

Using the SAS[®] System to Visualize Inter-Rater Agreement for Continuous Measurements in Medical Studies

Barbara Schneider, Department for Medical Statistics, University of Vienna, Austria

Abstract

In this presentation a graphical technique to check agreement visually is discussed. Emphasis is laid on how this statistical method can be performed within the SAS System. Data from clinical trials are presented. SAS code is reported using the following tools: Base SAS Software, PROC GPLOT and the Macro Language .

Introduction

Measurement in medical studies is very often an imprecise task and the errors associated with this should be quantified and understood. Since measurement error can seriously affect statistical analyses and interpretation, it is important to assess the amount of such an error . To investigate agreement in continuous variables a graphical technique proposed by Bland and Altman (1986) and the intraclass correlation coefficient are used. For categorical data the K-measure is appropriate.

Studies comparing two or more methods are common. The aim of these studies is to see if the methods 'agree' well enough for one method to replace the others or for the methods to be used interchangeably. The same considerations apply to studies comparing two or more observers using one method. An important aspect of method or observer comparison is the comparison of the repeatability of each observer or method.

Graphical Technique

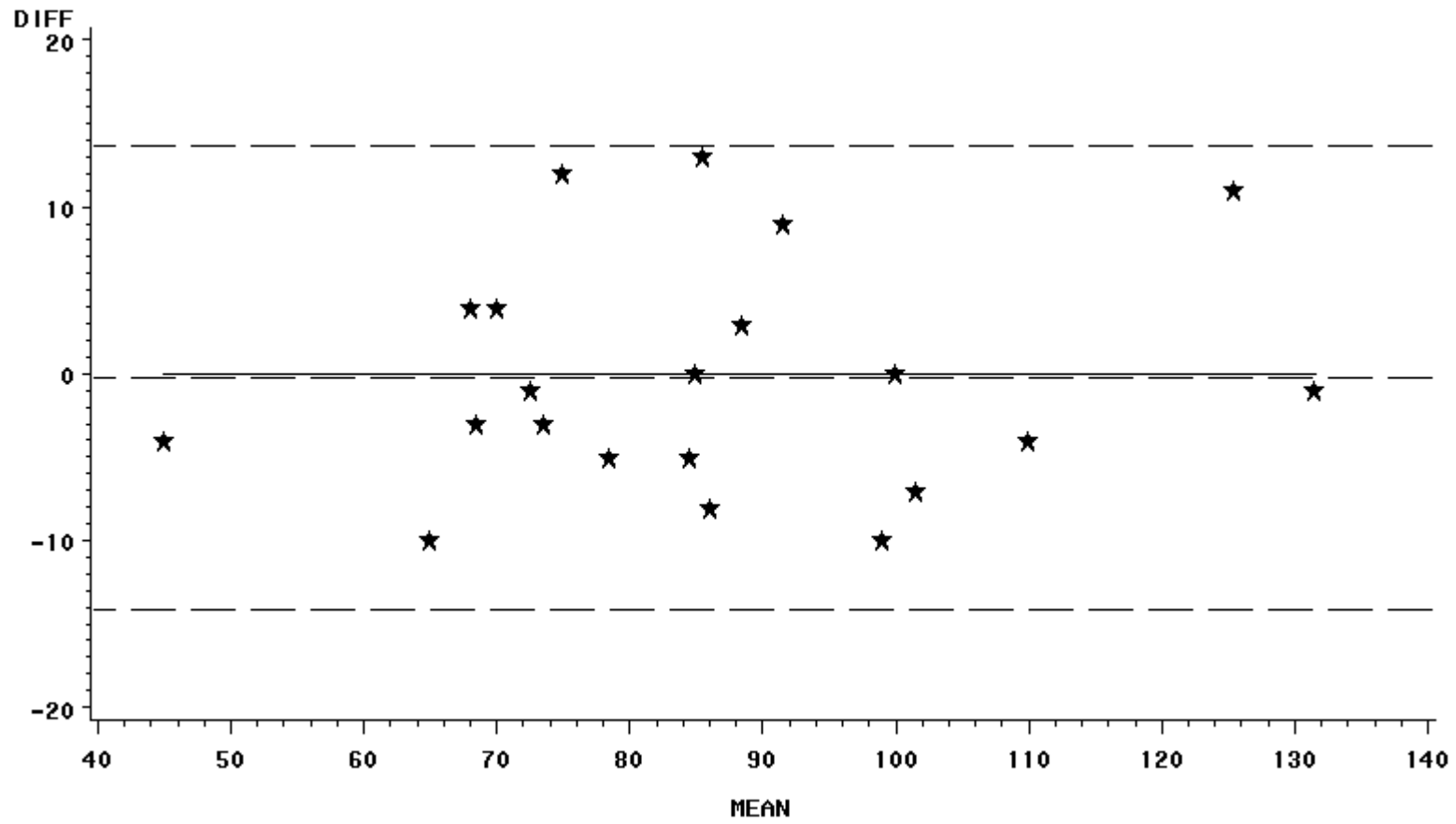
The inter-observer (within observer or between methods) agreement is demonstrated by a graphical technique suggested by Bland and Altman (Lancet, Feb. 8, 1989).

In order to assess inter-observer agreement graphically, the difference between the two measurements of each of the two observers are plotted against the mean of the two values of the observers for each patient.

Limits of agreement, defined as twice the standard deviation of the difference between the observers, are calculated and plotted in the figure. If we suppose that these differences follow a normal distribution, 95% of the differences will lie between these limits.

To demonstrate the procedure, data from Altman (1991) are used comparing two measurement methods. Measurements of transmitral volumetric flow (MF) by Doppler echocardiography and left ventricular stroke volume (SV) by cross-sectional echocardiography in 21 patients without aortic valve disease are shown.

The following program implements this technique within the SAS System and produces this plot:



```
goptions reset=(axis, legend, pattern, symbol,
title, footnote) norotate
      hpos=0 vpos=0 htext= ftext= ctext=
target= gaccess= gsfmode= ;
title;
```

```
data ms;
input patient mf sv;
cards;
```

```
1  47  43
2  66  70
3  68  72
4  69  81
5  70  60
6  70  67
7  73  72
8  75  72
9  79  92
10 81  76
11 85  85
12 87  82
13 87  90
14 87  96
15 90  82
16 100 100
17 104  94
18 105  98
19 112 108
20 120 131
21 132 131
```

```
;
run;
%macro p(x,y,l,u,s);
```

```
data temp;
set ms;
mean=mean(&x,&y);
diff=&y-&x;
r=0;
```

```
/*in order to show perfect agreement: diff=0 */
run;
```

```
proc univariate data=temp normal;
var mean diff ;
```

```
output out=o mean= m_mean m_diff
      std= s_mean s_diff
```

```
;
run;
```

```
proc print data=o;
run;
```

```
data o;
set o;
d1=m_diff+2*s_diff;
d2=m_diff-2*s_diff;
call symput("m1",m_diff);
call symput("d1",d1);
call symput("d2",d2);
run;
```

```
symbol1 c=black v=circle i=none l=1;
symbol2 c=black v=none i=join l=1;
```

```
proc gplot data=temp;
plot diff*mean=1 r*mean=2 / overlay vref=
&m1 &d1 &d2 lvref=2 cvref=black caxis=black
vaxis=&l to &u by &s
;
run;
```

```
title;
```

```
%mend p;
```

```
%p(mf,sv,-20,20,10);
quit;
```

SAS, Base SAS, SAS/GRAPH software are registered trademarks of SAS Institute Inc., Cary, NC, USA

REFERENCES

Bland J.M., Altman D. G. (1986) *Statistical Methods for assessing Agreement between two Methods of Clinical Measurement*, THE LANCET, Feb. 8, 1986

Altman D. G. (1991) *Practical Statistics for Medical Research*, 1st edn. Chapman&Hall

SAS[®] Language: Reference, Version 6, First Edition
SAS[®] Procedures Guide, Version 6, Third Edition
SAS/GRAPH[®] Software: Reference, Version 6, First Edition, Volumes 1 and 2

Address for correspondence:

Dipl.Ing. Dr. Barbara Schneider
Institut für Medizinische Statistik
Universität Wien
Schwarzspanierstr. 17
A - 1090 Wien
Austria