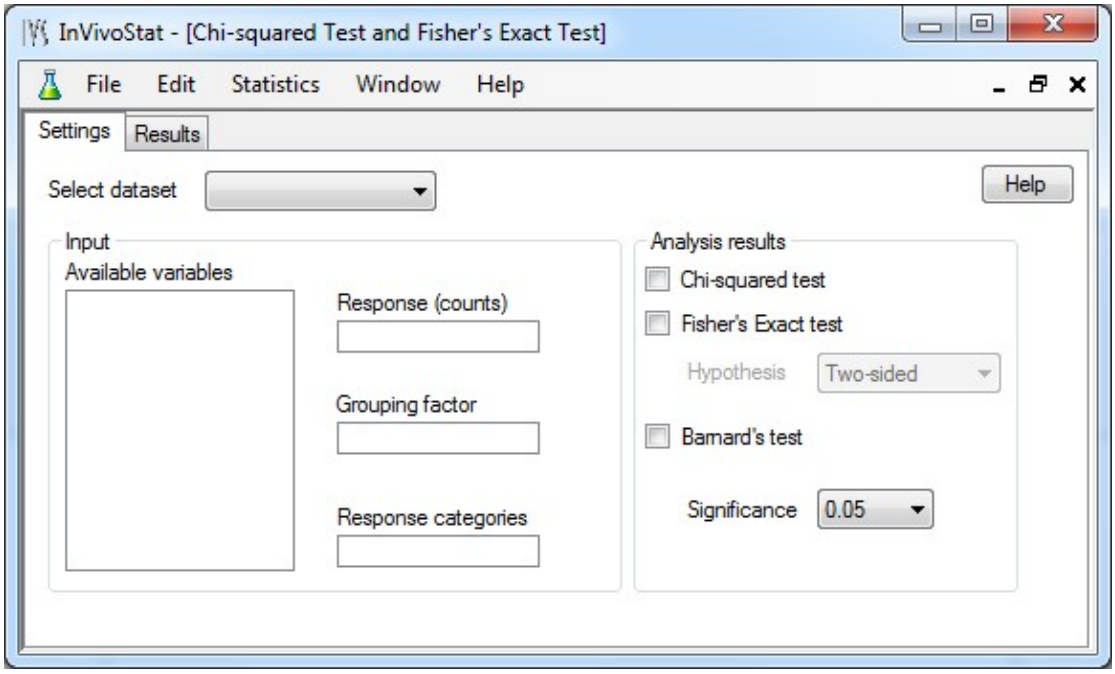
InVivoStat

Chi-Squared test and Fisher's Exact test Module

Tipsheet

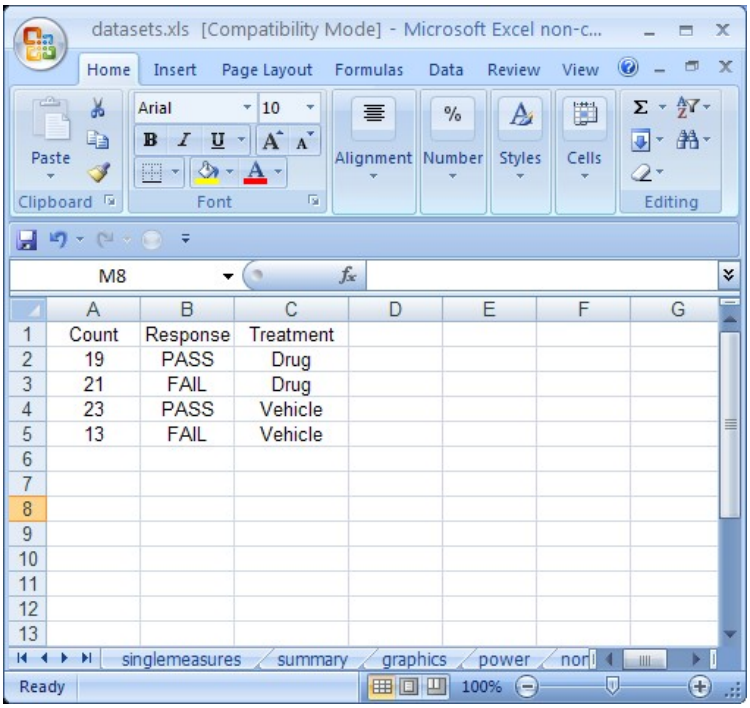
The Chi-squared test and Fisher's Exact test module in InVivoStat is available within the Additional Analyses sub-menu in the Statistics drop-down menu and is entitled 'Chi-squared test and Fisher's Exact test'. The user interface is:



The Chi-squared test and Fisher's Exact test module performs Chi-squared tests, Fisher's Exact tests and Barnard's test for categorical data. The analysis can be performed on a response which is categorised into two or more categories and so may be appropriate if the response measured is binary.

1 Setting up the model

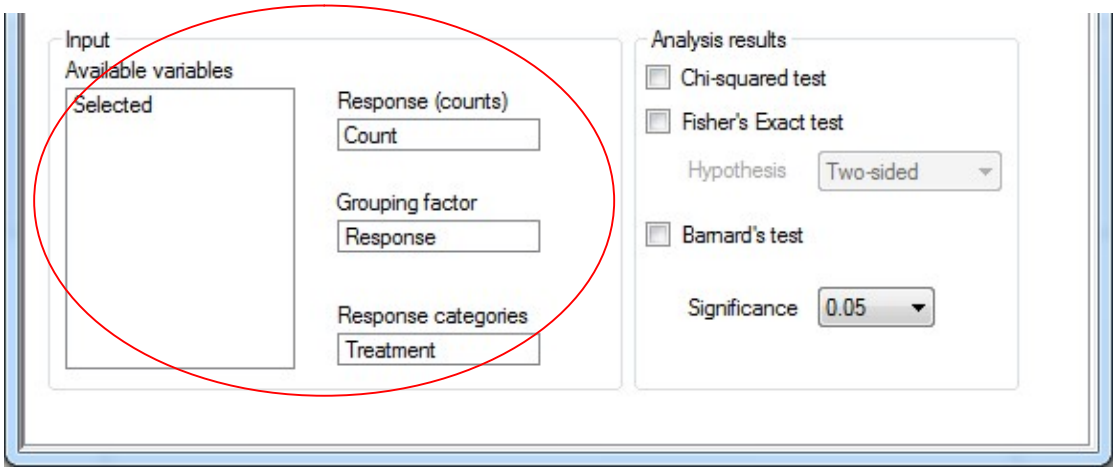
For example, in this experiment there were 40 animals in the Drug treated group and 36 animals in the Vehicle control group. The response for each animal was classed as either a 'pass' or a 'fail'. There were 19 passes in the drug treated group and 23 passes in the vehicle control group. The dataset was set up ready for InVivoStat as follows:



	A	B	C
1	Count	Response	Treatment
2	19	PASS	Drug
3	21	FAIL	Drug
4	23	PASS	Vehicle
5	13	FAIL	Vehicle

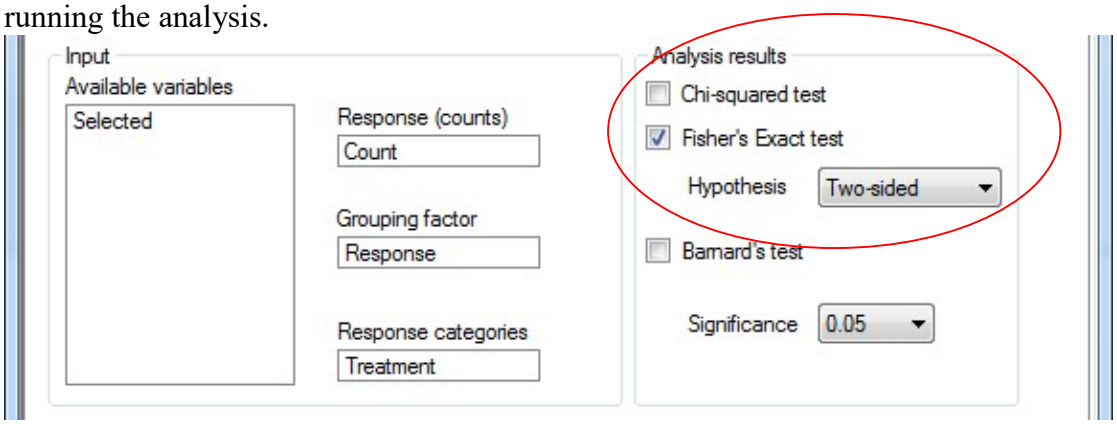
Once the dataset has been opened within InVivoStat, the user can select the variables for the analysis by dragging and dropping them from the 'Available variables' list into the 'Response (counts)', 'First factor' and 'Second factor' boxes.

We recommend the first factor defines the categories of the responses (for example Yes/No, Alive/Dead, Responder/Non-responder, Pass/Fail) and the second factor defines the treatment factor.



2 Selecting the analysis options

There are several results that are available to the user. These are selected before running the analysis.



1) Chi-squared test
Produces the results of the Chi-squared test of equality of proportions.

2) Fisher's Exact test
Produces the results of the Fisher's Exact test of equality of proportions. As a rule of thumb this test should be used instead of the Chi-squared test when the number of counts for any individual response/treatment combination is less than 5.

3) Barnard's test
Barnard's test is an alternative test to Fisher's Exact test. While not as well-known as Fisher's, it may be more appropriate test to use. Fisher's Exact test assumes the row and column totals (i.e. the individual group sizes and total number of responders and non-responders across all treatment groups) are fixed. While this is probably true for the individual group sizes it is rarely the case for the total number of responders.

4) Hypothesis
This option is available for the Fisher's Exact test (2 *x* 2 case) and allows the user to perform a two-sided or a one-sided test.

5) Significance level
The default is 5%, although this can be changed.

3 Output Results

Response
InVivoStat identifies the response being analysed and the two categorisation factors.

Contingency table of counts
InVivoStat produces a table of the counts categorised by the two factors. This is useful if there are multiple replicates of each of the factor combinations present in the dataset.

Table of expected counts
This table gives the expected results under the null hypothesis of no association between the two factors.

Chi-squared test table
This table gives results of the Chi-squared test. For the 2 x 2 case the test is calculated using Yates' continuity correction.

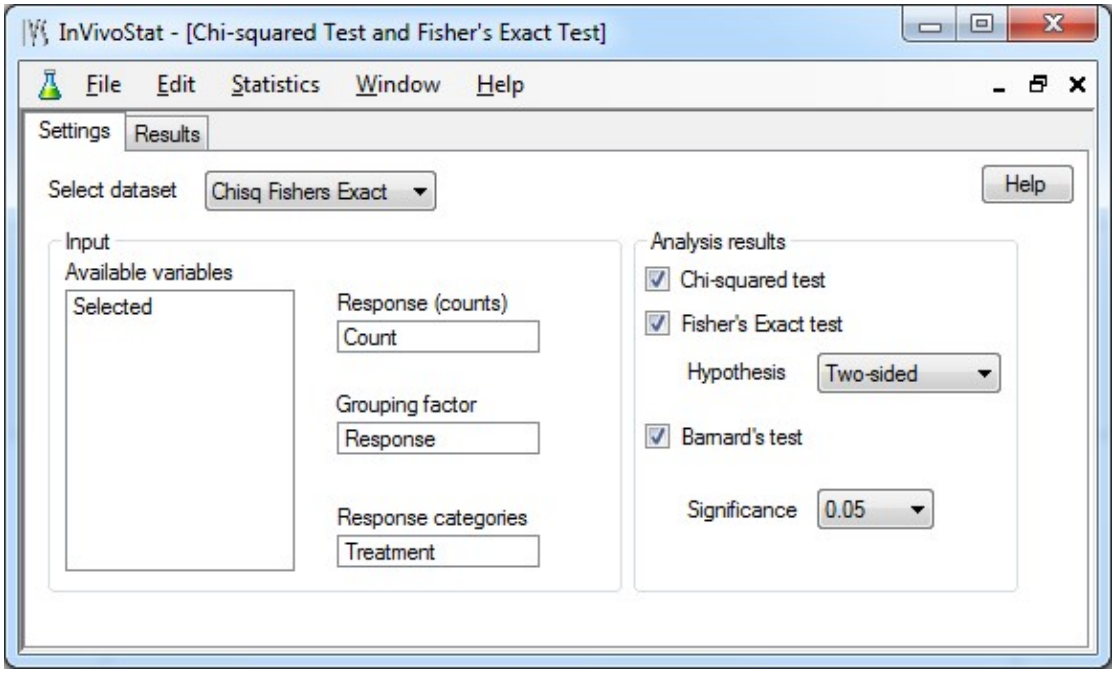
Fisher's Exact test table
This table gives results of the Fisher's Exact test.

Barnard's test table
This table gives results of the Barnard's test.

References
Finally a list of references for the methods applied in the analysis is given.

4 Sample output

Options:



InVivoStat Chi-squared Test and Fisher's Exact Test

Response

The Count response is currently being analysed by the Chi-squared Test and Fisher's Exact Test module. The response is separated into categories, as defined by the factors Response and Treatment.

Note

This module should be used to analyse count data that can be expressed in the form of a contingency table. These tests assess the significance of the association (contingency) between the two treatment classifications.
For more information on the theoretical approaches that are implemented within this module, see Bate and Clark (2014).

Contingency table of counts

	Drug	Vehicle
FAIL	21	13
PASS	19	23

The values in this table are the sum of the individual entries in the imported dataset.

Table of expected results (under the null hypothesis of no association)

	Drug	Vehicle	Column totals
FAIL	17.89	16.11	34
PASS	22.11	19.89	42
Row totals	40	36	76

The values in this table are the expected results, given the row and column totals, under the assumption of no association between the two factors.

Chi-squared test

	Test statistic	Degrees of freedom	p-value
Result	1.45	1	0.2287

Note: For the 2 x 2 case, the chi-squared test is calculated with Yates' continuity correction.
The chi-squared test is not significant at the 5% level of significance as the p-value is greater than 0.05.

Fisher's exact test

	p-value
Result	0.1724

The Fisher's exact test is not significant at the 5% level of significance as the p-value is greater than 0.05.

Barnard's exact test

	p-value
Result	0.1799

Barnard's test is a more powerful test than Fisher's exact test in certain situations as it is an unconditional test, see Lydersen et al. (2009). This test only assumes the row totals are fixed and not the column totals, unlike Fisher's exact test.
The two-sided Barnard's exact test is not significant at the 5% level of significance as the p-value is greater than 0.05.

Statistical references

Bate ST and Clark RA. (2014). The Design and Statistical Analysis of Animal Experiments. Cambridge University Press.
Lydersen S, Fagerland MW and Laake P. (2009). Recommended tests for association in 2 x 2 tables. Statistics in Medicine, 28, 1159-1175.

R references

R Development Core Team (2013). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org.
Lecoutre, Eric (2003). The R2HTML Package. R News, Vol 3. N. 3, Vienna, Austria.
Peter Calhoun (2013). Exact: Unconditional Exact Test. R package version 1.4. http://CRAN.R-project.org/package=Exact.