Power and Sample Size Calculation – Software workflow for SPSS

To access the IBM SPSS Statistics documentation on Power Analysis, click here. Note: Results generated in SPSS may vary from your output in G*Power. In SPSS you are also limited with the plots you can develop for exploring different sample size scenarios.

1. Difference between 2 means

Example: Chicken welfare – Bone density

The bone density of chickens is an important indication of their welfare. You want to test to see if (mineral) bone density can be improved from 120 to at least 130 mg/cm^3.

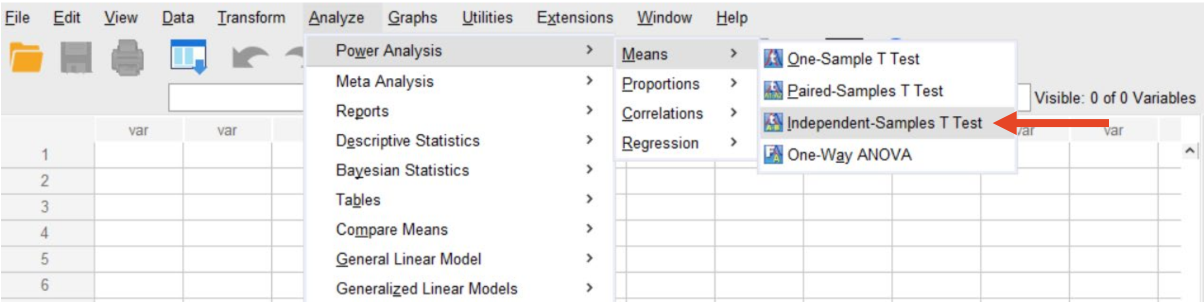
- Treatment group (high mineral diet)
- Control group (normal diet)
- Response variable: Measure the tibia bone density after 6 weeks growth

Question 1: How many chickens do you need to detect a difference in bone density of 10mg/cm^3?

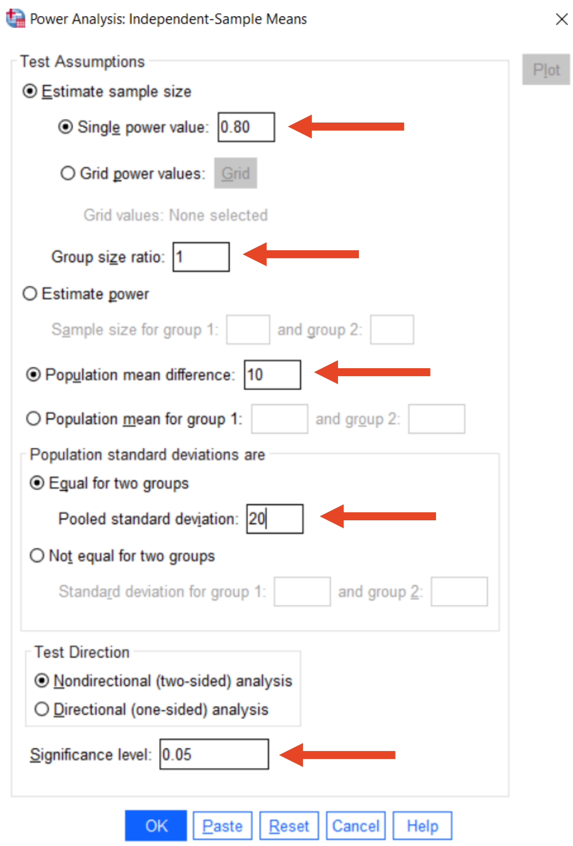
Step 1	Determine experiment type and statistical test	T-test (assume normality)
Step 2	Set α and $1 - \beta$	$\alpha = 0.05$ and $1 - \beta = 0.8$
Step 3	Set the smallest effect size of interest (SESOI)	SESOI = 10mg/cm^3
Step 4	Estimate the variance	You know from previous studies what the typical variation in bone density is for the control diet. You don't know about the treatment diet. You will use an estimate from the control diet of SD = 20mg/cm^3. Assume equal group sizes, n1 = n2.
Step 5	Calculate the minimum sample size	Put all the information into SPSS. For access to the IBM SPSS Statistics documentation on Power Analysis of Independent-Samples T Test, click here.
Step 6	Explore scenarios	Consider how much your within-study standard deviation could vary from your point estimate. You will also run the sample size calculation using SD = 15 (possible min value) and SD = 30 (possible max value).

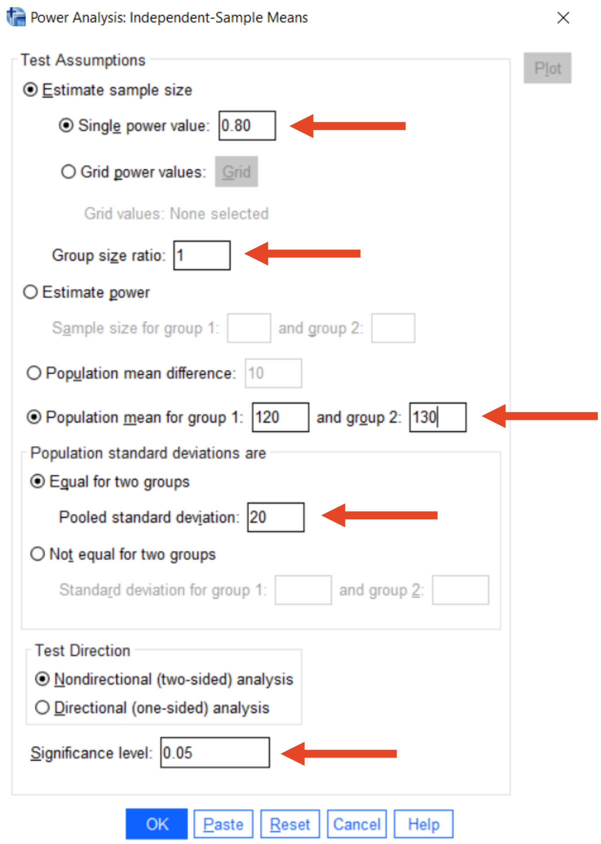
Methods:

1. Analyze > Power Analysis > Means > Independent-Samples T Test



2. Enter the values for the chick experiment as per either the left (specifying population mean difference) or right (specifying population mean for group 1 and group 2) screenshot below:





3. Click OK. Your output should be as follows:

Power Analysis Table

	N1	N2	Actual Power[b]	Test Assumptions			
				Power	Std. Dev.[c]	Effect Size	Sig.
Test for Mean Difference[a]	64	64	.801	.8	20	.500	.05

a. Two-sided test.

b. Based on noncentral t-distribution.

c. Group variances are assumed to be equal.

4. Repeat the process using SD = 15 mg/cm^3. Assume equal group sizes, n1 = n2. Your output should be as follows:

Power Analysis Table

	N1	N2	Actual Power[b]	Test Assumptions			
				Power	Std. Dev.[c]	Effect Size	Sig.
Test for Mean Difference[a]	37	37	.808	.8	15	.667	.05

a. Two-sided test.

b. Based on noncentral t-distribution.

c. Group variances are assumed to be equal.

5. Repeat the process using SD = 30 mg/cm^3. Assume equal group sizes, n1 = n2. Your output should be as follows:

Power Analysis Table

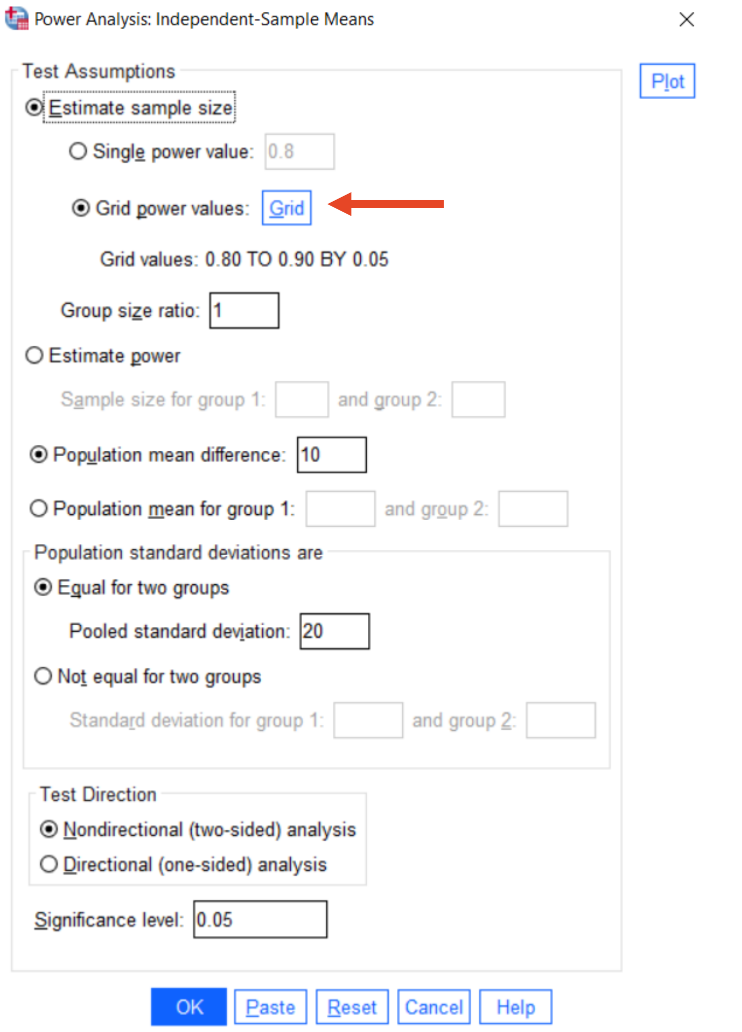
	N1	N2	Actual Power[b]	Test Assumptions			
				Power	Std. Dev.[c]	Effect Size	Sig.
Test for Mean Difference[a]	143	143	.802	.8	30	.333	.05

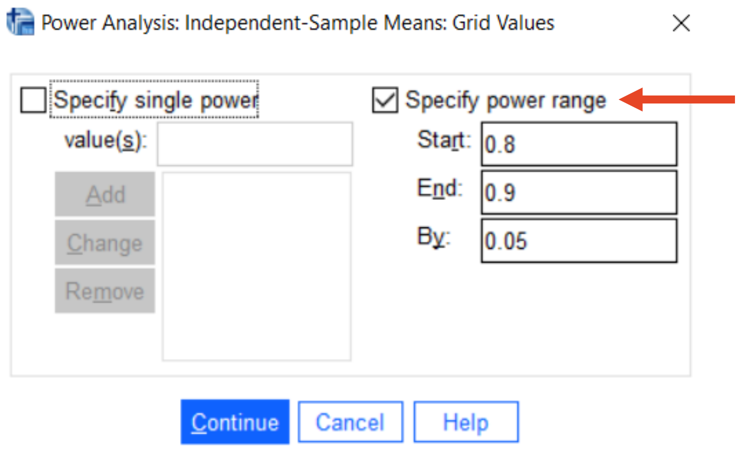
a. Two-sided test.

b. Based on noncentral t-distribution.

c. Group variances are assumed to be equal.

6. For a specified SESOI and SD, you can compare sample sizes for different levels of power. Enter the values as per the screenshots below using the Grid power values option and specifying the power range:





7. Click OK. Your output should be as follows:

Power Analysis Table

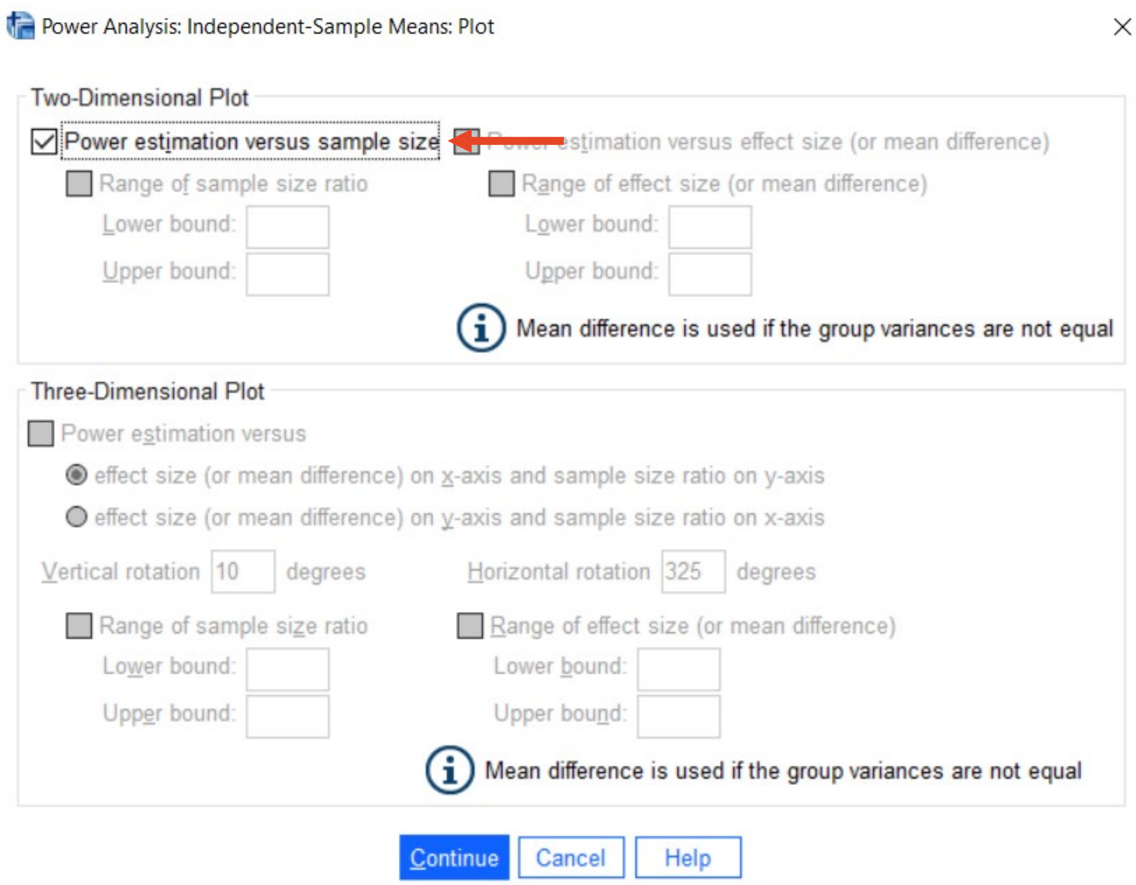
Test for Mean Difference[a]	N1	N2	Actual Power[b]	Test Assumptions			
				Power	Std. Dev.[c]	Effect Size	Sig.
1	64	64	.801	.800	20	.500	.05
2	73	73	.851	.850	20	.500	.05
3	86	86	.903	.900	20	.500	.05

a. Two-sided test.

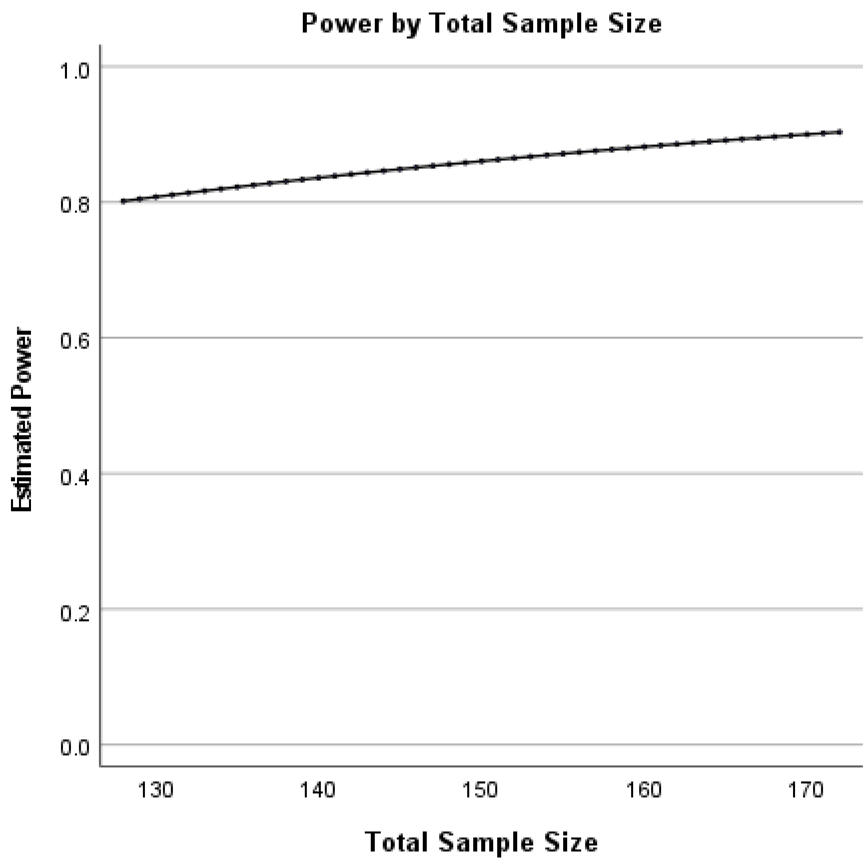
b. Based on noncentral t-distribution.

c. Group variances are assumed to be equal.

8. You can also plot the information in the table above by clicking Plot and checking the Power estimation versus sample size box as per below:



9. Click Continue to generate your plot. Note: The x-axis shows the total sample size, rather than the sample size per group. Your plot should be as follows:



2. Difference between 2 means (Mann-Whitney)

Example: Happiness Survey

You want to measure happiness using the Lyubomirsky & Lepper scale. Each item response ranges from 1 (unhappy) to 7 (happy). The score is the sum of 4 items, so the range is 4~28.

A pilot study on two groups produced the following results that can be used for the power calculation:

	Values		Ranks	
	Single	Married	Single	Married
	12	20	3	1
	11	15	4	2
	10	9	5	6
	6	8	8	7
Avg	9.8	13.0	5	4
SD	2.6	5.6		

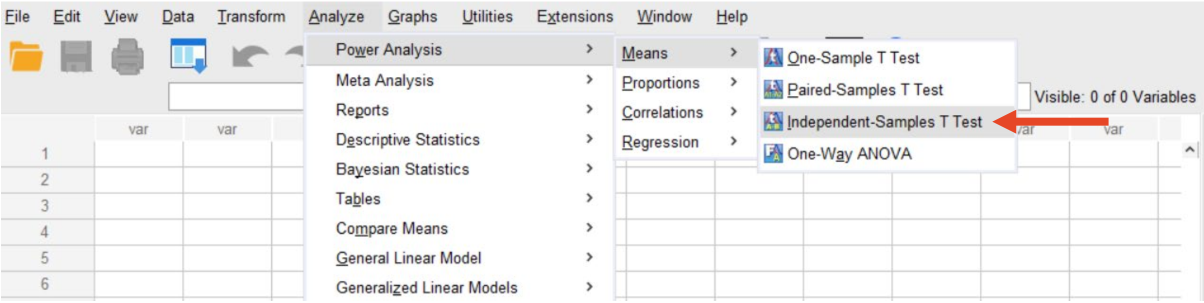
You want to apply the happiness survey to different groups of people (e.g. single vs. married) to see if there is a difference in scores.

Question 2: What is a meaningful difference?

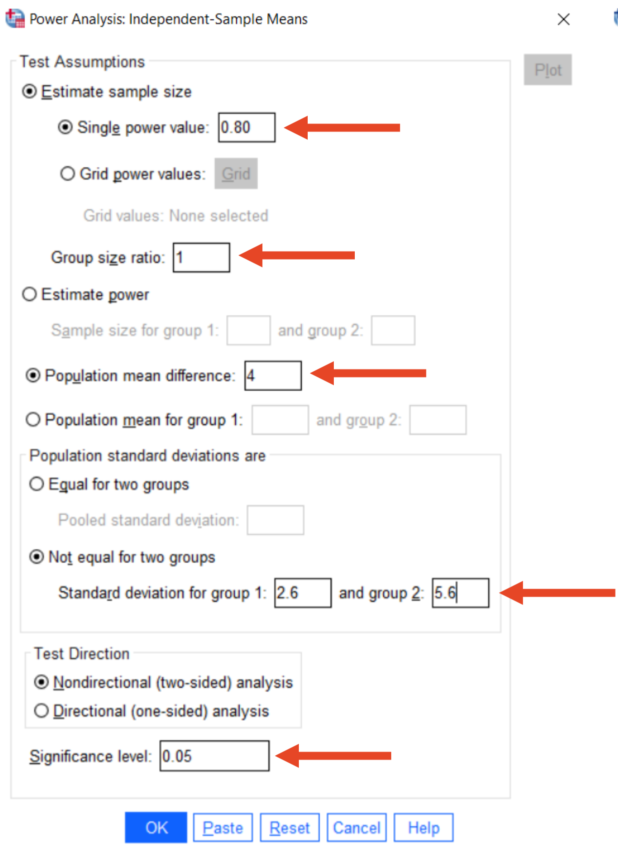
Step 1	Determine experiment type and statistical test	Mann-Whitney (also called Wilcoxon rank sum)
Step 2	Set α and 1 – β	α = 0.05 and 1 - β = 0.8
Step 3	Set the smallest effect size of interest (SESOI)	SESOI = 4 points
Step 4	Estimate the variance	SD1 = 2.6 and SD2 = 5.6
Step 5	Calculate the minimum sample size	Heuristic method – Do the calculations as if performing the corresponding parametric test (i.e., the t-test), then add 15% to the sample size. Note: There are currently no options in SPSS to run sample size calculations for non-parametric tests, so the heuristic method will be used. Put all the information into SPSS. For access to the IBM SPSS Statistics documentation on Power Analysis of Independent-Samples T Test, click here.

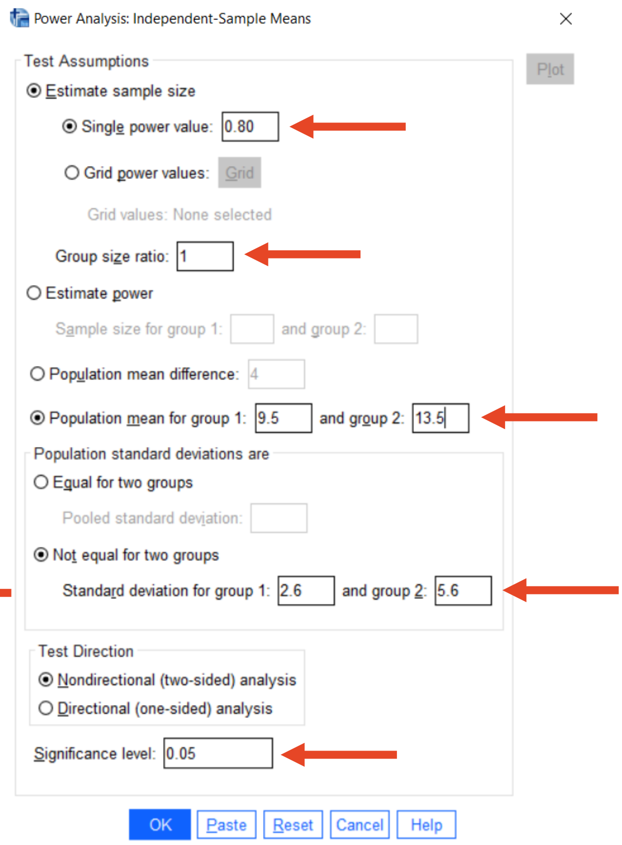
Methods:

1. Analyze > Power Analysis > Means > Independent-Samples T Test



2. Enter the values for the happiness experiment as per either the left (specifying population mean difference) or right (specifying population mean for group 1 and group 2) screenshot below:





3. Click OK. Your output should be as follows:

Power Analysis - Independent Sample Means

Power Analysis Table

	N1	N2	Actual Power[b]	Test Assumptions				
				Power	Std. Dev1	Std. Dev2	Mean Difference	Sig.
Test for Mean Difference[a]	21	21	.818	.8	2.6	5.6	4.000	.05

a. Two-sided test.

b. Based on noncentral t-distribution.

4. Add 15% for non-parametric. N = 21 x 1.15 = 24.15. Since you cannot have 0.15 of a person, you should round up the sample size to 25 people per group.

3. Difference between 2 proportions

Example: Happiness Survey

The survey scores could also be analysed as proportions by considering how many report a value above a threshold (say >14 means "happy").

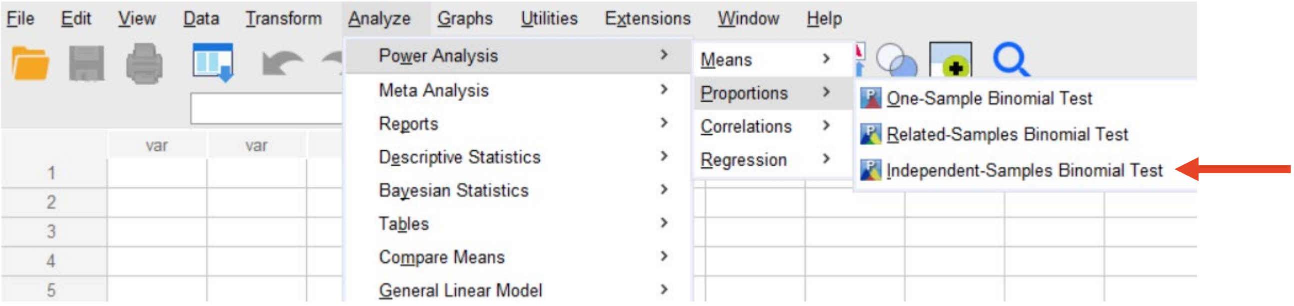
- Singles group: P1 = proportion of subjects who respond "happy"
- Married group: P2 = proportion of subjects who respond "happy"

Question 3: Say you want to find a minimum difference in proportions of P1 – P2 = 0.1. What sample size is required?

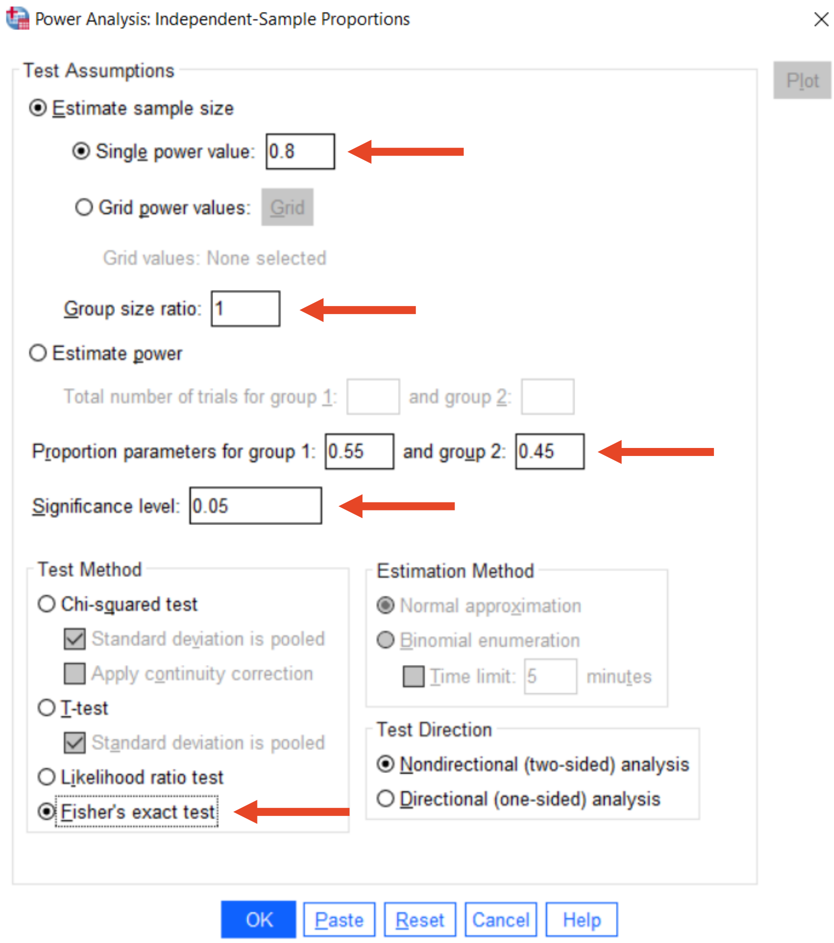
Step 1	Determine experiment type and statistical test	Fisher's Exact test (should be used when sample sizes are going to be small but can also be used for larger sample sizes providing you with a more conservative estimate).
Step 2	Set α and $1 - \beta$	$\alpha = 0.05$ and $1 - \beta = 0.8$
Step 3	Set the smallest effect size of interest (SESOI)	SESOI = P1 – P2 = 0.1
Step 4	Estimate the variance	You also need to estimate the two proportions. Let's first assume that there will be maximum variance (p = 0.50), so let's try using P1 = 0.55 and P2 = 0.45.
Step 5	Calculate the minimum sample size	Put all the information into SPSS. For access to the IBM SPSS Statistics documentation on Power Analysis of Independent-Samples Binomial Test, click here.
Step 6	Explore scenarios	You will also run the sample with P1 = 0.85 and P2 = 0.95.

Methods:

1. Analyze > Power Analysis > Proportions > Independent-Samples Binomial Test



2. Enter the values for the happiness experiment as per the screenshot below.



3. Click OK. Your output should be as follows:

Power Analysis Table

	N1	N2	Actual Power[b]	Test Assumptions				
				Power	Risk Difference	Risk Ratio	Odds Ratio	Sig.
Test for Proportion Difference[a]	411	411	.800	.8	.100	1.222	1.494	.05

a. Two-sided test using large-sample approximation.

b. Based on the Fisher's exact test.

4. Repeat the process using P1 = 0.85 and P2 = 0.95. Your output should be as follows:

Power Analysis Table

	N1	N2	Actual Power[b]	Test Assumptions				
				Power	Risk Difference	Risk Ratio	Odds Ratio	Sig.
Test for Proportion Difference[a]	153	153	.800	.8	-.100	.895	.298	.05

a. Two-sided test using large-sample approximation.

b. Based on the Fisher's exact test.