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Reporting the Results of Statistical Tests in APA Format

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Abstract

Reporting the results of statistical tests is a topic of concern to students of the behavioral sciences. The American Psychological Association (APA) provides a widely-used standard for reporting the results of statistical tests. This paper provides an overview of the correct approach for reporting statistical tests in APA format. Several examples of correct wording and formatting are provided.

Reporting the Results of Statistical Tests in APA Format

Students often struggle with the basic concepts of quantitative research and inferential statistics including null and alternative hypotheses, choosing the correct statistical procedure, and interpreting the results of their statistical test. Even after mastering these basic concepts, the student is still faced with another set of complex and sometimes confusing tasks. The tasks include writing the results of the statistical test in clear, simple language and formatting the narrative in a consistent fashion so that readers will be able to understand the statistics used, the results obtained, and their significance or lack of it.

Students of introductory statistics are instructed to write explicitly and in great detail the various steps of hypothesis testing, to state their null and alternative hypotheses explicitly in words and symbols, and to include detailed tables of their statistical tests. This helps the student break the statistical concepts into smaller units and helps both students and instructors troubleshoot the point at which the student may have gone astray. In addition to being able to do and understand the statistical tests, students need to know how to report their findings, and especially how to use APA formatting to do so.

In published behavioral research, a shorthand way of stating the results of statistical tests is preferred. This shorthand method makes the text more compact, reduces the need for tables, and provides a standard way for readers to determine what tests were performed and whether or not the results were significant.

According to the *Publication Manual of the American Psychological Association* (APA, 2001), when reporting inferential statistics, the writer must include adequate information to allow the reader to understand the analyses conducted and possible alternative explanations for the results obtained.

APA (2001) has rules for reporting statistics and for typing statistical and mathematical copy. Inferential tests such as t tests, F tests, and chi-square tests have definite format requirements. There should not be a hyphen between t and test or between F and test, even though that is common practice in statistics textbooks. Latin letters such as t , F , M , SD , and so on should be italicized. APA requires that Greek letters used to report statistics should not be italicized. Most of these symbols are lower case, for example χ^2 , η^2 , λ , and ρ . The APA manual provides a list of the appropriate abbreviations for sample statistics represented as individual Latin letters and acronyms such as ANOVA, as well as for Greek letters used as symbols for population parameters and statistical indexes.

Because of the wide availability of statistics software and other computational aids, tables of critical values are less important than they once were. APA journals no longer use the critical-value method to report statistical results. Instead, authors simply report the p value for their obtained test statistic, along with adequate information for other researchers to interpret the reported results. It is not necessary to state the null hypothesis and the alternative hypotheses. Even though these hypotheses figure prominently in the inferential decisions made, discussing them is a “background” issue. Instead, the researcher states what he or she expects or believes will happen (the research question that can be transformed into the alternative hypothesis). This statement typically occurs at the end of the introductory section of the paper. The actual statistical tests are reported in the Results section. With rare exception, it is not necessary to give references for statistics in common use or to explain what program or other computational aid was used to run the statistical test.

The APA manual states:

When reporting inferential statistics (e.g., t tests, F tests, and chi-square tests), include information about the obtained magnitude or value of the test statistic, the degrees of freedom, the probability of obtaining a value as extreme or more extreme than the one obtained, and the direction of the effect. Be sure to include sufficient descriptive statistics (e.g., per-cell sample size, means, correlations, standard deviations) so that the nature of the effect being reported can be understood by the reader and for future meta-analyses. This information is important, even if no significant effect is being reported. (p. 22)

Examples of Reporting Statistical Results

Below, examples of the correct use of APA formatting to meet the requirements stated in the APA manual are presented. These examples are from the *Excel 2007 Data and Statistics Cookbook, Second Edition* (Pace, 2008). The APA-preferred methods of reporting a t test, an F test, and a chi-square test are demonstrated. In all matters concerning correct APA format, the student is encouraged to purchase a copy of the APA manual and to consult it regularly. In the examples, there is no discussion of critical values, null and alternative hypotheses, or of accepting or rejecting any hypothesis. Instead, the narrative clearly indicates that the null hypothesis was rejected and the alternative hypothesis was supported simply by saying that the result was statistically significant. Similarly, when the writer states that the results were not significant, it is understood the null hypothesis was retained, and no support was found for the alternative hypothesis. This way of reporting statistical results is common across a wide variety of academic disciplines including social and behavioral sciences.

The reader verifies the significance or lack of significance of the results by comparing the p level of the obtained statistic to the alpha level stated explicitly by the writer. It is customary to state the required significance level for statistical tests, which is customarily set at .05. If an

alpha level of .05 was used for all statistical tests, one statement to that effect is all that is needed. APA also recommends that an effect-size measure be reported with each statistical test.

Note in the following examples that when an index such as the correlation coefficient or η^2 cannot exceed 1, no leading 0 is reported before the decimal. Also, note that in APA format, statistics are generally reported to two decimal places, though p levels are often reported to three places for precision.

Example 1: Reporting the Result of a t Test

A study compared psychological need for competence scores for student leaders to those of a randomly selected class of students at the same university. Leaders ($M = 79.71$, $SD = 11.57$) expressed significantly higher levels of need for competence than did the randomly selected students ($M = 70.92$, $SD = 13.64$), $t(40) = 2.22$, $p = .016$, one-tailed, $d = .69$.

Notice in Example 1 that it is clear that the test was an independent-samples t test, and that the alternative hypothesis was directional because a one-tailed test was conducted. Statistics for the participant group included the mean and standard deviation. The obtained t , the degrees of freedom, and the probability of obtaining that value of t or a greater value when the null hypothesis is true were reported succinctly by providing the p level. APA format prefers that there is no hyphen between p and value (2001, p. 24). Many statistical packages label this value “significance” or “significance level” (2001, p. 24), and in general it is the “exact probability (p value) that should be reported” (2001, p. 25). No mention is made of any hypothesis, but the results clearly indicate that the null hypothesis was rejected and support for the alternative hypothesis was found. There was no need to say that the obtained t was greater than some critical value, because that statement is redundant with claiming statistical significance and provides less information than does the p value. Because the reported p value is less than the stated alpha level

of .05, it is understood that (a) the results are significant, (b) the absolute value of the obtained t will be larger in absolute value than the critical value of t , (c) the null hypothesis was rejected, and (d) support for the alternative hypothesis was found. Finally, Cohen's d as a measure of effect size was stated. That is the way a t test is reported in APA format (2001). Readers can interpret the magnitude of the effect-size index so this does not need to be stated.

Example 2: Reporting the Result of an F test

This is an example from a study comparing the course grades of students who took statistics either as an online course, as a compressed video course, or in the classroom. A one-way ANOVA showed that the method of instruction had a significant effect on the course grades, $F(2, 53) = 3.53, p = .037, \eta^2 = .122$. Post hoc analysis using Tukey's HSD criterion indicated that classroom instruction ($M = 82.44, SD = 13.94$) did not differ from compressed video instruction ($M = 80.28, SD = 7.84$) and there was no difference between online instruction ($M = 71.67, SD = 15.54$) and video courses (see above). The classroom method produced significantly higher grades than the online method, $p < .05$.

Example 3: Reporting the Result of a Chi-Square Test

We compared the frequency of using various computational tools in statistics courses by departments of psychology, business, and mathematics. The tools compared were SPSS, Excel, and Minitab. We expected that the tool of choice would vary by department. A chi-square test of independence indicated that the choice of a computational tool was associated with the department in which the statistics course is taught, $\chi^2(4, N = 88) = 26.881, p < .001$, Cramér's $V = .39$.

Conclusion

Reporting the results of statistical tests should be straightforward and simple. Clear language should be employed. The writer is not to offer opinion or anecdote in the Results section, though those may be appropriate in the Discussion section. APA format should be strictly followed. One excellent way to see APA formatting in action is to read research papers published in APA journals and in other good journals that require APA formatting.

Note also that the “royal” *we* to refer to a sole author has been long abandoned, and that APA recommends avoiding third party references to the author of the current article because these can be confusing to the reader: “Pronouns confuse readers unless the referent for each pronoun is obvious; readers should not have to search previous text to determine the meaning of the term” (2001, p. 37). Instead of referring to oneself in the third person as “the author,” or “the researcher,” APA suggests the use of *we* to refer to oneself and other coauthors, and *I* to refer to oneself if you are the sole author of the paper. Similarly, “Writing ‘the experimenters instructed the participants’ when ‘the experimenters’ refers to yourself is ambiguous and may give the impression that you did not take part in your own study. Instead, use a personal pronoun: ‘We instructed the participants’” (p. 38). For students interested in purchasing a basic statistics text written by reputable authors who are also psychologists and excellent statisticians, Howell’s text (2008) and Gravetter & Wallnau (2008) are recommended. These two books conform to APA style requirements while being statistically sound. Howell also presents a decision tree inside the back cover of his book that allows the reader to determine the situations under which a given statistical test is appropriate.

Unfortunately, there are also many statistics and research methods books available that are neither statistically sound nor APA compliant. So, when in doubt, the writer should always consult the APA manual.

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