principal, LivingCapitalMetrics Consulting

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NeuroMET : www.lgcgroup.com/EMPIR-neuromet

This project has received funding from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme

NeuroMET: *Innovative measurements for improved diagnosis and management of neurodegenerative diseases*

EURAMET's Research Programmes

- EURAMET's research programmes (EMRP and EMPIR) support the collaboration of European metrology institutes, industrial organisations and academia through Joint Research Projects (JRPs). They are structured around European Grand Challenges in such areas as Health, Energy, the Environment and also aim to progress fundamental science.
- See https://www.euramet.org/ for more details.

EMRP
European Metrology Research Programme
Programme of EURAMET
The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

EMPIR EURAMET
The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States