R grid Graphics

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Overview

• A user’s view of statistical graphics
• A developer’s view of statistical graphics
• Making the transition via grid
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A User’s View
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- Advantages
  - High-level conceptual view

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

User Coordinates

-2 0 2

●

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

• Disadvantages
  – Look funny, dress funny, have no life, have no friends
  – Technical, low-level view

• Advantages
  – Almost anything is possible
  – More things appear possible
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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()`)

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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 ...

... without losing all your friends.
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A Developer Constructs a Scatterplot
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Plot Region
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A Developer Constructs a Scatterplot
Constructing a Scatterplot in grid

What is R?

• A language and environment for statistical computing and graphics

A sample session:

```
shell$ R
R> 1 + 1
[1] 2
R> if (1 + 1 == 2) TRUE else FALSE
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R> plot(1:10, 1:10)
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```
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

Plot Region

xlo xhi
ylo
yhi
grid Graphical Objects

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

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

Plot Region

Margin

Margin

Margin

Margin

0.1 0.3 0.5 0.7 0.9

0.1

0.3

0.5

0.7

0.9

●

●

●

●

●

●

●

●

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●

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●

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●
grid Units

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

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

My Special Plot
A Developer Constructs a Legend

My Special Plot

● males
○ females

0.1 0.3 0.5 0.7 0.9
0.1 0.3 0.5 0.7 0.9
●
●
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

Plot Region

Plot Region
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](image)
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
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

<table>
<thead>
<tr>
<th></th>
<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>June</td>
<td><img src="June1.png" alt="Graph" /></td>
<td><img src="June2.png" alt="Graph" /></td>
<td><img src="June3.png" alt="Graph" /></td>
<td><img src="June4.png" alt="Graph" /></td>
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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

| Mon |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
A Developer Gets Creative

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

```r
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

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A Developer Gets Creative

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

```r
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()
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June
A Developer Gets Creative

June

July
Other Stuff and Future Directions

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

- Integration of grid and standard ("base") graphics
- Constant improvements in convenience
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- Integration of grid and standard (“base”) graphics
- Constant improvements in convenience
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.
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