## How to conduct a Fisher's exact test in Cytel Studio Chong Ho Yu, Ph.D. http://www.creative-wisdom.com

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The objective of this write-up is to illustrate the procedure of running a Fisher's exact test as a supplement to a conventional Pearson's Chi-square test. For the conceptual framework of exact tests, please consult:

- Yu, C. H. (2003). Resampling methods: Concepts, applications, and justification. *Practical Assessment Research and Evaluation*, 8(19). Retrieved from <a href="http://pareonline.net/getvn.asp?v=8&n=19">http://pareonline.net/getvn.asp?v=8&n=19</a>
- Yu, C. H. (2007). Resampling: A conceptual and procedural introduction. In Jason Osborne (Ed.), *Best practices in quantitative methods* (pp. 283-298). Thousand Oaks, CA: Sage Publications.

#### Steps

In Cytel Studio, choose New from the pull down menu File. Next, select Table Data and then click OK.



In this example, we will use two categorical variables, and each variable has two categories. Thus, we will use a 2-colum X 2-row table.

Table Settings	8 X
Dimensions Tables 1 Rows 2 Columns 2 Auxiliary Cell Information Auxiliary Cell Information Auxiliary Cell Information Column Percent Column Percent	Scores Row Column Poisson Data Rate Multiplier
Save Settings Permanently	Reset Help

In this hypothetical data set, there are 48 male students and 42 female students. Some of them are majoring in science while some are majoring in art. We want to know whether gender makes a difference in choosing a major. It could be not the otherwise. Choosing an art major cannot make me a girl. In this step, we can simply enter the labels and the data as follows:

Table1	Male	Female	Total
Art	12	18	30
Science	36	24	60
Total	48	42	90

Next, from the pull down menu **Nonparametrics**, scroll down to **Unordered R X C Table**. Three options will pop up. Although the goal is to perform a Fisher's exact test, you can run a **Pearson's Chi-square test** first to obtain the Chi-square value.

Nonparametrics Power&SampleSize Crossover Options	Win
INFERENCE FOR CONTINUOUS DATA	
One-Sample Goodness-of-Fit	•
Paired Samples	F .
Two Independent Samples (with or without Strata)	•
K Related Samples	•
K Independent Samples	•
INFERENCE FOR CATEGORICAL DATA	
One Sample Rates and Proportions	•
Poisson Rates	•
Two Related Binomials	•
Two Independent Binomials	•
Stratified 2 x 2 Tables	F .
C Ordered Binomials (with or without Strata)	
I wo Ordered Multinomials (with or without Strata)	Desurs la Chi servere
Unordered K X C Table	Pearson's Chi-square
Singly Ordered R x C Table	Ficher Freeman Helton
Stratified R x C Tables (CMH)	Fisher-Reeman-Haiton
Stratilieu (CX C Tables (CMH)	
INFERENCE FOR CORRELATED CATEGORICAL DATA	
C Binomial Populations	
Multiple Binary Outcomes	•
INFERENCE FOR MEASURES OF ASSOCIATION	
Ordinal Response	•
Nominal Response	•
Measures of Agreement	<b>&gt;</b>
Settings for Nonparametric Procedures	

Another window will prompt you to choose an inference method. You can select any one of the options. With such a small sample size, Cytel Studio will yield both asymptotic and exact p values by default.

Pearson's Chi-Square Test		P	X
[Inference for Categorical Data	: Unordered RxC	Table:]	
Compute	Exact (	C Exact using Mont	e Carlo
OK Reset	Options	Cancel	Help

The Chi-square test shows you the p values, the **Pearson Chi-square statistics** and the **Chi-square with Yates CC**.

## **Pearson Chi-Square Test**

Summary of the 1	Test Statistic:	
Number of Columns:	2	
Number of Rows:	2	
Data File:		
chisqr ( method = monte,	time_limit = none , u	use_impsamp = no );

	Y	Minimum	Maximum	Mean	Std. Dev	
	12	0	30	16	2.244	1
Pearson Chi-Square Stat Chi-Square Statistic with Inference:	tistic h Yates CC	3.214		_		
				P-Va	alue	
Туре	Statistic	DF	Tail	1-Sided	2-Sided	Point Prob.
Asymptotic	3.214	1	.GE.	0.0365	0.073	6
Exact	3.214		.GE.		0.116	0.07319
Exact	12		.LE.	0.05828		0.03661

Elapsed time: 0:0:0.01

Next, run a **Fisher's exact test**. Again, you have three options. With a small data set, you can select the **Exact** option, which will use all possible permutations. However, when you have a large data set, it could be very computing-intensive and time-consuming. It is better to choose **Exact using Monte Carlo** by default. In this option, a subset of all possible permutations will be simulated.

Fisher-Freeman-Halton Test	<b>?</b> X
[Inference for Categorical Data: Unordered RxC Table:]	
Compute C Asymptotic Only C Exact © Exact using OK Reset Options Cancel	Monte Carlo Help

In this example, you can see that the statistics of the Fisher's exact test is slightly different from that of the Pearson's Chi-square test. Using a two-sided test, both test concur that there is no gender effect in major selection.

# **Fisher's Exact Test**

fisher\_exact ( method = monte, time\_limit = none , use\_impsamp = no );
Data File:

Number of Rows:2Number of Columns:2

#### Summary of the Test Statistic:

	Y	Minimum	Maximum	Mean	Std. Dev	Observed
	12	0	30	16	2.244	3.172
Inference: Hypergeometric Prob. of	the table:	0.03661				/
				P-V	alue	
Туре	Statistic	DF	Tail	1-Sided	2-Sided	Point Prob.
Asymptotic	3.172	1	.GE.	0.03745	0.0749	
Exact	3.172		.GE.		0.116	0.03661

Elapsed time: 0:0:0.01