8. kongres Hrvatskog društva za medicinsku biokemiju i laboratorijsku medicinu s međunarodnim sudjelovanjem
22. – 26. rujna 2015., Rijeka, Hrvatska

Statistička usporedba mjernih postupaka

Mladen Petrovečki

Klinički zavod za laboratorijsku dijagnostiku Kliničke bolnice Dubrava, Zagreb; Katedra za medicinsku informatiku, Medicinski fakultet Sveučilišta u Rijeci

Rijeka University School of Medicine Department of Medical Informatics

Uvod

Usporedba mjerenja

- brojnost, količina, sadržaj, koncentracija
  - iste tvari u kliničkom laboratoriju ili
  - (općenito) istog pokazatelja (varijable) u znanstvenom istraživanju
- usporedba posebnim statističkim postupcima
  - uspoređuju **isti** pokazatelj u dva (ili više) mjerenja
  - ista skupina ispitanika,
  - različiti mjerni sustavi (uređaj, instrument, test, upitnik...)

Koeficijenti korelacije brojčanih pokazatelja

- Pearsonov koeficijent korelacije (r, r_P)
- Spearmanov koeficijent korelacije rangova (r, r_S)
- Kendallov koeficijent korelacije rangova (Kendallov τ)
- biserijski koeficijent (r_{PB})
- koeficijent eta (η)
- koeficijent višestruke korelacije (R)

Koeficijenti korelacije kategoričkih pokazatelja

- koeficijent φ
- Pearsonov koeficijent kontingencije C
- Cramerov V
- Tschuprowljev T
- koeficijent λ Goodmana i Kruskala

Mjere podudarnosti

- kategorički pokazatelji
  - Linov koeficijent konkordancije W
  - interklasni koeficijent korelacije (ICC, engl. *interclass correlation coefficient*)
  - koeficijent ponovljivosti (BSI, engl. *British Standards Institute repeatability coefficient*)
  - Cohenov kappa (κ)
- grafički postupci
  - Bland-Altmanov grafikon
  - grafikon Krouwera i Montijeve

Regresijski postupci

- jednostavna regresija
  (linearna, polinomska, semilogaritamska...)
- višestruka linearna regresija
- logistička regresija
- Coxova regresija proporcionalnih rizika
- Passing-Bablokova regresija
- Demingova regresija

Regresijski postupci

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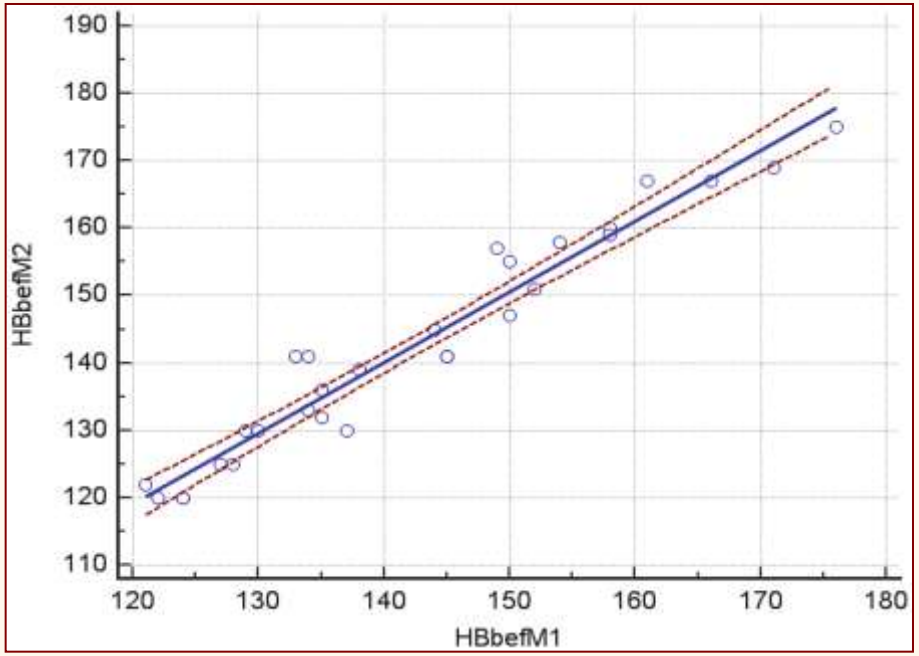
- Demingova regresija

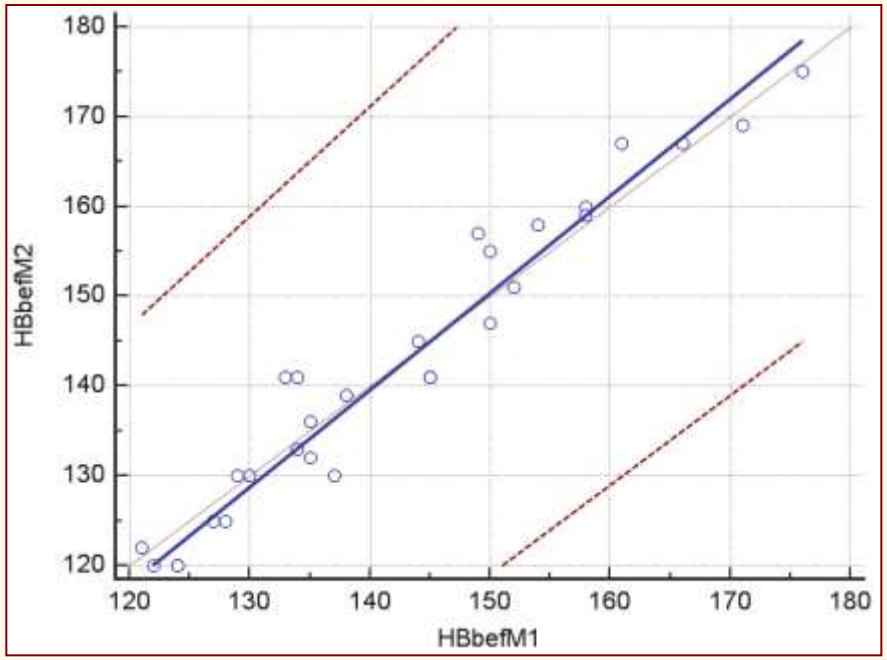
Nekoliko primjera

Korelacija i linearna regresija



- hemoglobin (g/L)
- N = 29
- r = 0,973 (0,943 – 0,987; 95%CI)
- *P* < 0,001
- y = -6,99±6,87 + 1,05±0,05 x

Passing-Bablokova regresija



Variable X	HBbefM1
Variable Y	HBbefM2
Sample size	29

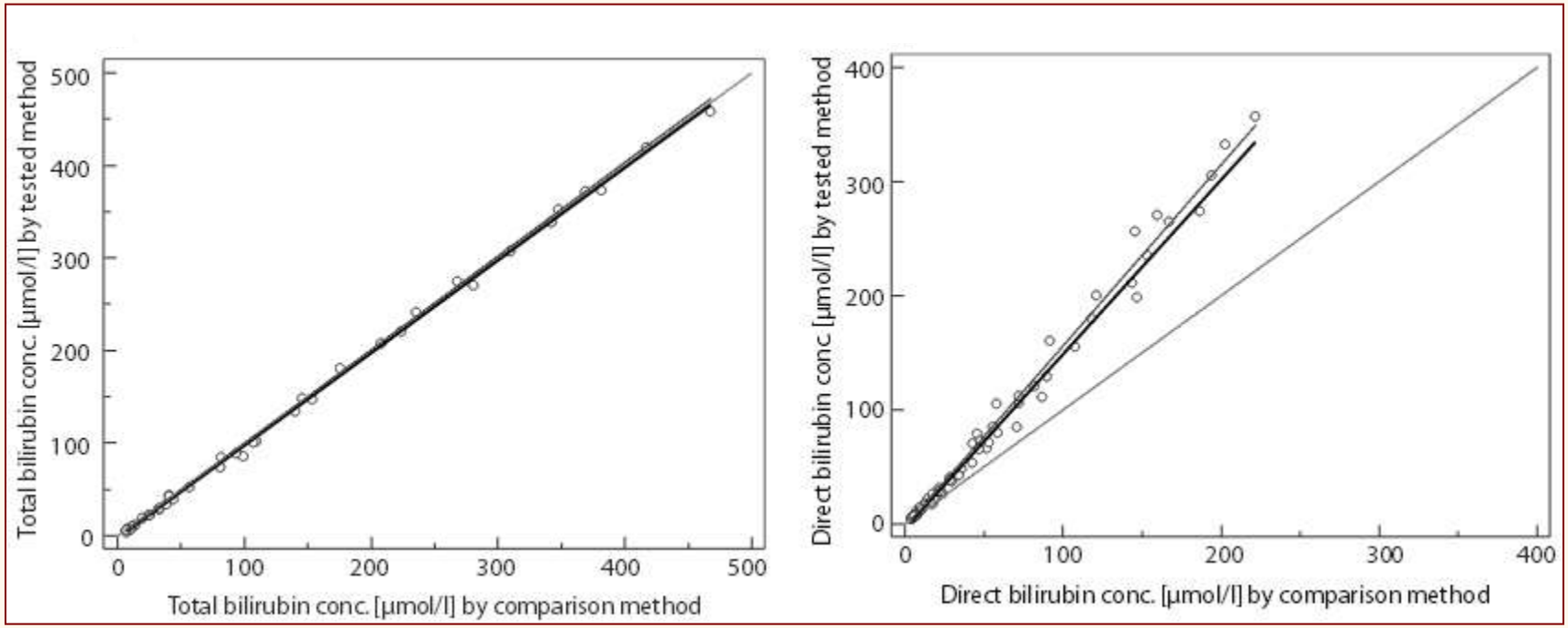
	Variable X	Variable Y
Lowest value	121,0000	120,0000
Highest value	176,0000	175,0000
Arithmetic mean	142,4138	142,6207
Median	138,0000	141,0000
Standard deviation	15,1834	16,3956
Standard error of the mean	2,8195	3,0446

Regression Equation

y = -12,166667 + 1,083333 x

Systematic differences	
Intercept A	-12,1667
95% CI	-31,0000 to 0,0000
Proportional differences	
Slope B	1,0833
95% CI	1,0000 to 1,2222
Random differences	
Residual Standard Deviation (RSD)	2,6643
± 1.96 RSD Interval	-5,2220 to 5,2220
Linear model validity	
Cusum test for linearity	No significant deviation from linearity (P=0,86)

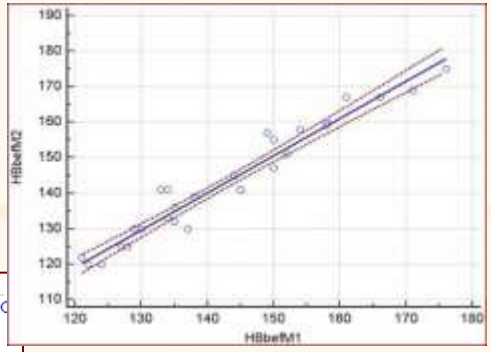
Passing-Bablokova regresija

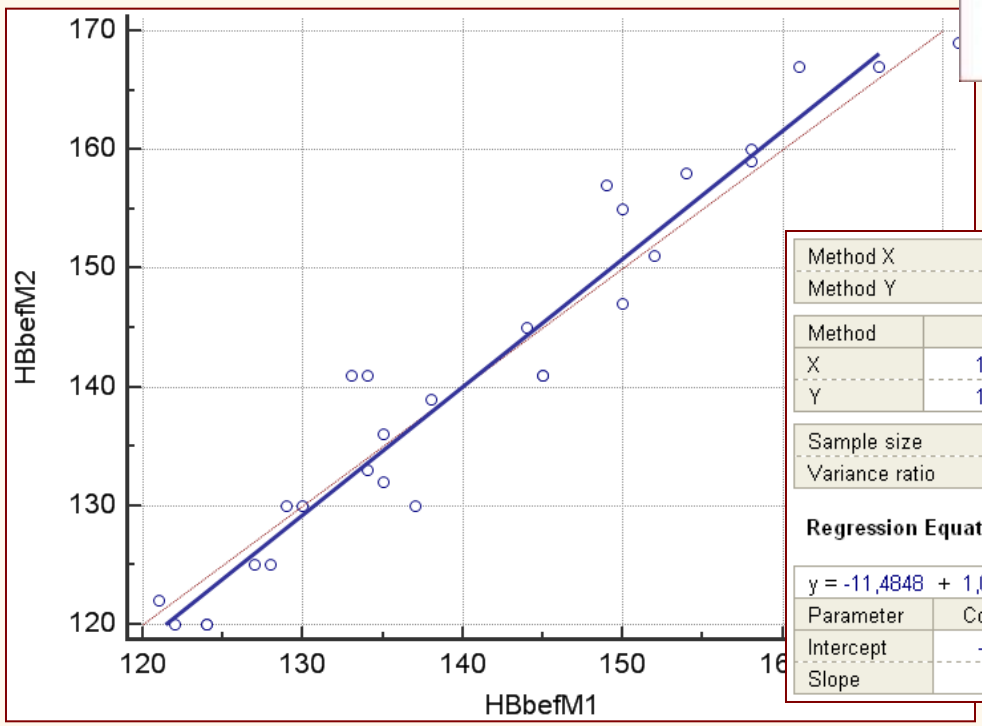


N	40	70
raspon mjerenja (µmol/L)	3 – 468	4 – 357
r	0,99 (P < 0,001)	0,99 (P < 0,001)
jednadžba (95%CI)	y = -3.0 (-3.8 – -2.1) + 1.00 (0.98 – 1.01) x	y = -3.2 (-4.2 – -1.9) + 1.52 (1.47 – 1.58) x
"cusum" test	P > 0.1	P < 0,01

Bilić-Zulle L. Comparison of methods: Passing and Bablok regression. Biochemia Medica 2011;21(1):49–52.

Demingova regresija





Method X	HBbefM1
Method Y	HBbefM2

Method	Mean	Coefficient of variation (%)
X	142,4138	3,00
Y	142,6207	3,00

Sample size	29
Variance ratio	0,9971

Regression Equation

y = -11,4848 + 1,0821 x

Parameter	Coefficient	Std. Error	95% CI
Intercept	-11,4848	6,4452	-24,6872 to 1,7176
Slope	1,0821	0,04595	0,9880 to 1,1762

- parametrijska analiza
- normalna raspodjela podataka

Demingova regresija

Method X	HBbefM1
Method Y	HBbefM2

Method	Mean	Coefficient of variation (%)
X	142,4138	6,00
Y	142,6207	3,00

Sample size	29
Variance ratio	3,9884

Regression Equation

y = -13,9373 + 1,0993 x

Parameter	Coefficient	Std. Error	95% CI
Intercept	-13,9373	6,7274	-27,7177 to -0,1569
Slope	1,0993	0,04836	1,0003 to 1,1984

Method X	HBbefM1
Method Y	HBbefM2

Method	Mean	Coefficient of variation (%)
X	142,4138	3,00
Y	142,6207	3,00

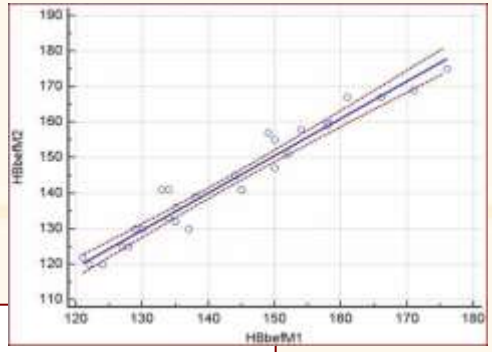
Sample size	29
Variance ratio	0,9971

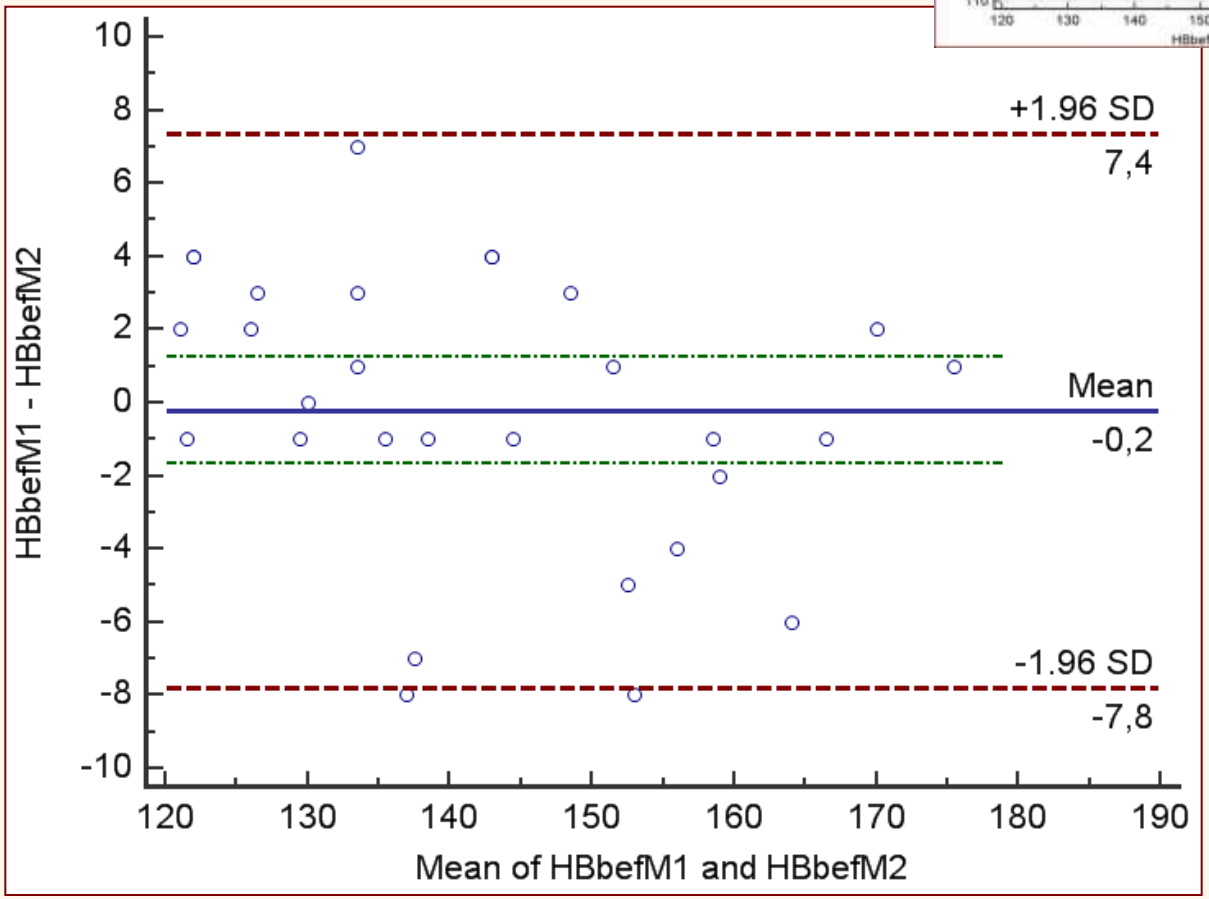
Regression Equation

y = -11,4848 + 1,0821 x

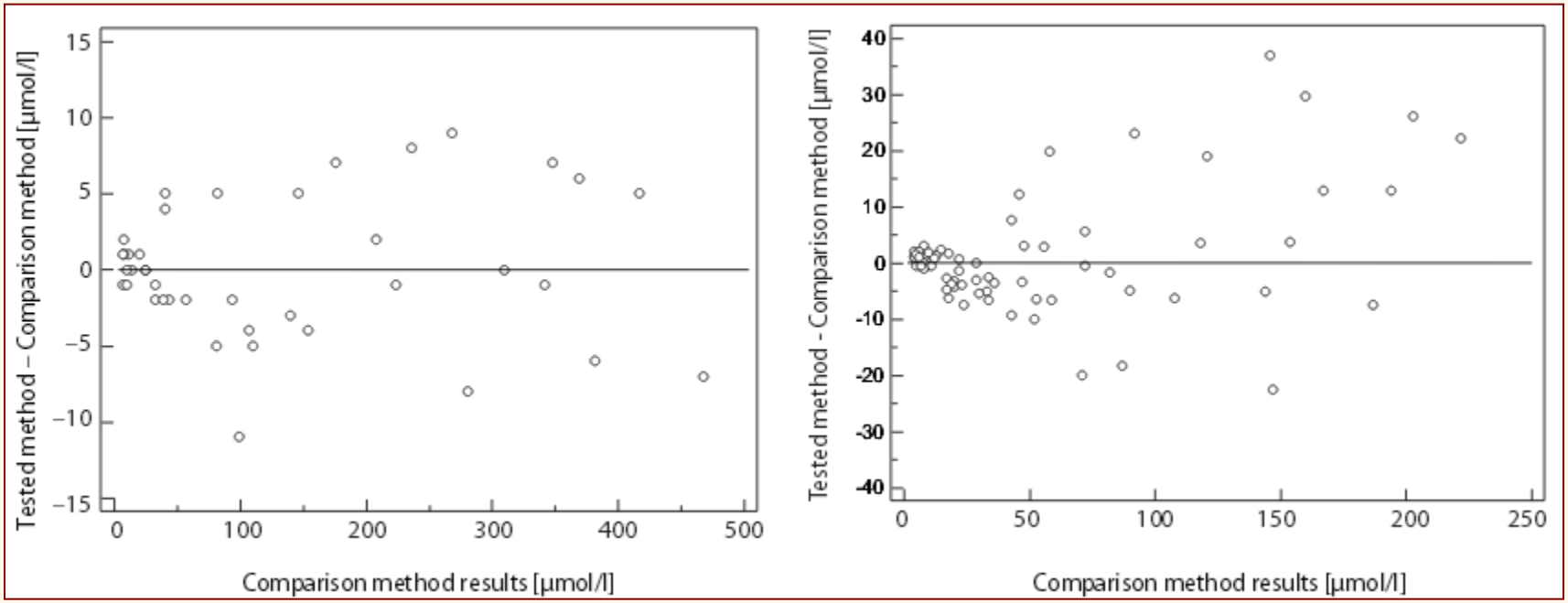
Parameter	Coefficient	Std. Error	95% CI
Intercept	-11,4848	6,4452	-24,6872 to 1,7176
Slope	1,0821	0,04595	0,9880 to 1,1762

Bland-Altmanov grafikon





Bland-Altmanov grafikon



Bilić-Zulle L. Comparison of methods: Passing and Bablok regression. Biochemia Medica 2011;21(1):49–52.

Bland-Altmanov grafikon

Lessons in biostatistics *Biochemia Medica 2015;25(2):141–51*

Understanding Bland Altman analysis

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Measurement in Medicine: the Analysis of Method Comparison Studies†

D. G. ALTMAN and J. M. BLAND‡

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‡ Department of Clinical Epidemiology an
St George's Hospital Medical School, Cra

Summary: Methods of analysis used in t
measurement are reviewed. The use of c
between means is criticized. A simple pa
analysis of variance and simple graphic

Lancet. 1986 Feb 8;1(8476):307-10.

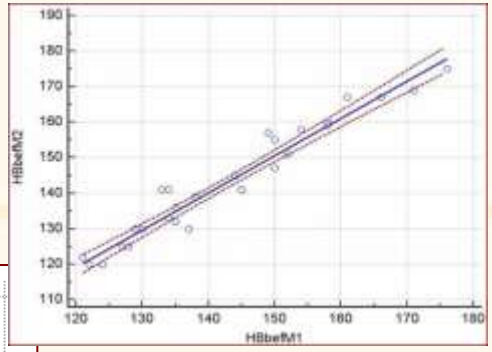
Statistical methods for assessing agreement between two methods of clinical measurement.

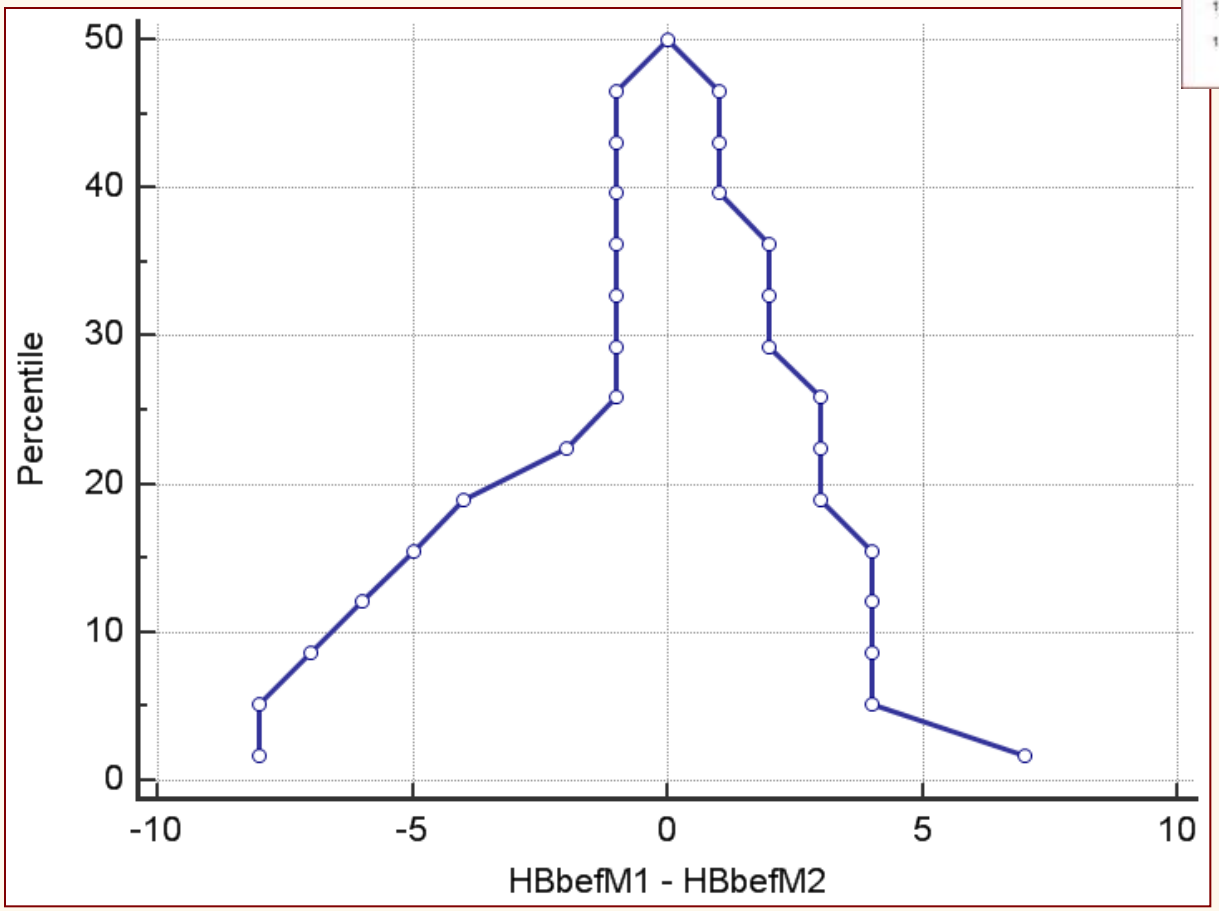
Bland JM, Altman DG.

Abstract

In clinical measurement comparison of a new measurement technique with an established one is often needed to see whether they agree sufficiently for the new to replace the old. Such investigations are often analysed inappropriately, notably by using correlation coefficients. The use of correlation is misleading. An alternative approach, based on graphical techniques and simple calculations, is described, together with the relation between this analysis and the assessment of repeatability.

Krouwer-Montijev grafikon





Krouwer-Montijev grafikon

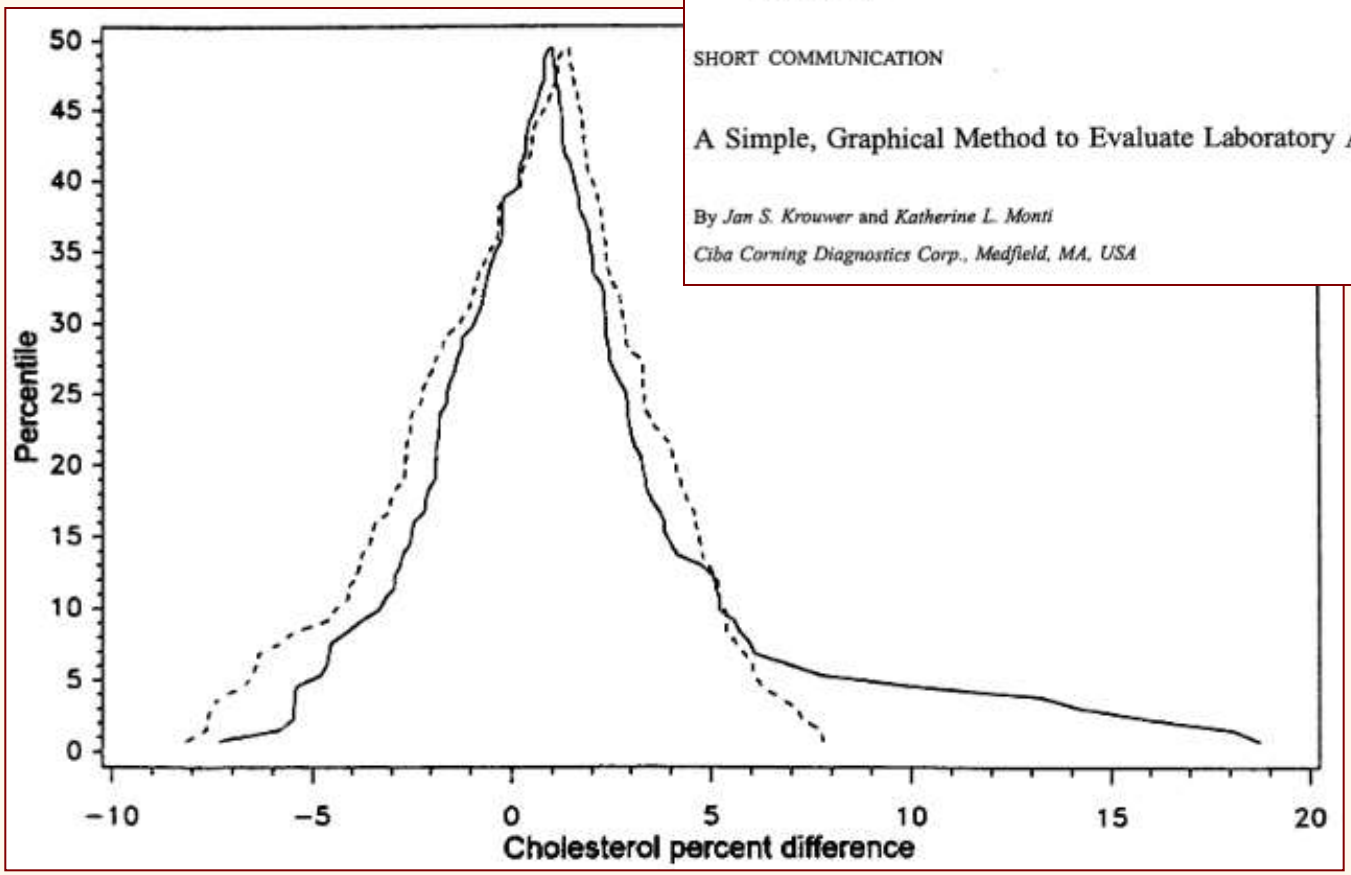
Eur J Clin Chem Clin Biochem
1995; 33:525–527
© 1995 Walter de Gruyter & Co.
Berlin · New York

SHORT COMMUNICATION

A Simple, Graphical Method to Evaluate Laboratory Assays

By *Jan S. Krouwer* and *Katherine L. Monti*

Ciba Corning Diagnostics Corp., Medfield, MA, USA



Mjere podudarnosti/slaganja

Table 3. Contingency table for measuring interrater reliability using measures of agreement (data present arbitrary distribution of N = 38 samples of negative, positive and highly positive findings of immunofluorescent patterns of antineutrophil cytoplasmic antibodies (ANCA) by two independent observers)*

Observers		Observer B			Total (N)
		negative (N)	positive (N)	highly positive (N)	
Observer A	negative (N)	9	1	0	10
	positive (N)	2	12	3	17
	highly positive (N)	1	0	10	1
Total (N)		12	13	13	38

Measures of agreement		
	κ	0.72
	κ_{LW}	0.75
	κ_{QW}	0.78
	W	0.78
	ICC	0.78

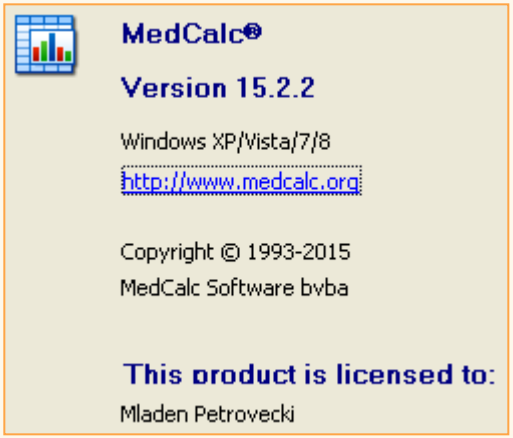
*Abbreviations: N – number of subjects, κ – kappa statistics, LW – linear weight, QW – quadratic weight, W – concordance coefficient, ICC – interclass correlation coefficient.

Petrovečki M. Measures of association (neobjavljeno).

Zaključak

- Usporedba mjernih postupaka
  - ✓ Bland-Altmanov grafikon
  - ✓ Krouwer-Montijev grafikon
  - ✓ Passing-Bablokova regresija
  - ✓ Demingova regresija
  - ✓ koeficijent konkordancije W
  - ✓ interklasni koeficijent korelacije (ICC)
  - ✓ Cohenov κ

Hvala na pozornosti



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