RItools: Randomization Inference Tools

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Context

Three main modes of probabilistic inference[1]:

Model-Based Repeated-Sampling Inference For most political scientists this is just "inference." Requires specification of a model for $Y|X$.

Bayesian Inference Same requirements as above plus a model for θ.

Randomization Inference Requires a model for the "assignment mechanism" ($Z|X$).

"Randomization-based tests of sharp null hypotheses (essentially due to Fisher 1925,1935) comprise an elegant and very appealing method of drawing causal inferences, but is too limited to address the full complexity of practical problems." (Rubin 1991, page 1214)

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[1]See Rubin 1990, 1991 and Barnett 1999 for more about these different modes of inference.

Motivation: Execute Design Based Data Analysis

Common test statistics like those proposed by Fisher; Cochran, Mantel, and Haenszel; and McNemar all can be written as <u>sum statistics</u>: $t(\mathbf{Z}, \mathbf{r}) = \mathbf{Z}^T \mathbf{q}$, where $\mathbf{Z}$ is random assignment, $\mathbf{r}$ is fixed response, and $\mathbf{q}$ is some function of $\mathbf{r}$ (Rosenbaum, 2002). Sum statistics have normal approximations with moments that are easy to calculate.

The RItools function `xBalance()` executes randomization based tests very quickly via such normal approximations.

Example: Balance Assessment after Matching

`thefmbal<-xBalance(z ~ x₁+...+xₖ,~matches,data=thedf)`
`plot(thefmbal)`

Applications So Far
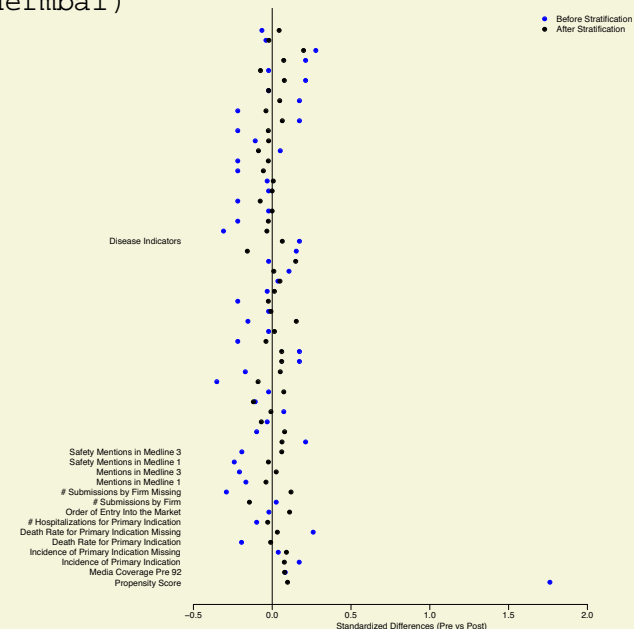
- <u>Binary non-random assignment, Binary outcome:</u> Effect of a rule change at the US Food and Drug Administration on drug safety.
- <u>Binary non-random Assignment, Continuous Outcomes:</u> Effect of SAT coaching on SAT score.
- <u>Binary random assignment, Binary non-random dose, Binary outcome:</u> Effect of receiving a vote turnout intervention on voting.

Help Needed

We have not yet directly included exact methods (whether simulation, analytic, or sampling based) as options, although we plan to have at least one "slow=TRUE" argument for small sample sizes. We are not certain about how to implement this option (or set of options).

We have not released this package on CRAN yet. We are newbies when it comes to methods, classes, formulæ, and all that goes into R programming. We'd love any and all advice.