

¹ pwranova: An R package for power analysis of flexible ANOVA designs and related tests

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Software

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⁵ Summary

⁶ Power analysis is a critical step in the design of psychological and behavioral experiments, yet
⁷ existing tools often lack the flexibility to accommodate complex ANOVA designs. pwranova is
⁸ an R package that performs power analysis for between-, within-, and mixed-factor ANOVA
⁹ designs, with full support for main effects, interactions, and planned contrasts (custom contrasts
¹⁰ with user-defined weights).

¹¹ The package allows researchers to calculate statistical power, required total sample size,
¹² significance level, or minimal detectable effect sizes expressed as partial eta squared or Cohen's
¹³ f .

¹⁴ In addition to ANOVA, pwranova provides complementary functions for common related tests,
¹⁵ including *t*-tests (one-sample, paired, and two-sample) and tests of Pearson's correlation
¹⁶ (using either the *t*-distribution or Fisher's *z*-transformation approach). This makes the package
a convenient toolkit for planning experimental studies in psychology and related fields.

Statement of need

¹⁹ Researchers in psychology and the behavioral sciences frequently rely on analysis of variance
²⁰ (ANOVA) to analyze factorial designs with multiple between- and within-participant factors.
²¹ However, existing tools such as GPower ([Faul et al., 2007](#)) and the *pwr* R package ([Champely, 2020](#))
²² offer only limited flexibility when it comes to handling such complex designs. For example,
²³ specifying interactions in multi-factor mixed designs is difficult or not directly supported in
²⁴ these tools. They also generally do not allow direct specification of user-defined contrasts, and
²⁵ while effect sizes can be specified via Cohen's f^* ([Cohen, 1988](#)), they do not directly support
²⁶ partial eta squared, which is more commonly reported in psychological research as a standard
²⁷ effect size index.

²⁸ pwranova addresses these limitations by providing:

- ²⁹ - Support for between-, within-, and mixed-factor ANOVA designs, including both main effects
and interactions.
- ³¹ - Power analysis for planned contrasts with flexible, user-defined weight specification.
- ³² - Methods based on the noncentral *F*-distribution.
- ³³ - Integrated functions for related *t*-tests and Pearson correlations.
- ³⁴ - A unified and extensible R implementation designed for reproducible research workflows.

³⁵ In addition, pwranova not only extends power analysis to complex factorial ANOVA designs
³⁶ but also incorporates related *t*-tests and correlation tests within the same framework. This
³⁷ integration allows researchers to conduct power analysis for a wide range of commonly used
³⁸ statistical tests in a consistent and reproducible way.

³⁹ This combination of flexibility and reproducibility makes pwranova especially useful for
⁴⁰ experimental psychologists and cognitive scientists, as well as researchers in the behavioral,

⁴¹ social, and biological sciences designing studies with complex factorial structures. Detailed
⁴² examples and tutorials are available on the package website:
⁴³ <https://mutopsy.github.io/pwranova/>

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⁴⁷ and readability during the writing process. All content was critically reviewed and finalized by
⁴⁸ the author.

⁴⁹ References

- ⁵⁰ Champely, S. (2020). *Pwr: Basic functions for power analysis*. [https://CRAN.R-project.org/
51 package=pwr](https://CRAN.R-project.org/package=pwr)
- ⁵² Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence
⁵³ Erlbaum Associates.
- ⁵⁴ Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*power 3: A flexible statistical
⁵⁵ power analysis program for the social, behavioral, and biomedical sciences. *Behavior
56 Research Methods*, 39(2), 175–191. <https://doi.org/10.3758/BF03193146>