Sampling in urban settings

Sampling in urban settings presents two challenges. These are:

1. How to select the areas of a town or city to sample?

2. How to select households in the selected areas?

These challenges are addressed below.

Selecting areas of the town or city to sample

There is no single or simple solution to this problem. You will usually be looking for areas in which either the boundaries are known or can be easily defined **and** easily found.

If you are working in a setting in which there has been a recent census then you could use the boundaries of the *enumeration districts* used in the census. You should be able to get these from the government's central statistics office. There are potential problems with this approach. Urban areas can be subject to rapid change due to activities such as property development, land or inward migration and some peri-urban areas and informal or illegal settlements may not have been included in the census. In some contexts census enumeration districts may have been invented or removed for political purposes such as gerrymandering of electoral districts to disadvantage members of political, ethnic, religious, linguistic, or class groups. If you intend to use census enumeration districts then you should make some check for completeness of coverage and, if needed, remedy any gaps in the coverage. The use of *electoral divisions* or *wards* suffers from similar potential problems.

Another option is to use the *catchment areas* of clinics or schools. The problem with this approach is that coverage of schools and clinics may be patchy and with some, usually disadvantaged, areas not being covered and not included in maps of catchment areas.

Some towns and cities are structured in blocks and, in such cases, it makes sense to take a sample of blocks. You should make sure that this does not exclude informal or illegal settlements and peri-urban settlements which may not conform to the block structure of the more formal settlements.

If maps are available then you could use these to *segment* the town into small areas of approximately equal volume (i.e. approximately the same number of houses) in each. You should make sure that the map is reasonably up-to-date and includes peri-urban settlements and informal or illegal settlements. You may need to update an older map.

A similar approach is to use satellite imagery. Useful satellite imagery is available though free services such as Google Earth (**`http://earth.google.com`**). The quality (i.e.) resolution of the images available from these services is variable but is usually good enough to enable segmentation or to help update an older map. *Figure SS*, for example, shows a typical satellite image of a moderately sized town in Central Africa segmented into areas of very approximately equal volume.

When creating segments using maps or satellite images it is a good idea to use main roads, rivers, canals, railway lines, public parks, &c. as boundaries. This simplifies the segmentation process and also simplifies fieldwork by making areas and their boundaries easy to locate and sample.

Figure SS : Segmenting a town using a satellite image

It should be noted that you may only be interested in sampling from particular areas (e.g. you may be interested in sampling only in disadvantaged areas). In this case you need only identify, segment (if necessary), and sample the areas you are interested in. This is accepted practice in sentinel-site surveillance systems.

Once you have defined areas to be sampled you can take a sample of households in these areas. Three sampling techniques may be used:

Census sampling : With this approach you sample **all** areas. You will probably want to use this approach if you want the surveillance system to cover a small portion of the city or town (e.g. disadvantages areas).

Probability sampling : With this approach you take a random or systematic sample of areas. An easy way to take a random sample of areas is to assign a unique number to each area, write these numbers on separate pieces of paper, fold the papers, put them in a bowl, shake the bowl, and pick out six or more pieces of paper. The numbers on the papers picked out of the bowl correspond to the areas that you will take your sample from. Systematic sampling involves listing the areas and picking (e.g.) every third area. If the list is organised spatially then a systematic sample often produces a better (i.e. more even) sample than a random sample. *Figure PS1* and *Figure PS2* illustrate random and systematic sampling.

Spatial sampling : There are many approaches to spatial sampling. The simplest approach is *centric systematic area sampling* (see *Figure SPS*). This method almost guarantees an even spatial sample.

Figure PS1 : An example of random sampling for areas to sample

Sampling procedure used:

Each area was numbered (1 to 26).

Six areas were selected at random (11, 13, 15, 17, 22, 23).

Figure PS2 : An example of systematic sampling for areas to sample

Sampling procedure used:

Each area was numbered (1 to 26).

A sampling interval was calculated as:

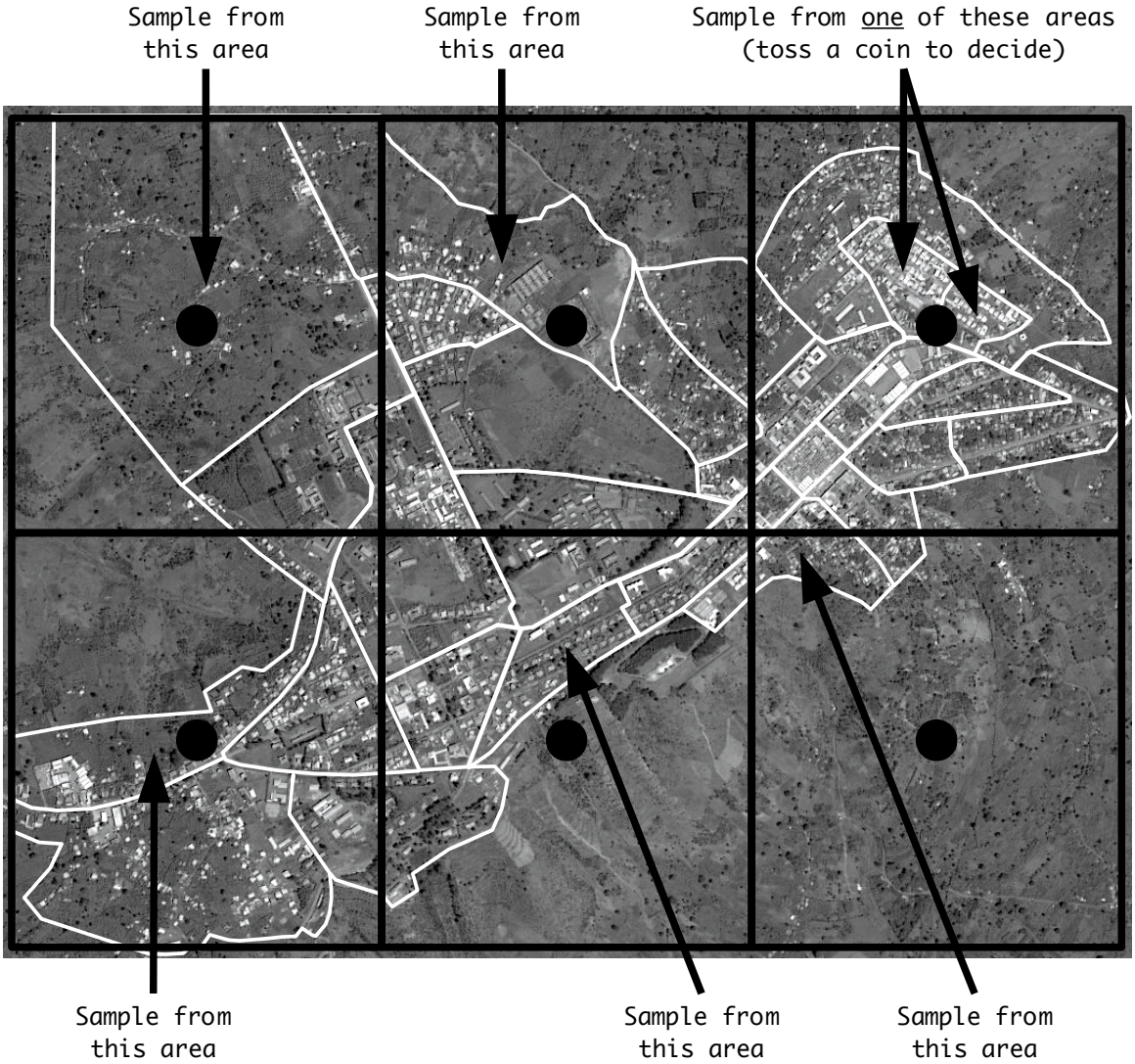
$$Sampling\ interval = \frac{Total\ number\ of\ areas}{Number\ of\ areas\ to\ sample} = \frac{26}{6} \approx 4$$

The first area to sample (2) was chosen using a random number between 1 and 4.

Other areas to sample were chosen by successive addition of the sampling interval:

$$2 + 4 = \underline{\mathbf{6}},\ 6 + 4 = \underline{\mathbf{10}},\ 10 + 4 = \underline{\mathbf{14}},\ 14 + 4 = \underline{\mathbf{18}},\ 18 + 4 = \underline{\mathbf{22}}$$

Figure SPS : An example of systematic sampling for areas to sample



Sampling procedure used:

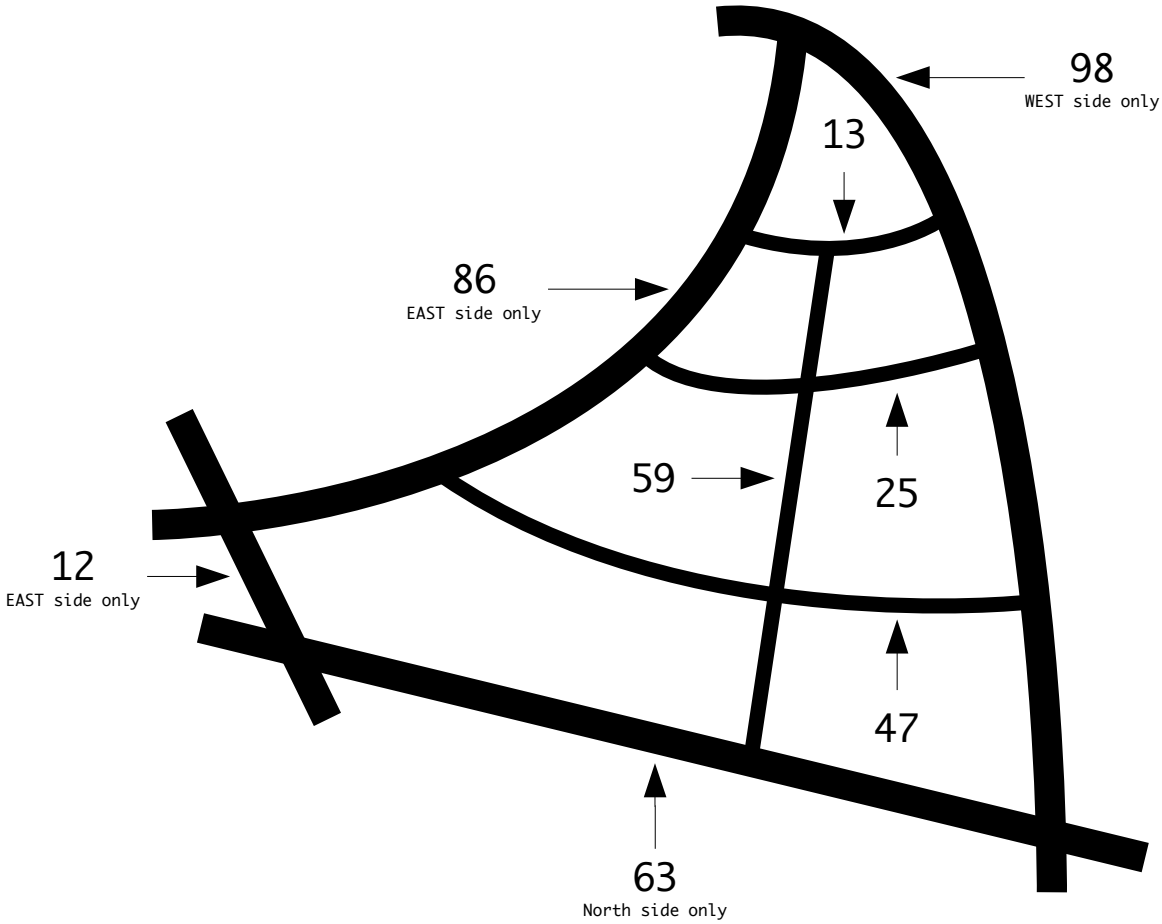
A grid was drawn over the map / image.

The areas closest to the centre of each grid square were selected fort sampling.

Selecting households in the selected areas

One method of sampling household in urban settings is *door counting with systematic sampling*. In this method a rough map of the streets in a selected area is made and the number of doorways on each street is counted. The number of doorways on each street are then copied onto the rough street map (as shown in *Figure DC*). Note the use and treatment of main roads as area boundaries in *Figure DC*.

Figure DC : Rough street map with door counts



The total number of doorways is calculated. A *step size* (n) is calculated by dividing the total number of doorways by the number of houses to be sampled. A systematic sample is then taken by sampling every n^{th} house along on a route round the area that includes all streets in the area (not the treatment of area boundaries in *Figure DC*). Streets can be sampled in any order. If you find that you have sampled all streets but have not yet sampled the required number of houses or children then you should return to the street with the largest number of houses to collect the remainder of the sample.

Example : There are 403 doorways in the area shown in *Figure DC*. We need to sample 48 houses. The step size is:

$$\textit{Step size} = \frac{403}{48} \approx 8$$

A route is planned around the streets of the area and every eighth house is sampled.