



Tutorials and worked examples for simulation,  
 curve fitting, statistical analysis, and plotting.  
<http://www.simfit.org.uk>

A data matrix of pseudo-random numbers can be generated using program **rannum** after selecting the distribution, parameters required, number of rows, and number of columns.

This can be very useful when exploring the variation to be expected in typical experiments. So there are default choices for the distributions of the columns (or rows by transposition using **editmt**) but SIMFIT also allows user to simulate random matrices with a very large choice for the column distributions by joining  $m$  random columns of length  $n$  together using program **editmt** to form a  $n$  by  $m$  matrix.

### Example 1: Simulating analysis of proportions

For instance, from the main SIMFIT menu, choosing [Simulate] then running program **rannum** was used to simulate a binomial distribution with  $N = 10$  and  $p = 0.5$ . The resulting random matrix was written to a data file that was then read into program **simstat** for analysis of proportions leading to the following results.

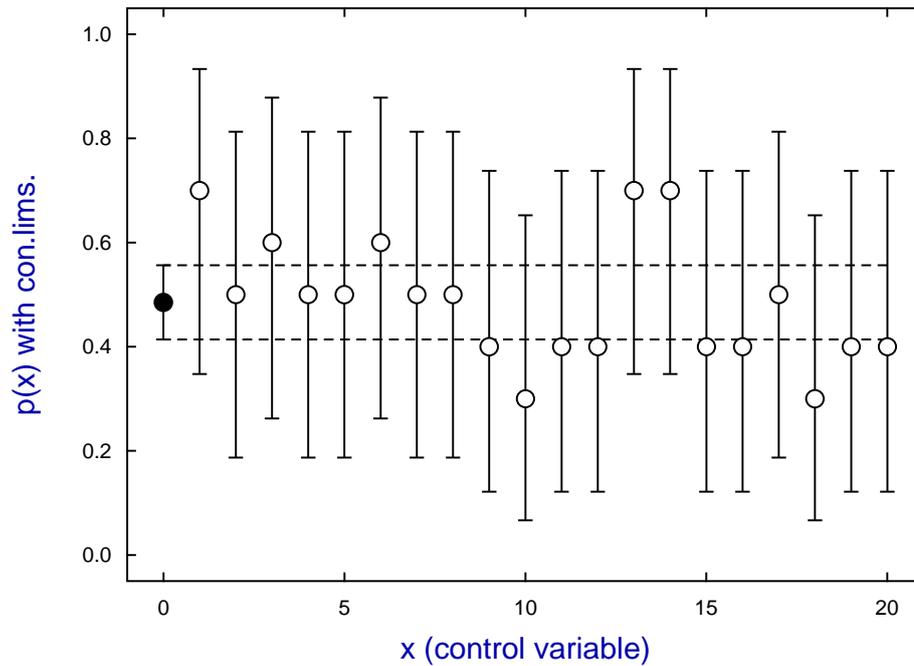
$y$	$N$	lower 95%	$\hat{p}$	upper 95%
7	10	0.34755	0.70000	0.93326
5	10	0.18709	0.50000	0.81291
6	10	0.26238	0.60000	0.87845
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5	10	0.18709	0.50000	0.81291
5	10	0.18709	0.50000	0.81291
4	10	0.12155	0.40000	0.73762
3	10	0.06674	0.30000	0.65245
4	10	0.12155	0.40000	0.73762
4	10	0.12155	0.40000	0.73762
7	10	0.34755	0.70000	0.93326
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#### Successes and number of trials for binomial $N, p = 10, 0.5000$

To test $H_0$ : equal binomial $p$ -values	
Sample-size (rows)	20
Overall sum of $Y$	97
Overall sum of $N$	200
Overall estimate of $p$	0.4850
Lower 95% confidence limit	0.4139
Upper 95% confidence limit	0.5565
$-2 \log \lambda (-2LL)$	11.67, $NDOF = 19$
$P(\chi^2 \geq -2LL)$	0.8991
$\chi^2$ test statistic ( $C$ )	11.43, $NDOF = 19$
$P(\chi^2 \geq C)$	0.9085

The next figure illustrates the wide 95% confidence limits for the  $p$  estimates for the individual samples of size 10 (open circles) compared to the overall estimate for the pooled sample (filled circle).

## p-estimated as a function of x



### Example 2: simulating analysis of variance

Program **rannum** provides several options for random matrices, but it is possible to control the distributions for the columns by generating sample vectors, i.e. columns, then joining them up to form a matrix. For instance, the distribution of errors in many experiments are more like a Cauchy than a normal distribution. So three columns of Cauchy random numbers with  $A = 0, B = 1$  were generated then joined together by program **editmt** to form this 10 by 3 data matrix, and from the results it seems that ANOVA was not sensitive to the outliers (indicated by **\***) in this particular simulation.

0.7553767	0.0114847	0.1967812
<b>*15.782768</b>	-10.974171	0.0389082
0.1525358	0.0614315	-0.6627294
0.3088897	-0.4970650	-2.0314559
-0.4559783	0.2725820	-0.7291483
2.8106498	<b>*8.2014348</b>	0.9221295
-0.9132832	-1.3773182	-1.5086666
-0.7499996	1.5989911	-1.5862460
-1.1157865	-0.8385944	-3.8728595
1.3796620	-0.6206551	<b>*23.120279</b>

1-Way Analysis of Variance: Grand Mean 9.227E-01  
Transformation:- x (untransformed data)

Source	SSQ	NDOF	MSQ	F	p
Between Groups	27.72	2	13.86	0.3885	0.6818
Residual	963.1	27	35.67		
Total	990.8	29			

Kruskal-Wallis Nonparametric One Way Analysis of Variance

Test statistic	NDOF	p
2.114	2	0.3476