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jtools: Analysis and Presentation of Social Scientific Data

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Software

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Summary

jtools is an R package designed to ease the exploration and presentation of regression models with a focus on the needs of social scientists. Most notably, it generates results summaries that are meant to provide some of the conveniences of commercial software such as Stata (e.g., calculating robust standard errors and integrating them into a results table). Additionally, jtools includes plotting functions to help users better understand and share the results and predictions from fitted regression models.

Statement of need

Among the users of R are working or trainee scientists who are accustomed to software that provides detailed and customizable summaries of regression results "out of the box" (i.e., integrated into the modules that fit the model). While R's `summary()` function provides useful information for many regression models — such as the method provided for `lm()` including coefficients, standard errors, test statistics, and *p*-values — there is typically little flexiblity for customizing the output. Generating results summaries with additional information, such as robust standard errors, confidence intervals, transformed/centered variables, and variance inflation factors demands considerably more programming knowledge and effort for the user, requiring more time and making mistakes more likely. These same concerns exist for the case of plotting predicted values from regression models.

`jtools` provides an alternative to `summary()`, `summ()`, that allows users more flexibility in generating results tables for supported regression models. Importantly, these capabilities are accessible almost solely through arguments to `summ()`, thereby requiring little more programming knowledge than what is already required to fit a regression model and print a minimal summary to the console. For plotting, the package includes `effect_plot()` for creating line plots for a focal predictor variable. Users may add confidence intervals (including the ability to use robust standard errors for the plotted intervals), the observed data as plotted points, partial residuals as plotted points, and rug plots. Categorical predictors can be plotted as bar charts of single points with error bars as well. Finally, `jtools` features the function `plot_coefs()` that allows users to plot regression coefficients with confidence intervals for one or more models. This is particularly useful for comparing nested/related model specifications (Kastellec & Leoni, 2007). Plots are generated with `ggplot2` — allowing knowledgeable users to further customize the appearance — but do not require the user to know how to use `ggplot2`.

To support survey researchers, `jtools` functions generally support the use of sampling weights and survey design objects created by the `survey` package (Lumley, 2004). To fill in a gap in `survey`'s offerings, it adds `svycor()`, which calculates survey-weighted correlation matrices for survey design objects. In addition, `weights_tests()` implements the tests for the ignorability of sampling weights first devised by DuMouchel & Duncan (1983) and Pfeffermann & Sverchkov (1999). In layman's terms, these tests allow researchers to check whether the use of sampling weights to make data better resemble a population meaningfully change their statistical results compared to ignoring those weights.

Alternative software

Other R packages exist to achieve some of these ends. In some cases, `jtools` is using third-party packages for computation and simply repackaging the results (e.g., `sandwich` [Zeileis et al. (2020)] for robust standard errors and `pbkrtest` [Halekoh & Højsgaard (2014)] for computation of *p*-values for multilevel models). `modelsummary` (Arel-Bundock, 2022) provides comparable functionality to `summ()` and has some advantages, such as a greater range of supported models and more support for exporting to external documents. `gtsummary` (Sjoberg et al., 2021) also has extensive functionality for exporting to external documents, although its ability to include and calculate customized statistics is more limited. These may be preferred for those whose sole goal is to quickly export straightforward regression summaries to LaTeX or other documents. Neither `modelsummary` nor `gtsummary` are designed for interactive (console) use as `jtools` is.

`marginaleffects` (Arel-Bundock, 2024), `sjPlot` (Lüdecke, n.d.), see (Lüdecke et al., 2021), and `ggeffects` (Lüdecke, 2018) offer support for plotting predicted values from fitted regression models and again have some of their own advantages, such as more supported model types. Each of these offer overlapping functionality with emphasis on `ggplot2` graphical output. Of these, only `ggeffects` offers the same partial residual functionality that `jtools` does. A design difference for `jtools` in comparison to others (to varying degrees) is that `jtools` tends to perform many steps in a single function call, with the user making choices via function arguments. Many of these other packages tend to have multi-step usage patterns, in which the user creates an object with one function which is then passed to another function, and so on. For instance, `ggeffects` recommends that users fit a model, then pass the model to generate marginal effect estimates to another function, pass the outputted marginal effects to a hypothesis testing function, then passing the output of that function to a `plot()` S3 method (although it is possible to skip one or more steps). This type of interface can provide for more flexibility for the user as well as R code that is more explicit On the other hand, less-experienced programmers may find these multi-step workflows more confusing or error-prone.

There is also overlap in functionality with the `car` and `effects` packages (Fox & Weisberg, 2019), like the computation of variance inflation factors and partial residuals, although `jtools` aims to improve the user interface, such as by allowing non-standard evaluation, and support more model types in some cases. The use of `ggplot2` for graphics is another important distinction from `car`. `car` does not produce model summaries in general, so the user would need to incorporate `car`'s variance inflation factors into a table through some other means or otherwise just inspect them devoid of that context.

Real-world use

At the time of writing, Google Scholar has tracked 556 references to `jtools`. These are predominantly, but not solely, in the social sciences, such as psychology, communication, and political science. For example, Sutin et al. (2023) uses `summ()` to calculate degrees of freedom for a multilevel model in a study of personality and aging. Urban-Wojcik et al. (2022) also use `summ()`, in this case to summarize regression models with robust standard errors in their study of physical activity and the hippocampus. Kraft et al. (2022) generate plotted regression summaries with `plot_coefs()` in a study of asthma sufferers. Finally, Spälti et al. (2023) use `weights_tests()` to assess the sensitivity of their estimates to the influence of survey sampling weights in their research on scientific misperceptions.

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