2-way Contingency Table Analysis

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This page computes various statistics from a 2-by-2 table. It will calculate the Yates-corrected chi-square, the Mantel-Haenszel chi-square, the Fisher Exact Test, and other indices relevant to various special kinds of 2-by-2 tables:

1. analysis of risk factors for unfavorable outcomes (odds ratio, relative risk, difference in proportions, absolute and relative reduction in risk, number needed to treat)
2. analysis of the effectiveness of a diagnostic criterion for some condition (sensitivity, specificity, pos & neg predictive values, pos & neg likelihood ratios, diagnostic and error odds ratios)
3. measures of inter-rater reliability (% correct or consistent, mis-classification rate, kappa, Forbes' NMI)
4. other measures of association (contingency coefficient, Cramer's phi coefficient, Yule's Q)

Many of these concepts are explained in detail in an online Evidence-based Medicine Glossary. For more information about a particular index, click on the <more info> link for that index.

Confidence intervals for the estimated parameters are computed by a general method (based on "constant chi-square boundaries") given in: *Statistical Methods for Rates and Proportions* (2nd Ed.) Section 5.6, by Joseph L. Fleiss (Pub: John Wiley & Sons, New York, 1981). This method is also described in Numerical Recipes in C (2nd Ed.) Section 15.6, by William H. Press et al. (Pub: Cambridge University Press, Cambridge UK, 1992)

Enter numbers into the four cells below. Make sure that the row and column totals add up correctly. Then click the Compute button.

Warning: Do not enter cell counts with a leading zero! That is, if a cell count is 34, enter it as 34, **not as 034**. Some browsers will mis-interpret some numbers entered with leading zeros, and will produce **wrong results** (with no warning message). For more information about this, and for other things to be aware of before using this page for the first time, make sure you read the JavaStat user interface guidelines.

Observed Contingency Table

*	Outcome Occurred	Outcome did not Occur	Totals
Risk Factor Present or Dx Test Positive	8124 = a	74 = b	8198 = r1
Risk Factor Absent or Dx Test Negative	8146 = c	51 = d	8197 = r2
Totals	16270 = c1	125 = c2	16395 = t

Confidence Level: 95 %

Compute

Chi-Square Tests

Type of Test	Chi Square	d.f.	p-value

Pearson Uncorrected	4.262	1	0.039
Yates Corrected	3.899	1	0.048
Mantel-Haenszel	4.261	1	0.039

Fisher Exact Test

Type of comparison (Alternate Hypothesis)	p-value
Two-tailed (to test if the Odds Ratio is *significantly different* from 1): If you don't know which Fisher Exact p-value to use, **use this one**. This is the p-value produced by SAS, SPSS, R, and other software.	0.048
Left-tailed (to test if the Odds Ratio is *significantly less* than 1):	0.024
Right-tailed (to test if the Odds Ratio is *significantly greater* than 1):	0.985
Two-tailed p-value calculated as described in Rosner's book: (2 times whichever is smallest: left-tail, right-tail, or 0.5) It tends to agree closely with Yates Chi-Square p-value.	0.048
Probability of getting *exactly* the observed table: (This is not really a p-value; don't use this as a significance test.)	0.009
Verification of computational accuracy: (This number should be very close to 1.0; the closer, the better.)	1.00000000005125

Quantities derived from a 2-by-2 table

Quantities Derived from the 2-by-2 Contingency Table	Value	95% Conf. Interval	
Odds Ratio (OR) = (a/b)/(c/d);	0.687	0.481	0.981
Relative Risk (RR) = (a/r1)/(c/r2);	0.997	0.995	1.000
Kappa	-0.003	-0.005	-0.000
Overall Fraction Correct = (a+d)/t ; (often referred to simply as "Accuracy")	0.499	0.497	0.500
Mis-classification Rate, = 1 - Overall Fraction Correct;	0.501	0.500	0.503
Sensitivity = a/c1; (use exact Binomial confidence intervals instead of these)	0.499	0.499	0.500
Specificity = d/c2; (use exact Binomial confidence intervals instead of these)	0.408	0.326	0.495
Positive Predictive Value (PPV) = a/r1; (use exact Binomial confidence intervals instead of these)	0.991	0.990	0.992
Negative Predictive Value (NPV) = d/r2; (use exact Binomial confidence intervals instead of these)	0.006	0.005	0.008
Difference in Proportions = a/r1 - c/r2;	-0.003	-0.005	-0.000
# Needed to Treat = 1 / Difference in Proportions;	356.531	188.586	7042.774
Absolute Risk Reduction (ARR) = c/r2 - a/r1; <more info>	0.003	0.000	0.005
Relative Risk Reduction (RRR) = ARR/(c/r2); <more info>	0.003	0.000	0.005
Positive Likelihood Ratio (+LR) = Sensitivity / (1 - Specificity);	0.843	0.740	0.991

Negative Likelihood Ratio (-LR) = (1 - Sensitivity) / Specificity;	1.227	1.009	1.537
Diagnostic Odds Ratio = (Sensitivity/(1-Sensitivity))/((1-Specificity) /Specificity);	0.687	0.481	0.981
Error Odds Ratio = (Sensitivity/(1-Sensitivity))/(Specificity /(1-Specificity));	1.447	2.056	1.019
Youden's J = Sensitivity + Specificity - 1;	-0.093	-0.175	-0.005
Number Needed to Diagnose (NND) = 1 / (Sensitivity - (1 - Specificity)) = 1 / (Youden's J); <more info>	-10.790	-213.147	-5.707
Forbes' NMI Index; <more info>	0.003	0.011	0.000
Contingency Coefficient;	0.016	0.030	0.001
Adjusted Contingency Coefficient;	0.023	0.043	0.001
Phi Coefficient (= Cramer's Phi, and = Cohen's w Index, for 2x2 table);	-0.016	-0.030	-0.001
Yule's Q = (a*d-b*c)/(a*d+b*c) = (OR - 1) / (OR + 1); <more info>	-0.185	-0.350	-0.009
Equitable Threat Score = (a-e)/(a+b+c-e), where e = r1*c1/t; <more info>	-0.001	-0.003	-0.000

If you don't see your favorite "quantity" in this list,
drop me a line and let me know how that quantity is calculated from the four cell counts,
and I'll add it to the collection!

Reference: Bernard Rosner, *Fundamentals of Biostatistics*, 6th Ed., 2006

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