Effect Size and Statistical Power: Practice Exercises

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Applications

- For the remainder of the workshop you may
  - complete the following exercises on effect size and power estimation
  - calculate effect size and power estimates for your own research
- All necessary formulas are in the presentation
- When you finish the exercises, you can obtain answers at:

  http://www.uoregon.edu/~stevensj/workshop/answers.pdf

Example A

Luft & Vidoni (2002) examined preservice teachers' knowledge about school to career transitions before and after a teacher internship. Some of the obtained results were:

	Before		After				
Knowledge about:	$\overline{X}$	*sd*	$\overline{X}$	*sd*	*t*	*p*	*r*
Writing	2.92	1.44	3.92	.79	-2.25	.05	.59
Use of Hands-on activities	4.58	.67	4.75	.45	-1.00	.34	.71
Class assignments	3.67	.49	4.08	.79	-1.82	.10	.56

Twelve students participated in the study and completed the pre and post testing.

Example B

Boling & Robinson (1999) conducted a fixed-effects, omnibus ANOVA to study which activities best supported lecture based distance education. Data were:

Activity Group	$\bar{X}$	*sd*	*n*
Individual Learning	80.00	12.11	37
Cooperative Learning	86.56	8.83	39
Interactive Multimedia	81.23	13.18	39

Note. Pooled *sd* was 11.36

Example C

This is a hypothetical example examining relationships between four reading ability groups, two math ability groups and performance on a math problem solving test. The design has (4)(2) = 8 cells with 10 participants in each cell for a total N of 80. Results of the two factor ANOVA are:

Tests of Between-Subjects Effects

Dependent Variable: Problem Solving Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
MATH	49.613	1	49.613	51.103	.000
READ	60.238	3	20.079	20.682	.000
MATH * READ	50.137	3	16.713	17.215	.000
Residual	69.900	72	.971		
Total	229.888	79			

Computing Effect Size

1. Using data from Example B, compute Cohen's d for the comparison of cooperative learning to individual learning and for the comparison of individual learning to interactive multimedia

2. Using Example C, compute ω^2, η^2, η^2_p for the interaction effect

G*Power Exercises (assume α = .05 for all exercises)

Using the data from example A, complete the following exercises:

3. Estimate the power of the repeated measures *t*-test for the knowledge of writing outcome given α, sample size, and effect size (you need to estimate with G*Power).

4. Determine the necessary sample size to achieve a power of .80 for the knowledge of writing outcome.

G*Power Exercises

5. Using the same information, determine the minimum detectable effect size if power is .80

6. Using the data in example C, estimate the required sample size for the interaction effect assuming partial eta = .30, power = .80

7. Using example C, compute the required effect size for the main effect of math assuming power = .70; n = 10 per cell and total N = 80.

Use OD to complete the following exercises

8. For a Group randomized CRT with n=10, δ = .6, ICC = .12, how many clusters are needed to achieve a power of .80?
9. For a Group randomized CRT with n=30, ICC = .04, J = 8, what effect size is needed to achieve a power of .80?
10. For the same parameters as question 2, how does the answer change with a covariate that explains 64% of the variance?

Use OD to complete the following exercises

11. Estimate the optimal design for a Group Randomized CRT with a total budget of $8000, a cluster cost of $500, a member cost of $15, ICC = .10, δ = .40, what are the optimal n, J, and resulting power? How could this study be improved without a substantial increase in budget?

12. For a multisite CRT with the following parameters: K =12 districts, schools as the cluster variable J, n = 15, δ = .25, ρ =.12, σ_{δ}^{2} = .02, and blocking accounts for 16% of the variance, what cluster size is needed to achieve power of .80?

Use OD to complete the following exercises

13. If a covariate is added that accounts for 49% of the variance, what cluster size is needed to achieve power of .80?

14. If a J of 10 was chosen for the study in question 7, and K was reduced to 8, what effect size would be needed to achieve a power of .80?

Answers to all exercises are available at:

http://www.uoregon.edu/~stevensj/workshops/answers.pdf