Assistive Technologies for Second-Year Statistics Students who are Blind

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JSE CAUSE Webinar. Sep 2015.
At Wake Forest University, a student who is blind enrolled in a second course in statistics. The course covered simple and multiple regression, model diagnostics, model selection, data visualization, and elementary logistic regression.

Specifically, this talk will detail the extensive use of screen readers, \LaTeX, a modified use of R and the BrailleR package, a desktop Braille embosser, and a modified classroom approach.

Intro
There are six essential skills:

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<th>Interpreting</th>
<th>Producing</th>
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<td>Computer Code</td>
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<td>Images and Graphical Displays</td>
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• $n = 46$ so-called “High Peaks” mountains of the Adirondacks in upstate New York
• Two variables are Time (hours needed for a round trip to hike to summit) and Length (miles).

$$Time = \beta_0 + \beta_1 \cdot Length + \epsilon, \quad \epsilon \sim N(0, \sigma)$$
High Peaks

> library(Stat2Data)
> data(HighPeaks)
> attach(HighPeaks)
> lm1=lm(Time~Length)
> summary(lm1)

Call:
  lm(formula = Time ~ Length)

Residuals:
     Min       1Q   Median       3Q      Max
-2.44910 -0.66870 -0.01220  0.55900  4.00340

Coefficients:  
                Estimate Std. Error t value  Pr(>|t|)    
(Intercept)   2.04817    0.80371   2.548  0.0144 *  
Length        0.68427    0.06162  11.105 2.39e-14 ***  
---
Signif. codes:  0 ’***’ 0.001 ’**’ 0.01 ’*’ 0.05 ’.’ 0.1 ’ ’ 1

Residual standard error: 1.449 on 44 degrees of freedom  
Multiple R-squared: 0.737, Adjusted R-squared: 0.7311
F-statistic: 123.3 on 1 and 44 DF,  p-value: 2.39e-14
High Peaks

**Figure:** Scatterplot and Residual plot for Time (hours) vs. Length (miles). Students will use these figures to assess assumptions of linearity and constant variance.
Figure: Quantile comparison and histogram of residuals.
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Well, it ain’t no use to sit and wonder why, babe
Even you don’t know by now
And it ain’t no use to sit and wonder why, babe
It’ll never do somehow
When your rooster crows at the break of dawn
Look out your window, and I’ll be gone
You’re the reason I’m a-traveling on
But don’t think twice, it’s all right.

∼ Bob Dylan, Don’t Think Twice

(play sound)
Mathematical Writing: Braille

- Grade 2 standard English Braille has $2^6 - 1 = 63$ unique characters; not enough for math!
- 8-bit Braille extends to $2^8 - 1 = 255$ characters, and covers all ASCII symbols

All mathematical information can be encoded in ASCII through \LaTeX; therefore, a student can read math with a refreshable Braille display or using a screen reader, and can write using either a refreshable Braille display or a standard keyboard.

Effectively, the student reads and writes in \LaTeX source code, and “compiles” in her head.
\( Time = \beta_0 + \beta_1 \cdot Length + \epsilon, \quad \epsilon \sim N(0, \sigma) \)

\[ C_p = \frac{SSE_m}{SSE_k/(n-k-1)} + 2(m+1) - n \]

Time = \( \beta_0 + \beta_1 \cdot Length + \epsilon \), \( \epsilon \sim N(0, \sigma) \)

\[ C_p = \frac{SSE_m}{SSE_k/(n-k-1)} + 2(m+1) - n \]

(fast)
(middle speed)
(slow)
Mathematical Writing

BrailleNote® by HumanWare
• Modify the PATH variable to allow R to run in the terminal window
• Use the BrailleR package and the command txtStart keeps a log file; keep open in an internet browser and refresh
Images and Graphical Displays

>VI(hist(lm1$resid))
This is a histogram, with lm1$resid marked on the x-axis, unless you explicitly used the xlab argument.
There are a total of 46 elements for this variable.
It has 8 bins with equal widths, starting at -3 and ending at 5.
The mids and counts for the bins are...

mid = -2.5  count = 4
mid = -1.5  count = 6
mid = -0.5  count = 14
mid = 0.5   count = 13
mid = 1.5   count = 5
mid = 2.5   count = 1
mid = 3.5   count = 2
mid = 4.5   count = 1

Residuals from Time ~ Length
Images and Graphical Displays
Conclusion and References


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