

# Bibliography

- Agresti, A. (1988), “A model agreement between ratings on an ordinal scale.” *Biometrics*, 44, 539–548.
- Agresti, A. (1992), “Modeling patterns of agreement and disagreement.” *Statistical Methods in Medical Research*, 1, 201–218.
- Aickin, M. (1990), “Maximum likelihood estimation of agreement in the constant predictive probability model, and its relation to cohen’s kappa.” *Biometrics*, 46, 293–302.
- Altman, D.G. (1991), *Practical Statistics for Medical Research*. Chapman and Hall.
- Axelson, R.D. and C.D. Kreiter (2009), “Reliability.” In *Assessment in Health Professions Education* (Steven M. Downing and Rachel Yudkowsky, eds.), 57–74, Taylor and Francis.
- Benini, R. (1901), *Principii di Demongraphia: Manuali Barbera Di Scienze Giuridiche Sociali e Politiche*. 29, G. Barbera, Firenze, Italy.
- Bennett, E. M., R. Alpert, and A.C. Goldstein (1954), “Communications through limited response questioning.” *Public Opinion Quarterly*, 18, 303–308.
- Berry, K.J. and P.W. Mielke Jr. (1988), “A generalization of cohen’s kappa agreement measure to interval measurement and multiple raters.” *Educational and Psychological Measurement*, 48, 921–933.
- Brennan, R.L. and D.J. Prediger (1981), “Coefficient kappa: some uses, misuses, and alternatives.” *Educational and Psychological Measurement*, 41, 687–699.
- Byrt, T., J. Bishop, and J.B. Carlin (1993), “Bias, prevalence and kappa.” *Journal of Clinical Epidemiology*, 46, 423–429.
- Cantor, A.B. (1996), “Sample-size calculations for cohen’s kappa.” *Psychological Methods*, 1, 150–153.

- Carmines, E.G. and R.A. Zeller (1979), *Reliability and Validity Assessment*. Sage Publications.
- Cochran, W.G. (1977), *Sampling Techniques*. John Wiley & Sons, Inc., New York.
- Cohen, J. (1960), “A coefficient of agreement for nominal scales.” *Educational and Psychological Measurement*, 20, 37–46.
- Cohen, J. (1968), “Weighted kappa: Nominal scale agreement with provision for scaled disagreement or partial credit.” *Psychological Bulletin*, 70, 213–220.
- Conger, A.J. (1980), “Integration and generalization of kappas for multiple raters.” *Psychological Bulletin*, 88, 322–328.
- Cook, R.Dennis and Sanford Weisberg (1982), *Residuals and Influence in Regression*, 1 edition. Monographs on Statistics and Applied Probability, Chapman and Hall, 733 Third Avenue, New York NY 10017.
- Cronbach, L.J. (1951), “Coefficient alpha, and the internal structure.” *Psychometrika*, 16, 297–334.
- Eckes, T. (2011), *Introduction to Many-Facet Rasch Measurement*. Peter Lang, Internationaler Verlag der Wissenschaften.
- Efron, B. (1979), “Bootstrap methods: another look at the jackknife.” *Annals of Statistics*, 7, 1–26.
- Everitt, B.S. (1992), *The Analysis of Contingency Tables*, 2 edition. Chapman and Hall, London.
- Feinstein, A.R. and D.V. Cicchetti (1990), “High agreement but low kappa: I. the problems of two paradoxes.” *Journal of Clinical Epidemiology*, 43, 543–549.
- Fenning, S., T.J. Craig, M. Tanenberg-Karant, and E.J. Bromet (1994), “Comparison of facility and research diagnoses in first-admission psychotic patients.” *American Journal of Psychiatry*, 151, 1423–1429.
- Finn, R.H. (1970), “A note on estimating the reliability of categorical data.” *Educational and Psychological Measurement*, 30, 71–76.
- Flack, V.F., A.A. Afifi, P.A. Lachenbruch, and H.J.A. Schouten (1988), “Sample size determinations for the two rater kappa statistic.” *Psychometrika*, 53, 321–325.
- Fleiss, J.L. (1971), “Measuring nominal scale agreement among many raters.” *Psychological Bulletin*, 76, 378–382.
-

- Fleiss, J.L. (1981), *Statistical Methods for Rates and Proportions*. John Wiley & Sons.
- Fleiss, J.L., J. Cohen, and B.S. Everitt (1969), “Large sample standard errors of kappa and weighted kappa.” *Psychological Bulletin*, 72, 323–327.
- Fleiss, J.L., J.C.M. Nee, and J.R. Landis (1979), “The large sample variance of kappa in the case of different sets of raters.” *Psychological Bulletin*, 86, 974–977.
- Goodman, L.A. and W.H. Kruskal (1954), “Measures of association in cross classifications.” *Journal of the American Statistical Association*, 49, 1732–1769.
- Grove, W.M., N.C. Andreasen, P. McDonald-Scott, M.B. Keller, and R.W. Shapiro (1981), “Reliability studies of psychiatric diagnosis.” *Archives of General Psychiatry*, 38, 408–413.
- Guttman, L. (1945), “The test-retest reliability of qualitative data.” *Psychometrika*, 11, 81–95.
- Gwet, Kilem L. (2008a), “Computing inter-rater reliability and its variance in the presence of high agreement.” *British Journal of Mathematical and Statistical Psychology*, 61, 29–48.
- Gwet, Kilem L. (2008b), “Variance estimation of nominal-scale inter-rater reliability with random selection of raters.” *Psychometrika*, 73, 407–430.
- Gwet, Kilem L. (2016), “Testing the difference of correlated agreement coefficients for statistical significance.” *Educational and Psychological Measurement*, 76, 609–637.
- Gwet, Kilem L. (2020), “Large-sample variance of fleiss generalized kappa.” *Educational and Psychological Measurement*, URL <https://doi.org/10.1177%2F0013164420973080>.
- Gwet, Kilem L. (2021), *Handbook of Inter-Rater Reliability - Volume 2: Intraclass Correlation Coefficients for Quantitative Ratings*, 5 edition, volume 1. AgreeStat Analytics, Maryland, USA.
- Hayes, A.F. and K. Krippendorff (2007), “Answering the call for a standard reliability measure for coding data.” *Communication Methods and Measures*, 1, 77–79.
- Holley, J.W. and J.P. Guilford (1964), “A note on the g index of agreement.” *Educational and Psychological Measurement*, 24, 749–753.
- Holsti, O.R. (1969), *Content Analysis for the Social Sciences and Humanities*. Addison-Wesley, Reading, MA.

- Hripcsak, G. and A.S. Rothschild (2005), “Agreement, the f-measure, and reliability in information retrieval.” *Journal of the American Medical Informatics Association*, 12, 296–298.
- Hubert, L. (1977), “Kappa revisited.” *Psychological Bulletin*, 84, 289–297.
- Janson, H. and U. Olsson (2001), “A measure of agreement for interval or nominal multivariate observations.” *Educational and Psychological Measurement*, 61, 277–289.
- Janson, H. and U. Olsson (2004), “A measure of agreement for interval or nominal multivariate observations by different sets of judges.” *Educational and Psychological Measurement*, 64, 62–70.
- Janson, S. and J. Vegelius (1979), “On generalizations of the g index and the phi coefficient to nominal scales.” *Multivariate Behavioral Research*, 14, 255–269.
- Jung, H.W. (2003), “Evaluating interrater agreement in spice-based assessments.” *Computer Standards & Interfaces*, 25, 477–499.
- Kendall, M. and A. Stuart (1976), *The Advanced Theory of Statistics*, 3 edition, volume 3. Griffin, London.
- Khan, L., G. Mitera, L. Probyn, M. Ford, M. Christakis, J. Finkelstein, A. Donovan, L. Zhang, L. Zeng, J. Rubenstein, A. Yee, L. Holden, and E. Chow (2011), “Interrater reliability between musculoskeletal radiologists and orthopedic surgeons on computed tomography imaging features of spinal metastases.” *Current Oncology*, 18, 282–287.
- Klein, D. (2018), “Implementing a general framework for assessing interrater agreement in stata.” *The Stata Journal*, 18, 871–901.
- Kolmogorov, A.N. (1999), “The theory of probability.” In *Mathematics - Its Contents, Methods and Meaning* (A.D. Aleksandrov, A.N. Kolmogorov, and M.A. Lavrent’ev, eds.), chapter Chapter XI, 229–264, Dover Publications - Dover Books on Mathematics.
- Kottner, Jan and David L. Streiner (2011), “The difference between reliability and agreement.” *Jurnal of Clinical Epidemiology*, 64, 701–702.
- Kraemer, H.C. (1979), “Ramifications of a population model for  $\kappa$  as a coefficient of reliability.” *Psychometrika*, 44, 461–472.
- Kraemer, H.C., V.S. Peryakoil, and A. Noda (2002), “Kappa coefficients in medical research.” *Statistics in Medicine*, 21, 2109–2129.
-

- Krippendorff, K. (1970), "Estimating the reliability, systematic error, and random error of interval data." *Educational and Psychological Measurement*, 30, 61–70.
- Krippendorff, K. (1978), "Reliability of binary attribute data." *Biometrics*, 34, 142–144.
- Krippendorff, K. (2012), *Content Analysis: An Introduction to Its Methodology*, 3 edition. Thousand Oaks, CA: SAGE Publications, Inc., California, USA.
- Krippendorff, Klaus (2004), "Measuring the reliability of qualitative text analysis data." *Quality and Quantity*, 38, 787–800.
- Krippendorff, Klaus (2011), "Agreement and information in the reliability of coding." *Communication Methods and Measures*, 5, 93–112.
- Krippendorff, Klaus (2018), *Content Analysis: An Introduction to Its Methodology*, 4 edition. SAGE Publications, Inc.
- Kuder, G.F. and M.W. Richardson (1937), "The theory of the estimation of test reliability." *Psychometrika*, 2, 151–160.
- Landis, J.R. and Koch G. (1977), "The measurement of observer agreement for categorical data." *Biometrics*, 33, 159–174.
- Leone, M.A., P. Gaviani, and G. Ciccone (2006), "Inter-coder agreement for icd-9-cm coding of stroke." *Neurological Sciences*, 27, 445–448.
- Light, R.J. (1971), "Measures of response agreement for qualitative data: some generalizations and alternatives." *Psychological Bulletin*, 76, 365–377.
- Likert, Rensis (1932), "A technique for the measurement of attitudes." *Archives of Psychology*, 22, 3–55.
- Lindsay, B.G., M. Markatou, S. Ray, K. Yang, and S. Chen (2008), "Quadratic distances on probabilities: A unified foundation." *The Annals of Statistics*, 36, 983–1006.
- Mathet, Yann, Antoine Widlöcher, and Jean-Philippe Métivier (2015), "The unified and holistic method gamma ( $\gamma$ ) for inter-annotator agreement measure and alignment." *Computational Linguistics*, 41, 437–479.
- Maxwell, A.E. (1977), "Coefficient of agreement between observers and their interpretation." *British Journal of Psychiatry*, 130, 79–83.
- McCarthy, P.J. (1966), "Replication: An approach to the analysis of data from complex surveys." Technical Report 14, National Center for Health Statistics, Vital and health statistics, Washington, D.C. Series 2: Data evaluation and methods.
-

- McIver, J.P. and E.G. Carmines (1981), *Unidimensional Scaling*. Thousand Oaks, CA: Sage.
- Metropolis, N. and S. Ulam (1949), “The monte-carlo method.” *Journal of the American Statistical Association*, 44, 335–341.
- Neyman, J. (1934), “On the two different aspects of the representative method: the method of stratified sampling and the method of purposive selection.” *Journal of the Royal Statistical Society*, 97, 558–606.
- Nunnally, J.C. (1978), *Psychometric Theory*, 2 edition. McGraw-Hill, New York.
- Osgood, C.E. (1959), “The representational model and relevant research methods.” In *Trends in Content Analysis* (I. de Sola Pool, ed.), 33–88, University of Illinois Press, Urbana.
- Park, H.M. and H.W. Jung (2003), “Evaluating interrater agreement with intraclass correlation coefficient in spice-based software process assessment.” In *Proceedings of the Third International Conference On Quality Software*, 308–314, Dallas, TX, USA.
- Perreault, W.D. and L.E. Leigh (1989), “Reliability of nominal data based on qualitative judgments.” *Journal of Marketing Research*, 26, 135–148.
- Quenouille, M.H. (1949), “Approximate tests of correlation in time series.” *Journal of The Royal Statistical Society, Series B*, 11, 68–84.
- Quenouille, M.H. (1956), “Notes on bias in estimation.” *Biometrika*, 61, 353–360.
- Rowland, W.J. (1984), “The relationships among nuptial coloration, aggression, and courtship in male threespine sticklebacks.” *Canadian Journal of Zoology*, 51, 453–466.
- Särndal, C.E., B. Swensson, and J. Wretman (2003), *Model Assisted Survey Sampling*. Springer-Verlag New York, Inc., New York.
- Savkov, A., J. Carroll, R. Koeling, and J. Cassell (2016), “Annotating patient clinical records with syntactic chunks and named entities: the harvey corpus.” *Lang Resources & Evaluation*, 50, 523–548.
- Schuster, C. and A. von Eye (2001), “Models for ordinal agreement data.” *Biometrical Journal*, 43, 795–808.
- Scott, W.A. (1955), “Reliability of content analysis: the case of nominal scale coding.” *Public Opinion Quarterly*, XIX, 321–325.

- Shoukri, M.M. (2010), *Measures of Interobserver Agreement and Reliability*, 2 edition. CRC/Biostatistics Series, Chapman and Hall/CRC Press.
- Sim, J. and C.C. Wright (2005), “The kappa statistic in reliability studies: use, interpretation, and sample size requirements.” *Physical Therapy*, 85, 257–268.
- Stein, C.R., R.B. Devore, and B.E. Wojcik (2005), “Calculation of the kappa statistic for inter-rater reliability: The case where raters can select multiple responses from a large number of categories.” In *Proceedings of the Thirtieth Annual SAS® Users Group International Conference*, SAS Institute Inc., SAS Institute Inc, Cary, NC.
- Tanner, M.A. and M.A. Young (1985), “Modeling agreement among raters.” *Journal of American Statistical Association*, 80, 175–180.
- Tinsley, Howard E. A. and David J. Weiss (1975), “Interrater reliability and agreement of subjective judgments.” *Journal of Counselling Psychology*, 22, 358–376.
- Tinsley, Howard E. A. and David J. Weiss (2000), “Journal of counselling psychology.” In *Handbook of Applied Multivariate Statistics and Mathematical Modeling* (S. D. Tinsley, H. E. A. & Brown, ed.), 94–124, Academic Press, New York.
- Traub, R.E. (1994), *Reliability for the Social Sciences: Theory and Applications*. Sage Publications, Beverly Hills.
- Tukey, J.W. (1958), “Bias and confidence in not quite large samples (abstract).” *Annals of Mathematical Statistics*, 29, 614.
- von Eye, A. and E.Y. Mun (2006), *Analyzing Rater Agreement: Manifest Variable Methods*, pap/cdr edition. Lawrence Erlbaum Associates.
- Wongpakaran, Nahathai, Tinakon Wongpakaran, Danny Wedding, and Kilem L. Gwet (2013), “A comparison of cohen’s kappa and gwet’s ac1 when calculating inter-rater reliability coefficients: a study conducted with personality disorder samples.” *BMC Medical Research Methodology*, 13, URL <https://doi.org/10.1186/1471-2288-13-61>.
- Zhao, X., J.S. Liu, and K. Deng (2013), “Assumptions behind intercoder reliability indices.” In *Communication Yearbook* (C.T. Salmon, ed.), volume 36, 419–480, Routledge.



# List of Notations

$AC_1$ , 65, 70, 118, 138, 141, 142, 150, 157	$FC_1$ , 179 $FC_2$ , 179
$AC_1$ , 185	$\hat{\cdot}$ , 61
$AC_2$ , 113, 118, 150, 161	IAA, 288
$AC_2$ , 185	ICD-9-M, 50
$ACM$ , 241	$I_r$ , 93
$\alpha$ , 138, 146, 148, 330–332	$\kappa$ , 61, 173
$\alpha_A$ , 149, 152	$\kappa_0$ , 173
$\hat{\alpha}_A$ , 143, 149	$\kappa_{1G}$ , 151, 152, 154, 157, 182
$\hat{\alpha}_K$ , 70, 79, 118, 194	$\kappa_{2G}$ , 182
$\hat{\alpha}_{K k_0}$ , 274	$\kappa_C$ , 61
$\hat{\alpha}_{K k_0}^{(i)}$ , 275	$\kappa_F$ , 180
$\hat{\alpha}_{K i}$ , 194	$\kappa_{F i}$ , 193
$\hat{\kappa}_{K i}$ , 266	$\kappa_{F i}^*$ , 193
$\hat{\alpha}_{K i}^*$ , 194, 266	$\kappa_{G i}$ , 193
$\hat{\alpha}'_K$ , 112, 194	$\kappa_{G i}^*$ , 193
$\alpha_K$ , 65	$\hat{\kappa}$ , 173
$\alpha_{K k_0}^{*(i)}$ , 275	$\hat{\kappa}_{1G}$ , 142, 158, 182, 185
$\alpha_{K i}$ , 194	$\hat{\kappa}_2$ , 66
$\alpha_S$ , 334	$\hat{\kappa}_{2G}$ , 113, 161, 164, 182, 185, 259
BP, 117	$\hat{\kappa}_{BP}$ , 112, 188, 259
BRR, 202	$\hat{\kappa}_{BP k_0}$ , 258
$\bar{c}$ , 332	$\hat{\kappa}_{BP i}$ , 267
$C_N^n$ , 178	$\hat{\kappa}_{BP i}^*$ , 267
$C_R^r$ , 178	$\hat{\kappa}_C$ , 61, 69, 78, 83, 89, 105–107, 116, 187, 259, 267
CROSSTAB, 38	$\hat{\kappa}_{C k_0}$ , 255
$\varepsilon_{ik}$ , 262	$\hat{\kappa}_{C k_0}^{*(i)}$ , 276
$\varepsilon_n$ , 65, 71, 79, 113, 118	$\hat{\kappa}_{C i}$ , 195, 268
$f$ , 185, 193	$\hat{\kappa}_{C i}^*$ , 195, 268

$\widehat{\kappa}'_C$	108	$n'$ , 75, 79, 116, 118, 119, 158, 262
$\widehat{\kappa}_F$ , 77, 171, 181, 265		
$\widehat{\kappa}_{F k_0}$ , 272, 276		$p_a$ , 58, 59, 69, 75, 89, 108, 116, 119, 142, 158, 164, 181, 195, 259
$\widehat{\kappa}_{F k_0}^{(i)}$ , 273, 277		$p_{a k_0}$ , 251, 271
$\widehat{\kappa}_{F k_0}^{\star(i)}$ , 273		$p_{a i}$ , 192, 195, 264
$\widehat{\kappa}_{F i}$ , 265		$p'_a$ , 65, 70, 79, 118, 189
$\widehat{\kappa}_{F i}^{\star}$ , 265		$p_a^{\star}$ , 113
$\widehat{\kappa}'_F$ , 117		$\overline{p}_{+k}$ , 116
$\widehat{\kappa}^{(-g)}$ , 201		$\overline{p}_{.k}$ , 78
$\widehat{\kappa}_G$ , 66, 70, 78, 119, 263		$\overline{p}_{l+}$ , 187
$\widehat{\kappa}_{G k_0}$ , 251, 271		$\overline{p}_{+k}$ , 187
$\widehat{\kappa}_{G k_0}^{(i)}$ , 271		PC, 50
$\widehat{\kappa}_{G k_0}^{\star(i)}$ , 271		PC <sub>2</sub> , 179
$\widehat{\kappa}_{G i}$ , 264		PCA, 31
$\widehat{\kappa}_{G i}^{\star}$ , 264		$P_a$ , 25, 157, 180
$\widehat{\kappa}$ , 173		$P_{a i}$ , 25
$\widehat{\kappa}_q$ , 70, 78, 117		$P_e$ , 157, 180
$\widehat{\kappa}_{q i}$ , 194		$P_{ik}$ , 180
$\widehat{\kappa}_S$ , 64, 69, 186, 259		$P_{kl}$ , 148, 153
$\widehat{\kappa}_{S k_0}$ , 256		$p_e$ , 60, 61, 69, 78, 89, 95, 108, 111, 113, 116, 117, 119, 142, 158, 164, 181, 187–189, 259
$\widehat{\kappa}_S$ , 111		$p_{e k_0}$ , 251, 255, 256, 271
$\lambda$ , 93		$p_{e i}$ , 193, 195, 264
$M$ , 130		$p_{e i}^{\star}$ , 265, 267, 268
$M_{kl}$ , 127		$p_{e i}^{**}$ , 265, 267, 268
$\overline{n}$ , 76		$p'_e$ , 159
$\overline{n}_{.k}$ , 75, 76		$p_{gk}$ , 77, 116, 159
$N_E$ , 148		$\overline{\pi}_k$ , 187, 193, 195
$n_g$ , 77, 116		$\overline{\pi}_{kl}$ , 187, 188
$n_{gk}$ , 75–77, 116, 159		$\overline{\pi}_{k+}$ , 193, 195
$N_k^{(E)}$ , 147		$\overline{\pi}_{+l}$ , 193, 195
$N_{kk}^{EH}$ , 152		$\widehat{\pi}_k$ , 69, 70, 77, 79, 181
$N_{kk}^{EE}$ , 152		$\pi_k$ , 69, 111, 113, 117, 119, 142, 158, 180, 185, 189
$N_{kk}^{HE}$ , 152		$p_{ik}$ , 181
$N_{kk}^{HH}$ , 152		$\pi_{k k_0}$ , 249, 271
$n_{kl}$ , 68, 185		$\pi_{k k_0}^{\star}$ , 272
$N_{kl}^{(H)}$ , 147		$\pi_k^{\star}$ , 265
NLP, 48		$p_k$ , 245, 263
		$p_{k_0}$ , 271

$p'_{k_0}$ , 271	$s_n$ , 176, 177
$p_{k \mathbb{H}}^{(A)}$ , 143, 148	SRS, 201
$p_{kk}$ , 142	$s_r^*$ , 176, 177, 184
$p_{kl}$ , 68, 185	$s_T$ , 332
$p_{kl k_0}$ , 247	$T_w$ , 161, 186
$p_{kl}^{(k_0)}$ , 247	$T_w^*$ , 263
$p'_{kl}$ , 161	$U$ , 130
$p_{k+}$ , 68, 142, 185, 189	$\mathcal{U}_{\mathcal{R}}$ , 176
$p_{+k}$ , 68, 142, 185	$\mathcal{U}_{\mathcal{S}}$ , 176
$p_{+l}$ , 189	
$r$ , 74	$v(\widehat{\alpha}_K)$ , 189, 194, 266
$\bar{r}$ , 75, 118, 334	$v(\widehat{\alpha}_{K k_0})$ , 275
$\bar{r}_{\cdot k}$ , 74, 75	$\bar{v}$ , 332
$\bar{r}^*$ , 332	$v(\widehat{\kappa}_{BP})$ , 188, 194, 267
$\mathcal{R}$ , 153	$v(\widehat{\kappa}_C)$ , 187, 195, 268
$R_i$ , 180	$v(\widehat{\kappa}_{C k_0})$ , 276
$R_{ik}$ , 25, 180	$v(\widehat{\kappa}_F)$ , 193, 265
$R_{ik}^*$ , 180	$v(\widehat{\kappa}_{F k_0})$ , 273
RCM, 242	$v(\widehat{\kappa}_G)$ , 185, 193, 264
$r_i$ , 74, 75, 116, 118, 158, 181, 262	$v(\widehat{\kappa}_{G k_0})$ , 271
$r_{ik}$ , 74, 75, 116, 158, 181, 262	$v(\widehat{\kappa}_S)$ , 186
$r_{ik}^*$ , 116, 118, 119, 164, 181, 263	$v(p_a)$ , 190, 194
$S$ , 93	RDIST, 39
$s_i$ , 331	WDF, 40
$s_k$ , 159	$w_{kl}$ , 90, 108, 127, 129, 130, 161, 262
$s_k^2$ , 78	$x_k$ , 108, 128–130
$s_{kl}$ , 116	$x_l$ , 111



# Author Index

- Afifi, A.A., 206  
Agresti, A., 11, 175  
Aickin, M., 33, 138, 140, 141, 143, 146, 148, 168  
Alpert, R., 58  
Altman, D.G., 223  
Andreasen, N.C., 140  
Axelson, R.D., 17  
Benini, R., 58  
Bennett, E.M., 58  
Berry, K.J., 100, 102, 172  
Bishop, J., 97, 364  
Brennan, R.L., 58, 70, 78, 95, 100, 111, 117, 194, 364  
Bromet, E.J., 56  
Byrt, T., 97, 364  
Cantor, A.B., 206  
Carletta, J., 8  
Carlin, J.B., 97, 364  
Carmines, E.G., 29, 331  
Chen, S., 156  
Chow, E., 338  
Christakis, M., 338  
Cicchetti, D.V., 82, 84, 86, 97, 142  
Ciccone, G., 8  
Cochran, W.G., 176  
Cohen, J., 26, 54, 58, 60–62, 84, 89, 90, 100, 102, 108, 121, 150, 152, 172, 187, 317, 350, 363–365  
Conger, A.J., 39, 73, 74, 76, 77, 87, 96, 115, 116, 159, 171, 195, 201, 350  
Craig, T.J., 56  
Cronbach, L.J., 26, 29, 330  
Deng, K., 8, 98, 136  
Devore, R.B., 10, 50, 51  
Donovan, A., 338  
Eckes, T., 7, 10, 11  
Efron, B., 202  
Everitt, B.S., 187, 222, 317  
Feinstein, A.R., 82, 84, 86, 97, 142  
Fenning, S., 56  
Finkelstein, J., 338  
Finn, R.H., 359  
Flack, V.F., 206  
Fleiss, J.L., 29, 40, 69, 74, 76, 77, 87, 95, 117, 158, 180, 185, 187, 222, 241, 317, 351, 356, 365  
Ford, M., 338  
Gaviani, P., 8  
Goldstein, A.C., 58  
Goodman, L.A., 93  
Grove, W.M., 140  
Guilford, J.P., 58, 66  
Guttman, L., 58  
Gwet, K.L., 33, 66, 74, 83, 85, 97, 112, 118, 138, 140, 141, 143, 156, 168, 184, 185, 192, 204, 286, 310, 351  
Hayes, A.F., 64

- Holden, L., 338  
Holley, J.W., 58, 66  
Holsti, O.R., 56  
Hripcsová, G., 50  
Hubert, L., 76  
  
Janson, H., 100, 102, 115  
Janson, S., 58, 93  
Jung, H.W., 8, 199  
  
Keller, M.B., 140  
Kendall, M., 204  
Khan, L., 338  
Klein, D., 365  
Koch, G., 62, 221, 222, 352  
Kolmogorov, A.N., 11  
Kottner, J., 5  
Kraemer, H.C., 33, 85, 172, 201  
Kreiter, C.D., 17  
Krippendorff, K., 5, 8, 63, 64, 79, 112,  
    117, 129, 194, 290, 291, 293  
Kruskal, W.H., 93  
Kuder, G.F., 333  
  
Lachenbruch, P.A., 206  
Landis, J.R., 62, 221, 222, 351, 352  
Leigh, L.E., 93–95  
Leone, M.A., 8  
Light, R.J., 28, 29, 95, 241, 278  
Likert, R., 331  
Lindsay, B.G., 156  
Liu, J.S., 8, 98, 136  
  
Métivier, J.P., 287, 288, 290, 291  
Markatou, M., 156  
Mathet, Y., 287, 288, 290, 291  
Maxwell, A.E., 58  
McCarthy, P.J., 202  
McDonald-Scott, P., 140  
McIver, J.P., 331  
Metropolis, N., 225  
Mielke, P.W., 100, 102, 172  
Mittera, G., 338  
  
Mun, E.Y., 175  
Nee, J.C.M., 351  
Neyman, J., 176  
Noda, A., 33, 85, 172  
Nunnally, J.C., 333  
  
Olsson, U., 100, 102, 115  
Osgood, C.E., 56  
  
Park, H.M., 199  
Perreault, W.D., 93–95  
Peryakoil, V.S., 33, 85, 172  
Prediger, D.J., 58, 70, 78, 95, 100, 111,  
    117, 194, 364  
Probyn, L., 338  
  
Quenouille, M.H., 202  
  
Ray, S., 156  
Richardson, M.W., 333  
Rothschild, A. S., 50  
Rowland, W.J., 74  
Rubenstein, J., 338  
  
Särndal, C.E., 176  
Savkov, A., 49  
Schouten, H.J.A., 206  
Schuster C., 11  
Scott, W.A., 8, 63, 69, 77, 97, 100, 172,  
    186, 317  
Shapiro, R.W., 140  
Shoukri, M.M., 175  
Sim, J., 39, 67  
Stein, C.R., 10, 50, 51  
Streiner, D.L., 5  
Stuart, A., 204  
Swensson, B., 176  
  
Tanenberg-Karant, M., 56  
Tanner, M.A., 11  
Tinsley, H.E.A., 4  
Traub, R.E., 29  
Tukey, J.W., 202
-

- Ulam, S., 225  
Vegelius, J., 58, 93  
Verzani, J., 350  
von Eye, A., 11, 175  
Wedding, D., 66  
Weiss, D.J., 4  
Widlöcher, A., 287, 288, 290, 291  
Wojcik, B.E., 50, 51  
Wojcik, B.F., 10  
Wongpakaran, N., 66  
Wongpakaran, T., 66  
Wretman, J., 176  
Wright, C.C., 39, 67  
Yang, K., 156  
Yee, A., 338  
Young, M.A., 11  
Zeller, R.A., 29  
Zeng, L., 338  
Zhang, L., 338  
Zhao, X., 8, 98, 136
-



# Subject Index

- Absolute Category Membership, 241  
AC<sub>1</sub> Coefficient, 65, 70, 78, 113, 118, 142, 150, 151  
    Multiple-Rater, 157  
    Variance, 185, 192  
AC<sub>2</sub> Coefficient, 113, 118, 160  
    Conditional Reliability, 271  
    Interval/Ordinal Ratings, 160  
    Multiple-Rater, 164  
    Variance, 185, 192  
Affiliation, 180  
    Weight, 108  
Agreement  
    for Cause, 142  
    Full/Partial, 108  
Aickin's Alpha, 143  
Alpha  
    Aickin, 143  
    Cronbach, 331  
    Krippendorff, 64, 79, 112  
    Standardized Cronbach, 334  
Alternate Hypothesis, 304  
Alternative Hypothesis, 304  
  
BAK Coefficient, 97  
Balanced Repeated Replication, 202  
Benchmark, 34, 62, 220  
    Altman, 222  
    Fleiss, 222  
    Landis and Koch, 222  
    Probabilities, 234  
    Scale, 62  
  
Benchmarking, 34, 220  
Benchmarking Model, 234  
Bipolar Weights, 130  
Brennan-Prediger Coefficient  
    Conditional, 258, 275  
Three Raters or More, 78, 117  
Two Raters, 70  
Validity Coefficient, 267  
Variance for Multiple Raters, 194  
Variance for Two Raters, 188  
Weighted, 112  
  
Carroll, J., 290  
Cassell, J., 290  
Categorization, 289  
Chance Agreement, 13, 26, 57, 60, 62  
    Correction, 60  
    Percent, 60  
Chance-Corrected Coefficient, 57, 115  
Circular Weights, 129  
Cohen's Kappa  
    Variance for 2 Raters, 187  
Complex Sampling, 179  
Conditional  
    AC<sub>2</sub>, 251, 271  
    Brennan-Prediger, 258, 275  
    Conger, 276  
    Fleiss, 272  
    Inference, 182  
    Kappa, 255  
    Krippendorff, 273  
    Krippendorff's Alpha, 256

- Percent Agreement, 242, 250  
Pi, 256  
Probability, 148  
Reliability, 245  
Standard Error, 190  
Use probability, 252  
Validity, 245  
Conditioned Event, 243  
Conditioning, 242  
Conditioning Event, 242  
Confidence Bound, 231  
    Lower, 231  
    Upper, 231  
Confidence Interval, 207  
Conger's Kappa, 77, 116  
    Conditional Reliability, 276  
    Validity Coefficient, 267  
    Variance, 195, 268, 276  
Contingency Table, 38  
Continuum, 291  
Critical Value, 225, 306  
  
E-subjects, 147  
Error Margin, 206, 231  
Estimand, 32, 173  
Estimate, 173  
Estimator, 32, 173  
Expected Chance Agreement, 60  
  
Fleiss' Kappa  
    Coefficient, 76, 117  
    Conditional Reliability, 272  
    Validity Coefficient, 265  
    Variance, 193, 265, 273  
For-cause agreement, 146  
Full Agreement, 89, 108, 110  
Fully-Crossed, 179  
  
G-Index, 66, 188  
Gold Standard, 30, 241  
Gwet's AC<sub>1</sub>  
    Coefficient, 65, 113  
Construct, 151  
Estimand, 151  
Multiple-Rater, 78, 157, 158  
Probabilistic Model, 153  
Variance, 185  
Weighted, 113  
Gwet's AC<sub>2</sub>  
    Coefficient, 118, 160  
    Multiple-Rater, 118, 164  
    Variance, 193  
  
H-subjects, 147  
Hypothesis  
    Alternate/Alternative, 304  
    Null/Research/Statistical, 304  
  
Identity Weights, 110, 164  
Inference, 31  
    Statistical, 31  
Influence Analysis, 314  
Inter-Annotator  
    Agreement, 288  
    Reliability, 8  
Inter-group Reliability, 337  
Inter-Rater Reliability  
    Applications, 7  
    Definition, 4, 10  
    Parameter, 32  
    Sample Size Calculation, 211, 213, 214, 216  
    Type of, 27  
Intercoder Reliability, 8  
Internal Consistency, 29, 330  
Interval  
    Data, 102  
    Estimation, 182  
Intra-Rater Reliability, 6, 287  
Item-Total Correlation, 336  
  
Jackknife, 201  
k-subject, 245  
Kappa, 58, 105
-

- Conger, 77  
Fleiss, 76  
Marginal Homogeneity Dependency, 86  
Multiple raters, 72  
Multiple-level scale, 72  
Paradoxes, 82  
Trait Prevalence Dependency, 83  
Koeling, R., 290  
KR-20, 333  
Krippendorff's Alpha, 70, 79, 112, 117  
    Conditional Reliability, 273  
    Validity Coefficient, 266  
Variance, 266, 274
- Left-tailed Test, 305  
Level of Confidence, 182  
Linear Weights, 90, 128  
Linearization Method, 310
- Margin of Error, 206
- Nominal Scale, 25  
Nondeterministic, 141  
Null Hypothesis, 304, 306
- One-tailed Test, 305
- Ordinal  
    Data, 102  
    Scale, 25  
    Weights, 127
- P-value, 306  
PABAK Coefficient, 97  
Paradox, 82  
Parameter, 173  
Partial Agreement, 26, 89, 102, 108, 110, 180  
Partially Crossed, 179  
Percent Agreement, 56, 59, 75  
    Variance, 189  
    Weighted, 89  
Perreault & Leigh Index, 93
- Pi Coefficient, 69  
Pivot Statistic, 305  
Point Estimation, 182  
Principal Component Analysis, 31  
Psychometrics, 330
- Quadratic Weights, 90, 108
- Radical Weights, 129  
Random Rating, 224, 225  
Rater Sample, 176  
Rater Sampling, 15  
Ratings  
    Raw Representation, 103  
    Vector Representation, 103
- Ratio Data, 102  
Ratio Weights, 129  
Relative Category Membership, 242  
Reliability, 4  
    Inter-Annotator, 8  
    Inter-Rater, 4  
    Intercoder, 8  
    Internal Consistency, 29  
    Intra-Rater/Test-Retest, 6  
        versus Validity, 30  
    Reliability Measure, 259  
    Replicate Sample, 202  
    Replication Methods, 202  
    Research Hypothesis, 304  
    Right-tailed Test, 305
- Sample Size Calculation  
    AC<sub>1</sub> Coefficient, 213  
    Brennan-Prediger Coefficient, 214  
    Fleiss Generalized Kappa, 216
- Sampling  
    Distribution, 173  
    Error, 177  
    Fraction, 185, 201  
    Plan, 16  
    Rater/Subject Population, 15
- Savkov, A., 290  
Scoring Rubric, 18

- Scott's Pi  
    Definition, 63, 69  
    Variance, 186  
    Weighted, 111  
Significance Level, 306  
Simple Ordinal Weights, 127  
Simple Random Sampling, 178  
Standard Error, 14  
Standardized Cronbach's Alpha, 334  
Statistical  
    Hypothesis, 304, 306  
    Independence, 63  
    Inference, 61, 182  
    Noise, 304  
    Significance, 304  
Statistically Significant, 221  
Subject Sample, 15, 176  
Subject Sampling, 15  
  
Test of Hypothesis, 182  
Test Statistic, 305  
Test-Retest Reliability, 6  
Text Annotation, 287  
Textbook Cases, 140  
Total Disagreement, 102  
Total Variance  
    Calculation, 204  
    Definition, 203  
Two-Tailed Test, 305  
  
Unconditional  
    Inference, 182  
    Reliability, 245  
Unidimensionality, 335  
Unitization Analysis Zone, 292  
Unitizing, 289  
  
Validity, 245  
    Analysis, 243  
    Measure, 259  
Validity Coefficient  
    AC<sub>2</sub>, 263  
  
Brennan-Prediger, 267  
Conger, 267  
Fleiss, 265  
Krippendorff, 266  
Unconditional, 259  
Variable, 19  
Variance  
    AC<sub>1</sub> - 2 Raters, 185  
    AC<sub>2</sub> - 2 Raters, 185  
    AC<sub>2</sub> - 3 Raters+, 193  
    Brennan-Prediger - 2 Raters, 188  
    Brennan-Prediger - 3 Raters+, 194  
    Cohen's Kappa - 2 Raters, 187  
    Conditional Conger, 276  
    Conditional Fleiss Reliability, 273  
    Conditional Krippendorff, 274  
    Conger's Kappa, 195  
    Definition, 184  
    Estimators, 184  
    Fleiss' Kappa - 3 Raters+, 193  
    Krippendorff - 2 Raters, 188  
    Krippendorff - 3 Raters+, 194  
    Percent Agreement - 2 Raters, 189  
    Scott's Pi - 2 Raters, 186  
    Three Raters or More, 192  
    Unconditional, 203  
  
Weighted  
    Kappa, 89, 108  
    Percent Agreement, 89  
Weighting, 89  
Weights  
    Bipolar, 130, 132  
    Circular, 129, 132  
    Custom, 122  
    Identity, 131  
    Linear, 90, 91, 128, 132  
    Ordinal, 127, 132  
    Quadratic, 90, 91, 108, 132  
    Radical, 129, 131  
    Ratio, 129, 132  
    Use for Defining Agreement, 121
-

# **Handbook of Inter-Rater Reliability, 5<sup>th</sup> Ed.**

## **Vol 1: Analysis of Categorical Ratings**

**I**nter-rater reliability assessment has become an essential component in the process of evaluating the quality of experimental data in almost all fields of research. The 4th edition of the *Handbook of Inter-Rater Reliability* covered the analysis of categorical and quantitative ratings in a single volume. In response to comments on previous editions, the current 5th edition is released in 2 volumes. Volume 2 is devoted to the analysis of quantitative ratings, whereas the current volume 1 focuses on the analysis of categorical ratings.

Here is the link to the webpage of volume 1, where you can find, a link to the errata page, some example workbooks, and other datasets:

**[www.agreestat.com/books/cac5/](http://www.agreestat.com/books/cac5/)**

Here are a few topics that are new to the 5<sup>th</sup> edition:

- Chapter 2 describes various methods for setting up your dataset of ratings before analysis.
- New sample size calculation procedures for chance-corrected agreement coefficients are presented in chapter 6.
- Several new techniques for analyzing categorical ratings are described in chapter 9. Among these are the inter-annotator agreement, useful in Natural Language Processing, the testing of the difference of 2 agreement coefficients for statistical significance, and many others.

### **About the Author**

#### **Kilem L. Gwet, Ph.D.**

Statistical consultant, mathematical statistician, researcher, and instructor. Over 20 years of experience in various industries, and several publications in peer-reviewed journals.

### **AgreeStat Analytics**

PO Box 2696  
Gaithersburg, Maryland 20886-2696 – USA

