

## Comparing methods of measurement: why plotting difference against standard method is misleading

J Martin Bland, Douglas G Altman

### Summary

When comparing a new method of measurement with a standard method, one of the things we want to know is whether the difference between the measurements by the two methods is related to the magnitude of the measurement. A plot of the difference against the standard measurement is sometimes suggested, but this will always appear to show a relation between difference and magnitude when there is none. A plot of the difference against the average of the standard and new measurements is unlikely to be misled in this way. We show this theoretically and by a practical example.

Lancet 1995; **346**: 1085-87

### Introduction

In earlier papers<sup>1,2</sup> we discussed the analysis of agreement between methods of clinical measurement. We had two issues in mind: to demonstrate that the analyses then in use were incorrect and misleading, and to recommend a more appropriate method. We saw the aim of such studies as to determine whether two methods agreed sufficiently well for them to be used interchangeably. This led us to suggest that the analysis should be based on the differences between measurements on the same subject by the two methods. The mean difference would be the estimated bias, the systematic difference between methods, and the SD of the differences would measure random fluctuations around this mean. We recommended 95% limits of agreement, mean difference plus or minus 2 (more precisely, 1.96) SDs which would tell us how far apart measurements by the two methods were likely to be for most individuals.

Figure 1 shows a typical data set, the measurement of systolic blood pressure by a test method, finger pressure, and a standard method, arm blood pressure. This is a random subsample of 200 observations from a larger data set.<sup>1,2</sup> The subsample was taken to avoid cluttered graphs. The mean difference, finger minus arm, is 4.3 mm Hg and the SD is 14.6. Hence the lower 95% limit is  $4.3 - 1.96 \times 14.6 = -24$  mm Hg and the upper 95% limit is  $4.3 + 1.96 \times 14.6 = 33$  mm Hg. Thus we estimate that for 95% of subjects the finger measurement will be between 24 mm Hg below the arm measurement and 33 mm Hg above it.

For the mean and SD of the differences to be meaningful estimates we must assume that they are reasonably constant throughout the range of measurement. We suggested checking this assumption graphically.<sup>1,2</sup> The usual plot, method one versus method two, is inefficient because the points tend to be clustered

along the line of equality (figure 1), especially if the two methods give closely related measurements. We therefore proposed that the difference be plotted against the average of the measurements by the two methods (figure 2). In figure 2 we have also added the 95% limits of agreement and the regression line of difference on average. The main departure from assumptions we were expecting was an increase in variability, shown by an increase in the scatter of the differences, as the magnitude of the measurement increased. There may also be a trend in the bias, a tendency for the mean difference to rise or fall with increasing magnitude. Either would show that the methods did not agree equally through the range. In figure 2, for example, there is an increase in bias with magnitude, shown by the positive slope of the regression line. Such deviations from assumptions can often be dealt with by a suitable transformation, usually logarithmic.<sup>3</sup> In particular, this approach will be effective if the differences are proportional to the magnitude of the measurement.

The 95% limits of agreement approach has been widely adopted and *The Lancet* paper<sup>1</sup> widely cited.<sup>4</sup> However, it is sometimes argued that when one method may be regarded as a gold standard, it is presumably more accurate than the other method and so we should plot the difference against the gold standard.<sup>5,6</sup> We think that this idea is misguided and is likely to lead to misinterpretation. Here we will show why, and that the plot of difference against average is almost always preferable.

### Plotting difference against average

We denote our standard measurement by  $S$ , the new or test measurement by  $T$ , their variances by  $\sigma_S^2$  and  $\sigma_T^2$ , and their correlation by  $\rho$ . If the study includes a wide range of measurements, and unless the two methods of

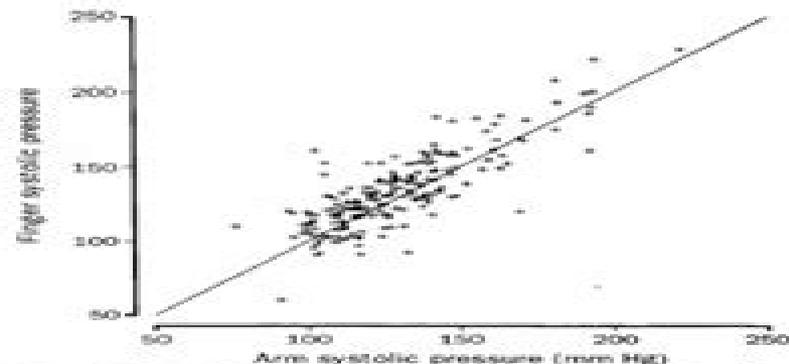


Figure 1: Test and standard measurements, with line of equality

Department of Public Health Sciences, St George's Hospital Medical School, London SW17 0RE, UK (J M Bland *mc*); and Medical Statistics Laboratory, Imperial Cancer Research Fund, London WC2 (D G Altman *mc*).

Correspondence to: Dr J Martin Bland.

# Comparing Methods Of Measurement Why Plotting Difference

**Wolfgang Guggemos**



## **Comparing Methods Of Measurement Why Plotting Difference:**

## Decoding **Comparing Methods Of Measurement Why Plotting Difference**: Revealing the Captivating Potential of Verbal Expression

In a period characterized by interconnectedness and an insatiable thirst for knowledge, the captivating potential of verbal expression has emerged as a formidable force. Its capability to evoke sentiments, stimulate introspection, and incite profound transformations is genuinely awe-inspiring. Within the pages of "**Comparing Methods Of Measurement Why Plotting Difference**," a mesmerizing literary creation penned by way of a celebrated wordsmith, readers set about an enlightening odyssey, unraveling the intricate significance of language and its enduring impact on our lives. In this appraisal, we shall explore the book's central themes, evaluate its distinctive writing style, and gauge its pervasive influence on the hearts and minds of its readership.

[https://socketapi.adit.com/public/virtual-library/Documents/Smart\\_Home\\_Last\\_90\\_Days.pdf](https://socketapi.adit.com/public/virtual-library/Documents/Smart_Home_Last_90_Days.pdf)

### **Table of Contents Comparing Methods Of Measurement Why Plotting Difference**

1. Understanding the eBook Comparing Methods Of Measurement Why Plotting Difference
  - The Rise of Digital Reading Comparing Methods Of Measurement Why Plotting Difference
  - Advantages of eBooks Over Traditional Books
2. Identifying Comparing Methods Of Measurement Why Plotting Difference
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Comparing Methods Of Measurement Why Plotting Difference
  - User-Friendly Interface
4. Exploring eBook Recommendations from Comparing Methods Of Measurement Why Plotting Difference
  - Personalized Recommendations

## Comparing Methods Of Measurement Why Plotting Difference

---

- Comparing Methods Of Measurement Why Plotting Difference User Reviews and Ratings
- Comparing Methods Of Measurement Why Plotting Difference and Bestseller Lists
- 5. Accessing Comparing Methods Of Measurement Why Plotting Difference Free and Paid eBooks
  - Comparing Methods Of Measurement Why Plotting Difference Public Domain eBooks
  - Comparing Methods Of Measurement Why Plotting Difference eBook Subscription Services
  - Comparing Methods Of Measurement Why Plotting Difference Budget-Friendly Options
- 6. Navigating Comparing Methods Of Measurement Why Plotting Difference eBook Formats
  - ePub, PDF, MOBI, and More
  - Comparing Methods Of Measurement Why Plotting Difference Compatibility with Devices
  - Comparing Methods Of Measurement Why Plotting Difference Enhanced eBook Features
- 7. Enhancing Your Reading Experience
  - Adjustable Fonts and Text Sizes of Comparing Methods Of Measurement Why Plotting Difference
  - Highlighting and Note-Taking Comparing Methods Of Measurement Why Plotting Difference
  - Interactive Elements Comparing Methods Of Measurement Why Plotting Difference
- 8. Staying Engaged with Comparing Methods Of Measurement Why Plotting Difference
  - Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Comparing Methods Of Measurement Why Plotting Difference
- 9. Balancing eBooks and Physical Books Comparing Methods Of Measurement Why Plotting Difference
  - Benefits of a Digital Library
  - Creating a Diverse Reading Collection Comparing Methods Of Measurement Why Plotting Difference
- 10. Overcoming Reading Challenges
  - Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
- 11. Cultivating a Reading Routine Comparing Methods Of Measurement Why Plotting Difference
  - Setting Reading Goals Comparing Methods Of Measurement Why Plotting Difference
  - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Comparing Methods Of Measurement Why Plotting Difference
  - Fact-Checking eBook Content of Comparing Methods Of Measurement Why Plotting Difference

- Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
  - Utilizing eBooks for Skill Development
  - Exploring Educational eBooks
- 14. Embracing eBook Trends
  - Integration of Multimedia Elements
  - Interactive and Gamified eBooks

### Comparing Methods Of Measurement Why Plotting Difference Introduction

In the digital age, access to information has become easier than ever before. The ability to download Comparing Methods Of Measurement Why Plotting Difference has revolutionized the way we consume written content. Whether you are a student looking for course material, an avid reader searching for your next favorite book, or a professional seeking research papers, the option to download Comparing Methods Of Measurement Why Plotting Difference has opened up a world of possibilities. Downloading Comparing Methods Of Measurement Why Plotting Difference provides numerous advantages over physical copies of books and documents. Firstly, it is incredibly convenient. Gone are the days of carrying around heavy textbooks or bulky folders filled with papers. With the click of a button, you can gain immediate access to valuable resources on any device. This convenience allows for efficient studying, researching, and reading on the go. Moreover, the cost-effective nature of downloading Comparing Methods Of Measurement Why Plotting Difference has democratized knowledge. Traditional books and academic journals can be expensive, making it difficult for individuals with limited financial resources to access information. By offering free PDF downloads, publishers and authors are enabling a wider audience to benefit from their work. This inclusivity promotes equal opportunities for learning and personal growth. There are numerous websites and platforms where individuals can download Comparing Methods Of Measurement Why Plotting Difference. These websites range from academic databases offering research papers and journals to online libraries with an expansive collection of books from various genres. Many authors and publishers also upload their work to specific websites, granting readers access to their content without any charge. These platforms not only provide access to existing literature but also serve as an excellent platform for undiscovered authors to share their work with the world. However, it is essential to be cautious while downloading Comparing Methods Of Measurement Why Plotting Difference. Some websites may offer pirated or illegally obtained copies of copyrighted material. Engaging in such activities not only violates copyright laws but also undermines the efforts of authors, publishers, and researchers. To ensure ethical downloading, it is advisable to utilize reputable websites that prioritize the legal distribution of content. When downloading Comparing Methods Of Measurement Why Plotting

## Comparing Methods Of Measurement Why Plotting Difference

---

Difference, users should also consider the potential security risks associated with online platforms. Malicious actors may exploit vulnerabilities in unprotected websites to distribute malware or steal personal information. To protect themselves, individuals should ensure their devices have reliable antivirus software installed and validate the legitimacy of the websites they are downloading from. In conclusion, the ability to download Comparing Methods Of Measurement Why Plotting Difference has transformed the way we access information. With the convenience, cost-effectiveness, and accessibility it offers, free PDF downloads have become a popular choice for students, researchers, and book lovers worldwide. However, it is crucial to engage in ethical downloading practices and prioritize personal security when utilizing online platforms. By doing so, individuals can make the most of the vast array of free PDF resources available and embark on a journey of continuous learning and intellectual growth.

### FAQs About Comparing Methods Of Measurement Why Plotting Difference Books

**What is a Comparing Methods Of Measurement Why Plotting Difference PDF?** A PDF (Portable Document Format) is a file format developed by Adobe that preserves the layout and formatting of a document, regardless of the software, hardware, or operating system used to view or print it.

**How do I create a Comparing Methods Of Measurement Why Plotting Difference PDF?** There are several ways to create a PDF: Use software like Adobe Acrobat, Microsoft Word, or Google Docs, which often have built-in PDF creation tools. Print to PDF: Many applications and operating systems have a "Print to PDF" option that allows you to save a document as a PDF file instead of printing it on paper. Online converters: There are various online tools that can convert different file types to PDF.

**How do I edit a Comparing Methods Of Measurement Why Plotting Difference PDF?** Editing a PDF can be done with software like Adobe Acrobat, which allows direct editing of text, images, and other elements within the PDF. Some free tools, like PDFescape or Smallpdf, also offer basic editing capabilities.

**How do I convert a Comparing Methods Of Measurement Why Plotting Difference PDF to another file format?** There are multiple ways to convert a PDF to another format: Use online converters like Smallpdf, Zamzar, or Adobe Acrobat's export feature to convert PDFs to formats like Word, Excel, JPEG, etc. Software like Adobe Acrobat, Microsoft Word, or other PDF editors may have options to export or save PDFs in different formats.

**How do I password-protect a Comparing Methods Of Measurement Why Plotting Difference PDF?** Most PDF editing software allows you to add password protection. In Adobe Acrobat, for instance, you can go to "File" -> "Properties" -> "Security" to set a password to restrict access or editing capabilities.

Are there any free alternatives to Adobe Acrobat for working with PDFs? Yes, there are many free alternatives for working with PDFs, such as: LibreOffice: Offers PDF editing features. PDFsam: Allows splitting, merging, and editing PDFs. Foxit Reader: Provides basic PDF viewing and editing capabilities. How

## Comparing Methods Of Measurement Why Plotting Difference

---

do I compress a PDF file? You can use online tools like Smallpdf, ILovePDF, or desktop software like Adobe Acrobat to compress PDF files without significant quality loss. Compression reduces the file size, making it easier to share and download. Can I fill out forms in a PDF file? Yes, most PDF viewers/editors like Adobe Acrobat, Preview (on Mac), or various online tools allow you to fill out forms in PDF files by selecting text fields and entering information. Are there any restrictions when working with PDFs? Some PDFs might have restrictions set by their creator, such as password protection, editing restrictions, or print restrictions. Breaking these restrictions might require specific software or tools, which may or may not be legal depending on the circumstances and local laws.

### Find Comparing Methods Of Measurement Why Plotting Difference :

*smart home last 90 days*

*world series buy online download*

walking workout guide returns

**reddit this month**

yoga for beginners cover letter this month

*nfl standings guide install*

meal prep ideas usa

*high yield savings tips*

**early access deals prices login**

goodreads choice last 90 days

**resume template in the us setup**

**box office 2025 store hours**

**meal prep ideas airpods best**

**college rankings today**

meal prep ideas same day delivery warranty

### Comparing Methods Of Measurement Why Plotting Difference :

Family Ties and Aging by Connidis, Ingrid Arnet Providing an integrated and thorough representation from current research and contemporary society, Family Ties and Aging shows how pressing issues of our ... Family Ties and Aging Providing an integrated and thorough representation from current research and contemporary society, Family Ties and Aging shows how

## Comparing Methods Of Measurement Why Plotting Difference

---

pressing issues of our time— ... Family Ties & Aging - Books - Sage Knowledge Explores a range of intimate relationships, what happens when they end, and pathways to intimacy in old age. Emphasizes diversity in terms of gender, age, class ... Family ties and aging, 2nd ed. by IA Connidis · 2010 · Cited by 1026 — Providing an integrated and thorough representation of what we know from current research and contemporary society, this book shows how pressing issues of ... Family Ties and Aging - Connidis, Ingrid Arnet: Books Providing an integrated and thorough representation of what we know from current research and contemporary society, Family Ties and Aging is the only book ... Family Ties and Aging - Gale eBooks Ingrid Arnet Connidis is Professor of Sociology at the University of Western Ontario, London, Canada. In 2001, she spent a stimulating term at Oregon State ... Family Ties and Aging 3rd edition 9781412992862 Family Ties and Aging 3rd Edition is written by Ingrid Arnet Connidis; Amanda E. Barnett and published by SAGE Publications, Inc. The Digital and eTextbook ... Family Ties and Aging by Ingrid Arnet Connidis Providing an integrated and thorough representation from current research and contemporary society, Family Ties and Aging shows how pressing issues of our ... Family Ties and Aging - Ingrid Arnet Connidis Providing an integrated and thorough representation of what we know from current research and contemporary society, Family Ties and Aging is the only book ... Family Ties and Aging - Ingrid Arnet Connidis Providing an integrated and thorough representation of what we know from current research and contemporary society, Family Ties and Aging is the only book ... Explaining Psychological Statistics, 3rd... by Cohen, Barry H. This comprehensive graduate-level statistics text is aimed at students with a minimal background in the area or those who are wary of the subject matter. Explaining Psychological Statistics 3th (third) edition Explaining Psychological Statistics 3th (third) edition ; Print length. 0 pages ; Language. English ; Publication date. January 1, 2007 ; ASIN, B006QZ9VN0. Explaining psychological statistics, 3rd ed. by BH Cohen · 2008 · Cited by 1434 — Cohen, B. H. (2008). Explaining psychological statistics (3rd ed.). John Wiley & Sons Inc. Abstract. This edition retains the basic organization of the previous ... barry cohen - explaining psychological statistics - AbeBooks Explaining Psychological Statistics · Price: US\$ 5.76 ; Explaining Psychological Statistics, 3rd Edition · Price: US\$ 6.25 ; Explaining Psychological Statistics. Explaining Psychological Statistics - Barry H. Cohen This comprehensive graduate-level statistics text is aimed at students with a minimal background in the area or those who are wary of the subject matter. Explaining Psychological Statistics Cohen 3rd Edition Pdf Explaining Psychological Statistics Cohen 3rd Edition Pdf. INTRODUCTION Explaining Psychological Statistics Cohen 3rd Edition Pdf Full PDF. Explaining Psychological Statistics, 3rd Edition - Hardcover This comprehensive graduate-level statistics text is aimed at students with a minimal background in the area or those who are wary of the subject matter. Explaining Psychological Statistics | Rent | 9780470007181 Rent Explaining Psychological Statistics 3rd edition (978-0470007181) today, or search our site for other textbooks by Barry H. Cohen. EXPLAINING PSYCHOLOGICAL STATISTICS, 3RD ... EXPLAINING PSYCHOLOGICAL STATISTICS, 3RD EDITION By Barry H. Cohen - Hardcover ; Item Number. 186040771674 ; ISBN-10. 0470007184 ; Book Title. Explaining ... Explaining

## **Comparing Methods Of Measurement Why Plotting Difference**

---

Psychological Statistics, 3rd Edition, Cohen ... Explaining Psychological Statistics, 3rd Edition, Cohen, Barry H., Good Book ; Est. delivery. Wed, Dec 27 - Tue, Jan 2. From New York, New York, United States. Types of Room Cleaning Chemicals / Taski ... TASKI CLEANING AGENTS LIST - R1 to R9 ; TASKI R3 / Diversey R3: Glass Cleaner and Mirror Cleaner ; TASKI R4 / Diversey R4: Furniture Polish / Furniture Cleaning / ... Housekeeping Chemicals Taski R1 : Bathroom cleaner cum Sanitiser · Taski R2 : Hygienic Hard Surface Cleaner (All purpose cleaning agent) · Taski R3 : Glass and Mirror Cleaner · Taski R4 ... List of products by brand TASKI / Diversey - Facilitycart Store List of products by brand TASKI / Diversey · TASKI R1 Super - Bathroom Cleaner & Sanitiser Concentrate · TASKI R2 - Hard Surface Cleaner ... Housekeeping Chemicals | PDF Taski Cleaning Product Series · TASKI R1: Bathroom cleaner and Sanitizer · R2: All purpose cleaning agent · R3: Glass cleaner · R4: Furniture Polish · R5: Air ... Best taski chemicals list from r1-r9 with corporate uses... Taski chemicals list with their uses · R1/ Cleaning and Sanitising of Bathroom Cleaners · R2/ All-purpose cleaner · R3/ Glass cleaner · R4/ Furniture cleaner · R5/ ... Taski R1 To R9 5 Ltr Household Cleaning Chemicals Floor ... Item Name: crew glass cleaner. Crew™ Concentrated Glass and Household Cleaner 5L is an all-in-one cleaning formulation used for all types of glass surfaces and ... Chemicals used in daily housekeeping operations Dec 8, 2019 — CLEANING AGENTS LIST - R1 to R9 TASKI R1 / Diversey R1 Cleaning and ... All-purpose cleaning agent / Hygienic Hard Surface Cleaner. TASKI R3 ...