Point Mapping Activity – Mapping Liver Disease Incidence in Northern England

Scenario:

You are working as a GIS analyst for a health board in northern England. You have been asked to help prepare a report on angiosarcoma, a malignant tumor of the blood vessels in the liver. One of the potential risk factors for angiosarcoma is exposure to polyvinyl chloride (PVC), either in gaseous form or dissolved in drinking water. Exposure to PVC is a known occupational risk for factory workers in the plastics industry and appropriate measures are in place to minimise the risks of exposure. However, there is also some suggestion that residents close to a waste incinerator, which has emitted PVC as fumes, may have experienced elevated levels of angiosarcoma over the past 20 years.

A case-control data set has been developed to investigate the extent of this problem, which has drawn together all cases of angiosarcoma diagnosed between 1980-2000, as well as healthy controls of similar age attending health centres over the same period.

The health board is preparing a report on the risks of angiosarcoma and you have been asked to produce a map of disease incidence that will form part of this report. After a review by members of the local health trust, the report will be made available to the general public over the internet.

Data set:

The spatial data available to you consist of three map layers:

- **northeast**: a generalized boundary of your health board area. Note that a small number of cases and controls fall outside this boundary because it has been generalized.
- **Livercases**: locations of individuals diagnosed with angiosarcoma of the liver between 1980 and 2000, geo-coded using residential address at time of diagnosis. These data are subject to confidentiality restrictions that prevent disclosure to the general public.
- **Livercontrols**: healthy controls of similar age to those diagnosed with angiosarcoma, who attended health centres for routine blood pressure testing. As with the angiosarcoma cases, these individuals have been geo-coded using residential address at the time of consultation. As with the case data, this information is subject to confidentiality restrictions that prevent disclosure.
- **Incinerator**: the location of the incinerator that previously emitted PVC fumes.

Note 1: The co-ordinates for this data (as used in the original study) set are all in metres and are not referenced to any geographical projection system. You may find

that this information is useful in planning your cartography for the data set. It is particularly useful to know this if you decide to use the 'point density' function here and wish to interpret its output

Note 2: although the scenario here is fictitious, the data used in this exercise are a public domain data set made available by Dr. Peter Diggle of Lancaster University. The original source data are available here:
http://www.maths.lancs.ac.uk/~diggle/pointpatterns/Datasets/

Task:

Using your knowledge of cartographic principles, produce a map of the local case: control ratio across the study area for inclusion in the health board's report. For your own record, write a brief summary (approx. 300 words) of the spatial patterns of angiosarcoma incidence that are apparent in the study area.

Hints:

- Try heading for the 'spatial analyst tools' and the 'point density' tool within the 'density' set of tools here (this was a tool that we used with the John Snow data set). To start with, try running the tool on the 'livercases', accepting the default settings for the radius and output grid size (note: you can leave the 'population field' set to 'none'. This would only be used were we to have multiple cases georeferenced to each point, rather than just one, e.g. if we had four cases all referenced to the same point location, we might use a 'population field' that contained such counts). Make a note of the radius setting.
    - Try running 'point density' again on the 'livercontrols', again accepting the default setting for output grid cell size and using the same radius as you did above.
    - Next, try heading for the 'spatial analyst' tools again, select 'math', and then 'trigonometric' and then 'divide'. Now try dividing one of your output density grids by the other – this should give you a local case: control ratio.
    - Instead of using the 'point density' tool, try running the same operation using the 'kernel density' tool within the same 'density' group within the 'spatial analyst' tools. This works in a similar way, except that with 'point density', a point is treated in a binary ('on' / 'off') way, counting towards the local density of cases if it is inside the radius drawn around a given grid point on the map, and not counting if it is outside the radius. With 'kernel density', instead of there being a sudden change with a point being included / excluded as the radius is reached, a kernel allows a point's importance in the density calculation to decline more gradually as its distance from a grid point increases. You should see a smoother output

density as a result.

- Try experimenting with changing the radius setting in the calculation – how does this affect the output density?