SCIENTIFIC AIR SOLUTIONS

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Spatial Analysis

Spatial maps are a three-dimensional analysis in which two dimensions (X and Y) represent the positions of points on a horizontal plane, and the third (Z) represents data associated with the points. The data can be visualized as elevations above or below the plane.

Data may consist of:

(1) measured numerical values, (colony forming units (CFU/l) air sampling for mold, temperature, moisture content, etc.) or derived numerical values (differences, ratios, probabilities, etc.) associated with fixed points on the horizontal plane and
(2) the X, Y-coordinates of the fixed points.

All variables are treated as continuous although CFU/l are discrete. The points are fitted to a three dimensional surface representing the variable (Z-axis) as a function of position on the X, Y-plane.

The surface can be represented in two dimensions by a contour map, which shows the configuration of the surface by means of isolines (contours) drawn at regular intervals of Z, on the X, Y plane through the origin. Each contour represents the intersection of a horizontal plane with the surface, which means that all points on a contour have the same Z-value.

Observed Z-values are posted to coordinates on a map of a facility, (packaging room, warehouse, retail store, etc.), entered as a base map and then creates a denser grid of Z-values by interpolation, using one of several available algorithms. Normally radial basis functions with multiquadric algorithm is used, which is flexible and provides a good overall interpretation of most data sets. After interpolating, contours of Z are produced, based on the interpolated grid values. Goodness of fit is estimated by calculating residuals - differences between observed numbers and numbers predicted by the fitted surface.

Residuals and other derived values, such as differences and probabilities, can also be mapped by means of contour analysis. Spatial changes are best examined by grid subtraction, which is done by subtracting the value of each node in a grid from the corresponding node values of a second, identical grid; the differences are then assigned to corresponding nodes of a third grid and difference contours drawn. Areas of increase are indicated on difference plots by positive contours and areas of decline by negative contours.

In viewing areas for microbial levels, it is helpful to draw contours of indicator variables, rather than raw CFU/l counts, because indicator variables are affected less by unusually large (or small) counts. Indicator variables are obtained by converting observed CFU/l to probability. Sampling locations are first sorted in descending order by CFU/l, then cumulative and normalized CFU/l are calculated for each location.

The normalized CFU/ (cumulative CFU/l divided by the total number of CFU/l in all locations) gives the probability of an equal or higher CFU/l count. An indicator value of 1 is assigned to all locations for which probability equals or exceeds some set level or action threshold (determined by experience and the needs of industry) and a value of 0 is assigned to the remainder.

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