

Work each of the exercises first by hand and then using G*Power 3. Check your solutions with those shown at the end of the document.

1. We wish to determine whether a morale problem exists among the employees of the Müller salt mines. We plan to administer a standardized test of morale to some number of miners. We know that among miners nationwide the mean score on this test is **50**, with a standard deviation of **10**. **How many Müller miners should we test** if we want to have an **85%** chance of detecting a difference between the mean for Müller miners and the nationwide mean? Assume that we have decided that **3** points is the minimum nontrivial effect size – that is the three point difference between 50 (the national mean) and 47 (the mean for our miners were there a three point morale problem). Employ a **.05** criterion for α .

2. Suppose you are to evaluate the effectiveness of a new program at Müller mines. The program, which involves employees participating in loosely structured recreational activities at the employer's expense, was expected to change workers' morale, productivity, etc. For a random sample of **36** employees you have both pre- and post-program morale scores. Assuming that morale scores have a standard deviation of **10** and that the correlation between pre-program morale and post-program morale is **+0.595**, **what are your chances of detecting a change in mean morale** as small as **3** points if you employ a **.05** criterion for alpha?

3. You are going to evaluate the effectiveness of Program A (that described in problem number 2 above) versus Program B. Program B involves more rigidly structured recreational activities. If you have morale-change scores (post-program morale minus pre-program morale) for each of **40** employees under Program A and for each of **60** employees under Program B, **what are your chances of detecting an effect** as small as **three-tenths** of a standard deviation? That is, if the programs differ from one another by less than 0.3 of a standard deviation, you consider the two programs to be essentially equivalent in effectiveness. Assume that you employ a **.05** criterion for alpha.

Solutions

$$1. \quad d = \frac{3}{10} = .3 \quad N = \left(\frac{\delta}{d} \right)^2 = \left(\frac{3.00}{.3} \right)^2 = 100$$

Test family		Statistical test	
t tests		Means: Difference from constant (one sample case)	
Type of power analysis			
A priori: Compute required sample size - given α , power, and effect size			
Input Parameters		Output Parameters	
Determine =>	Tail(s)	Two	Noncentrality parameter δ
	Effect size d	0.3	Critical t
	α err prob	0.05	Df
	Power (1- β err prob)	0.85	Total sample size
		Actual power	0.851052

2. d is still .3, but we need correct it for the power-enhancing effect of the within-subjects design.

$$d_{Diff} = \frac{d}{\sqrt{2(1-\rho)}} = \frac{.3}{\sqrt{2(1-.595)}} = 1/3. \quad \delta = d_{diff} \sqrt{n} = 1/3 \sqrt{36} = 2.00$$

From the power table, power = 0.52.

Test family		Statistical test	
t tests		Means: Difference between two dependent means (matched pairs)	
Type of power analysis			
Post hoc: Compute achieved power - given α , sample size, and effect size			
Input Parameters		Output Parameters	
Determine =>	Tail(s)	Two	Noncentrality parameter δ
	Effect size dz	0.333333333	Critical t
	α err prob	0.05	Df
	Total sample size	36	Power (1- β err prob)
			0.494079

$$3. d = .3. \quad \tilde{n} = \frac{2}{\frac{1}{40} + \frac{1}{60}} = 48 \quad \delta = d\sqrt{\frac{\tilde{n}}{2}} = .3\sqrt{\frac{48}{2}} = 1.47$$

From the table:

Delta	Power	Interpolation for delta = 1.47
1.40	.29	Power = .29 + $\frac{7}{10}(.32 - .29) = .31$
1.50	.32	

Test family

t tests ▼

Statistical test

Means: Difference between two independent means (two groups) ▼

Type of power analysis

Post hoc: Compute achieved power - given α , sample size, and effect size ▼

Input Parameters

Tail(s) Two ▼

Effect size d 0.3

α err prob 0.05

Sample size group 1 40

Sample size group 2 60

Determine =>

Output Parameters

Noncentrality parameter δ 1.469694

Critical t 1.984467

Df 98

Power (1- β err prob) 0.307217