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Research

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COMPCOR: A Computer Program for Comparing Correlations Using Confidence Intervals

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ABSTRACT

Although there have been separate programs written for computing confidence interval procedures for independent and dependent correlations for some standard statistical software packages, the user must have solid knowledge of the statistical software package needed for their application. Moreover, if the confidence interval procedures are neither contained within a particular software package nor if there is a separate program or routine written to perform these procedures, then it becomes problematic for the user. Therefore, a user-friendly, interactive, stand-alone computer program written in FORTRAN 77, for a Windows environment, computes the confidence interval procedures for comparing independent and dependent correlations. The user simply inputs the necessary correlations and sample size and needs no intermediate or advanced knowledge of the statistical software package.

KEYWORDS: Independent correlations; Dependent correlations; Confidence intervals; Computer program.

ABBREVIATIONS: IT: Iowa Test of Basic Skills; CM: Children's Memory Scale; MBEMA: Montreal Battery of Evaluation of Musical Abilities.

INTRODUCTION

Comparing independent or dependent correlations is often based on standard statistical significance tests.[1-7] Independent correlations come from different samples. For example, suppose that a school administrator is interested in determining if there was a difference between the correlations of the mathematics scores on the Iowa Test of Basic Skills (IT) and scores on the Children's Memory Scale (CM) for grades 2 and 6 (H_o: $\rho_1=\rho_2$). If the correlation for grade 2 was .50 and the correlation for grade 6 was .20 with sample sizes of 100 and 200, respectively, then the z-test for independent correlations would equal 2.79, $p<.01$. The conclusion would be that there is a significantly higher correlation between the mathematics scores of the IT and CM scores for grade 2 than for grade 6 children. Although the Fisher's z-test for examining the difference between independent correlations is shown in many standard statistics textbooks,[1] it is not usually contained in the standard statistical packages unless a researcher writes a separate program for performing it.

Dependent correlations, however, are those contained within the same sample. One hypothesis consists of testing the difference between two dependent correlations with one element in common (H_o:$\rho_{12}=\rho_{13}$). For example, suppose that the same administrator is interested in determining if the correlation between the mathematics scores on the IT would be significantly higher with CM scores (r=.60) than with the overall scores of the Montreal Battery of Evaluation of Musical Abilities (MBEMA) (r=.30) for 100 grade 5 children. Moreover, suppose that the correlation between the scores of the CM and MBEMA was .20. There are number of

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procedures for testing the null hypothesis of $\rho_{12}=\rho_{13}$, that either compare the correlations using the t distribution[2] or *via* Fisher's z' transformation which purportedly distributes out as z.[3] Research indicated that they were deficient under certain conditions with regard to Type I error rate and power.[4] Consequently,[5] offered Method D2 as an alternative to the standard techniques. They provided this alternative in R and S-PLUS programs. Nevertheless, using the[3] z-test, the value was 2.832, $p<.01$ indicating that the correlation between mathematics scores on the IT and CM scores was significantly higher than the correlation between mathematics scores on the IT and MBEMA scores for grade 5 children.

A second hypothesis consists of testing the difference between two dependent correlations with no elements in common (H_o:$\rho_{12}=\rho_{34}$). Suppose that the administrator is now interested in determining if the correlation between the mathematics scores on the IT and CM scores would be higher (r=.50) after a brief memory skill course (e.g., mnemonics) than before one for grade 4 children (r=.30). Here is a hypothetical correlation matrix for a sample size of 50:

	IT before	CM before	IT after	CM after
IT before	–	.30	.75	.25
CM before		–	.15	.65
IT after			–	.50
CM after				–

Using the procedure,[3] the z-test value was -1.75, $p>.05$. This indicates that there was no statistically significant difference between the correlations of the mathematics scores on the IT and CM scores before and after the mnemonic intervention for grade 4 children. In a simulation of four possible procedures for testing the null hypothesis of $\rho_{12}=\rho_{34}$, which included the z-test,[3] one procedure was entirely too liberal, whereas the other three were a bit conservative when the predictor-criterion correlation was low.[6] Nevertheless, the best significance test procedures for testing dependent correlations with zero and one element in common, based upon their findings,[6] were programmed for Windows.[7]

Although statistical significance tests are used for testing these hypotheses, more emphasis has been placed on confidence intervals for performing the same task. The confidence interval separately provides the magnitude and precision of the particular effect, whereas these characteristics are confounded in standard hypothesis testing *p* values[8] provided confidence interval techniques which purportedly have better control of Type I errors and have more power than the standard statistical significance tests. Although many of these techniques have been programmed in R,[9] and recently in SAS and SPSS as separate programs,[10] the problem is that many researchers who are basic users of these packages or do not use them at all, may have difficulty in applying these programs. In some cases, researchers may resort to computing these techniques by hand. Therefore, in order to make these confidence interval approaches more generalizable to researchers, the purpose of the user-friendly, stand-alone program was to compute them for testing differences between: a) independent correlations;[8] and b) two dependent correlations with either zero or one element in common[8] in a Windows platform.

DESCRIPTION

The user is queried interactively for the particular test, correlations, sample size, and the confidence interval probability (e.g., 95%). The normal curve value associated with computing the confidence interval for the individual correlations was obtained using the algorithm by.[11] The program responds with a restatement of the input correlations, sample size, the confidence interval for the individual correlations, the confidence interval for testing the differences between correlations and a brief statement mentioning that confidence intervals containing zero are non-significant. The program is written in FORTRAN 77, using the GNU FORTRAN compiler, and runs on a Windows PC or compatible. The output is contained in COMPCOR.OUT.

Sample outputs based upon the hypothetical scenarios are given in Tables 1-3. The output indicates there are no differences in the general conclusions using the confidence interval approach[8] and the standard statistical significance tests.[6] Although there were no differences in the general conclusions, given the findings of[7] in terms of Type I error rates and power,[8] it is still important for researchers to have a potentially better option at their disposal.

The difference between independent correlations	Sample Sizes	Confidence Interval for r1	Confidence Interval for r2	Confidence Interval for the difference between r1 and r2
		The 0.9500 confidence interval for 0.5000	The 0.9500 confidence interval for 0.2000	The 0.9500 confidence interval for the difference between 0.5000 and 0.2000
r1=0.5000	r1=100.0000	has a lower bound of 0.3366	has a lower bound of 0.0630	has a lower bound of 0.0915
r2=0.2000	r2=200.0000	and an upper bound of 0.6341	and an upper bound of 0.3296	and an upper bound of 0.4917

If the interval contains 0, then it is non-significant.

Table 1: Sample output from COMPCOR for testing the difference between independent correlations.

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Testing the difference between dependent correlations with one element in common	The sample size	Confidence Interval for r12	Confidence Interval for r13	Confidence Interval for the difference between r12 and r13
		The 0.9500 confidence interval for 0.6000	The 0.9500 confidence interval for 0.3000	The 0.9500 confidence interval for the difference between 0.6000 and 0.3000
r12 = 0.6000	100.0000	has a lower bound of 0.4575	has a lower bound of 0.1101	has a lower bound of 0.0914
r13 = 0.3000		and an upper bound of 0.7125	and an upper bound of 0.4688	and an upper bound of 0.5098

If the Interval contains 0, then it is non-significant.

Table 2: Sample output from COMPCOR for testing the difference between dependent correlations with one element in common.

Testing the difference between correlations with no elements in common	The sample size	Confidence Interval for r12	Confidence Iinterval for r34	Confidence Interval for the difference between r12 and r34
		The 0.9500 confidence interval for 0.3000	The 0.9500 confidence interval for 0.5000	The 0.9500 confidence interval for the difference between 0.3000 and 0.5000
r12=0.3000	50.0000	has a lower bound of 0.0236	has a lower bound of 0.2575	has a lower bound of -0.4307
r34=0.5000		and an upper bound of 0.5338	and an upper bound of 0.6833	and an upper bound of 0.0235

If the Interval contains 0, then it is non-significant.

Table 3: Sample output from COMPCOR for testing the difference between dependent correlations with no elements in common.

AVAILABILITY

COMPCOR.FOR and the executable version (COMPCOR.EXE) may be obtained at no charge by sending an e-mail request to N. Clayton Silver, Department of Psychology, University of Nevada, Las Vegas, Las Vegas, NV 89154-5030 at fdnsilvr@unlv.nevada.edu.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

1. Howell DC. Statistical Methods for Psychology. 8th ed. Belmont, CA: USA Wadsworth; 2010.

2. Williams, EJ. The comparison of regression variables. *J R Stat Soc Series B Stat Methodol*. 1959; 396-399.

3. Dunn OA, Clark VA. Correlation coefficients measured on the same individuals. *J Am Stat Assoc* 1969; 64, 366-377. doi: 10.1080/01621459.1969.10500981

4. Hittner JB, May K, Silver NC. A Monte Carlo evaluation of tests for comparing dependent correlations. *J Gen Psychol.* 2003; 130: 149-168. doi: 10.1080/00221300309601282

5. Wilcox R, Tian T. Comparing dependent correlations. *J Gen Psy.* 2008; 135: 105-112. doi: 10.3200/GENP.135.1.105-112

6. Silver NC, Hittner JB, May K. Testing dependent correlations with nonoverlapping variables: A Monte Carlo simulation. *J of Exp Ed.* 2004; 73: 53-69. doi: 10.3200/JEXE.71.1.53-70

7. Silver NC, Hittner JB, May K. A FORTRAN 77 program for comparing dependent correlations. *App Psy Meas.* 2006; 30: 152-153. doi: 10.1177/0146621605277132

8. Zou GY. Toward using confidence intervals to compare correlations. *Psy Meth.* 2007; 12, 399-413. doi: 10.1037/1082-989X.12.4.399

9. Diedenhofen B, Musch J. cocor: A Comprehensive Solution for the Statistical Comparison of Correlations. Website: comparingcorrelations.org 2015; Accessed June 27, 2015.

10. Weaver B, Wuensch KL. SPSS and SAS programs for comparing Pearson correlations and OLS regression coefficients. *Beh Res Meth.* 2013; 45: 880-895.

11. Wichura MJ. Algorithm AS241: The percentage points of the normal distribution. *App Stat.* 1988; 37: 477-484. doi: 10.2307/2347330