Creating Animations with R

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useR! 2010 @ NIST, Gaithersburg, MD
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Demo in Statistics
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Introduction

- PhD?...
- some statistics ideas can be visualized
- and hopefully can be fun!
- the R package **animation**
  - in the beginning, the world was full of math formulae...
  - let there be animations, and there was *(awake)* audience
  - ...
  - and I created the R package **animation**
- to turn ideas into animations, quickly and faithfully
- John M. Chambers Statistical Software Award 2009
- begin with `install.packages('animation')` and enjoy!
Newton’s Method

Root-finding by Newton–Raphson Method: $5x^3 - 7x^2 - 40x + 100 = 0$

$\text{Figure 1: How Newton’s method works: } x_{k+1} = x_k - \frac{f(x_k)}{f'(x_k)}$
Figure 2: and when Newton’s method does not work
Quincunx (the Bean Machine)

Figure 3: From randomly falling beans to the Normal distribution!
Figure 4: Bootstrapping i.i.d data and show the distribution of $\bar{x}_{\text{boot}}$
Moving Window Auto-Regression

Figure 5: Moving Window Auto-Regression
Exporting Animations

- we can view the animations in the (default) windows graphics device
- but Linux users often find the pictures flickering (R does not support double buffering)
- the animation package supports four output formats
  - an HTML page which looks like a movie player
  - GIF created by ImageMagick
  - Flash by SWF Tools
  - PDF by \LaTeX\ with the animate package
## Supported Formats

<table>
<thead>
<tr>
<th>Format</th>
<th>Function</th>
<th>Required tools</th>
<th>Viewer</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTML</td>
<td><code>ani.start()</code></td>
<td></td>
<td>web browser (JavaScript)</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td><code>ani.stop()</code></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GIF / MPEG</td>
<td><code>saveMovie()</code></td>
<td>ImageMagick (convert)</td>
<td>image viewer / movie player</td>
<td>No*</td>
</tr>
<tr>
<td>Flash</td>
<td><code>saveSWF()</code></td>
<td>SWF Tools (*2swf)</td>
<td>Flash player / browser plugin</td>
<td>No*</td>
</tr>
<tr>
<td>PDF</td>
<td><code>saveLatex()</code></td>
<td>pdfLaTeX</td>
<td>Acrobat Reader</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 1: Supported output formats in the **animation** package (* depends on the viewer)
Other Approaches

the other two related packages (on Omegahat and R-Forge)

SVGAnnotation  SVG animation with *smooth* transition between animation frames (the function `animate()`), but currently only the browser Opera supports SVG animations\(^1\)

swfDevice  generate native SWF files from R (graphics device `swf()`)

\(^1\)sorry, this impression came from one year ago and might be inaccurate... Joran told me that Chrome and Safari also support SVG animations: http://yihui.name/en/2010/07/my-talk-onAnimations-at-userR-2010/
Conclusions

- we can reveal the processes of some statistical methods in a very straightforward way
- R is flexible enough to keep students awake in class
Thanks!

- Q&A?
- Homepage & Blog: http://yihui.name (slides & R code available in my CV page)
- Email: xie@yihui.name
- and check http://animation.yihui.name for more demonstrations online