Parametric Test

Quadrat Analysis

\[
\sum_{i=1}^{m} (x_i - \bar{x})^2
\]

\[
s^2 = \frac{m - 1}{m - 1}
\]

\[
VMR = \frac{s^2}{\bar{x}}
\]

\[
z = \sqrt{\frac{m - 1}{2}} (VMR - 1)
\]

\[m\] is the number of quadrats,
\[\bar{x}\] is the mean of the number of points per quadrat,
\[s^2\] is the variance of the number of points per quadrat,
\[(x_i - \bar{x})^2\] is the cell deviate, and
\[VMR\] is the variance-mean ratio.

Example: The grid to the right has been drawn over a set of burglary locations in a small urban area. Each dot represents one burglary. We are interested in determining whether the burglaries are randomly occurring within the urban area or if there is clustering. If there is a large amount of variability in the frequency of points within cells, then the data are clustering. Conversely, if the points are randomly distributed, cell to cell variability would be minimal. Obviously the choice of cell (quadrat) size is important, in that we do not want too many cells having no observations. Although there is no rule as to the number of observations each cell should have, somewhere between 1 and 2 is usually sufficient. Cell deviates are the points per cell minus the mean, squared… e.g. \((0-1.17)^2 = 1.3689\). Number of cells is simply the number of cells having that number of points. The sum of the number of cells must equal \(m\). Total deviates is equal to the cell deviates multiplied by the cells per point.

\[H_0: \text{The distribution of crime is not significantly different than random.}\]

\[H_a: \text{The distribution of crime is significantly different than random.}\]

\[\alpha = 0.05\]

Total points = 43

\[m = 36\] (number of cells, 6x6)

\[df = m-1 = 35\]

\[\bar{x} = \frac{43}{36} = 1.19\]

\[s^2 = \frac{19.7908}{36 - 1} = 0.5655\]

\[VMR = \frac{0.5655}{1.19} = 0.475\]

\[z = \sqrt{\frac{36 - 1}{2}} (0.475 - 1) = -2.196\]

Since \(-2.196 < -1.96\) reject \(H_0\).

There are 2 critical values for quadrat analysis, \(z_L\) and \(z_H\). If \(z < z_L\) then we reject \(H_0\) and state that the pattern is significantly clustered. If \(z > z_H\) then we reject \(H_0\) and state that the pattern is significantly uniform. When \(z\) falls between \(z_L\) and \(z_H\) then we accept \(H_0\) and state that the pattern is random. At an \(\alpha\) of 0.05 the critical values are always: \(z_L = -1.96\) and \(z_H = +1.96\). The exact probability can be taken from the \(Z\) table.

The pattern of burglaries in the urban study area are significantly clustered \((z = -2.196, p = 0.0132)\).