Reviewer: James Bullard
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R Graphics

The production of graphical output is fundamental to most if not all statistical analyses. A large fraction of R users and R programmers however, are not fully aware of the flexibility of the graphical capabilities available in R. *R Graphics* by Paul Murrell provides a complete reference to both the traditional graphics system as well as the newer **grid** graphics system. Many books exist which demonstrate various plotting techniques in R, but these books are only interspersed with the plotting and rarely go into details about the R graphics routines themselves. *R Graphics*, in contrast, is exclusively devoted to the graphics routines. This book gives no guidance on which plots are appropriate for certain types of data. This is a great book if you know what you would like to plot, but don't know how.

The book is divided into two separate and roughly equal parts. The first part of the book is devoted to the traditional graphics system, the second portion is devoted to the newer **grid** system. Both Part I and Part II start simply and then each chapter becomes progressively more involved. In Chapter 1, Murrell provides an introduction to R graphics in general and provides a host of example plots to demonstrate the power of both graphical systems. Murrell briefly mentions the distinction between the traditional system and the **grid** system, however a more extended treatment about when to use **grid** instead of the traditional plotting system is lacking.

In Chapter 2, Murrell goes into the basic plotting commands which most R users will be familiar with. He briefly discusses 3-dimensional plots and some of the more esoteric traditional plotting functions, but leaves most of the details to the code. In Chapter 3, Murrell gets into customizing the layouts and setting up multi-panel plots. This chapter is an essential reference for R package writers who wish to use the traditional system to construct novel multi-panel plots. This is consistent with the entire book. The book is ideal for programmers who need a reference on the aspects of the graphics system with an eye towards programming to it. The book is not for R users who need a howto manual on what plots to make and in what contexts. Chapter 3 is by far the longest chapter of the book and it contains a wealth of information on creating complex layouts, constructing plots by successive painting operations, annotating plots, and using bitmap images to name a few. This information is all available

online from a variety of locations, but one of the real values of the first part of the book is that it brings together in a concise and clear presentation all of these disparate sources.

Part II of the book is dedicated to the **grid** graphics system. Murrell is a core developer of R and is the primary author of the **grid** package. This intimacy with **grid** is best seen in Chapters 5, 6 and 7 where he discusses the object model of the system and how best to program to this model.

Chapter 4 is an overview of the **lattice** package which is an implementation of the trellis graphics system developed at Bell labs by Bill Cleveland. This is a short chapter and an interested reader can find numerous other references to both the **lattice** package and trellis graphics in general. The **lattice** package is built using **grid** and for this reason the chapter is found in Part II of the book. Because **grid** graphics system provides no high-level plotting methods, Murrell presents the **lattice** package first and states that it is the simplest way to utilize the newer features available in **grid**. The only drawback of this approach, however, is that **grid** has not been presented at this point which leads to a fair amount of forward reference.

Chapters 5, 6, and 7 go on to present the **grid** system. This is the single best presentation available on this newer system. Murrell's treatment is ideal for package writers and relatively experienced R programmers. He provides details and best practices for the development of graphics using the available **grid** components. It could be argued that the first portion of the book was of general utility for basic R users, but it would be hard to maintain such an argument for this last portion of the book.

Chapter 5 provides a brief overview of some high-level grid components such as viewports, panels, and dimensions. Chapter 6 lays down the **grid** object model. **grid** is written using old-style S3 classes, however much of this has been abstracted away from the user. Murrell discusses each component in turn, but a top-level picture of the entire object model is noticeably lacking. Finally, in Chapter 7 the author goes on to discuss the construction of new graphical objects (`grob`s) which can be used in conjunction with other **grid** components. The author provides a detailed example of constructing a new `grob` and some of the subtleties associated with this process. This extended example is a very valuable demonstration of how best to develop new graphics components for your own R packages.

R Graphics by Paul Murrell provides a comprehensive treatment of both graphics systems available to R users. The book is best for fairly knowledgeable R programmers, although a small appendix on R programming is provided. The book is beautifully layed out without color nor an excess of whitespace. The extensive index along with the chapter overviews and summaries are very helpful for the readers who wish to use the book as a quick reference. One small complaint was due to the references. While the code snippets always had references to which plot they produced the plots never had references to the code snippets which produced them. This made it time consuming to scan the code to decide which snippet produced the plot of interest. If one is to judge a book based on the number of times which they refer to it in order to solve a problem then this book has already proved invaluable. With detailed examples, very few errors, and a concise and comprehensive treatment *R graphics* by Paul Murrell provides an excellent reference to the graphical capabilities available to both R users and R developers.

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