

Assessing access to healthcare in a Zimbabwean district with a mobile immunisation outreach programme

Scenario

Buhera District is a rural area in the Manicaland Province of Zimbabwe where poverty and poverty-related diseases are endemic. Most of the population do not have access to any form of transport and mortality from preventable diseases such as measles remains high. To tackle this problem in remote communities, during the 1990s, the government instituted a programme of immunisation by outreach teams, visiting villages on pre-arranged days. Two outreach teams work in Buhera District, one covering the north of the district and other covering the south of the district.

The government also has a target level of healthcare provision – namely that no child should have to walk more than 5 km to receive adequate healthcare. Is this target being met for immunisation services in Buhera (with the added complication that some of the immunisation services are delivered by the mobile outreach teams)? Your task in this scenario is to determine this.

Data

You have been provided with the following data sets:

- **Child_dense:** a population surface, which contains gridded estimates of the number of children under 5 years living in raster squares that are 500 by 500 metres. This was created by combining published 1992 census data (see the Southern Africa Humanitarian and Disaster Management GIS Library web site under 'references') with a 1:250,000 point map of settlements within the district. This is stored in ESRI 'floating point' raster grid format.
- **Health_centres:** the location of government and faith organisation-run health centres within the district, based on a GPS survey.
- **Outreach_visit_schedule.xls:** This Excel sheet contains the X and Y coordinates of villages visited by the two mobile immunisation units (whose ID codes are in the **outreach** field) operating in the district. Every second month, the outreach team conducts a series of visits. The week of the month in which the team visits is documented in this spreadsheet (**visitweek**), as is the day of the week (**visitday**). These data are fictitious.
- **Roads:** Roads and tracks in the study area, digitised from a 1:250,000 scale map maintained by the local government department.
- **Buhera:** A raster outline of Buhera district, based on published census boundary data (see the Southern Africa Humanitarian and Disaster

Management GIS Library web site under 'references'). This is stored in ESRI ASCII raster grid format.

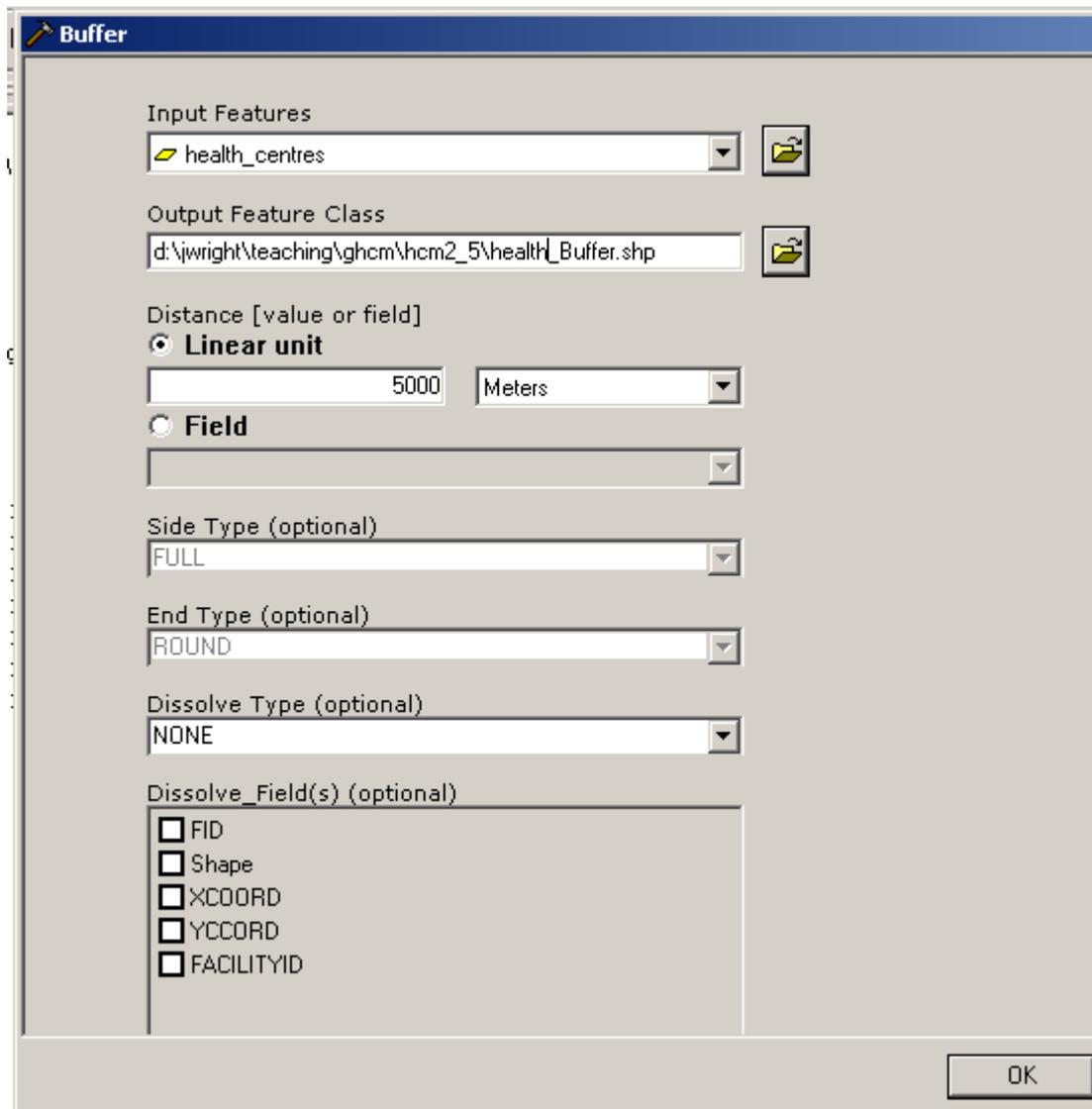
Exercise:

Begin by importing the raster population surface. To do this, within the ArcToolBox, choose *conversion tools*, then *to raster* and then *float to raster*. As the *input floating point raster file*, choose **child_dense** and call the output raster map layer **popdense**. Note that to see this map layer, you may need to change how it is displayed by ArcView. To do this, double-click on this raster grid, and choose *properties*, then the *symbolology* tab and then select the *classified* (rather than *stretched*) option.

You should also import the ASCII raster grid file containing the district outline. To do this, within the ArcToolBox, choose *conversion tools*, then *to raster* and then *ASCII to raster*. Make sure that the *output data type* is set to **integer** and select **buhera** as the input file. In this grid, pixels within the district are coded 1.

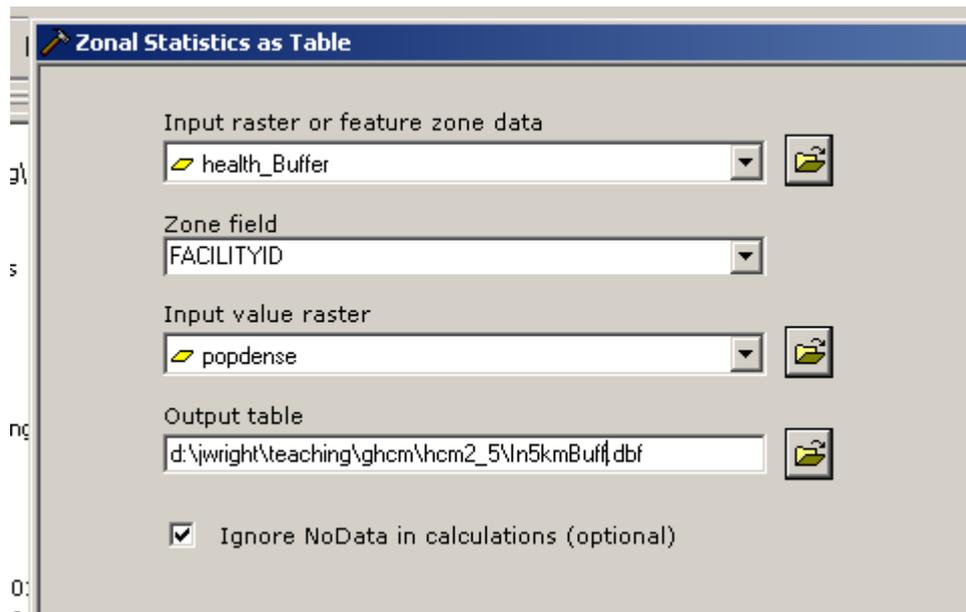
Finding the children within the accessibility target distance for each health centre

Next, open up the **health_centres** map layer and create a 5km buffer around these fixed location health facilities. To do this, you will need to use the *buffer* tool, located under the ArcToolBox in *analysis tools / proximity*. The screenshot below indicates the options to enter here. Note that a *dissolve type* of *none* here retains separate, overlapping buffers for each health centre. A *dissolve type* of *all* would create a single, merged set of buffer zones for all the health centres.



We can compute how many children under 5 years live within 5km of these permanent, fixed location health facilities as follows:

- Make sure that you have the Spatial Analyst extension loaded up (go to the *tools* menu, then choose *extensions* and make sure that the *spatial analyst* box is checked)
- Within the ArcToolBox, go to *spatial analyst / zonal / zonal statistics as table*. This tool will summarise the number of children within 5km of each health facility. The *input raster or feature zone data* in this case are our buffer zones and the *facilityID* is the *zone field* – the attribute that is unique to each of our health centres (each health centre has a different facilityID). The *input value raster* is a grid containing numbers. The grid cells lying within each of our buffer zones will be summarised into a new table (Note: *zonal statistics* produces a new map layer showing the number of children in each health centre's buffer zone; *zonal statistics as table* produces the same results, but as a table only and not a map layer).



The results of this calculation will be stored in a new table. You can view this table (the *output table* – called **in5kmbuff** in the above screenshot) by right-clicking on it and choosing open attributes.

OID	VALUE	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM
0	1	306	76500000	0	100	100	1.01307	6.33642	310
1	2	262	65500000	0	200	200	1.20229	12.4631	315
2	3	310	77500000	0	200	200	1.09677	11.5531	340
3	4	266	66500000	0	100	100	1.14662	6.76548	305
4	6	307	76750000	0	25	25	0.586319	2.13125	180
5	7	312	78000000	0	25	25	0.528846	2.70786	165
6	8	257	64250000	0	25	25	0.77821	3.05231	200
7	9	287	71750000	0	30	30	0.749129	3.04664	215

Each row in this table represents a different clinic and the ID codes for each clinic are stored in the *value* field. Various summary statistics are stored in the remaining fields. The *count* field is a count of the number of pixels lying within each 5km clinic buffer zone. The *min*, *max*, *range*, *mean*, *std*, and *sum* fields are all summary statistics for each buffer zone based on the figures in the population surface, representing number of children under 5 years. Of most interest to us is the *sum* field, which indicates the total number of children under 5 years in each clinic catchment.

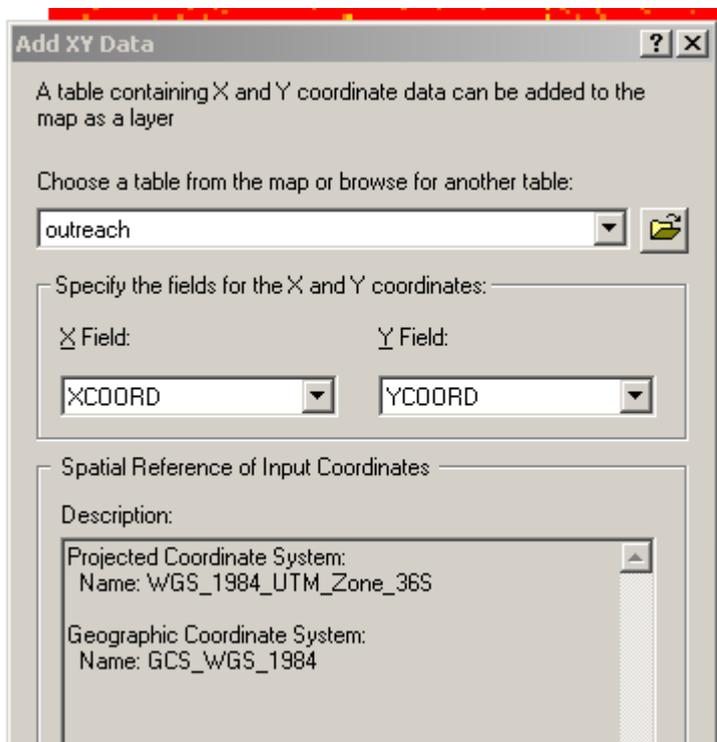
Task 1:

We have a weakness in that at the moment, our table not only counts up children who live in Buhera district, but those who live just outside its boundaries in neighbouring districts too. Using the ArcToolBox functions under *Spatial Analyst Tools* and / or *Analysis Tools* can you think of a way of counting up just the children who live in Buhera district and live in any of the buffer zones?

Finding the children within the accessibility target distance of mobile outreach services

We now need to calculate distances to the villages visited by the mobile outreach teams. As a first step towards doing this, we need to produce a map layer of the places visited by the mobile outreach immunisation teams. To do this:

- Open the **outreach_visit_schedule** workbook in Excel, then choose *save as...* from the *file* menu. Under *save as type*, scroll down until you find **dbf IV (dbase)** format and save your file as **outreach.dbf**. This is a file format that ArcGIS can read.
- Open the **outreach** file within ArcMap (via *file...add data*) and then choose *add XY data*. This will enable us to create a vector point map layer from our table.



- Under *choose a table from the map or browse for another table* make sure you select **outreach** and select XCOORD as the X field and YCOORD as the Y field.
- Although not essential, you may also wish to select the correct spatial reference for our new point map. To do this, click on *edit...* then click on *select..* and choose *projected coordinate systems*, then *utm*, and then *wgs 84*. If you then select the spatial reference system *WGS 1984 UTM Zone 36S*, this is the most commonly used spatial reference system in western Zimbabwe.

We are now in a position to buffer the locations visited by the outreach teams too and complete our picture of healthcare access for the district.

Assignment Activity:

Task 2:

Drawing on the work that you have already done so far, produce a report which includes figures for the number of children living in the district who are:

1. within the government target distance of a health centre;
2. within the government target distance of a mobile clinic;
3. outside the government target distance for mobile clinics and also outside this distance for the health centres;

Write a brief report of 750 words which includes the answer to these questions, describes your method for obtaining the figures above, and very briefly describes the limitations of the GIS work you have undertaken.

References:

A good source of gridded population data for Africa is the AfriPop project:
<http://www.afripop.org/>