SSRMC Module 12 : Psychometrics

Introduction

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The Psychometrics Centre

- Educational and diagnostic tests e.g. BAS-III, WISC, CELF
- Organisational e.g. Watson-Glaser, Orpheus, Giotto
- Statistical, IRT, machine learning and AI techniques
- Software products e.g. Concerto, Apply Magic Sauce
- Web based assessment, ‘Discover My Profile’
- BPS Professional training courses
- Short courses, seminars and events (SEM in R, Mplus)
- PhDs in psychometrics
- Tutorial materials on website - www.psychometrics.cam.ac.uk
The programme

1: Introduction to psychometrics (John Rust)
   - Psychometrics, ancient and modern. Classical Test Theory
   - How to design and build your own psychometric test

2: Testing in the online environment (David Stillwell)
   - Testing via the internet. How to, plus do’s and don’ts
   - Putting your test online

3. Modern Psychometrics (Chris Gibbons)
   - Item Response Theory (IRT) models and their assumptions
   - Advanced assessment using computer adaptive testing

4: Testing with Automatic Item Generation (Luning Sun)
   - How to automatically generate ability items
   - Examples from the ICAR project
Introduction to psychometrics

- Definition: The science of psychological assessment
- From IQ to AI: Past, present and future
- The Theory of True Scores
- The Psychometric Principles
- Types of psychometric test
- Test construction exercise
Xunzi (Hsun Tzu c. 310 – 220 B.C.E.)
Socrates asks Glaucon:

“When you spoke of a nature gifted or not gifted in any respect, did you mean to say that one man will acquire a thing hastily, another with difficulty; that a little learning will lead the one to discover a great deal whereas the other, after much study and application, no sooner learns than he forgets; or again, did you mean that the one has a body which is a good servant of his mind, while the body of another is a hindrance to him? Would not these be the sort of differences which distinguish the man gifted by nature from the one who is ungifted?” (7, 359)
Edward Jenner ‘The Artist, Vol 19, 1807’

“For though all men are, as we trust and believe, capable of the divine faculty of reason, ..., yet it is not to all that the heavenly beam is disclosed in all its splendour. In order I place -

- **The Idiot**: the mere vegetative being, totally destitute of intellect,
- **The Dolt**: too weak and imperfect to acquire judgement,
- ** Mediocrity**: Includes the large mass of mankind. They echo the censure or the praise of that which they are not capable of criticising or admiring.
- **Mental Perfection**: They rule mankind by their wisdom, and contemplate glory, as the Eagle fixes his view on the Sun, undazzled by the rays that surround it.”
Where does intelligence come from?

• Gifted by the Gods (Plato)
• the Heavenly Beam (Jenner)
• Survival of the Fittest (Darwin)
• Genes (Mendel)
• Gaia a.k.a. Mother Nature
• Destiny (?)
Evolution of consciousness?

- Stones, plants, woodlice, fish, reptiles, birds,
- mammals, man, heroes, gods, *pervading spirit*
- Stages of existence (Prudentius, Kierkegaard)
- Stages of evolution (Darwin, 1870, Descent of Man)
  - “Savages”
  - “the lower races” (sic)
  - “the civilized nations”
- Spearman’s “g”: “psychophysiological energy”
- Eysenck “speed of nerve transmission”
The Victorians

Wundt  Cattell  Edgeworth

Galton  Kelvin  Gauss

If we tabulate the marks given by the different examiners they will tend to be disposed after the fashion of a gendarme’s hat.

I think it is intelligible to speak of the mean judgment of competent critics as the true judgment; and deviations from that mean as errors.

This central figure which is, or may be supposed to be, assigned by the greatest number of equally competent judges, is to be regarded as the true value, just as the true weight of a body is determined by taking the mean of several discrepant measurements.
Glowing with an inner light
The first psychometric revolution (1890-1990)
To sum up 20th century psychometrics

Samuel Taylor Coleridge
(Table Talk, 1831)

If men could learn from history, what lessons it might teach us!

But passion and party blind our eyes, and the light which experience gives us … … is a lantern on the stern which shines only on the waves behind.
Assessment revolutions

Innovation

- Examinations
- Mental Tests
- Social Networks
- CAT and ML

Intended consequences

- Meritocracy
- Diagnosis
- Communication
- Prediction
Assessment revolutions

Innovation

- Examinations
- Mental Tests
- Social Networks
- CAT and ML

Unintended consequences

- Discrimination
- Scientific Racism
- Big Brother
- AI
Ways forward

Neuropsychology

Behavioural Analytics
Personality testing – early days (1950-1975)

Questionnaire

Scoring

Store results
1975-1995

Questionnaire → Score → Store results
The century turns

- Questionnaire
- Scoring
- Store results
2012-2018

Questionnaire  Scoring  Store results
The future (or one of them)

Digital footprint

Real-time analysis

Real-time response
Take machine learning

Create your own online CAT with Concerto.

Open-source Online R-based Adaptive Testing Platform

Concerto is an open-source testing platform that allows users to create various online assessments, from simple surveys to complex IRT-based adaptive tests.

Concerto is free for academic and commercial use! Click here to launch Concerto!
In 2014 The Psychometrics Centre was awarded a 3-year project grant under the ORA Plus Scheme (3rd round) to develop the International Cognitive Ability Resource (ICAR), a public-domain and open-source tool that will provide a large and dynamic bank of cognitive ability measures for use in a wide variety of applications. Our ICAR international collaborators are Philipp Doebler and Heinz Holling from the University of Munster, and David Condon and William Revelle from North Western University, Illinois, USA.
myPersonality was a popular Facebook application that allowed users to take real psychometric tests. As well as the data from the tests, around 40% of the respondents agreed to give access to their Facebook profile data, and social network data.

Currently, the database contains more than 6,000,000 test results together with more than 4,000,000 individual profiles. Respondents come from various age groups, backgrounds and cultures. They have been highly motivated to answer honestly and
then Apply Magic Sauce

By analysing aspects of a given user’s online behaviour, our PredictionAPI engine can forecast a range of variables that includes happiness, intelligence, political orientation and more, as well as generate a Big Five personality profile.
Extraversion
Your online digital footprint

- Demonstrates your habits, lifestyle & desires
- Analysed psychometrically this can tell us:
  - What sort of person you are
  - Who are your friends
  - Your needs, hopes and expectations
  - What you are likely to do
  - or not do
• Every keystroke you make is recorded
• Algorithms identify patterns
• To creates a model of you…
• your Avatar in cyberspace
• …… and its shadow

• Online ‘testing’ opened a Pandora’s box that took psychometric assessment to new levels.
Futures for the internet

Communication

Big Brother
The machine can learn

- What you look at or search for online
- Where you are
- What you write in texts, tweets and emails
- The images and videos you paste
- Your gender, age, ethnicity, sexual orientation, income, health
- Your mood, beliefs and attitudes
- Your expectations, what you want, and are going to do
- And can respond to masses of people simultaneously in real time
- It can help you OR
- It can kill you
Futures for machine learning

Nice, kind robots

The singularity