R grid Graphics

Paul Murrell

The University of Auckland
New Zealand
Overview

• A user’s view of statistical graphics
• A developer’s view of statistical graphics
• Making the transition via grid
Overview

• A user’s view of statistical graphics
• A developer’s view of statistical graphics
• Making the transition via grid
Overview

- A user’s view of statistical graphics
- A developer’s view of statistical graphics
- Making the transition via grid
Overview

- A user’s view of statistical graphics
- A developer’s view of statistical graphics
- Making the transition via grid
A User’s View
A User’s View

• Advantages
  – High-level conceptual view

• Disadvantages
  – Eventually discover something impossible
  – Unable to see what is possible
A User’s View

• Advantages
  – High-level conceptual view

• Disadvantages
  – Eventually discover something impossible
  – Unable to see what is possible
A User’s View

• Advantages
  – High-level conceptual view

• Disadvantages
  – Eventually discover something impossible
  – Unable to see what is possible
A User’s View

- Advantages
  - High-level conceptual view

- Disadvantages
  - Eventually discover something impossible
  - Unable to see what is possible
A Developer’s View

User Coordinates

-2 0 2

●

line
circle
circle
circle
circle
text text text
A Developer’s View

- Disadvantages
  - Technical, low-level view

- Advantages
  - Almost anything is possible
  - More things appear possible
A Developer’s View

• Disadvantages
  – Technical, low-level view

• Advantages
  – Almost anything is possible
  – More things appear possible
A Developer’s View

- Disadvantages
  - Technical, low-level view
- Advantages
  - Almost anything is possible
  - More things appear possible
A Developer’s View

• Disadvantages
  – Technical, low-level view

• Advantages
  – Almost anything is possible
  – More things appear possible
The Transition from User to Developer

The S Language (S-Plus and R) is designed to blur the distinction and ease the transition between users and developers of statistical analysis and graphics software.

- High-level plotting functions (e.g., `plot()`)
- Low-level plotting functions (e.g., `lines()`, `text()`)

The Transition from User to Developer

The S Language (S-Plus and R) is designed to blur the distinction and ease the transition between users and developers of statistical analysis and graphics software.

- High-level plotting functions (e.g., `plot()`)
- Low-level plotting functions (e.g., `lines()`, `text()`)

The S Language (S-Plus and R) is designed to blur the distinction and ease the transition between users and developers of statistical analysis and graphics software.
The Transition from User to Developer

The S Language (S-Plus and R) is designed to blur the distinction and ease the transition between users and developers of statistical analysis and graphics software.

- High-level plotting functions (e.g., `plot()`)
- Low-level plotting functions (e.g., `lines()`, `text()`)

The Transition from User to Developer

In the S tradition, the grid add-on package for R is an attempt to provide users with a developer’s view of statistical graphics.
A Developer Constructs a Scatterplot
A Developer Constructs a Scatterplot
A Developer Constructs a Scatterplot

Plot Region

Margin

Margin

Margin

0.1 0.3 0.5 0.7 0.9
A Developer Constructs a Scatterplot
A Developer Constructs a Scatterplot

![Scatterplot Diagram]

- Plot Region
- Margin

The diagram illustrates a scatterplot with data points distributed within the plot region. The margins are marked to show the boundary of the plot area.
A Developer Constructs a Scatterplot

My Special Plot

Plot Region

Margin

Margin

0.1 0.3 0.5 0.7 0.9

0.1

0.3

0.5

0.7

0.9

●

●

●

●

●

●

●

●
grid Viewports

- grid viewports define a rectangular region and associate several coordinate systems with the region.

```R
> push.viewport(plotViewport(c(5, 5, 4, 2)))
```
grid Viewports
grid Graphical Objects

- grid provides various objects for adding to an image; these are always drawn relative to the current viewport.

```r
R> grid.rect()
R> grid.xaxis(at=seq(.1, .9, length=5))
R> grid.yaxis(at=seq(.1, .9, length=5))
R> grid.points(x, y)
```
grid Graphical Objects
grid Units

- grid provides several coordinate systems within every viewport; unit objects associate a value with a particular coordinate system.

R> grid.text("My Special Plot",
    y=unit(1, "npc") + unit(2, "lines"))
grid Units

My Special Plot

Plot Region
A Developer Constructs a Legend

My Special Plot

- males
- females

- [Graph showing data points for males and females]
A Developer Constructs a Legend

- grid viewports can be nested within each other.

```r
R> push.viewport(viewport(x=0, width=0.8, just="left"))
R> push.viewport(plotViewport(c(5, 5, 4, 2)))
```
A Developer Constructs a Legend
A Developer Constructs a Legend

- Drawing occurs within the current viewport.

```r
R> grid.rect()
R> grid.xaxis(at=seq(.1, .9, length=5))
R> grid.yaxis(at=seq(.1, .9, length=5))
R> grid.points(x, y, pch=pch)
R> grid.text("My Special Plot",
               y=unit(1, "npc") + unit(2, "lines"))
```
A Developer Constructs a Legend

My Special Plot

Plot Region
A Developer Constructs a Legend

- For the legend we just set up a different viewport ...

```r
R> pop.viewport()
R> push.viewport(viewport(x=1, width=0.2, just="right"))
```
A Developer Constructs a Legend

My Special Plot

0.1 0.3 0.5 0.7 0.9
0.1 0.3 0.5 0.7 0.9
●
●
My Special Plot
A Developer Constructs a Legend

- ... and draw some data symbols and text.

```r
R> grid.points(pch=1:2, x=unit(c(0.5, 0.5), "lines"),
            y=unit(1, "npc") - unit(1:2, "lines"))
R> grid.text(c("males", "females"), just="left",
            x=unit(c(1.5, 1.5), "lines"),
            y=unit(1, "npc") - unit(1:2, "lines"))
```
A Developer Constructs a Legend

My Special Plot

- △ males
- ○ females
A Developer Constructs a Legend

My Special Plot

- males
- females
A Developer Gets Creative

The ozone2 Data Set

The response is 8-hour average (surface) ozone (from 9AM-4PM) measured in parts per billion (PPB) for 153 sites in the midwestern US over the period June 3, 1987 through August 31, 1987, 89 days.

A Developer Gets Creative

June

July
A Developer Gets Creative

- First create a margin for labels

```r
R> margin <- unit(1, "lines")
R> push.viewport(viewport(x=margin,
                         y=margin,
                         width=unit(1, "npc") - 2*margin,
                         height=unit(1, "npc") - 2*margin,
                         just=c("left", "bottom")))
```
A Developer Gets Creative
A Developer Gets Creative

- Now carve up the viewport into many different regions. Grid layouts are very useful for this sort of thing.

```r
R> widths <- unit(c(1,2,1,2,1,2,1,2,1,2,1,2,1),
                    rep(c("null", "mm"), len=7))
R> heights <- unit(c(1, 1, 0.5, 0.5, 0.5, 1),
                    c("lines", rep("null", 5)))
R> push.viewport(
    viewport(
      layout=grid.layout(13, 6,
                         widths=widths,
                         heights=heights,
                         respect=TRUE)))
```
A Developer Gets Creative
A Developer Gets Creative

• Draw in a particular region by pushing a viewport that occupies that region.

R> push.viewport(viewport(layout.pos.row=1,
                           layout.pos.col=1))
R> grid.rect()
R> grid.text("Mon")
R> pop.viewport()
A Developer Gets Creative
A Developer Gets Creative

- Draw in a particular region by pushing a viewport that occupies that region.

R> push.viewport(viewport(layout.pos.row=2,
                         layout.pos.col=1))
R> push.viewport(datavp)
R> grid.rect()
R> grid.lines(1:5, ozdata[1,], default="native")
R> grid.points(1:5, ozdata[1,],
               pch=16, size=unit(2, "mm"))
R> pop.viewport(2)
A Developer Gets Creative

<table>
<thead>
<tr>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
<th>Sun</th>
</tr>
</thead>
<tbody>
<tr>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

Mon Tue Wed Thu Fri Sat Sun
A Developer Gets Creative

- It is possible for a viewport to occupy a combination of several regions.

```
R> push.viewport( viewport(layout.pos.row=4:5,
                           layout.pos.col=7) )
R> push.viewport( datavp )
R> grid.rect()
R> grid.lines(1:5, ozdata[11,], default="native")
R> grid.points(1:5, ozdata[11,],
               pch=16, size=unit(2, "mm"))
R> pop.viewport(2)
```
A Developer Gets Creative
A Developer Gets Creative

• It is possible for a viewport to occupy a combination of several regions.

R> push.viewport(viewport(layout.pos.row=2:4))
R> grid.text("June", x=unit(-0.5, "lines"),
    rot=90)
R> pop.viewport()
A Developer Gets Creative

<table>
<thead>
<tr>
<th>Mon</th>
<th>Tue</th>
<th>Wed</th>
<th>Thu</th>
<th>Fri</th>
<th>Sat</th>
<th>Sun</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>V</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

June
A Developer Gets Creative

[Diagrams showing trends over June and July, with lines indicating changes from Monday to Sunday]
Other Stuff and Future Directions

- Rotated viewports
- Frames and packing
- Editing grid objects
- grid locator

- Integration of grid and standard ("base") graphics
- More support for interactive graphics
- Saving/restoring graphics
Other Stuff and Future Directions

• Rotated viewports
• Frames and packing
• Editing grid objects
• grid locator

• Integration of grid and standard (“base”) graphics
• More support for interactive graphics
• Saving/restoring graphics
Other Stuff and Future Directions

- Rotated viewports
- Frames and packing
- Editing grid objects
- grid locator

- Integration of grid and standard ("base") graphics
- More support for interactive graphics
- Saving/restoring graphics
Other Stuff and Future Directions

- Rotated viewports
- Frames and packing
- Editing grid objects
  - grid locator
- Integration of grid and standard ("base") graphics
- More support for interactive graphics
- Saving/restoring graphics
Other Stuff and Future Directions

- Rotated viewports
- Frames and packing
- Editing grid objects
- grid locator

- Integration of grid and standard ("base") graphics
- More support for interactive graphics
- Saving/restoring graphics
Other Stuff and Future Directions

- Rotated viewports
- Frames and packing
- Editing grid objects
- grid locator

- Integration of grid and standard (“base”) graphics
- More support for interactive graphics
- Saving/restoring graphics
Other Stuff and Future Directions

- Rotated viewports
- Frames and packing
- Editing grid objects
- grid locator

- Integration of grid and standard ("base") graphics
- More support for interactive graphics
- Saving/restoring graphics
Other Stuff and Future Directions

- Rotated viewports
- Frames and packing
- Editing grid objects
- grid locator

- Integration of grid and standard ("base") graphics
- More support for interactive graphics
- Saving/restoring graphics
Summary

- **grid** is an attempt at providing a framework in which graphical pieces are easy to access, combine, and manipulate.

- I do not want or expect all users to create all of their graphs from small pieces, but ...
  ... I do want all users to be able to see the pieces that their graphs were created from and be able to add or modify the pieces as easily and coherently as possible and ...
  ... it would be nice if some users created some of their graphs from small pieces some of the time; I think we would see more interesting and more illuminating graphs as a result.
Summary

• grid is an attempt at providing a framework in which graphical pieces are easy to access, combine, and manipulate.

• I do not want or expect all users to create all of their graphs from small pieces, but ...

... I do want all users to be able to see the pieces that their graphs were created from and be able to add or modify the pieces as easily and coherently as possible and ...

... it would be nice if some users created some of their graphs from small pieces some of the time; I think we would see more interesting and more illuminating graphs as a result.
Summary

• grid is an attempt at providing a framework in which graphical pieces are easy to access, combine, and manipulate.

• I do not want or expect all users to create all of their graphs from small pieces, but ...

  ... I do want all users to be able to see the pieces that their graphs were created from and be able to add or modify the pieces as easily and coherently as possible and ...

  ... it would be nice if some users created some of their graphs from small pieces some of the time; I think we would see more interesting and more illuminating graphs as a result.
Summary

- grid is an attempt at providing a framework in which graphical pieces are easy to access, combine, and manipulate.

- I do not want or expect all users to create all of their graphs from small pieces, but ...

  ... I do want all users to be able to see the pieces that their graphs were created from and be able to add or modify the pieces as easily and coherently as possible and ...

  ... it would be nice if some users created some of their graphs from small pieces some of the time; I think we would see more interesting and more illuminating graphs as a result.
Summary

- Grid is an attempt at providing a framework in which graphical pieces are easy to access, combine, and manipulate.

- I do not want or expect all users to create all of their graphs from small pieces, but ...

  ... I do want all users to be able to see the pieces that their graphs were created from and be able to add or modify the pieces as easily and coherently as possible and ...

  ... it would be nice if some users created some of their graphs from small pieces some of the time; I think we would see more interesting and more illuminating graphs as a result.