Progress in Regression: Statistical and Practical Improvements to Rbrul

Daniel Ezra Johnson

FOCUS. Rbrul, a user-friendly front-end for regression in R, has become a popular tool that helps variationists analyze data with mixed-effects models, continuous variables, interactions, and other advantages over previous software. The paper introducing Rbrul (Johnson 2009) has been cited over 400 times, and its author has conducted 10 workshops on its use and on statistics, including at NWAV 39 (Johnson 2010a) and two Sociolinguistics Summer Schools. Like those workshops, this one will teach relevant statistical concepts alongside practical uses of the tool.

In its most recent version, the Rbrul program has been completely redesigned. Rather than a text-based menu interface, it is now a browser-based Shiny app. This provides a much more efficient and interactive user experience. Users explore their data, building and comparing models using an intuitive graphical interface. As the user makes adjustments, models update automatically. The interface discourages the habit of stepwise regression, a procedure that is statistically flawed and nearly taboo outside our field (Johnson 2010b). Also, several new practical features have been introduced, including the ability to recode, collapse and un-collapse categories easily.

It is now widely known that when tokens are grouped (e.g. by speaker or word), using mixed models lowers the chance of falsely claiming that predictors are significant (Type I error). Less well known is that Rbrul reports – alongside estimates of individuals' deviations from the community mean – a single number for the variability represented by each random effect. This quantity can be very usefully compared across different data sets. A recent paper (Fruehwald 2017) has given several reasons why variationists today should pay more attention to variance.

The Shiny app version of Rbrul is also able to model categorical dependent variables with three or more variants, something that has only rarely been attempted by variationists in the past. Such (pseudo-)multinomial models are appropriate when a variable is conceived as a choice between three (or more) variants. It is then possible to test whether such a model is better or worse than having two or more binary models arranged hierarchically (Rousseau & Sankoff 1989).

AIMS. First, participants will learn how to build and compare models with the Rbrul Shiny app. Second, they will learn the basic statistical theory behind mixed model variance estimation and multinomial logistic regression. In each case, they will practice applying the methods to data that will be provided. Participants are encouraged to bring one of their own data sets to practice with.

FORMAT. There will be four sections of approximately 30 minutes: one demonstrating the basics of the software itself, one on random effect variances, and one on multinomial regression. Each section will begin with exposition, followed by application and exploration (in pairs or individually, with roaming support). The last section will be in question and answer format (live and prepared questions). Participants can also make suggestions for improvements to Rbrul.

NOTE. The workshop is pitched towards the relative statistical beginner and/or command-line skeptic, but it will also try to show how Rbrul can be of use to people who are comfortable using R itself. GoldVarb purists and people already using the text-based Rbrul are equally welcome.

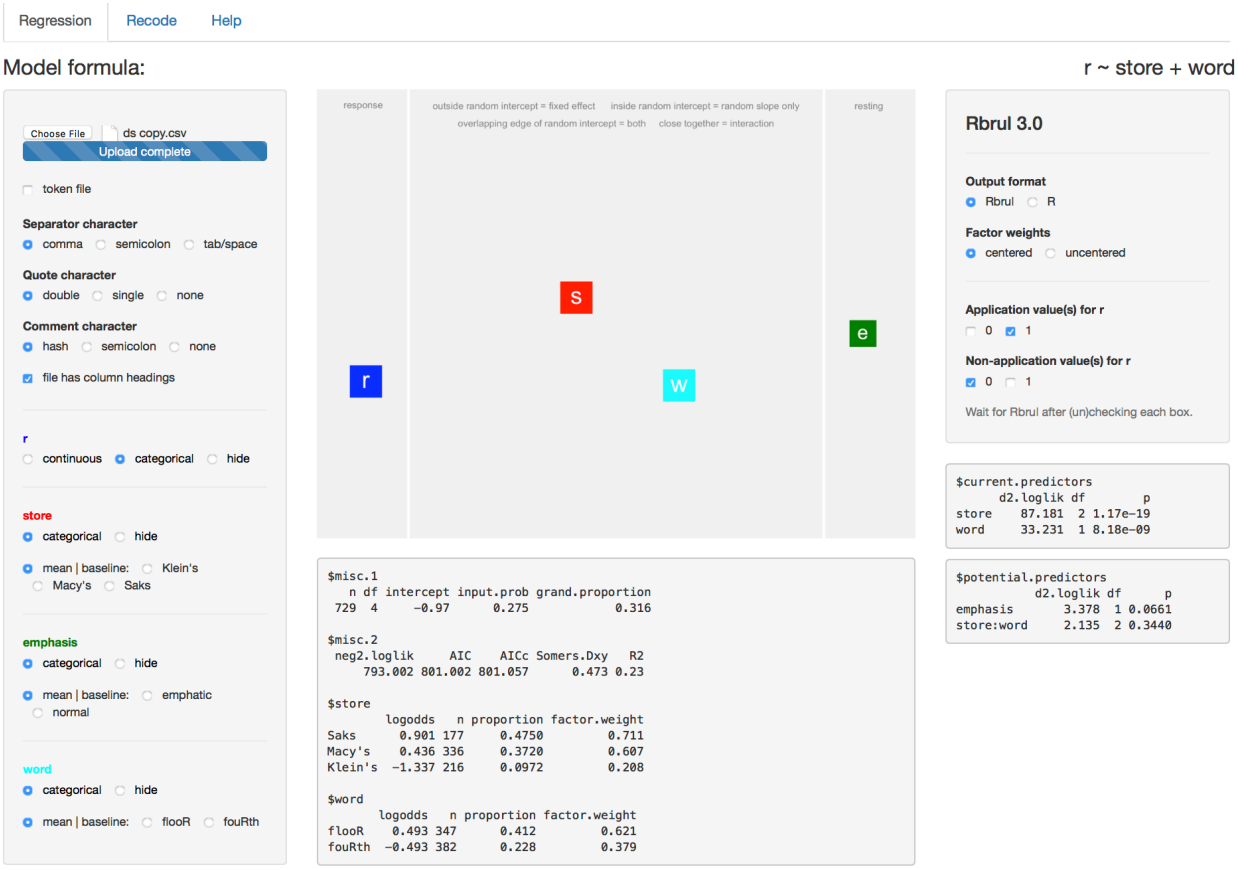
Fruehwald, Josef. 2017. Inter- and intra- speaker variance in sound change. Paper presented at 4th Workshop on Sound Change, Edinburgh.

Johnson, Daniel Ezra. 2009. Getting off the GoldVarb standard: Introducing Rbrul for mixed-effects variable rule analysis. *Language and Linguistics Compass* 3(1): 359-383.

Johnson, Daniel Ezra. 2010a. Quantitative analysis with Rbrul and R. Workshop conducted at New Ways of Analyzing Variation (NWAV) 39, San Antonio.

Johnson, Daniel Ezra. 2010b. Why stepwise isn't so wise. Invited panel presentation at New Ways of Analyzing Variation (NWAV) 39, San Antonio.

Rousseau, Pascale and David Sankoff. 1989. Statistical evidence for rule ordering. *Language Variation and Change* 1:1-18.



Data: Labov 1962 (thanks to John Paolillo). Bottom: output identical to previous Rbrul versions. Right: significance tests with p-values, either adding or dropping predictors.

Current predictors: store (red) and word (cyan) are significant predictors of post-vocalic /r/ (blue, $p < .05$). Potential predictors: emphasis (green) and the store:word interaction are not significant.