The general problem:

We have information about a random variable's distribution (whether frequentist or Bayesian).
We want information about the distribution of a transformation of that variable.
For example, we have $\text{var}(X)$; but we need $\text{var}(g(X))$.

Our specific example:

We would like a rough estimate of the variance of the ODDS RATIO.

The **ODDS RATIO** is an important measure of association in 2 by 2 tables.
The odds ratio is :

Population / Sample estimate

$$OR = \frac{odds(row1 \mid col1)}{odds(row1 \mid col2)} = \frac{odds(col1 \mid row1)}{odds(col1 \mid row2)} \qquad \widehat{OR} = \frac{M_{11}/M_{21}}{M_{12}/M_{22}} = \frac{M_{11}/M_{12}}{M_{21}/M_{22}}$$

A good rough estimate of the variance of $\log \widehat{OR}$ is

$$\text{var}\left(\log \widehat{OR}\right) = \text{var}\left(\log M_{11} - \log M_{21} - \log M_{12} + \log M_{22}\right) \approx \frac{1}{M_{11}} + \frac{1}{M_{12}} + \frac{1}{M_{21}} + \frac{1}{M_{22}}$$

Example: In the table

	G2 var	G2 wt	
G1 var	**10**	**12**	***22***
G1 wt	**14**	**64**	***78***
	24	***76***	***100***

$$\widehat{OR} = (10/14)/(12/64) = 3.81$$

$$\text{var}\left(\log \widehat{OR}\right) \cong 10^{-1} + 14^{-1} + 12^{-1} + 64^{-1} = 0.27$$

So a rough confidence interval for log OR is $\log(3.81) \pm 1.96 * \sqrt{0.27}$, which is the interval (0.318, 2.357), and a rough confidence interval for OR itself is (exp(0.318), exp(2.357)) = (1.37, 10.56).
A so-called "exact" method uses the noncentral hypergeometric distribution, parametrized by $\psi = \log(OR)$.
From the R function fisher.test(), we get (1.197927, 11.801156).

Lots of great stuff about 2x2 tables:
Agresti and Min, Simple improved confidence intervals for comparing matched proportions, Sta in Med 2005;
Agresti and Caffo, Teacher ' s Corner Successes and Two Failures, American Statistician 2000;
Richard Darlington, Some New 2 x 2 Tests.

The principle behind the delta method

The delta method uses a linear approximation:

$$g(x) \approx g(E(x)) + \dot{g}(E(X)) \cdot (X - E(X))$$

then concludes

$$\text{var}(g(X)) \approx \left(\dot{g}(E(X)\right)^2 \cdot \text{var}(X).$$

An important example is the log of a random variable:

$$\operatorname{var}(\log(X)) \approx \left(\frac{1}{E(X)}\right)^2 \operatorname{var}(X) = (\text{coefficient of variation})^2 \cdot$$

Another important example is the "lognormal" Y where $\log(Y) \sim N(0,1)$. Here the $\boldsymbol{g}$ function is exp(), the inverse of the log() function.