**Educational Notes in Research Methodology and Medical Statistics** 

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# Sample Size Calculation Guide - Part 7: How to Calculate the Sample Size **Based on a Correlation**

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#### **INTRODUCTION**

In the previous educational articles, we explained how to calculate the sample size for a rate or a single proportion, for an independent cohort study, for an independent case-control study, for a diagnostic test accuracy study, for a superiority clinical trial, and for a non-inferiority or equivalence clinical trial (1-6). In this article, we will explain how to calculate the sample size for a clinical study with the aim of detecting the correlation coefficient between two variables.

#### WHEN TO USE THE SAMPLE SIZE CALCULATION **PROCEDURE OF A CORRELATION**

The methods explained hereafter should be used in case of a clinical study designed to determine the correlation between two variables. This study might be a cross-sectional study, a cohort study, a case-control study, or a clinical trial as long as the primary objective is to determine the correlation between two variables.

#### **REQUIREMENTS**

- 1) Expected correlation coefficient
- 2) Statistical power
- 3) Alpha
- 4) Correlation coefficient for the null hypothesis (usually 0 or 0.2)

### **CALCULATION STEPS ON STATSDIRECT SOFTWARE**

- 1) Open a new report
- 2) From "analysis" menu, select "sample size."
- 3) Then select "correlation."
- 4) Then submit the data

#### **CALCULATION STEPS ON THE STATISTICS AND SAMPLE** SIZE CALCULATION ANDROID APP (FIGURE 1)

- 1) Open the app
- 2) Select "sample size calculator"

Sample Size Calculator	Sample Size Calculator	Sample Size Calculator
Random Sampling	Estimate a proportion	Estimate a correlation coefficient
Statistical Distribution Table	Estimate a proportion in finite population	$\left[ Z_{1-\alpha_{2}} + Z_{1-\beta} \right]^{2} + 2$
	Estimate a mean	$n \ge \left\lfloor \frac{1}{1 - \log_e \frac{1+r}{r}} \right\rfloor + 3$
Statistical Calculator	Estimate a correlation coefficient	$(2^{-1}-r)$
Statistical Analysis from Data Files	Estimate a sensitivity	Alpha (α) 0.05
Choose the correct test	Estimate a specificity	Beta (β) 0.1
Tetestal	Compare two proportions	Estimated correlation coefficient $(r) 0.46$
	Compare two proportions (Paired / Before -	
Let's relax	After)	CALCULATE
Preferences	Compare two means (use mean and standard deviation	Minimum sample size needed: 46
About	Compare two means (use effect size)	
	Compare two means (Paired / Before - After)	
	Compare multiple means	
	Case control study	
	Cohort study	
	Survival study	
	Pandom Sampling	
gure 1: Shows the calculation steps on the	e Android app, statistics and sample size calc	ulation

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	Luit	Insert	Format	Data	Analysis Gra	phics Tools Window Help
Return		Help	Ru	n 🔸	0	Correlation coefficient under null hypothesis (0 to 1)
					0.46	Correlation coefficient under alternative hypothesis (0 to 1)
					90.0 ~	% POWER (% probability of correctly detecting a real effect)
					5.0 ~	% ALPHA (% probability of incorrectly rejecting the null hypothesis
<u>Sampl</u>	<u>e size fo</u>	r Pearson	n correlatio	<u>on</u>		
<u>Sampl</u> Alpha	<u>e size fo</u> = 0.05	r Pearsoi	n correlatio	<u>on</u>		
<u>Sampl</u> Alpha Power	<u>e size fo</u> = 0.05 = 0.9	r Pearson	n correlatio	<u>on</u>		
<u>Sampl</u> Alpha Power Correl	e size fo = 0.05 = 0.9 ation co	<u>r Pearson</u> efficient	n correlatio	<u>on</u> hypoth	esis = 0	
<u>Sampl</u> Alpha Power Correl Correl	e size fo = 0.05 = 0.9 ation co ation co	r Pearson efficient efficient	<u>n correlatio</u> under null under alte	bn hypothe rnative	esis = 0 hypothesis = 0.4	5

3) Select "estimate the correlation coefficient"

4) Then submit the data

# CASE STUDY OF MICRORNA PLASMA LEVELS AS BIOMARKERS FOR EARLY DETECTION OF PROSTATE CANCER

Assume that we are conducting a study to investigate the role of microRNAs in plasma as potential biomarkers for early detection of prostate cancer (defined as elevated PSA). A recent study by McDonald et al. (7) reported the following sentence: "moderate positive correlations with serum PSA were observed for ... miR-34a among cases (r = 0.46; P-value = 0.02)". The null hypothesis is that there is no correlation between microRNAs in the plasma and serum PSA (r=0). The alternative hypothesis based on McDonald et al. is that there is a moderate correlation between microRNAs in the plasma and serum PSA (r=0.46).

## **CASE SOLUTION**

First, we determine the requirements

- Expected correlation between the two variables (r=0.46)
- Statistical power = 90% (or Beta error=0.1)
- Alpha = 5%
- Correlation coefficient of the null hypothesis (r=0.0)

Second, we run the calculations using the Statistics and Sample Size calculation app on Android (Figure 1) or the StatsDirect software for windows (Figure 2). The results show that a minimum sample size of 47 patients will be required for this study.

Second, we run the calculations as shown in Figure 1. The results show that a minimum sample size of 156 patients (n=78 per group) will be required for this randomized controlled trial (Figure 1).

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