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Construct validity of the Stress-Energy Questionnaire using Rasch analysis

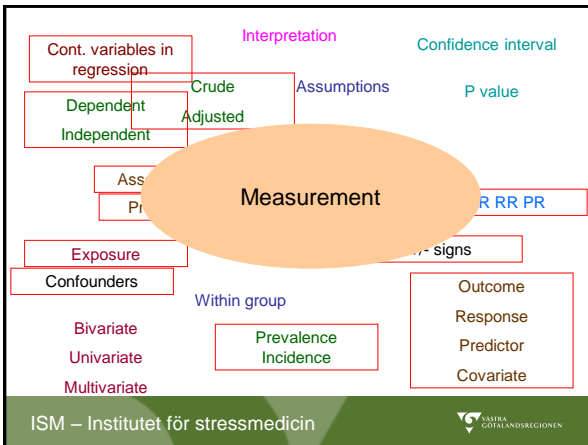
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Objective measurements

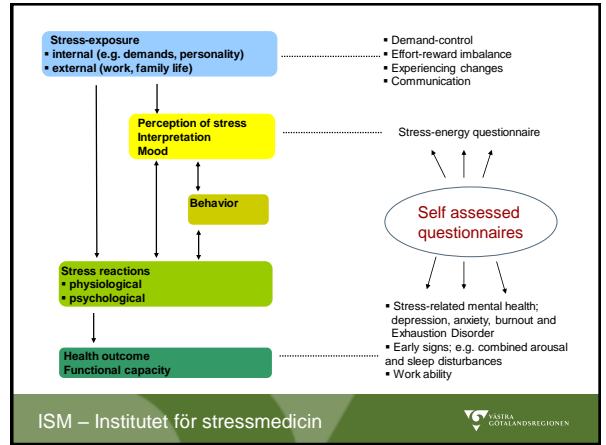
The slide features the title "Objective measurements" in green. Below the title are three photographs: a person in a dark jacket climbing a staircase, a person in a red top measuring their waist with a yellow tape measure, and a close-up of a hand holding a black smartwatch. The bottom of the slide has a green footer with the ISM logo and name.

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Measuring stress, working environment...

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Hur har Du känt Dig **Lärbetet** under den senaste veckan (besvaras bara om Du förvärvat arbetat en eller flera av de senaste 7 dagarna)?
 Svare genom att markera rutan under det svarsalternativ som bäst motsvarar hur Du känt Dig. Fyll i snabbt utan att tänka efter alltför mycket.

	Inte Alls 0	Knappast alls 1	Något 2	Ganska 3	Mycket 4	Mycket, mycket 5
Avslappnad	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Avspänd	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lugn	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stressad	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pressad	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Spänd	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Energisk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Aktiv	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Skärpt	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ineffektiv	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Passiv	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Rasch analysis of ... and feelings

"The comparison between particular individuals should be independent of which particular individual is also being compared, and it should be independent of which class were or might be considered as the reference class."

Symmetrically, a comparison between two individuals should be independent of whether the individuals were instrumental or not, and it should be independent of whether the individuals were the same or some other class.

Rasch, 1961, p 322

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Rasch analys. objective measurement and feelings cont.

Item, persons Latent traits Scales, tests, questionnaires Unidimensionality Monotonicity

Invariant comparisons and sufficiency

The additive structure, and the maintenance of the unit across a two-way frame of reference

Rasch analys – some aims

Scale development and construct validity

Judge the legitimacy of the scoring procedure (Do items work invariantly? Properly categorised?)

Evaluation of composite scores

Rasch model for dichotomous data

$$P\{X_{ni} = x\} = \frac{e^{x(\beta_n - \delta_i)}}{1 + e^{(\beta_n - \delta_i)}}$$

$$\ln\left(\frac{P_{ni}}{1 - P_{ni}}\right) = \beta_n - \delta_i$$

Probability of person n with ability β_n , succeeding on item i which has difficulty δ_i .

Rasch for dichotomous data - example

$$\beta_n = \ln\left(\frac{0.80}{1 - 0.80}\right) = 1.39$$

	Items										P
	1	2	3	4	5	6	7	8	9	10	
A	1	1	1	1	1	1	1	1	0	0	0.89
B	1	1	1	1	1	1	1	0	1	0	0.80
C	1	1	1	1	1	1	0	1	0	0	0.70
D	1	1	1	1	1	1	0	1	0	0	0.70
E	1	1	1	1	1	1	0	1	0	0	0.70
F	1	1	1	1	1	0	1	0	0	0	0.60
G	1	1	1	0	1	0	0	0	0	0	0.50
H	1	0	1	0	1	0	0	0	0	0	0.30
I	0	1	0	1	0	0	0	0	0	0	0.20
P	0.88	0.89	0.89	0.78	0.67	0.33	0.44	0.11	0.11		

$$\delta_1 = \ln\left(\frac{1 - 0.88}{0.88}\right) = -1.95$$

Example cont.

$$\ln\left(\frac{p_{B1}}{1-p_{B1}}\right) = \beta_B - \delta_1 = 1.39 + 1.44 = 2.83$$

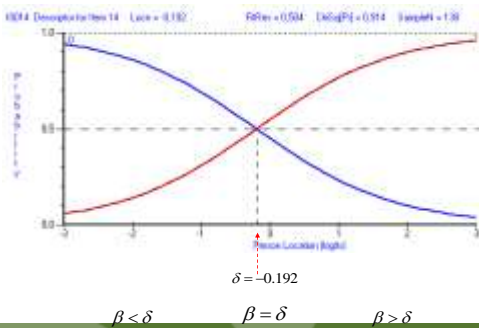
$$p_{B1} = \frac{\exp(2.83)}{1 + \exp(2.83)} = 0.94$$

Probability of person *B* with ability β_B succeeding on item *1* which has difficulty δ_1 .

ITERATION 1: EXPECTED VALUES

	1	2	3	4	5	6	7	8	9	10
A	0.97	0.97	0.97	0.97	0.94	0.91	0.71	0.79	0.38	0.38
B	0.94	0.95	0.95	0.95	0.89	0.83	0.55	0.66	0.23	0.23
C	0.91	0.92	0.92	0.92	0.83	0.74	0.41	0.53	0.15	0.15
D	0.91	0.92	0.92	0.92	0.83	0.74	0.41	0.53	0.15	0.15
E	0.91	0.92	0.92	0.92	0.83	0.74	0.41	0.53	0.15	0.15
F	0.86	0.88	0.88	0.88	0.76	0.64	0.31	0.42	0.10	0.10
G	0.81	0.83	0.83	0.83	0.68	0.55	0.23	0.33	0.07	0.07
H	0.64	0.67	0.67	0.67	0.48	0.34	0.11	0.17	0.03	0.03
I	0.51	0.55	0.55	0.55	0.35	0.23	0.07	0.11	0.02	0.02

Category probability curve



Rasch model – polytomous data

$$P\{X_{nij} = x\} = \frac{e^{-\tau_{1i} - \tau_{2i} \dots - \tau_{xi} + x(\beta_n - \delta_i)}}{\sum_{x'=0}^{m_i} e^{-\tau_{1i} - \tau_{2i} \dots - \tau_{x'i} + x'(\beta_n - \delta_i)}}$$


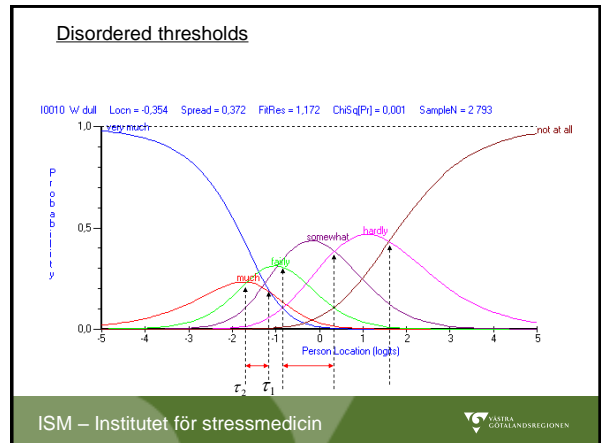
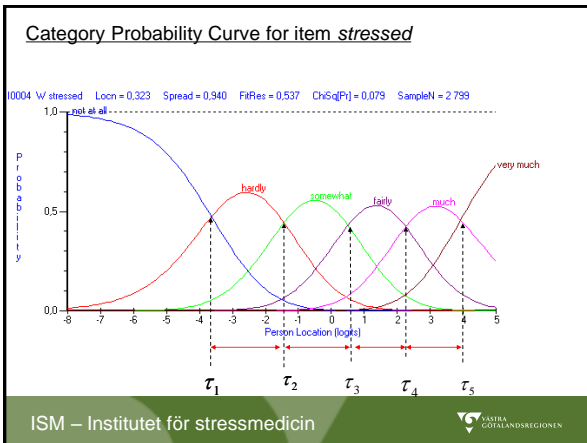
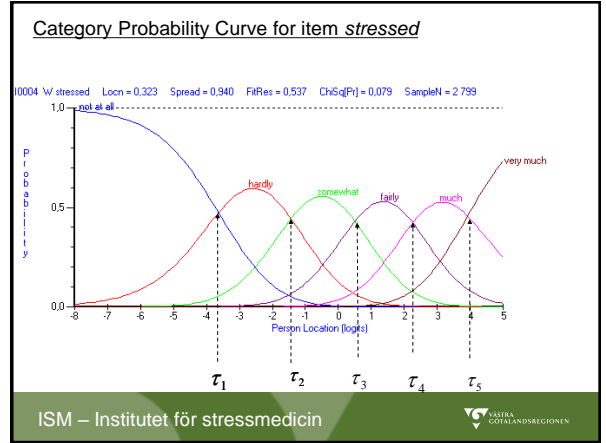
$$\ln\left(\frac{P_{nij}}{1 - P_{nij-1}}\right) = \beta_n - \delta_i - \tau_j$$

$$P\{x_{nij} = 0\} = \frac{e^{0(\beta_n - \delta_i)}}{e^{0(\beta_n - \delta_i)} + e^{-\tau_{1i}(\beta_n - \delta_i)} + e^{-\tau_{1i} - \tau_{2i} + 2(\beta_n - \delta_i)}}$$

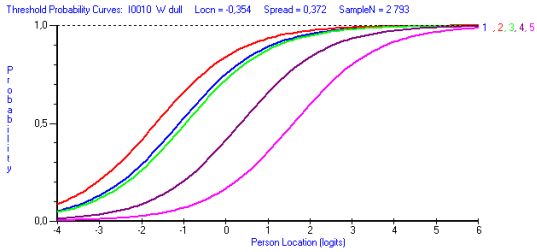
$$P\{x_{nij} = 1\} = \frac{e^{-\tau_{1i} + (\beta_n - \delta_i)}}{1 + e^{-\tau_{1i}(\beta_n - \delta_i)} + e^{-\tau_{1i} - \tau_{2i} + 2(\beta_n - \delta_i)}}$$

$$P\{x_{nij} = 2\} = \frac{e^{-\tau_{1i} - \tau_{2i} + 2(\beta_n - \delta_i)}}{1 + e^{-\tau_{1i}(\beta_n - \delta_i)} + e^{-\tau_{1i} - \tau_{2i} + 2(\beta_n - \delta_i)}}$$

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Threshold probability curve – item *dull*



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Goodness-of-fit

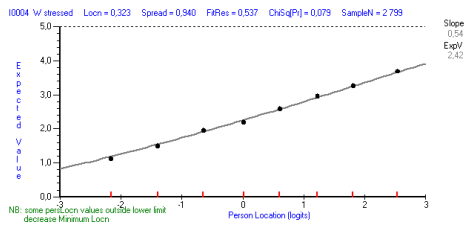
Overall, items, persons

- Graphical
- Residual values
- Chi2
- ANOVA

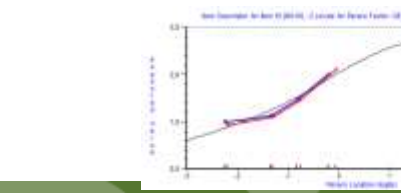
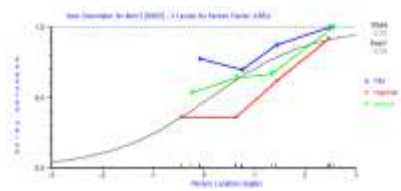
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Item characteristic curve (ICC) – item *stressed*



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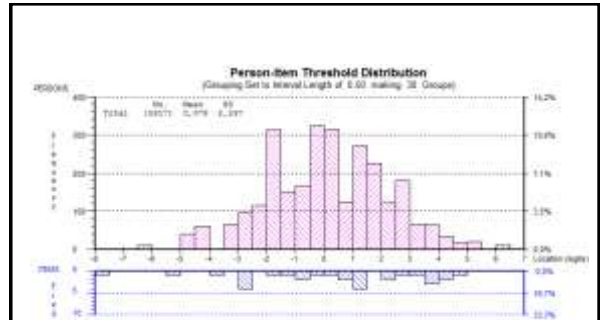
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Guttman pattern

Persons (n)	Responses to items						Total score (r _n)
	1	2	3	4	5	6	
1	0	0	0	0	0	0	0
2	0	0	0	0	0	1	1
3	0	0	0	0	1	1	2
4	0	0	0	1	1	1	3
5	0	0	1	1	1	1	4
6	0	1	1	1	1	1	5
7	1	1	1	1	1	1	6

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