**Supplemental Material**

*Quadrat Method*

Given equal-sized quadrats within a region R, the quadrat method uses the Pearson goodness-of-fit to test whether point-counts in the different quadrats are truly Poisson distributed (Smith, 2014). In simple terms, this statistic compares observed point-counts to the expected point-count under CSR and is given by:

|  |  |  |
| --- | --- | --- |
|  |  | (1) |

where is the point-count of quadrat , is the observed point-count in quadrat , and is the expected point-count under CSR (i.e., same for all quadrats under CSR). The common Poisson cell-count distribution has the form:

|  |  |  |
| --- | --- | --- |
|  | ) | (2) |

where is the random variable describing the number of points in quadrat , is the expected point density, and is the area of quadrat . Therefore, the expected point-count in each quadrat is given by the mean of the Poisson above which is:

|  |  |  |
| --- | --- | --- |
|  |  | (3) |

and since , the expected point-count becomes:

|  |  |  |
| --- | --- | --- |
|  |  | (4) |

where is the sample mean of all point-counts. Therefore, the statistic becomes:

|  |  |  |
| --- | --- | --- |
|  |  | (5) |

where is the sample variance of the point-count distribution. Since the number of quadrats is a constant, the statistic reduces to the ratio of variance over mean.

*K-function Method*

Unlike the quadrat method where scale (i.e., of quadrats) is fixed, the K-function allows scale to vary and incorporates its effects in the analysis. In addition, the K-function is not biased towards small-scale structures as is the case with traditional nearest-neighbor methods (Ripley, 1996). The K-function is therefore particularly suitable for patterns that display multiple structures at multiple scales. The K-function is given by (Ripley, 1976):

|  |  |  |
| --- | --- | --- |
|  |  | (6) |

where is the scale, is the Euclidean distance between points and , is the indicator function such that and , gives the total number of points within distance of , is the total number of points inside the study region, is a weighting factor to correct for edge effects, and is the point density. The expression in brackets can be understood as the average point count within distance of all points within the point pattern.

**K-function under CSR. ---** To characterize the K-function under CSR, the expected number of points within a circle of radius (represented by the expression in brackets in the equation above) needs to be quantified for random point patterns. As demonstrated before, the expected point count in region R under CSR follows a Poisson distribution and is therefore proportional to the area of region R as follows:

|  |  |  |
| --- | --- | --- |
|  |  |  (7) |

where is the average point density, is the expected point count in a circle of radius , and is the area of a circle of radius . Hence, the K-function simply reduces to the circle area under CSR as follows:

|  |  |  |
| --- | --- | --- |
|  |  | (8) |

**CSR test. ---** Testing the CSR hypothesis involves comparing the pattern’s K-function for a given scale to the area of a circle of the same scale as follows (Smith, 2014):

* , clustering at scale (mean point count higher than expected under CSR)
* , dispersion at scale (mean point count lower than expected under CSR)