

Index

- acceptability 59–60
- agreement 97, *see* measurement error and reliability
 - absolute agreement 105
 - chance agreement, *see* expected agreement
 - expected agreement 116–117
 - level of agreement 206–207
 - observed agreement 116
- analysis of variance (ANOVA) 104
 - random factors 104–105
 - fixed factors 105
- anchor 246, 248, 257
 - clinician-based 256
 - patient-based 256
- Apgar score 15
- application
 - in clinical practice 45, 144, 160, 164, 169, 245
 - in research 45, 144, 245
- area under the curve, *see* receiver operating characteristic (ROC) curve
- Bland and Altman method 113, 163, 166, 243
- Bland and Altman plot 113–114, 163, 167
- interpretation of 122–123
- limits of agreement 113–114, 122–123, 167, 217, 242, 260
- blood pressure 122, 128, 131–137, 239
- causal indicator 14
- ceiling effect, *see* floor and ceiling effects
- change 241
 - amount of change 257
 - change beyond measurement error 123
 - clinically important change 204
 - clinically relevant change 123, 245
 - global rating of change 214, 256
 - important change 204, 257
 - magnitude of change scores 216
 - minimal detectable change 243, *see* smallest detectable change
 - minimal important change (MIC) 123, 217–218, 245, 299–300
 - anchor-based method 246–247, 258
 - distribution-based method 246–247, 258
 - for deterioration 258
 - for improvement 258
 - mean change method 246
 - ROC method 246, 248–249, 254
 - visual anchor-based MIC distribution 247, 249, 252–253, 255
- minimal real change 243, *see* smallest detectable change

329 Index

- real change 123, *see* smallest detectable change
 - change
 - smallest detectable change (SDC) 123, 217, 242–245, 258–261, 299–300
 - statistical significance of 216, 245
 - true change 204, 243, 266
- classical test theory (CTT) 13, 18–20, 68, 72, 80, 100
 - basic formula 19, 137, 143, 186
- clinical knowledge 193
- clinician's perspective 245, 256
- clinimetrics 2
- coefficient of variation 115
- communality, *see* factor analysis
- components 75, *see* factors
- comprehensibility 58, 60, 184
- comprehensiveness 43, 155–157, 299
- computer adaptive testing (CAT) 26, 38, 141
- conceptual framework 9, 13–18, 42, 44, 187, *see* framework
- conceptual model 7–13, 33, 79, 151, 156, 173, 205
- concordance 97, *see* reliability
- consistency 97, *see* reliability
- construct 13, 14, 33, 35, 45, 151, 156, 205, 279, 282
 - complex construct 15, 151–152
 - definition of 31, 33, 279
 - development of 193
 - dimensionality of 169–185
 - multidimensional construct 12, 52
 - non-observable 12–13, 17
 - observable 12–13, 17
 - unidimensional construct 12, 20
 - unobservable construct 17, 19–20, 55, 65, 150
 - construct validity, *see* validity
- COOP-WONCA scales 46, 179–181
- correlation
 - correlation matrix 73, 75
 - direction and magnitude of 174, 180, 211–212
 - item-total correlation 81–82
 - inter-item correlations 72, 80–81, 84
 - of change scores 211
 - P* values of 212
 - polychoric correlations 80
 - sample size 191
 - statistical significance of 181
 - tetrachoric correlations 80
- correlation coefficient 163
 - intraclass correlation coefficient (ICC) 103–110, 127, 163, 300
 - confidence interval (CI) 127
 - for single measurements 103–107, 143
 - for averaged measurements 107–110, 143
 - for agreement (ICC_{agreement}) 106–107, 110, 119
 - for consistency (ICC_{consistency}) 105–107, 110
 - interpretation of 120
 - sample size calculation 127
 - Pearson's correlation coefficient 80, 98, 110, 163
 - Spearman's correlation coefficient 163
- COSMIN
 - boxes 286–287
 - checklist 284–287, 289, 293, 300, 303, 309
 - four-step procedure 285–286
 - manual 285–286
 - scoring system 291, 303, 309
 - study 3
 - taxonomy 3, 4, 97, 286
 - terminology 3
 - website 286

330 **Index**

- Cronbach's alpha 81–84, 112, 137–139, 243, 298, 300
 'alpha if item deleted' 82–83
 interpretation of 83–84
 as reliability parameter 137–139
- cultural adaptation 181–183
 cultural differences 185, 191
- data structure 65
- Decision studies (D studies) 137
 design of measurements 136
- dependability 97, *see* reliability
- difference 241
 direction and magnitude of 174, 177, 180–181
 statistical significant 212
 systematic difference 104, 113–114, 121
 true difference 132
- differential item functioning (DIF) 182, 185–186, 188–189
 non-uniform 186–189
 uniform 186–189
- dimension 66, 74
 number of dimensions 72
 underlying dimensions 72
- dimensionality 65, 71, 80
 examination using CTT 72
 examination using IRT 80
 multidimensionality 80
 of constructs 169–185
 optimizing 77
- discrimination
 between patients 89, 91, 101
 discrimination parameter, *see* parameter
- discriminative
 discriminative ability 69, 139, 210
 discriminative function 232
 discriminative power 69, *see* discriminative ability
- discriminative purpose 34, 44–45, 123, 156
- distribution
 of change scores 248
 of items scores 68, 85, 91
 of marginals 121
 of population scores 70, 90–91
 of scores 228–235
 using CTT methods 230–231
 using IRT methods 231–235
- effect indicator 13
- effect size 215–216, 218–219, 247
- eigenvalue, *see* factor analysis
- equivalence
 of factor loadings 186
 of intercepts 186
 of items 189
 of scores 182, 185
- error term 18–19, 100, 114
 random error 104, 107, 110, 114, 145
 systematic error 107, 110, 111
- evaluative purpose 34, 44–45, 156, 159, 202–203
- expert 38
 expert committee 184
 expert panel 156–157
 language expert 184
- external criterion 55, 246, 247
- factors 73, 186
 number of factors 74
 interpretation of 77
- factor analysis 51, 65–66, 71, 81, 169–185, 266–267, 298, 300
 common factor analysis 72
 communality 73–74, 77
 confirmatory factor analysis (CFA) 72, 79, 169–188, 266

331 Index

- eigenvalue 74–78
- exploratory factor analysis (EFA) 72, 169–185, 186
- factor loadings 73–74, 77–78, 186
- factor model 171
- fit index 155, 170
- hypothesized structure 72, 170–192
- item loadings 73
- multiple group factor analysis 186, 191
- principal components analysis (PCA) 72, 76
- rotation 77
- sample size 65, 80, 191
- scree plot 75, 77
- structure 65, 72, 74, 186
- feasibility 59, 60, 292
- Feinstein 2, 18
- field testing 31, 92
- floor and ceiling effects 91, 216, 232–235
- focus group 38, 70
- Food and Drug Administration (FDA) 152, 296
- formative element 15, *see* formative model
- formative and reflective models 13–18, 43–45, 83–84
- formative model 14, 17–18, 42, 50, 55, 65–66, 70
- form of administration 152
- four-dimensional symptom questionnaire (4DSQ) 19, 50
- framework
 - conceptual framework 9, 13–17, 18, 42, 44
 - content framework 156
- frequency distribution 85–86
- Generalizability and Decision studies (G and D studies) 131–137
- Generalizability studies (G studies) 131–135
- Generalizability coefficient (G coefficient) 131–132, 135–136, 138, 145
 - for agreement ($G_{\text{agreement}}$) 133, 137
 - for consistency ($G_{\text{consistency}}$) 133–135
- global rating scale 207, 241, 250
- gold standard 150, 159, 160, 163–165, 194, 202, 206–209
 - continuous 208
 - dichotomous 208
 - ordinal 208
- Guttman scale 21, 238
- Guyatt's responsiveness ratio 217–218, 259–260
- health-related quality of life (HRQL) 7, 9, 10, 39, 57
- hierarchical order 21, 43, 238
- hypotheses
 - a priori defined hypotheses 72, 211, 218
 - confirmation and rejection of 175, 205, 214
 - formulate hypotheses 151, 173, 205
 - number of 205
 - specific hypotheses 151, 153, 169–172, 174, 185, 211, 214, 219
 - testing of 151, 169–182, 202, 211, 299, 300, *see also* construct validity
- index 49, 51–53, 70
- information curve 140
 - amount of information 140–141
 - level of information 140
- internal consistency 80–84, 97, 137, 139, 298, 300
- internal reliability 137, *see* internal consistency
- International Classification of Functioning (ICF) 46, 158

332 **Index**

- interpretability 91, 227–268
 - concept of 228
 - of change scores 217–218
- interpretation
 - of change scores 241–268
 - of measurement properties 229
 - of single scores 235–241
- interview 38, 70
 - cognitive interview 265
 - probing method 58
 - three-step test interview 59, 265
- intraclass correlation coefficient,
 - see* correlation coefficient
- item
 - item bank 38
 - item characteristics 80
 - item characteristic curve (ICC) 22–25, 38, 85, 87–88, 139, 188
 - item correlation, 72, 80–81, 84,
 - see* correlations inter-item
 - item difficulty 20, 23, 84–86, 90, 140, 189, 231
 - item discrimination 84, 140, 189
 - item functioning characteristic 84
 - item level 68, 182
 - item loadings, 73, *see* factor analysis
 - item location 20, 90, 231–232, 237–239
 - item reduction 65–66, 72, 77, 81, 83–84, 88
 - item redundancy 83
 - item response 186
 - item response curve 68, *see* item characteristic curve
 - item scores 46, 51, 66
 - item-total correlation, 81–82,
 - see* correlation
 - item variance 69
- items
 - clustering of 231, 239
 - difficult and easy items 23, 69, 88, 91
 - difficulty of 43, 45, 70
 - formulation of 31, 41, 45, 85, 88–89
 - functioning of 80
 - importance of 66, 70
 - interpretation of 59
 - observable items 17
 - scarceness of 89, 91
 - selection of 31, 37–42, 45, 71, 85
- item response theory (IRT) 18, 20–26, 38, 65, 68, 80, 84, 169–188, 232
 - requirement of IRT studies 284, 286
 - sample size 65, 192
- item response theory (IRT) models 85
 - Birnbaum model 24, 85, 87
 - fit of the IRT model 85
 - generalized partial credit model 25
 - graded response model 25
 - Mokken analysis 25
 - multidimensional model 25
 - multigroup IRT 189, 191
 - one-parameter logistic model 23, 85,
 - see also* Rasch model
 - partial credit model 90
 - Rasch model 23, 85, 87, 90
 - two-parameter IRT model 24, 85
- kappa (Cohen's kappa) 115–119
 - for nominal variables 115–117
 - interpretation of 120–122
 - sample size calculation 127
 - unweighted kappa 118–119
 - weighted kappa for ordinal variables 117–119, 163
 - linear weights 118–119
 - quadratic weights 118–119
- language 152
 - language expert 184
- latent ability 20
- latent trait 20

333 Index

- level of ability 22, *see also* trait level
- level of measurement 162–163, 208
 - continuous 208
 - dichotomous 208
 - interval level 47
 - nominal level 46
 - ordinal level 46, 208
 - ratio level 48
- Likert
 - items 46
 - scales 66
- limits of agreement, *see* Bland and Altman method
- logistic regression analysis 185–188, 191
 - interaction term 186
 - ordinal logistic regression analysis 187–188
 - regression coefficient 186
- measurement
 - clinician-based 10
 - methods of, 7, 31, 35
 - objective 11, 97
 - patient-based 10, 12
 - standardization of 144
 - subjective 11–12, 97
- measurement error 19, 20, 96–97, 101–102, 104–105, 122–123, 204, 217–218, 242–243, 299–300
 - parameter, *see* parameter of measurement error
 - reduction of 145
- measurement instrument
 - application of 156
 - appropriateness of 275
 - characteristics of 10, 291–292, 303
 - content analysis 158
 - content of 275–311
 - development 32, 72, 89, 91, 157
 - format 292
 - evaluative 32, 123
 - multidimensional 36, 52, 56, 194
 - multi-item instrument 13, 17–18, 36–37, 42, 50, 52, 65, 70, 81, 137, 155
 - practicalities of 292
 - purpose of 34, 45, 156
 - quality of 275, 294, 301
 - selection of the best instrument 278, 300, 306, 310, 311
 - single item instrument 17, 36–37, 207
 - type of 280, 291
 - unidimensional 31, 52
- measurement invariance 169–185, 266
 - assessment of 169–185
 - dealing with 191
- measurement properties 30, 279, 284, 301, 303, *see also* studies of measurement properties
 - adequacy of measurement properties 296–300, 308
 - criteria for adequacy 300
 - results of measurement properties 291, 294, 301, 306–309
 - study of measurement properties
 - generalizability of results 284, 286, 296, 301, 305
 - methodological quality of 275, 284, 286–287, 297–298, 301–303, 307–308
 - requirement of IRT studies 284, 286
 - risk of bias 284
 - standards for design 284
 - standards for interpretability 284
 - standards for methodological quality 284
 - standards for statistical methods 284
- measurement scheme 129
- measurement theory 7, 13, 17–26

334 **Index**

- missing scores or values 66–68, 170–192, 220, 290
- Multidimensional Fatigue Index (MFI) 52
- multidimensional inventory 80
- multifactor inventory 80
- multiple indicator multiple cause (MIMIC) model 55
- multiple measurements, *see* repeated measurements
- multitrait-multimethod (MTMM) 181

- Neck Disability Index (NDI) 90–91, 230, 232–234, 303
- noise 204, *see* measurement error

- Objectives measurements 11

- paired *t*-test 98–99, 113
- parameter
 - difficulty parameter 22–25, 85–88, 90–91, 141
 - discrimination parameter 22, 24–25, 81, 85–88
 - of measurement error 101–102, 113, 120, 122–124, 247
 - for continuous variables 111
 - interpretation of 122–123
 - IRT analysis 139–141
 - of reliability 101–102, 120, 123, 229
 - confidence interval (CI) 126, 128
 - Cronbach's alpha 137–139
 - for categorical variables 119
 - for continuous variables 103–110
 - interpretation of 120–122, 126
 - IRT analysis 139–141
 - summary index 140
 - threshold parameter 23, *see* difficulty parameter

- patient
 - ability 20–21, 23, 139, 141, 237–238
 - groups of patients 142, 244
 - individual patients 142, 244
 - perspective 245, 256
 - preferences 56
- patient-reported outcome (PRO) 11, 17, 30, 157, 161, 163, 207, 245
- performance test 96, 125, 144, 292
- physical functioning 35, 141, 158, 185, 189, 190
- pilot-testing 31, 57–60, 65, 184
 - of non-PRO instruments 58, 60
 - of PRO instruments 58
- population, *see also* sample
 - characteristics of 278–293, 301, 305
 - stable population 244
 - target population 34, 45, 58, 65, 152, 156–157, 161, 168, 174, 184–185, 279–280, 282, 303
- precision 97, *see* reliability
- prediction 34
 - prediction models 35
 - predictive purpose 35, 156
 - predictive value 162, 164
- preference analysis 57
- principal components analysis (PCA), *see* factor analysis 72, 76
- PRISMA statement 302
- profile 51–52
- PROMIS 38, 141
- proxy respondents 59
- psychometrics 2
- publication bias 281

- rating
 - global rating of change, *see* change and scale
 - of importance 70
- recall bias 256

335 Index

- receiver operating characteristic (ROC)
 - curve 163, 165–166, 168, 208, 253–254
 - area under the curve 165, 168–169, 208
- reflective model 13, 15, 17–20, 42, 50, 55, 66, 70
- regression analysis 55
 - regression equation 73
 - standardized regression coefficients 73
- relevance 58, 155–157, 299
- reliability 72, 96–145, 162, 194, 195, 242, 298, 300
 - analysis 108
 - improvement of 144–145
 - inter-rater reliability 96–97
 - intra-rater reliability 96–97
 - of mean values 108, 137, 145
 - parameter, *see* parameter of reliability
 - test–retest reliability 96–97, 243
- reliability study
 - crossed design 130
 - design of 124–131
 - nested design 130
 - sample size 126–128
 - time interval 125, 290
- reliable change index (RCI) 243, 260
- repeatability 97, *see* reliability
- repeated measurements 96, 100, 111, 115, 128, 131, 135–136, 143–144
- reproducibility 97, *see* reliability
- response option 45, 66, 68
 - dichotomous response 46, 85
- response shift 261–268
 - adjustment for 267
 - assessment of 264–267
 - bias 267
 - conceptual model of 263–264
 - individualized measures 266
 - interpretation of 267–268
 - qualitative methods 264–267
 - quantitative methods 265–266
- recalibration 262–263, 266
- reconceptualization, 262, 266
- reprioritization 262, 266
- then-test 265, 267
- theoretical model, *see* conceptual model
- responsiveness 91, 196, 202–221, 235, 299
 - concept of 203–206
 - construct approach 202, 206, 211–215
 - criterion approach 202, 206
 - definition of 203, 215
 - in a clinical study 220
 - inappropriate measures of 215–218
 - responsiveness study 205, 210, 211
- Roland–Morris Disability Questionnaire (RDQ) 50, 85–89, 122, 227
- rotation 77, *see* factor analysis
 - orthogonal rotation 77
 - Varimax rotation 77–78
- sample
 - sample-dependent 138
 - heterogeneous sample 102, 112, 119–120, 138, 229
 - homogeneous sample 101, 112, 119–120, 138, 229
- sample size 191, 220, 290
- scale 49, 52, 70
 - average scores 50
 - continuous scale 163
 - deterministic scale 21
 - global rating scale 207, 241, 250–251
 - Guttman scale 21
 - hierarchical scale 21
 - interval scale 89
 - IRT scales 50
 - numerical rating scale 241–242
 - ordinal scale 68, 163
 - probabilistic scale 21

336 **Index**

- scale (*cont.*)
 - scale level 66, 182
 - scale scores 50–51
 - subscale 80
 - types of 47
 - unidimensional scale 80, 83, 298
 - visual analogue scale (VAS) 49
- score
 - adjusted score 191
 - average score 195
 - change score 252, *see* change and interpretation
 - clustering of 70
 - impact score 71
 - importance score 71
 - in formative models 51–57
 - in reflective models 50, 52
 - interpretation of 36
 - IRT based estimation of 231, 238
 - latent score 189
 - norm score 236
 - observed score 19, 98, 100, 189
 - population scores 70
 - scale score 51
 - single score 195
 - sum-scores 52, 56, 89, 239
 - true score 19, 20, 98, 100, 186, 195
 - unweighted score 51
 - weighted score 51, 53
- scoring options 31, 46
- scree plot 75, 77, *see* factor analysis
- SEIQOL-DW 54, 266
- sensibility 18
- sensitivity 162–164, 246, 252, 254
- sensitivity to change 216,
 - see* responsiveness
- Short-Form 36 (SF-36) 152, 177, 179–181, 187, 231–232, 236
- situation-dependent 151–152, 161–162, 174
- smallest detectable change, *see* change
- Spearman 2
- specificity 162–164, 246, 252, 254
- stability 97, *see* reliability
- standard deviation (SD)
 - half a SD (0.5 SD) 247, 259
 - of baseline scores 215–216
 - of change scores (SD_{change}) 216, 217, 244, 260
 - of single measurement 111
 - of difference ($SD_{\text{difference}}$) 111, 114, 243–244
- standard error (SE) in IRT 139–142
- standard error of measurement (SEM)
 - 101, 111–113, 243, 247, 259
 - SEM value 111
 - interpretation of 122
 - SEM for agreement ($SEM_{\text{agreement}}$) 111, 114
 - SEM for consistency ($SEM_{\text{consistency}}$) 111, 114–115
- standardized response mean (SRM) 215
- structural equation modelling 56–57, 181
- structural reliability 137, *see* internal consistency
- subjective measurements 11
- systematic review of measurement
 - properties 30, 275–311
 - best evidence synthesis 297,
 - see* qualitative analysis
 - conclusion of 300–302, 306
 - consistency of results 296–298, 301
 - data extraction 291, 301
 - data synthesis 286, 296–300, 306
 - (dis)similarity of settings 293, 296
 - (dis)similarity of studies 286, 297
 - (dis)similarity of study populations 293, 296, 301, 305
 - eligibility criteria 282–283

337 Index

- evidence 296
 - conflicting evidence 308
 - consistent evidence 308
 - indirect evidence 282
 - levels of evidence 298
- flow chart 284–285, 302
- generalizability of results 293, 296
- homogeneity of studies 296–298
- inclusion and exclusion criteria 282, 301
- qualitative analysis 296–298, 308
- quantitative analysis 296, *see* statistical pooling
- reporting of 302–309
- research question 276, 301
- search strategy 281, 302
 - building of 279
 - database 279, 283
 - documentation of 283
 - language restriction 281
 - methodological search filter 280
 - reference checking 281
 - search terms 279–280
 - time-limit 281
 - update the search 283
- similarity of studies 286
- statistical pooling 297
- types of 276

- then-test 265, 267, *see* response shift
- theories, *see* theories of measurement
- theta, *see* trait level
- think aloud method 58, 265
- thought test 14
- time interval 125, 205, 206, 244
- trait level 68, 89–91
- transition question 256
- translation 169–182, 185, 190
 - back 183
 - forward 182–183

- units of measurement 114, 119, 122
- utility analysis 56–57

- validity or validation 150–196
 - along a clinical study 192
 - concept of 151–154
 - concurrent validity 159–160, 163–167
 - construct validity 72, 150, 169–191, 194, 207, 299, 300
 - content validity 150, 154–158, 194, 216, 299
 - continuous process 151, 153
 - convergent validity 173, 176–178, 181
 - criterion validity 150, 159–169, 191, 194
 - cross-cultural validity 152, 169–181
 - discriminant validity 173, 176, 177, 181
 - discriminative validity 173, 175–179, 181
 - face validity 154–155, 194
 - hypothesis testing, *see* hypotheses
 - known group validity 173, *see* discriminative validity
 - longitudinal validity 196, *see* responsiveness
 - of change scores 203–204, 216–218
 - of single scores 151, 153, 203–204
 - predictive validity 159, 160, 163, 165, 167–169
 - sample size 191, 220
 - structural validity 169–181, 194
 - types of 150, 154, 194
- VARCOMP analysis 106
- variability 97, *see* reliability
- variables
 - categorical 48
 - continuous 48
 - discrete 48

338 **Index**

- variance
 - components of 104, 106, 129–130, 132–133, 135–137
 - cumulative percentage of explained variance 75
 - due to systematic differences 104–106
 - error variance 100, 104–106, 111, 132, 134, 135
 - explained variance of factors 73
 - explained variance of items 73,
 see communalities
 - observed variance 100
 - of patients 104, 132, 134
 - percentage of explained variance 74–76, 78
 - remaining variance 74
 - residual variance 104–105, 135
 - shared variance 72
 - total variance 74, 78, 100, 132, 134
 - true variance 100, 132
- variation
 - between patients 101, 107
 - day to day variation 96
 - restriction of 144
 - sources of variation 96, 128–129, 136, 145
- weighting
 - individual weighting 54
 - in formative models 57
 - preference weighting 56
- weights 51
 - empirical weights 54, 57
 - in IRT model 51
 - in Rasch model 51
 - in two-parameter IRT model 51
 - judgemental weights 54, 57
 - method of 57
 - using CTT 51
- WOMAC 185, 189–190, 276
- Wilson and Cleary model 7–13, 15