Prism Manual
Categorical Data Analysis

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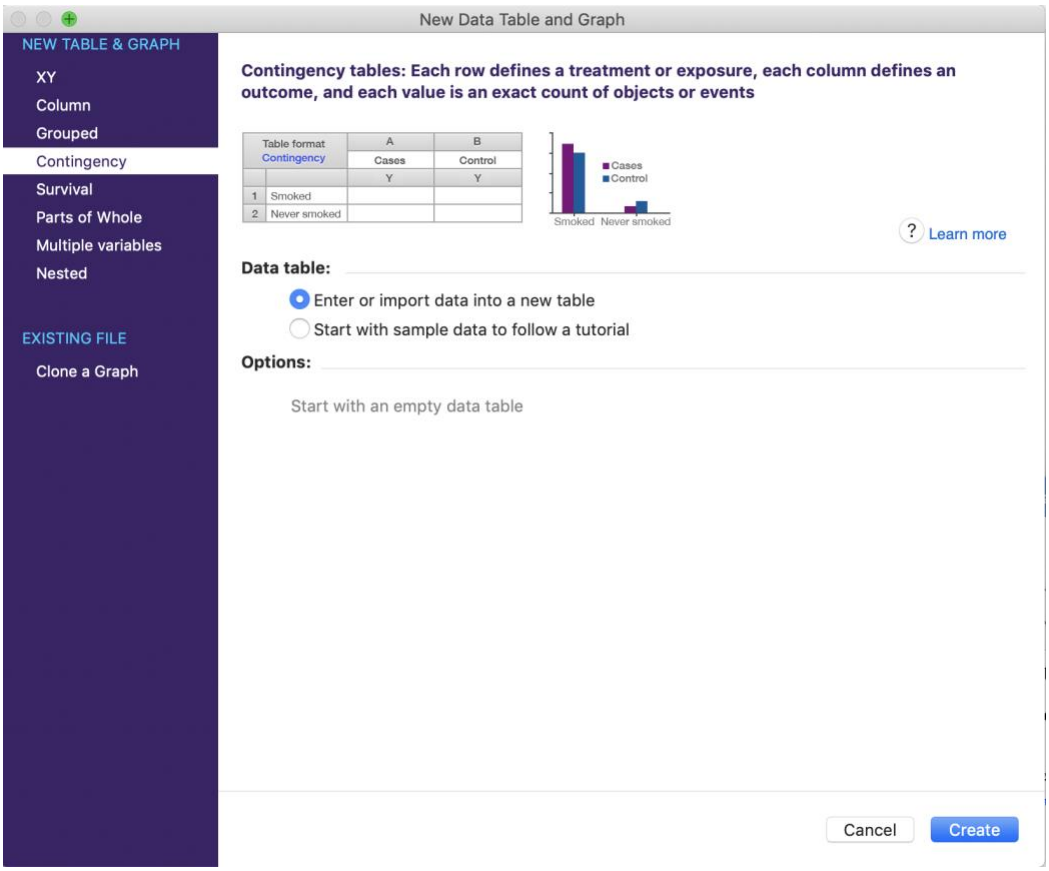
This lab will introduce the methods of conducting categorical data analysis using examples from Categorical data analysis workshop in Prism. For more analysis for categorical data analysis in Prism, please check chapter in Prism statistics guide. To learn more about the examples and interpretation, please categorical data analysis lecture note provided by BCBB.

0. Outline:

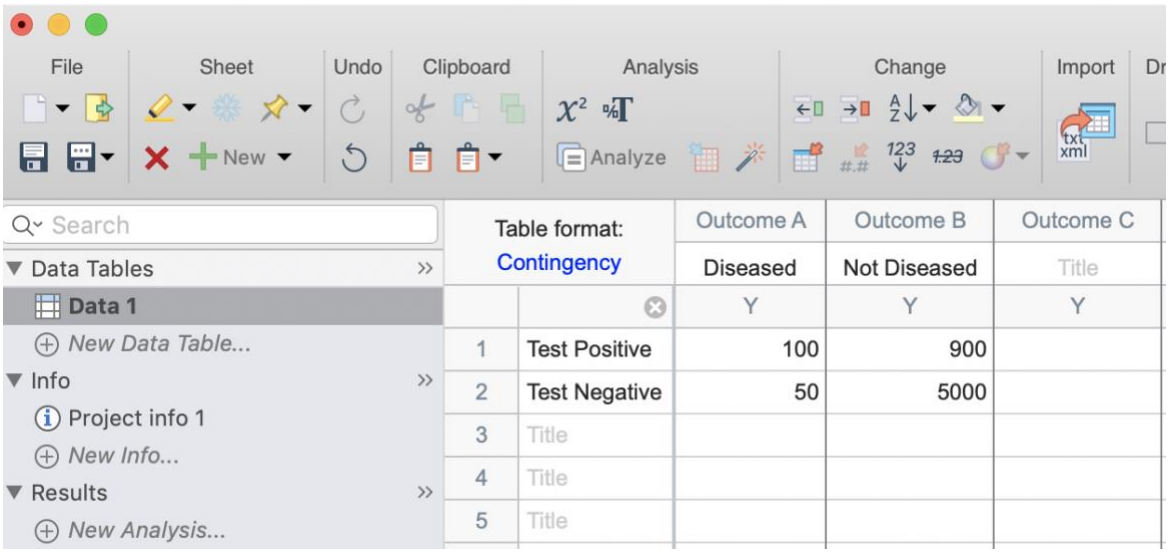
1) Positive predictive value and Negative predictive value
2) Sensitivity, Specificity
3) Odds ratio
4) Relative risk
5) Perform statistical testing for contingency table

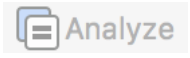
1. Positive predictive value and Negative predictive value

1.1 Copy the data 1 from Prism example.csv. Open Prism, Select **Contingency** under "New Table & Graph"; Select **Enter or import data into a new table**, then click **Create**.

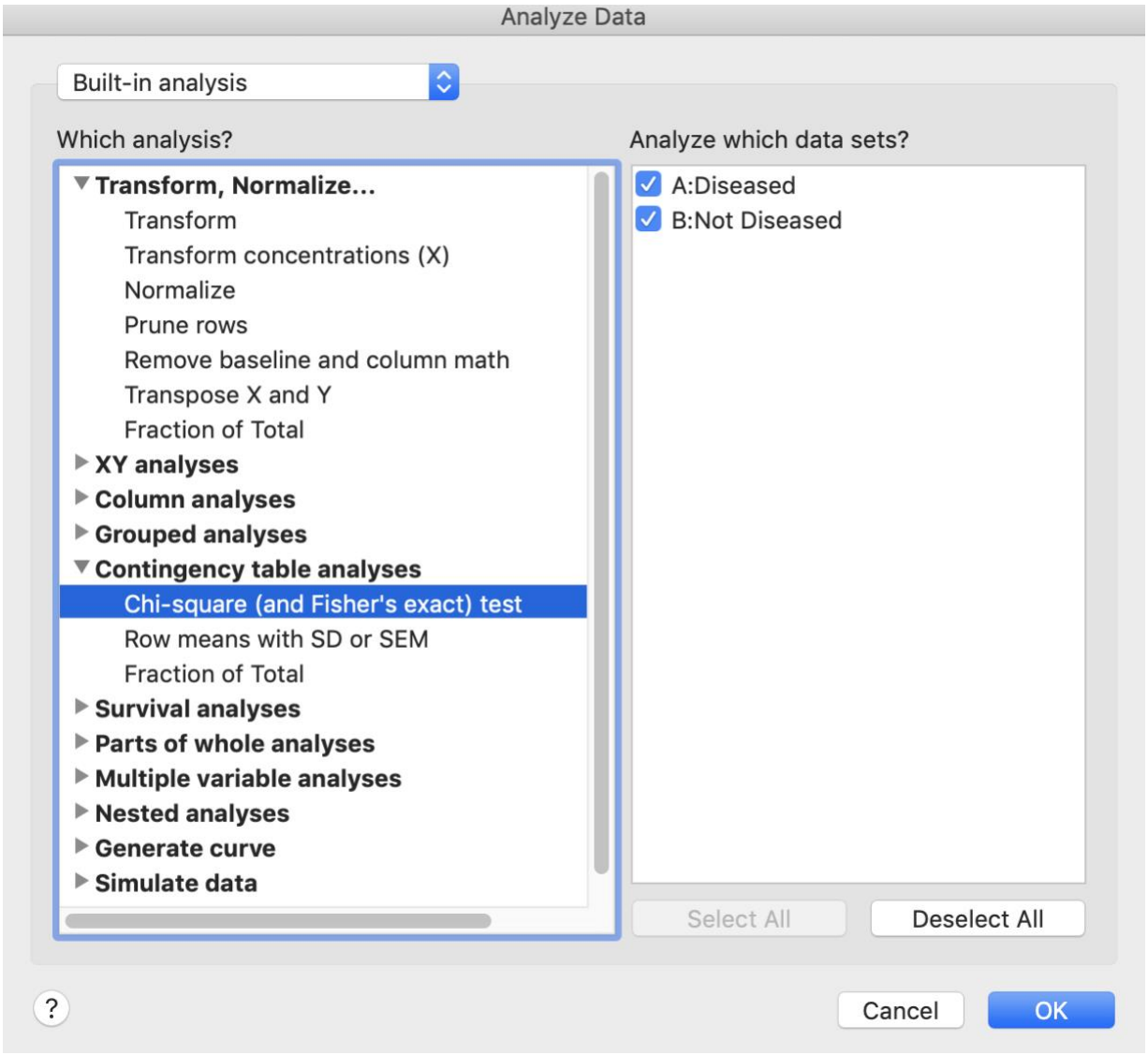


1.2 **Copy data 1** from "Prism examples.xlsx" into the blank sheet.

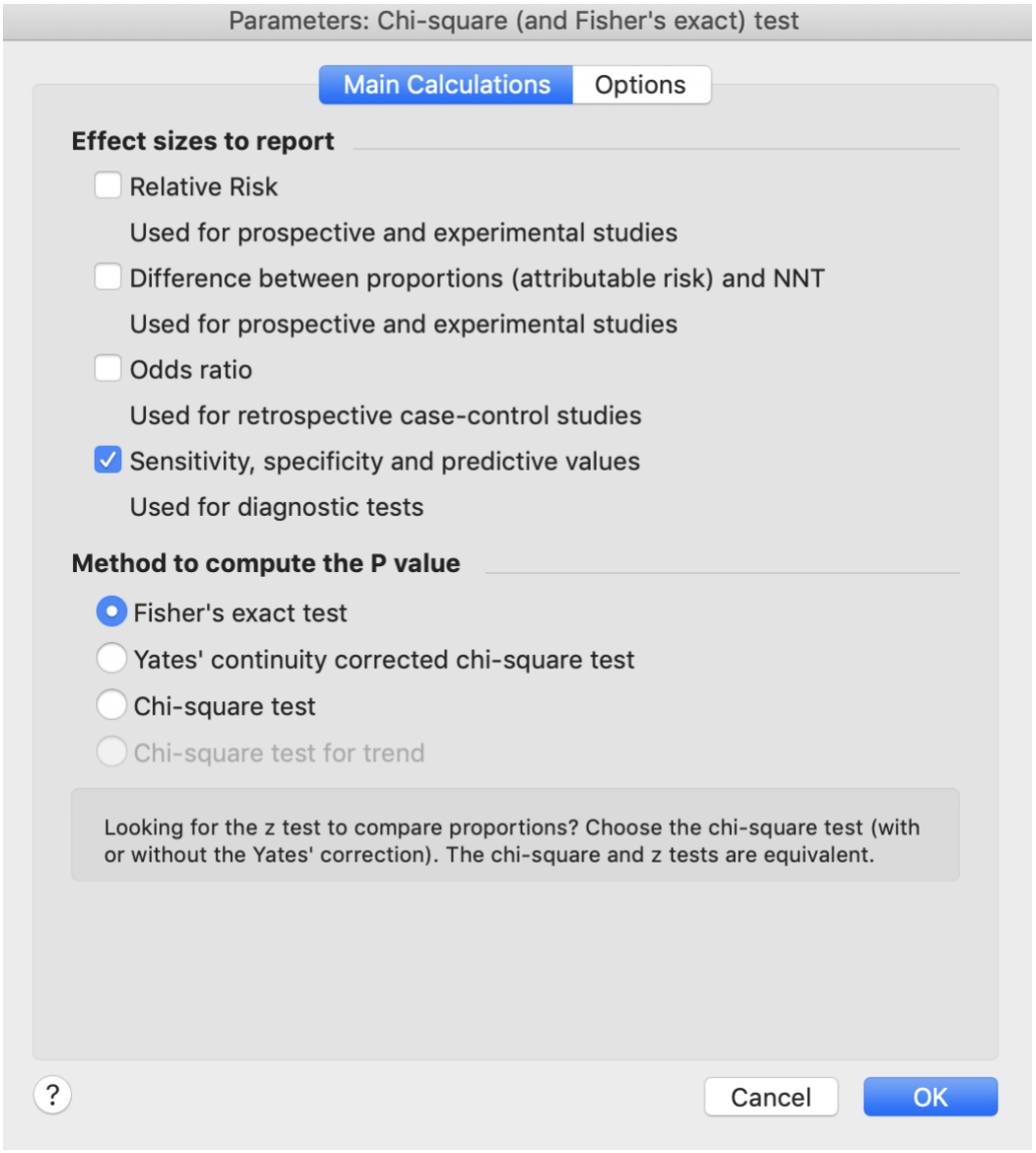


1.3 Click **Analyze** 

then select **Chi-square (and Fisher's exact) test** under Contingency table analyses list, then click **OK.**



1.4 Check **Sensitivity, specificity and predictive values** under Main Calculations menu. Click **OK**.

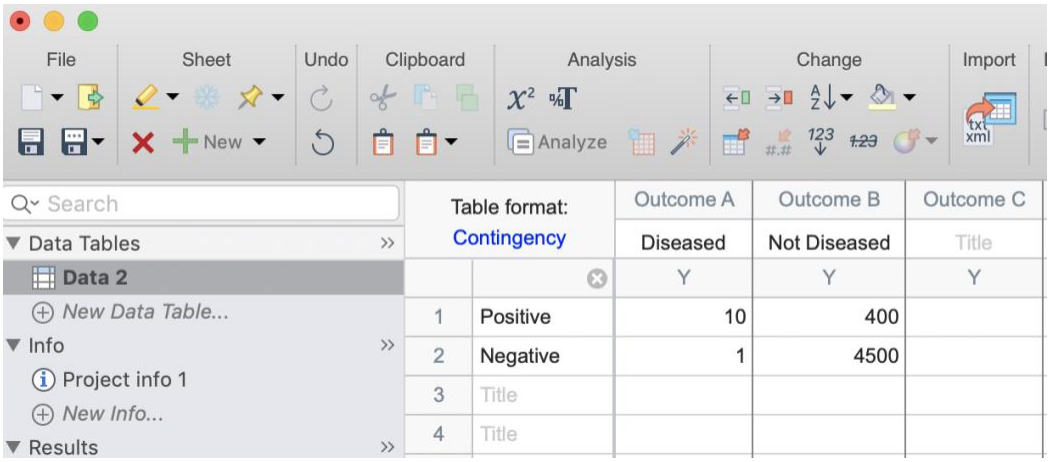


1.5 Prism will return the report with 95% confidence interval. They are circled in red below.

	Contingency				
4	Test	Fisher's exact test			
5	P value	<0.0001			
6	P value summary	****			
7	One- or two-sided	Two-sided			
8	Statistically significant (P < 0.05)?	Yes			
9					
10	**Effect size**	**Value**	**95% CI**		
11	Sensitivity	0.6667	0.5879 to 0.737		
12	Specificity	0.8475	0.8381 to 0.856		
13	Positive Predictive Value	0.1000	0.08291 to 0.12		
14	Negative Predictive Value	0.9901	0.9870 to 0.992		
15	Likelihood Ratio	4.370			
16					
17	**Methods used to compute CIs**				
18	Sensitivity, specificity, etc.	Wilson-Brown			
19					
20	**Data analyzed**	**Diseased**	**Not Diseased**	**Total**	
21	Test Positive	100	900	1000	
22	Test Negative	50	5000	5050	
23	Total	150	5900	6050	
24					
25	**Percentage of row total**	**Diseased**	**Not Diseased**		
26	Test Positive	10.00%	90.00%		
27	Test Negative	0.99%	99.01%		
28					
29	**Percentage of column total**	**Diseased**	**Not Diseased**		
30	Test Positive	66.67%	15.25%		
31	Test Negative	33.33%	84.75%		
32					
33	**Percentage of grand total**	**Diseased**	**Not Diseased**		
34	Test Positive	1.65%	14.88%		
35	Test Negative	0.83%	82.64%		
36					

2. Sensitivity, specificity

2.1 Open a blank contingency sheet (see 1.1). **Copy data 2** from “Prism examples.xlsx”.

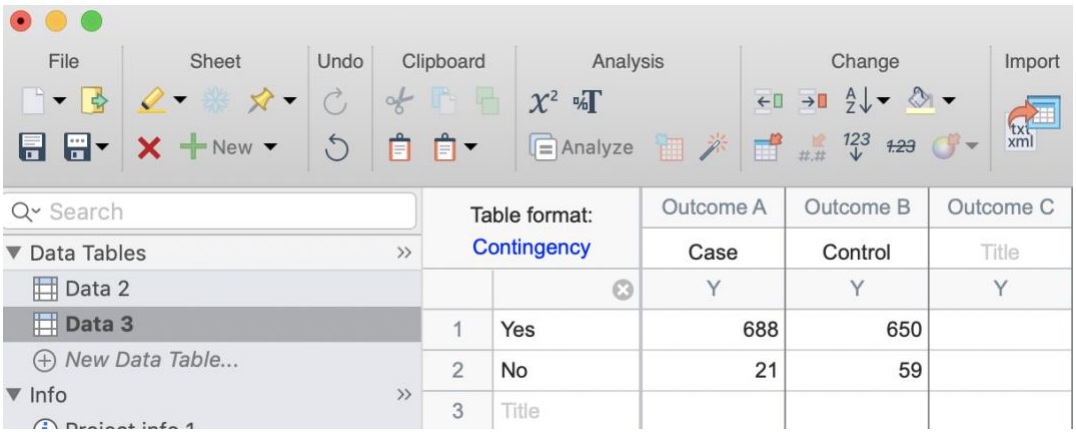


2.2 **Follow 1.3 and 1.4** (same way as calculating PPV and NPV). Prism will return result with 95% confidence interval.

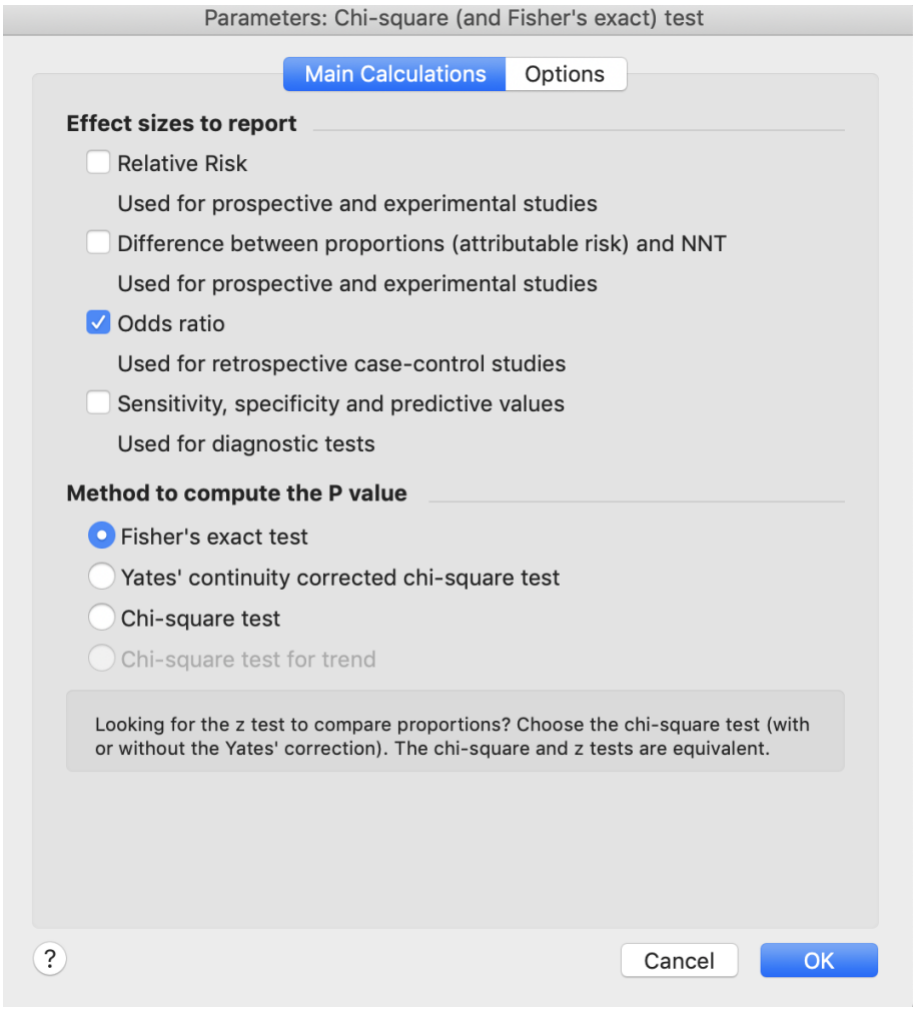
	Contingency			
1	**Table Analyzed**	Data 2		
2				
3	**P value and statistical significance**			
4	Test	Fisher's exact test		
5	P value	<0.0001		
6	P value summary	****		
7	One- or two-sided	Two-sided		
8	Statistically significant (P < 0.05)?	Yes		
9				
10	**Effect size**	**Value**	**95% CI**	
11	Sensitivity	0.9091	0.6226 to 0.995	
12	Specificity	0.9184	0.9104 to 0.925	
13	Positive Predictive Value	0.02439	0.01330 to 0.04	
14	Negative Predictive Value	0.9998	0.9987 to 1.000	
15	Likelihood Ratio	11.14		
16				
17	**Methods used to compute CIs**			
18	Sensitivity, specificity, etc.	Wilson-Brown		
19				
20	**Data analyzed**	**Diseased**	**Not Diseased**	**Total**
21	Positive	10	400	410
22	Negative	1	4500	4501
23	Total	11	4900	4911
24				
25	**Percentage of row total**	**Diseased**	**Not Diseased**	
26	Positive	2.44%	97.56%	
27	Negative	0.02%	99.98%	
28				
29	**Percentage of column total**	**Diseased**	**Not Diseased**	
30	Positive	90.91%	8.16%	
31	Negative	9.09%	91.84%	
32				
33	**Percentage of grand total**	**Diseased**	**Not Diseased**	
34	Positive	0.20%	8.14%	
35	Negative	0.02%	91.63%	

3. Odds ratio

3.1 Open a blank contingency sheet (see 1.1). **Copy data 3** from “Prism examples.xlsx”.



3.2 Click **Analyze,** select **Chi-square (and Fisher's exact) test** under Contingency table analyses list, then click **OK.** Select **Odds ratio.** Then **OK**.



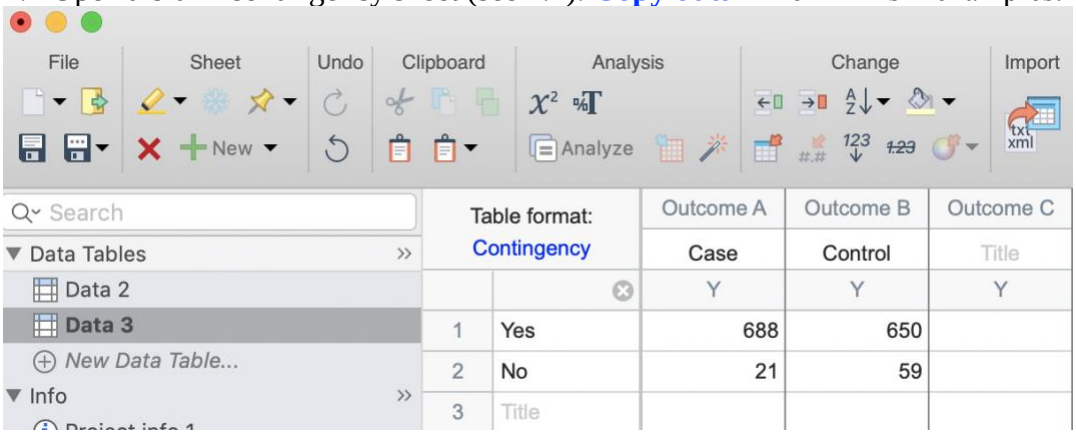
3.3 It will return result with 95% confidence interval. It is circled in Red below.

Contingency

2				
3	**P value and statistical significance**			
4	Test	Fisher's exact test		
5	P value	<0.0001		
6	P value summary	****		
7	One- or two-sided	Two-sided		
8	Statistically significant (P < 0.05)?	Yes		
9				
10	**Effect size**	**Value**	**95% CI**	
11	Odds ratio	2.974	1.819 to 4.900	
12	Reciprocal of odds ratio	0.3363	0.2041 to 0.54	
13				
14	**Methods used to compute CIs**			
15	Odds ratio	Baptista-Pike		
16				
17	**Data analyzed**	**Case**	**Control**	**Total**
18	Yes	688	650	1338
19	No	21	59	80
20	Total	709	709	1418
21				
22	**Percentage of row total**	**Case**	**Control**	
23	Yes	51.42%	48.58%	
24	No	26.25%	73.75%	
25				
26	**Percentage of column total**	**Case**	**Control**	
27	Yes	97.04%	91.68%	
28	No	2.96%	8.32%	
29				
30	**Percentage of grand total**	**Case**	**Control**	
31	Yes	48.52%	45.84%	
32	No	1.48%	4.16%	

4. Relative Risk

4.1 Open a blank contingency sheet (see 1.1). **Copy data 4** from "Prism examples.xlsx".



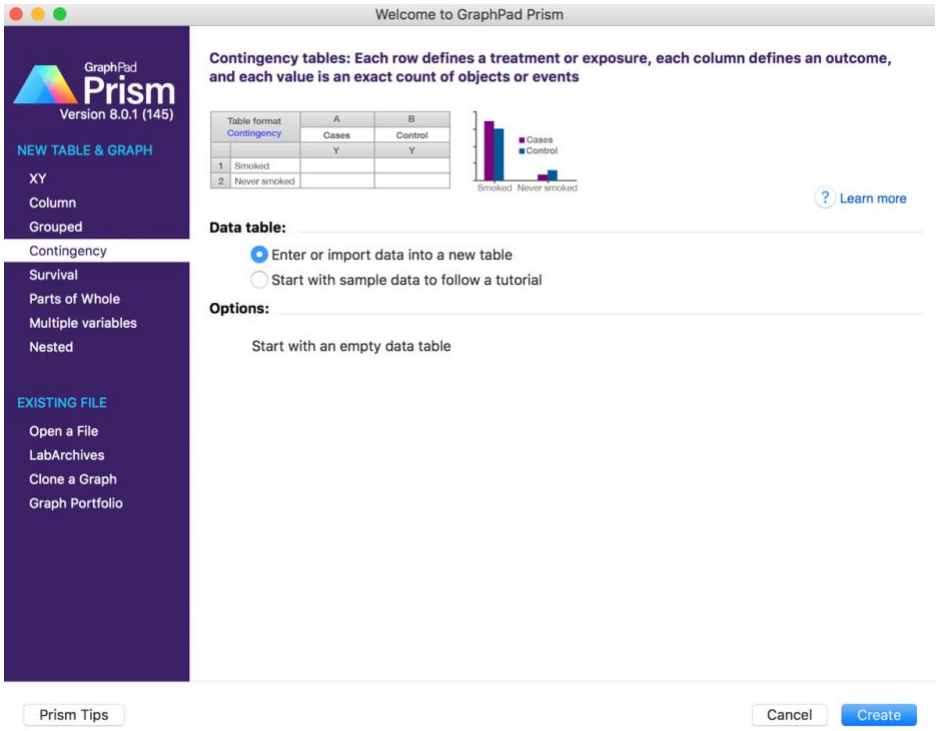
4.2 Click **Analyze,** select **Chi-square (and Fisher's exact) test** under Contingency table analyses list, then click **OK.** Select **Relative risk.** Then **OK**.

4.3 Result return with 95% confidence interval.

	Contingency			
1	**Table Analyzed**	Data 1		
2				
3	**P value and statistical significance**			
4	Test	Fisher's exact test		
5	P value	<0.0001		
6	P value summary	****		
7	One- or two-sided	Two-sided		
8	Statistically significant (P < 0.05)?	Yes		
9				
10	**Effect size**	**Value**	**95% CI**	
11	Relative Risk	0.5501	0.4339 to 0.697	
12	Reciprocal of relative risk	1.818	1.434 to 2.305	
13				
14	**Methods used to compute CIs**			
15	Relative Risk	Koopman asymptot		
16				
17	**Data analyzed**	**MI**	**No MI**	**Total**
18	Aspirin	104	10933	11037
19	Placebo	189	10845	11034
20	Total	293	21778	22071
21				
22	**Percentage of row total**	**MI**	**No MI**	
23	Aspirin	0.94%	99.06%	
24	Placebo	1.71%	98.29%	
25				
26	**Percentage of column total**	**MI**	**No MI**	
27	Aspirin	35.49%	50.20%	
28	Placebo	64.51%	49.80%	
29				
30	**Percentage of grand total**	**MI**	**No MI**	
31	Aspirin	0.47%	49.54%	
32	Placebo	0.86%	49.14%	
33				

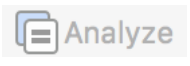
5. 1 Pearson Chi-square test

5.1.1 Select **Contingency** under "New Table & Graph"; Select **Enter or import data into a new table**, then click **Create**.

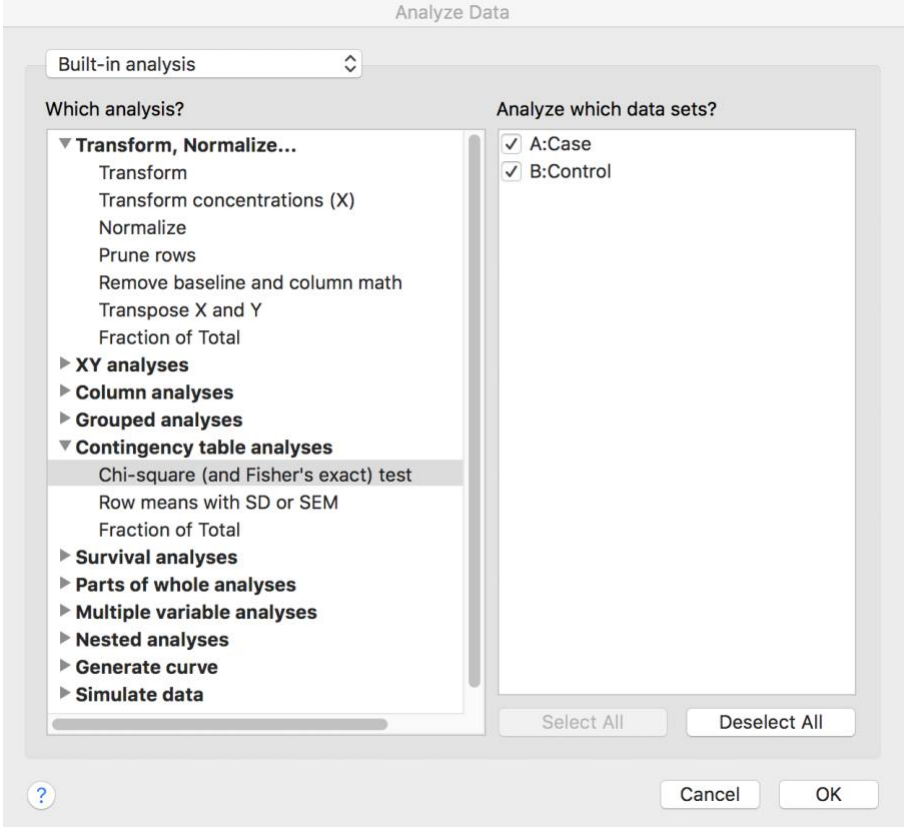


5.1.2 Open a blank contingency sheet (see 1.1). **Copy data 3** from "Prism examples.xlsx".

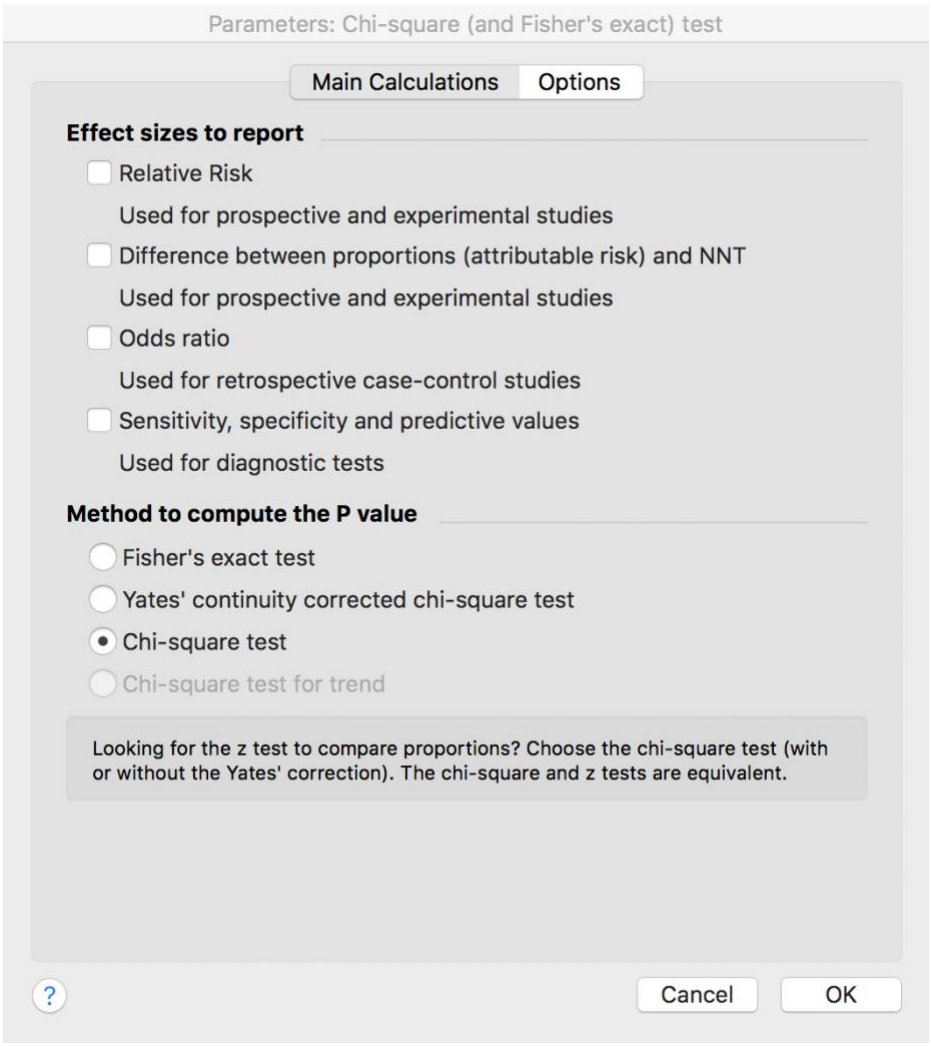
Table format: Contingency		Outcome A	Outcome B
		Case	Control
		Y	Y
1	smoking	688	650
2	not smoking	21	59

5.1.3 Click **Analyze** 

then select **Chi-square (and Fisher's exact) test** under Contingency table analyses list. Check the columns you want to analyze on the right side, then click **OK**.



5.1.4 Select test type under Method to compute P value and other report statistic under Effect sizes to report. Click **Chi-square test**, then **OK**.



5.1.5 Result includes p-value, marginal table, and marginal percentage. Chi-square statistic, degree of freedom and p-value are circled. Test result is significant, which means reject the null hypothesis that smoking and lung cancer are independent.

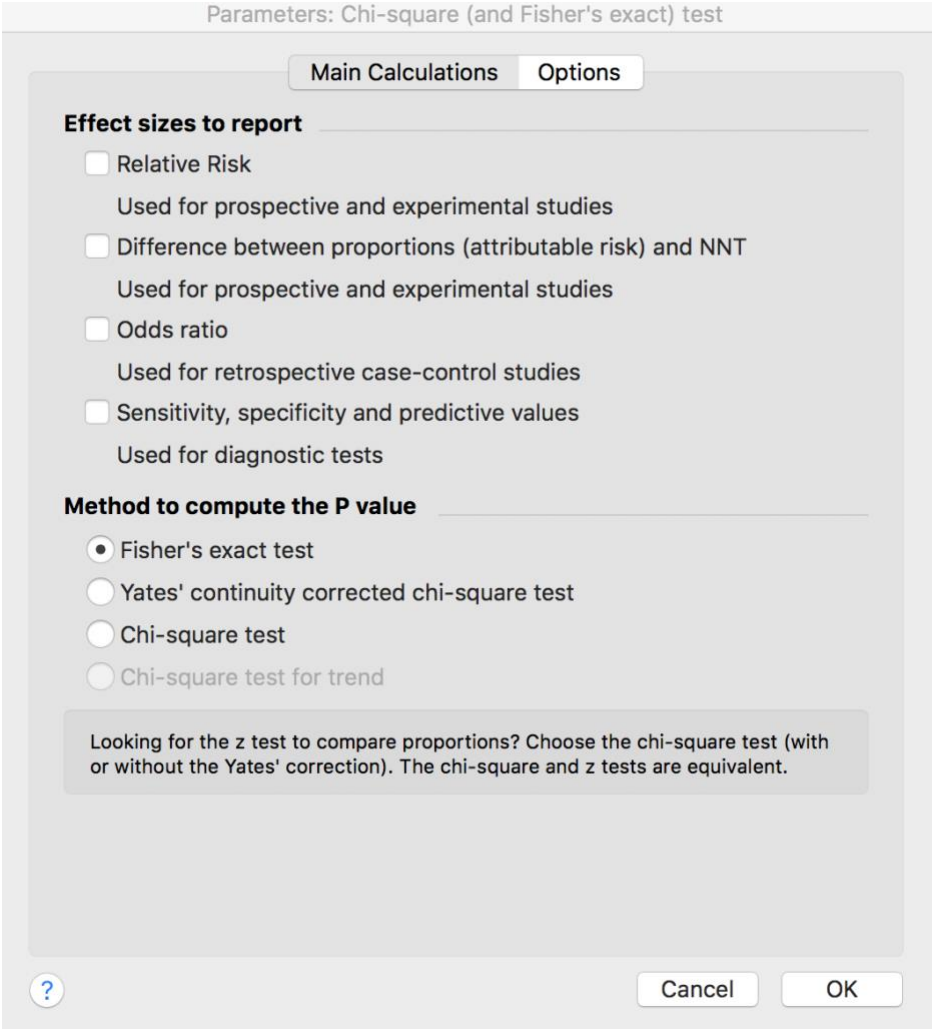
	Contingency			
1	Table Analyzed	Data 3		
2				
3	**P value and statistical significance**			
4	Test	Chi-square		
5	Chi-square, df	19.13, 1		
6	z	4.374		
7	P value	<0.0001		
8	P value summary	****		
9	One- or two-sided	Two-sided		
10	Statistically significant (P < 0.05)?	Yes		
11				
12	**Data analyzed**	**Case**	**Control**	**Total**
13	smoking	688	650	1338
14	not smoking	21	59	80
15	Total	709	709	1418
16				
17	**Percentage of row total**	**Case**	**Control**	
18	smoking	51.42%	48.58%	
19	not smoking	26.25%	73.75%	
20				
21	**Percentage of column total**	**Case**	**Control**	
22	smoking	97.04%	91.68%	
23	not smoking	2.96%	8.32%	
24				
25	**Percentage of grand total**	**Case**	**Control**	
26	smoking	48.52%	45.84%	
27	not smoking	1.48%	4.16%	

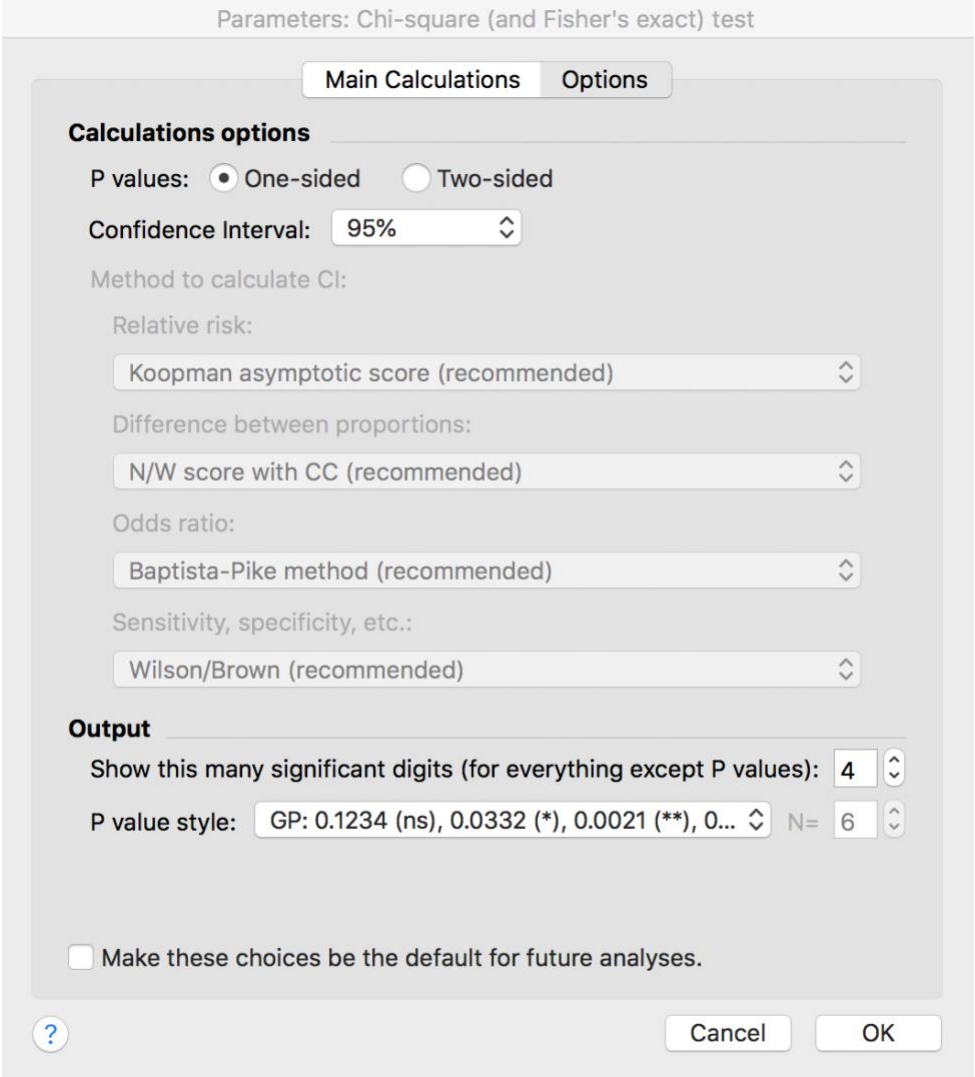
5.2 Fisher's exact test

5.2.1 Follow 5.1.1 to open a blank data sheet. Copy **data 5 from "Prism examples.xlsx".**

Table format: Contingency		Outcome A	Outcome B
		Guess mik first	Guess tea first
		Y	Y
1	Pour milk first	3	1
2	Pour tea first	1	3

5.2.2 Select test type under Method to compute P value and other report statistic under Effect sizes to report. Click **Fisher's exact test**, then go to **Options**, select **One-sided** under Calculations options, then click **OK**.





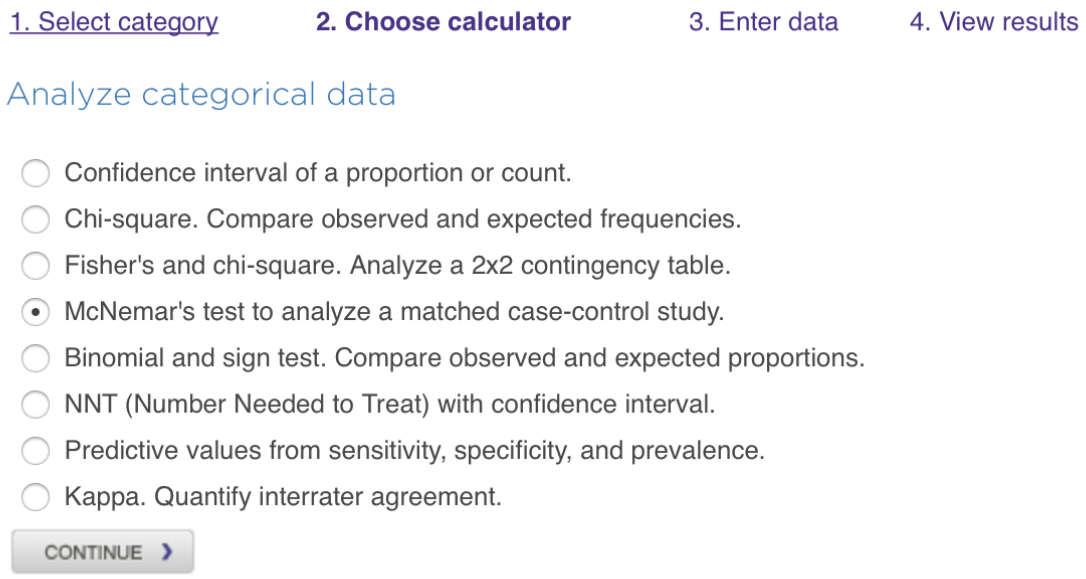
5.2.3 Review Result includes p-value, marginal table, and marginal percentage. p-value is circled. Test result is not significant, which means cannot reject the null hypothesis that pouring order and guessing order are independent.

	Contingency			
1	Table Analyzed	Data 1		
2				
3	**P value and statistical significance**			
4	Test	Fisher's exact test		
5	P value	0.2429		
6	P value summary	ns		
7	One- or two-sided	One-sided		
8	Statistically significant (P < 0.05)?	No		
9				
10	**Data analyzed**	**Guess mik first**	**Guess tea first**	**Total**
11	Pour milk first	3	1	4
12	Pour tea first	1	3	4
13	Total	4	4	8
14				
15	**Percentage of row total**	**Guess mik first**	**Guess tea first**	
16	Pour milk first	75.00%	25.00%	
17	Pour tea first	25.00%	75.00%	
18				
19	**Percentage of column total**	**Guess mik first**	**Guess tea first**	
20	Pour milk first	75.00%	25.00%	
21	Pour tea first	25.00%	75.00%	
22				
23	**Percentage of grand total**	**Guess mik first**	**Guess tea first**	
24	Pour milk first	37.50%	12.50%	
25	Pour tea first	12.50%	37.50%	

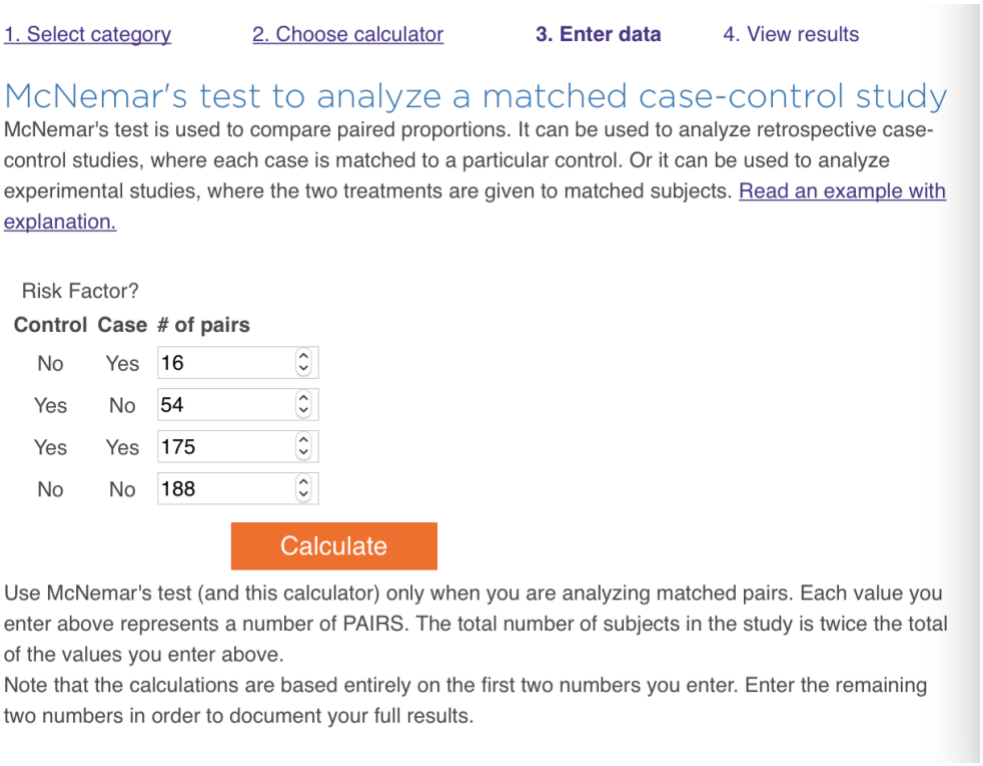
5.3 McNemar test

McNemar test is available via Prism web. (https://www.graphpad.com/quickcalcs/)

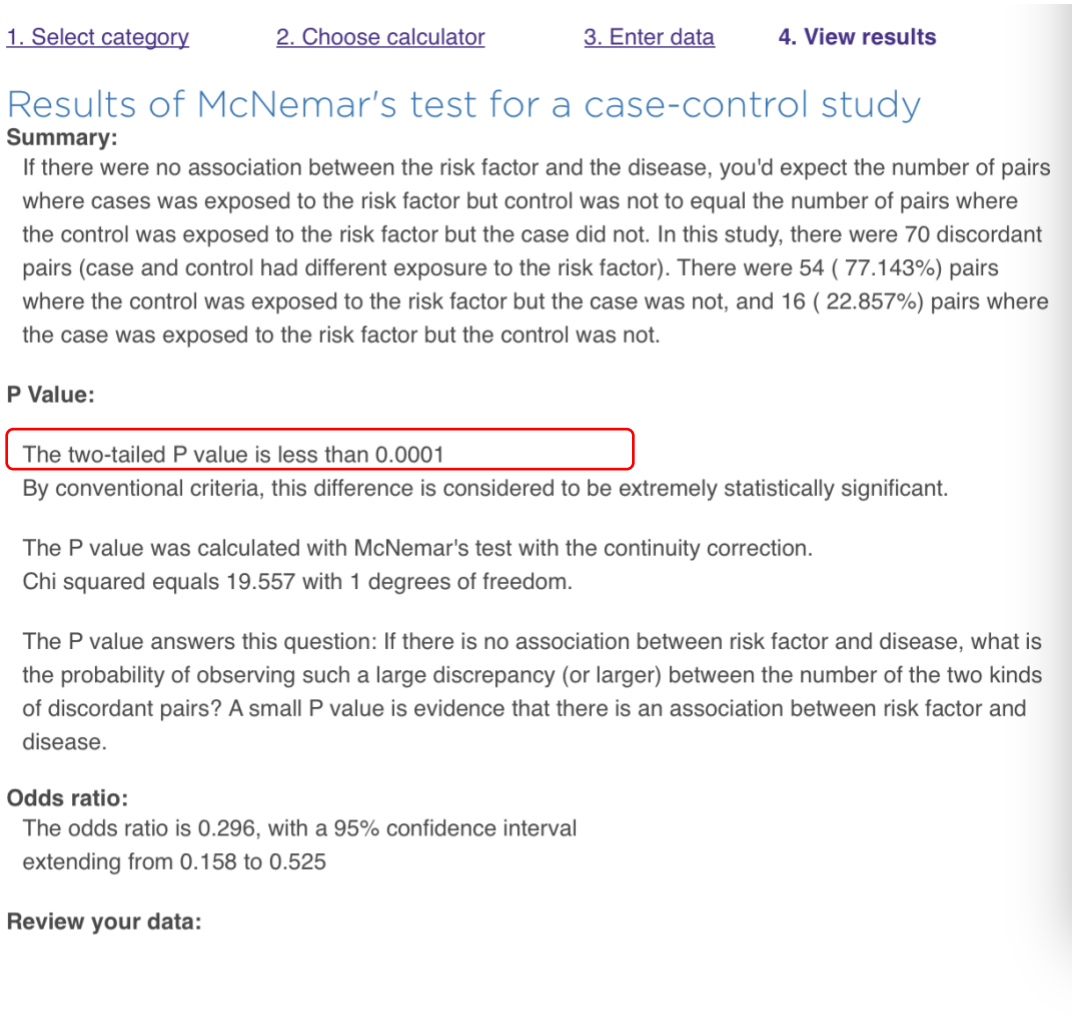
5.3.1 Click in the website above, select Categorical data, select **McNemar's test to analyze a matched case-control study**, then click **Continue**.



5.3.2 **Input # of pairs of case and control**. In our example, 2004 Election as case and 2008 Election as control (or they can be exchanged, result won't change), then click **Calculate**.



5.3.3 Results include summary, p-value, odds ratio and contingency table. The result is significant, we can reject the null hypothesis that 2004 and 2008 election are independent.



1. Select category 2. Choose calculator 3. Enter data **4. View results**

Results of McNemar's test for a case-control study

Summary:

If there were no association between the risk factor and the disease, you'd expect the number of pairs where cases was exposed to the risk factor but control was not to equal the number of pairs where the control was exposed to the risk factor but the case did not. In this study, there were 70 discordant pairs (case and control had different exposure to the risk factor). There were 54 (77.143%) pairs where the control was exposed to the risk factor but the case was not, and 16 (22.857%) pairs where the case was exposed to the risk factor but the control was not.

P Value:

The two-tailed P value is less than 0.0001

By conventional criteria, this difference is considered to be extremely statistically significant.

The P value was calculated with McNemar's test with the continuity correction.
Chi squared equals 19.557 with 1 degrees of freedom.

The P value answers this question: If there is no association between risk factor and disease, what is the probability of observing such a large discrepancy (or larger) between the number of the two kinds of discordant pairs? A small P value is evidence that there is an association between risk factor and disease.

Odds ratio:

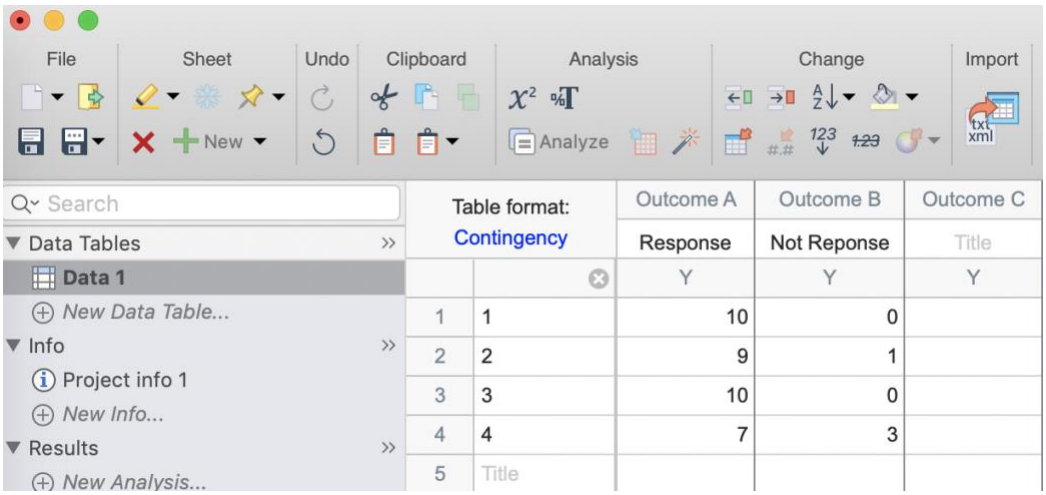
The odds ratio is 0.296, with a 95% confidence interval extending from 0.158 to 0.525

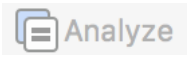
Review your data:

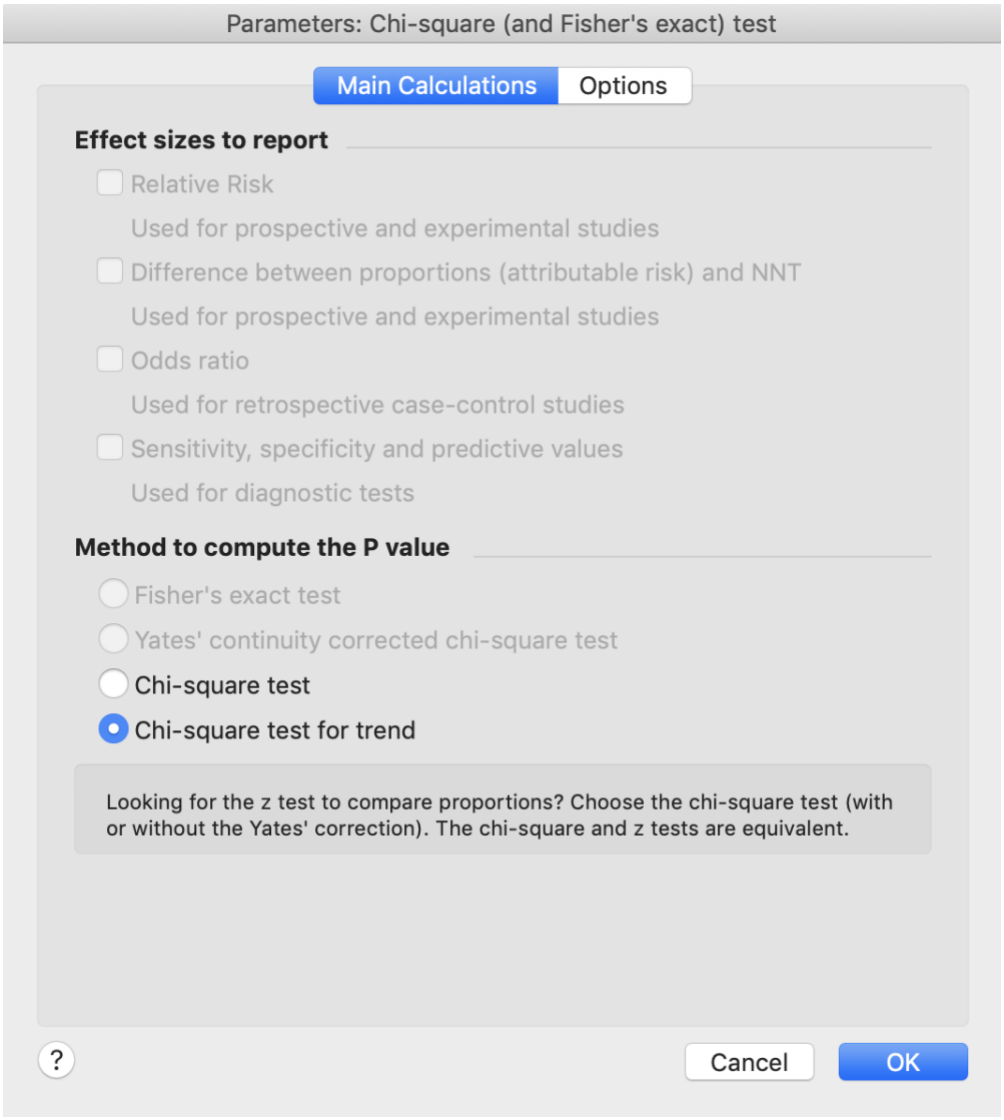
		Control		
		+	-	**Total**
Case	+	175	16	**191**
	-	54	188	**242**
	Total	**229**	**204**	**433**

5.4 Chi-square Test for Trend

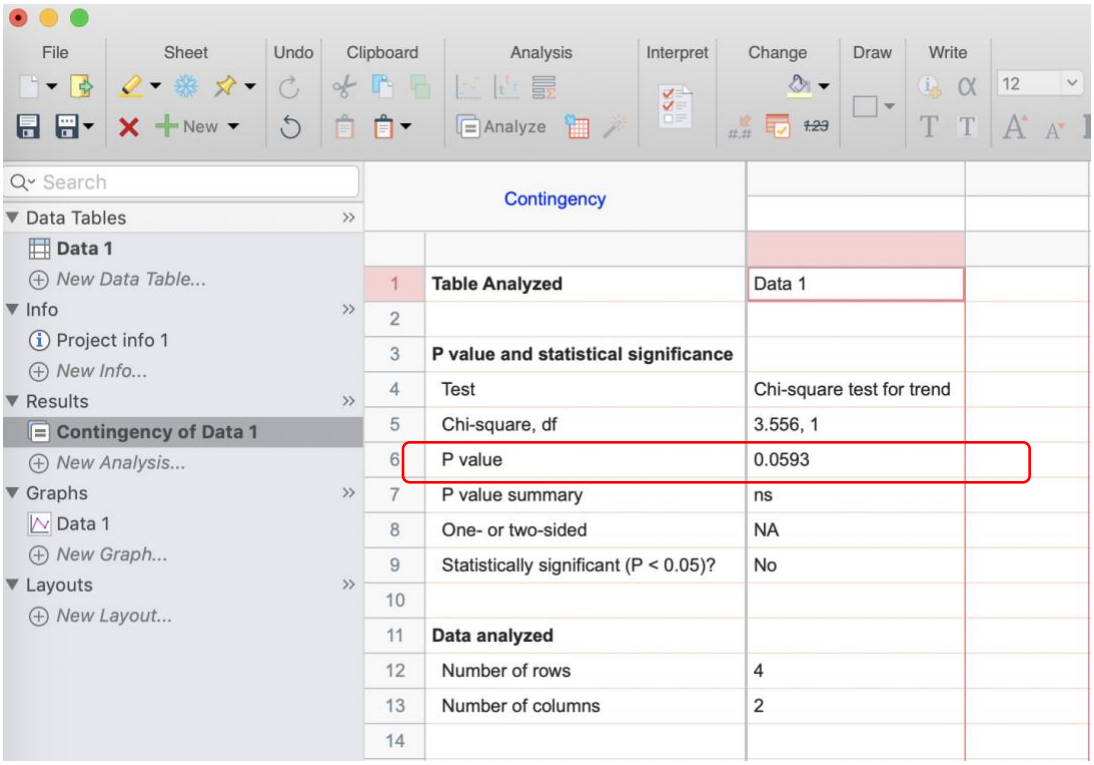
5.4.1 Follow 5.1.1 to open a blank data sheet. Copy **data 6 from "Prism examples.xlsx".**



5.4.2 Click **Analyze**  then select **Chi-square (and Fisher's exact) test** under Contingency table analyses list. Select **Chi-square for trend**. Click Options. Here only two-sided test is default. Then click **OK**.



5.4.3 Review results. P-value is 0.0593. This is two-sided test. We cannot reject the null hypothesis of no linear trend between response across increasing dosage at significance level 0.05.



In the end, if you have any questions regarding to this topic, please contact me (jingwen.gu@nih.gov) or submit a request to BCBB (bioinformatics@niaid.nih.gov).