

IRT as a tool for the measurement of
an individual's 'doing' and 'beings'
with an illustration to a sample of
Swedish diabetes patients.

Soffia Gudbjornsdottir, Registercentrum
and NDR

Pontus Roos, R.R. Institute of Applied
Economics

Background

- Measurement of outcome of health care services
- Shift from means, such as treatments and patient education, to health from an individual's perspective

Traditional health policy analysis has
focused more on the *means* to health
- than on **health itself**"

Prof. Ruger, Yale and Harvard, 2006

The biostatistical (BST) view of health

- The 'scientific' theory behind such views suggests that a person is healthy when they have no disease. Disease in turn is defined as the abnormal functioning of a biological part or process.
- More specifically, a condition is classified as disease when the measurement value of a functioning of a biological part or process falls outside the **normal distribution** of measurements belonging to others in the same sex and age category as the individual.

Limitations with BST

- The two most important flaws of the BST are its inability to adequately account for the influences of the environment on individual functioning, and its focus on the biological goals of survival and reproduction.

New direction in the definition of health

- Here, we follow new directions in the definitions and measurement of health, (Nordenfeldt, Sen, Nussbaum)
- Health of an individual should be understood to reflect the assessment of her **ability** to achieve a cluster of basic 'doings and beings'. Such an approach bridges the gap between the biomedical usage of the term 'health' to evaluate the presence of disease and its social and ethical usage to assess an individual's well-being and abilities to function in the world

Overview of 'our' thinking

A. Health care services in terms of activities for

- Treatment, Patient education, Availability

B. Intermediate outcomes

- Statistics from BST (blood pressure, cholesterol, mobility in arms and legs), Patient reported experience of quality of provided services.

C. Health related well-being or quality of life

- Patient reported health knowledge, health related problems in daily life activities, patient reported worry in living with a disease



Need method for measuring intermediate and final outcome for an individual

- Data
 - BST, very often continuous variables, such as visual acuity, blood pressure, blood sugar level. Source: National quality registers.
 - Patient self reported data. Questionnaires, no problem, some problem, large problems. Ordinal data. Source: Surveys.

Our index methods for measuring health requires data on a 'cardinal' scale. Continuous scale such as an scale for weight or temperature.

Illustration to diabetes

- From the national quality register we have information on BST variables, demographic and some social economic 'non- controllable' factors
- From surveys we have information on self reported health related variables showing abilities in doing and beings and quality of intermediate outcomes . Today sample of almost 10 000 type 2 diabetes patients.

Data requirement in an application to diabetes

- For each diabetes patient we have the following data (with an example)

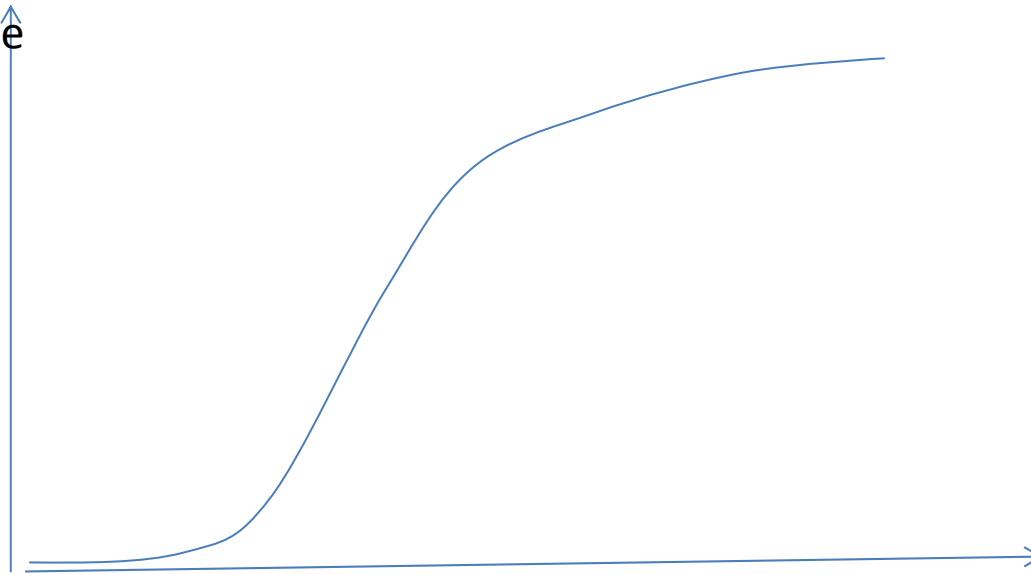
Blood sugar level	6,5	Scale >0
Blood pressure	150	Scale >0
Cholesterol	6,1	Scale >0
Quality of services, doctors	67	Scale 0-100
Quality of services, nurses	82	Scale 0-100
Ability of self management	125	Scale 0-200
Ability to perform daily life activities (problems)	390	Scale 0-500
Ability feeling secure (worry)	820	Scale 0- 1000
And Age, sex, duration,		

Indexes of health and components

- We use modern index approaches, based on so called distance functions, to estimate
- Overall diabetes health index
- And its two components
 - Health related to direct intermediate outcomes of services
 - Health related to doing and beings

Relationship between the two components of health

Health
intermediate
outcome



Health doing being

Latent nonobservable variables

- Patient experience of the quality of provided services (information, communication, availability) , Doctors and nurses. Ability of the health care unit to provide 'good' services.
- Patient self reported ability of self management
- Patient reported ability to feel secure living with diabetes (worry for complications)
- Patient reported ability to performs daily life activities

Diabetes self management

- F1 I feel that I have sufficient knowledge and skills to handle my diabetes
- To a large extent
- 1 2 3 4 5
- No at all
-
- F2 I feel that in general I can solve the problems that can occur in my own management my diabetes
- To a large extent
- 1 2 3 4 5
- No at all
-
- F3 I feel that in general I can handle my feelings and the daily stress of life that I am exposed to, without any effects on my own management of my diabetes
- To a large extent
- 1 2 3 4 5
- No at all
-
- F4 How frequent have you experienced that your blood sugar values have been low during the last month?
- Never
- 1 2 3 4 5
- Very often

Worry about complications

- F24 During the last month how frequent have you been worried for your blood-sugar to be too low
- Never Most of the time
- 1 2 3 4 5
-
-
- F25 Does your diabetes in general cause you to be worried for the future and the risk for complications?
- Worries me Worries me
- never most of the time
- 1 2 3 4 5

Item Response methods

- Polytomous IRT models
 - Rasch models
 - Graded Respons Models(GRM), developed by Samejima. Used in this study . Also recommended by Reeve et al for PROM.

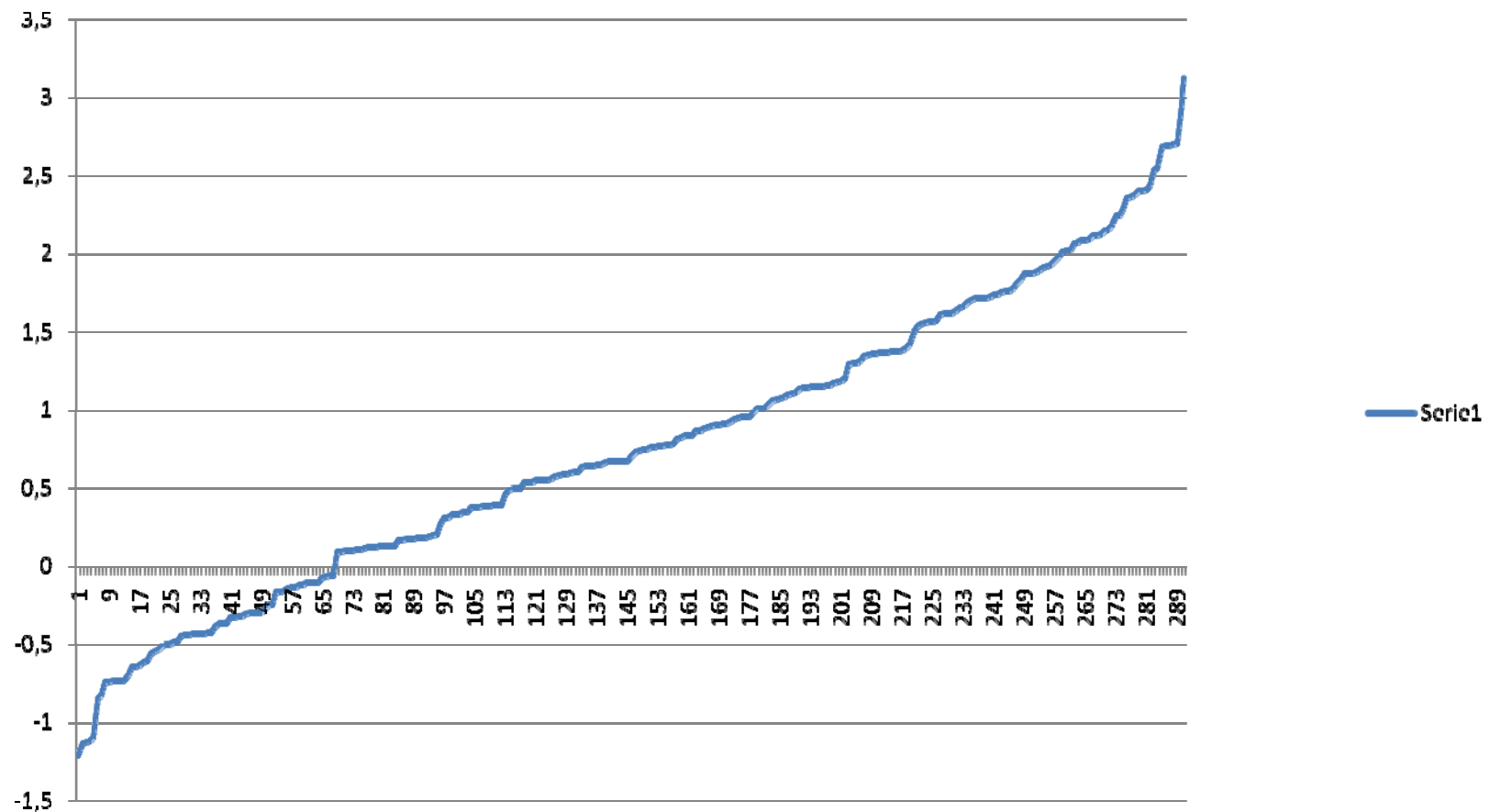
Software: R

Model selection: GRM is appropriate to use when item response can be characterized as ordered responses, and was explicitly developed for Likert type rating data. Beyond data characteristics models can be selected on the basis of measurement philosophy.

Estimation using GRM

- Step 1. Estimate the parameters in a given functional form showing the probability of observing each response category as a function of the underlying ability. Two characteristics of special interest
 - Item information curves
 - Item characteristic curves
- Step 2. Given the results from step 1 we are able to estimate an ability level on a continuous scale for each diabetes patient (or for each pattern of answers)

Example. Self care management. 4 questions, 5 categories. That is $5*5*5*5=625$ possible combinations of answers. The sample of diabetes patients include 289 combinations.



Some test statistics and rules of thumb

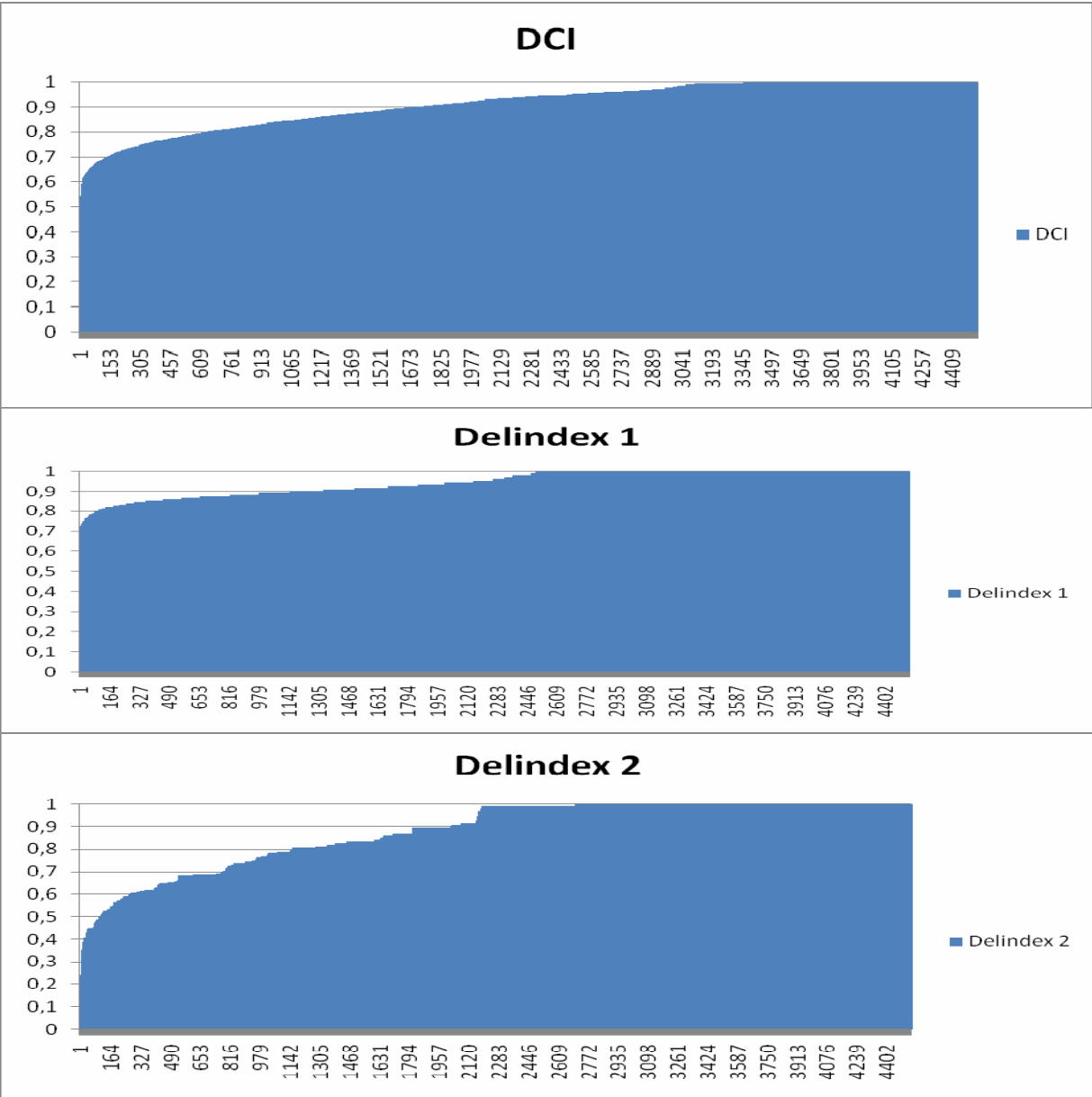
	Total information	Reliability (scale 0-1) 0,9-1,0 Good 0,8- 0,9 Adequate	H < 0,4 moderate >0,5 strong
Quality of services, doctors	10	0,91	0,67
Quality of services, nurses	20	0,95	0,78
Diabetes Self care	8	0,88	0,75
Feeling secure	4	0,75	0,45
Daily life activities	22	0,95	0,65

Reliability= $1 - SEE^2$. A residual based statistical fit test
 $SEE = 1/\sqrt{\text{information}}$

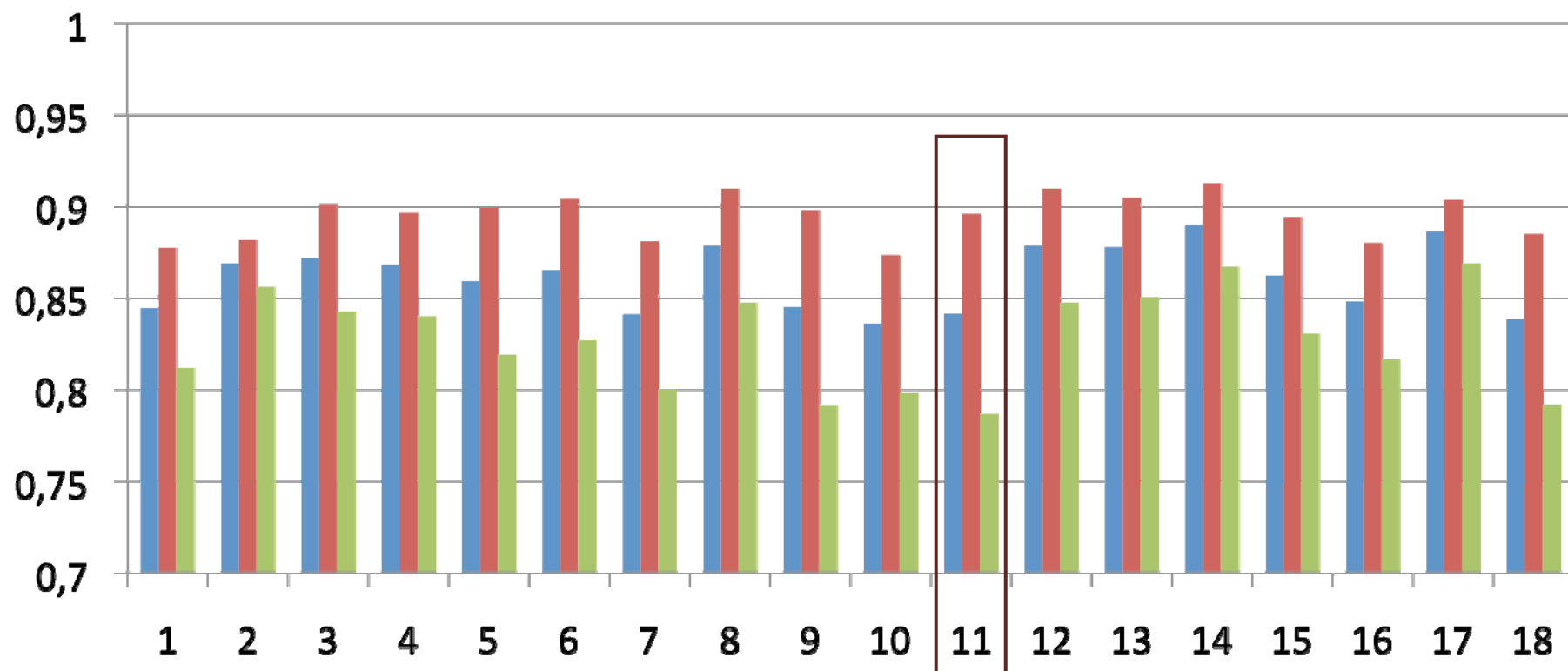
H is a test for how good items as a whole creates a scale. A Guttman error statistical fit test

Indexes of diabetes related health

- Overall health diabetes capability index, DCI
- DCI can be decomposed into
 - Sub index of health related to intermediate outcome variables
 - Sub index doing and beings



18 units for diabetes care services



■ Total health index

■ Sub index I. Outcome health care services

■ Sub index II. Daily life acyivities

The models and results can be used for

- Comparisons between health care units
- Simulation of potential gains for individuals
- Identification sub groups not doing well

- Extension to cost efficiency models
- Pay for health instead of pay by activity (performance)