CHI-SQUARE MEDIAN TEST

Objective: To test whether c different populations have the same median.

We need to have independent random samples from the populations. Once the data is obtained, the grand median of all the data is determined. Then a $2 \times c$ contingency table is formed with row one cells containing the counts of observations that exceed the grand median and row 2 cells containing the counts of observations less than or equal to the grand median:

	Pop1	Pop2	...	Pop c	
> gm	O_{11}	O_{12}	...	O_{1c}	R_1
$\leq$ gm	O_{21}	O_{22}	...	O_{2c}	R_2
	n_1	n_2	...	n_c	$\sum n_i$

Hypotheses. H_0: all populations have the same median

H_1: at least two populations have different medians

Test statistic: $T = \sum \frac{(O-E)^2}{E}$ which has an approximate $\chi^2(c-1)$ distribution under H_0.

Approximate **p-value** $= P(T \geq t_{\text{obs}})$ where $T \sim \chi^2(c-1)$.

Decision rule: Reject H_0 if $t_{\text{obs}} \geq (1-\alpha)$ quantile of $\chi^2(c-1)$ distribution,

or reject H_0 if p-value $\leq \alpha$.

Example. (See Conover.) Four different methods of growing corn were randomly assigned to a large number of different plots of land and the yield per acre was computed for each plot.

		Method		
1	2	3	4
83	91	101	78
91	90	100	82
94	81	91	81
89	83	93	77
89	84	96	79
96	83	95	81
91	88	94	80
92	91		81
90	89		
	84		

Here the grand median is 89. From the table above, we see that method 1 has 6 observations above 89, method 2 has 3 observations above 89, method 3 has 7 observations above 89, and method 4 has 0 observations above 89. This leads to the table . . .

	Meth1	Meth2	Meth3	Meth4	
> 89	6	3	7	0	16
≤ 89	3	7	0	8	18
	9	10	7	8	34

The test statistic value, t_{obs}, is calculated to be 17.54 and the p-value $= .001$. For a TI-83, put table counts into a matrix and use the χ^2 test.

The Median Test on MINITAB

1. **Put all data in column.**

MTB > print c1
C1

```
83   91   94   89   89   96   91   92   90   91   90
81   83   84   83   88   91   89   84   101  100  91
93   96   95   94   78   82   81   77   79   81   80
81
```

2. **Put corresponding method numbers into column 2.**

MTB > print c2
C2

```
1   1   1   1   1   1   1   1   1   2   2   2   2   2   2
2   2   2   2   3   3   3   3   3   3   3   4   4   4   4
4   4   4   4
```

3. **Enter the median test command.**

MTB > mood c1 c2

Mood median test of C1
Chisquare = 17.54   df = 3   p = 0.001

```
                                        Individual 95.0% CI's
  C2    N<=    N>    Median    Q3-Q1   ---------+---------+---------+-------
   1     3     6      91.0      4.0                      (--+---)
   2     7     3      86.0      7.2              (---+-----)
   3     0     7      95.0      7.0                          (---+------)
   4     8     0      80.5      2.7    (---+)
                                       ---------+---------+---------+-------
                                          84.0      91.0      98.0
  Overall median = 89.0
```