Documentation for
Pair-Matched Case-Control Studies

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This module calculates p-values and odds ratios for pair-matched case-control studies. First, the user is prompted to enter the number of case-control pairs into a table:

The upper left cell in the above table and lower right cell are concordant cells in that the case-control pairs have the same exposure (i.e., either both exposed or both not exposed). The numbers in these cells are not used in any calculations in this module. The upper right and lower left cells are the discordant cells where the case-control pairs differ in their exposure. In general, if exposure is associated with disease, one would expect the number of case-control pairs in the upper right cell (case exposed but matched control not exposed) to be larger than the number of pairs in the lower left cell.

Using the demo data, the results would appear as in the box below. The interpretation would be that matched odds ratio is 7.0 (95% Mid-P exact CI: 1.1, 159.0) and the Mid-P exact p-value = 0.039 implying a significant association between the exposure and the case-control status.

Matched Pair Case-Control Study

Single Table Analysis

		Controls			
		(+)	(-)		
Cases	(+)	3	7	10	
		30%	70%	100%	
		75%	43.8%		
	(-)	1	9	10	
		10%	90%	100%	
		25%	56.3%		
		4	16	20	
		20%	80%	100%	
		100%	100%		

Measures of Association

P Values

Test	Value	d.f.	1-tail	2-tail
McNemar:	4.5	1		0.03389
McNemar with continuity correction:	3.125	1		0.07710
Fisher exact			0.03516	0.07031
Mid-P exact			0.01953	0.03906

There are 8 discordant pairs.
Because this number is fewer than 20, it is recommended that only the exact results be used.

Odds-based Estimates

95% Confidence Intervals

Parameter	Point Estimate	Lower,Upper	Type
Pair-Matched Odds Ratio:	7	0.8614, 56.89[1]	Taylor series
CMLE Odds Ratio*	7	1.082, 159[1]	Mid-P Exact
		0.8993, 315.5[1]	Fisher Exact

*Conditional maximum likelihood estimate of Odds Ratio
(P)indicates a one-tail P-value for Protective or negative association; otherwise one-tailed exact P-values
are for a positive association.
Martin,D; Austin,H (1991) An efficient program for computing conditional maximum likelihood estimates
and exact confidence limits for a common odds ratio. Epidemiology 2, 359-362.

Results from OpenEpi, Version 2, open source calculator--MatchCC

http://www.openepi.com/MatchCC/MatchCC.htm
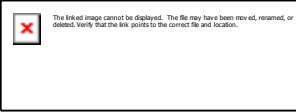Source file last modified on 12/03/2007 20:06:37

Formulae

Notation for the formulae:

Pair-matched case-control table setup:

	Control Exposed	Control Not Exposed
Case Exposed	W	X
Case Not Exposed	Y	Z

Statistical Tests:

McNemar/Mantel-Haenszel chi square =

$$\chi^2_{corrected} = \frac{(|X-Y|-1)^2}{X+Y}$$

Corrected McNemar/Mantel-Haenszel chi square =

$Z_{1-\alpha/2}$ = the two-sided Z value, 1.96 for a 95% confidence interval

α = the tail probability, e.g., 0.05 for a 95% confidence interval

Fisher exact one-sided p-value (Rosner, 2006):

$$p = \sum_{k=0}^{X}\binom{X+Y}{k}\left(\frac{1}{2}\right)^{X+Y}$$

If X<[(X+Y)/2]

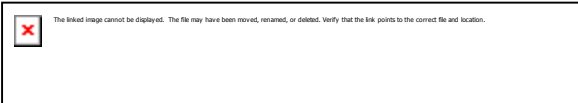$$p = \sum_{k=X}^{X+Y}\binom{X+Y}{k}\left(\frac{1}{2}\right)^{X+Y}$$

If X>[(X+Y)/2]

To get an exact 2-sided p-value, the one-sided p-values are multiplied by 2.

Odds Ratios and confidence intervals:

$$m\hat{O}R = \frac{X}{Y}$$

Mantel-Haenszel matched odds ratio and the CMLE odds ratio =

Taylor series confidence interval for Mantel-Haenszel odds ratio =

Fisher Exact confidence interval for the odds ratio using the F statistic approach (Liddell):

Lower bound =

$$\text{Upper bound} = \frac{(X+1)Finv(probability,2(X+1),2Y)}{Y}$$

For additional information on exact p-values and confidence intervals formulae, see Martin and Austin (1991).

References

Kleinbaum DG, Sullivan KM, Barker NF. ActivEpi Companion Textbook: A supplement for use with the ActivEpi CD-ROM. Springer-Verlag, New York, corrected 3rd printing, 2005.

Liddell FDK. Simplified exact analysis of case-referent studies; matched pairs; dichotomous exposure. Journal of Epidemiology and Community Health 1983;37:82-84.

Martin,D; Austin,H (1991) An efficient program for computing conditional maximum likelihood stimates and exact confidence limits for a common odds ratio. Epidemiology 2, 359-362.

Rosner B. Fundamentals of Biostatistics, 6th ed. Thomson, 2006.

Updates

Oct 24 2008 – the code was changed in Match CC for the chi-square value for the corrected chi-square - the formula was slightly off because of a misplaced parenthesis which resulted in tables where OR < 1 the corrected chi-square value was larger than it should have been but was correct when the OR > 1.