

Calculating sample size – Model Answers to Worksheet

Please read through the following study examples below. Using this study information and a copy of Altman's nomogram provided, estimate the sample size required for two equally sized groups in order to identify a clinically significant difference in mean scores between the two groups.

Example Study 1: Comparing means in independent groups using the Independent t-test

Objective of study: to examine the effectiveness of aciclovir suspension (15 mg/kg) for treating 1-7 year old children with herpetic gingivostomatitis lasting less than 72 hours.

Study Design: Randomised, double-blind placebo controlled trial with 'treatment' administered five times a day for 7 days.

Main outcome for determining sample size: Duration of oral lesions.

Sample Size Question: How many children would be needed for this study in order to have a 90% power of detecting a 2.5 day difference in duration of oral lesions between the trial and control groups at the 5% level of significance?

The authors assume that the standard deviation of duration of oral lesions is approximately 5 days.

1. In the space below, state the formula that should be used to calculate sample size in Altman's nomogram for the above study.

Independent samples t-test =

$$\frac{\delta}{\sigma}$$

δ : is the smallest difference in means that is clinically important.
 σ : assumed equal standard deviation of the observations in each of the 2 groups

2. Using the correct formula for Altman's Nomogram, calculate the standardised difference for the above study and then use Altman's nomogram to estimate the required sample size – show your workings below.

$\delta = 2.5$ days and $\sigma = 5$ days. Therefore, $2.5/5 = 0.50$.

On Altman's Nomogram, the line connecting a standardized difference of 0.50 and a power of 90% cuts the sample axis on the 0.05 alpha level at approximately 160/170.

160 divide by the number of groups (2) = $160/2 = 80$.

170 divide by the number of groups (2) = $170/2 = 85$

3. Write out your Power Statement below.

"Eighty/eight-five children would be required in each group to have a 90% chance of detecting a clinically important difference in means of 2.5 days (SD=5 days) at the 5% level of significance using the Independent-samples t-test."

Example Study 2: Comparing two proportions in independent groups using Chi-Square test.

Objective of study: to compare the effectiveness of corticosteroid injections with physiotherapy for the treatment of painful stiff shoulder.

Study Design: Randomised controlled trial (RCT) in which patients are randomly allocated to 6 weeks of treatment, these comprising either a maximum of three injections or twelve 30 minute sessions of physiotherapy for each patient.

Main outcome measure for determining sample size: treatment is regarded as successful after 7 weeks if the patient rates themselves as having made a complete recovery or as having much improvement (on a six-point Likert scale).

Sample Size Question: How many patients are required in order to have an 80% power of detecting a clinically important difference in success rates of 25% between the 2 groups at the 5% level of significance?

The authors assume a success rate of 40% in the group having the least successful treatment.

1. In the space below, state the formula that should be used to calculate sample size in Altman's nomogram for the above study.

Chi-Squared test =

$$\frac{P_1 - P_2}{\sqrt{\bar{P}(1 - \bar{P})}} \quad P_1 - P_2: \text{smallest difference in the proportion of 'success' in the 2 groups}$$

To calculate $\bar{p} = \frac{p_1 + p_2}{2}$

2. Using the correct formula for Altman's Nomogram, calculate the standardised difference for the above study and then use Altman's nomogram to estimate the required sample size – show your workings below.

$P_1 = 0.40$ and $P_2 = 0.65$ ← If success rate was assumed to be at 40% *for the least successful* treatment, then detecting a 25% difference in success rates would require the other treatment to have a 65% success rate.

$$\bar{p} = 0.40 + 0.65 / 2 = 0.525$$

Standardised difference =

$$\frac{P_1 - P_2}{\sqrt{\bar{P}(1 - \bar{P})}}$$

$$\frac{0.25}{\sqrt{0.525 \times 0.475}} = 0.50.$$

The line connecting a standardised difference of 0.50 and a power of 80% cuts the sample size axis on the 0.05 alpha level at 120. Therefore, approximately 60 patients are required in each group.

3. Write out your Power Statement below.

“Sixty patients would be required in each group to have an 80% chance of detecting a clinically important difference in success rates of 25% between the corticosteroid group and the physiotherapy group for the treatment of painful stiff shoulder at the 5% level of significance using the Chi-squared test.”

Calculating Effect size – Model Answer for comparison between Control and Intervention group on PANAS at time 2.

An independent samples t-test should have been conducted to compare PANAS Positive Affect scores and Negative Affect scores at time 2 between the Control (no leaflet) and Intervention (leaflet) groups.

Effect size should then have only been calculated on the PANAS Positive Affect scores, as only this statistic was significant.

Eta Squared =

$$\frac{t^2}{t^2 + (N_1 + N_2 - 2)}$$

$$\frac{2.051^2}{2.051^2 + (65 + 64 - 2)}$$

$$\frac{4.206601}{4.206601 + 127}$$

$$\frac{4.206601}{131.206601}$$

= 0.032 Half way between a small to moderate effect size.

Calculating Confidence Intervals (CI) - Model Answers to Worksheet

The following study example relates to both sections 1 and 2 below. Please read through the study example and then answer the questions in each section.

Researchers interested in studying the effect of inherited bleeding disorders on pregnancy and childbirth collected data from a sample of 64 women registered at a single haemophilia centre in London. The women were asked questions relating to their bleeding disorder and their first pregnancy (or current pregnancy if this was their first one).

Section 1: Confidence interval for the mean

Objective: Determine the mean age at first birth in women who have bleeding disorders. A sample of 49 of the women from the study was taken, which revealed:

Mean age of woman at birth of child = 27.01 years

Standard Deviation = 5.1282 years

First, calculate the Standard Error of the Mean (SEM) – show your working below:

$$SEM = \frac{5.1282}{\sqrt{49}} = 0.7326$$

The variable is approximately normally distributed but because the population variance is unknown, you need to use the t-distribution to calculate the Confidence Interval (CI).

Using the ‘Critical Values of t’ (or ‘t-distributions’) table in the Appendix of any of your stats books, please calculate the Confidence Intervals (CI) for the above study here and show the workings of your calculations:

$$27.01 \pm (2.011 \times 0.7326) = 25.54 \text{ years and } 28.48 \text{ years.}$$

2.011 is the percentage point of the t-distribution with $(49-1) = 48$ degrees of freedom giving a two-tailed probability of 0.05.

Write out the interpretation of your calculations as you would for a report:

“We are 95% certain that the true mean age at first birth in women with bleeding disorders in the population ranges from 25.54 to 28.48 years. This range is fairly narrow, reflecting a precise estimate.”

Section 2: Confidence interval for the proportion

Of the 64 women in the study, 27 (42.2%) reported that they experienced bleeding gums at least once a week. This is a relatively high percentage and may provide a way of identifying undiagnosed women with bleeding disorders in the general population.

Calculate the 95% Confidence Interval (CI) for the proportion with bleeding gums in the population. Show your workings and write-up your calculations as you would for a report:

Sample proportion = $27/64 = 0.422$

$$\text{Standard error of proportion} = \sqrt{\frac{0.422(1-0.422)}{64}} = \sqrt{\frac{0.422(0.578)}{64}} = \sqrt{\frac{0.243916}{64}}$$

$$= \sqrt{0.0038111875} = 0.0617$$

95% confidence interval = $0.422 \pm (1.96 \times 0.0617)$ = lower: 0.301, and upper: 0.543.

“We are 95% certain that the true percentage of women with bleeding disorders in the population who experience bleeding gums this frequently ranges from 30.1% to 54.3%. This is a fairly wide confidence interval, suggesting poor precision; a larger sample size would enable us to obtain a more precise estimate. However, the upper and lower limits of this confidence interval both indicate that a substantial percentage of these women are likely to experience bleeding gums. We would need to obtain an estimate of the frequency of this complaint in the general population before drawing any conclusions about its value for identifying undiagnosed women with bleeding disorders.”

References:

Example questions taken from Petrie, A., & Sabin, C. (2000). *Medical Statistics at a Glance*. Blackwell Science Ltd.

Data for Example Study 1 from Amir, J., Haral, L., Smetana, Z., & Varsano, I. (1977). Treatment of herpes simplex gingivostomatitis with aciclovir in children: a randomised, double-blind placebo-controlled study. *British Medical Journal*, 314, 1800-1803.

Data for Example Study 2 taken from van der Windt, D.A.W.M., Koes, B.W., Devillé, W., de Jong, B.A., & Bouter, M. (1998). Effectiveness of corticosteroid injections with physiotherapy for treatment of painful shoulder in primary care: randomised trial. *British Medical Journal*, 317, 1292-1296.

Data for Calculating Confidence Intervals from Dr R. A. Kadir, University Department of Obstetrics and Gynaecology, and Professor C. A. Lee, Haemophilia Centre and Haemostasis Unit, Royal Free Hospital, London.