Working with `fdim`

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2017-08-22

This vignette aims at providing an overview of how the calculation of the fractal dimension using the box-counting technique is carried out and then proceeds to give detailed instructions on how to calculate it using this package.

Introduction to how the box-counting technique works

The fdim package is used for calculating the fractal dimension of a single polygonal feature stored in an ESRI Shapefile using the box-counting technique. It is done by performing the following important steps:

- Importing the shapefile and calculating the extents of the polygon
- Overlaying a grid of square cells on top of this polygon
- Fill out a 5-by-2 matrix row-by-row with the size of the cell and the number of such cells required to completely cover the polygon
- Decrease the size of the cell and repeat the previous step until the matrix has been populated
- Plot a log-log scatterplot of the number of cells vs. the reciprocal of cell size
- Calculate the best-fit line through these points and find its slope
- Report the slope of this line as the fractal dimension of the polygon

Step-by-step procedure to calculate the fractal dimension

In order for the program to work correctly, the following conditions must be met before importing the shapefile:

- The file should be in ESRI shapefile format with the extension being .shp
- It must have its auxillary files with the same name (but different extensions) in the same directory
- The file must contain a *single polygon* feature in it

If all of the above conditions are met, performing the following steps will calculate the fractal dimension.

Generating the matrix:

The first step is to call the function `mb_dim`. The result obtained by calling this function needs to be stored in a variable for the actual calculation of the fractal dimension. This function (`mb_dim`) can be called in two ways: with or without arguments.

`mb_dim` with arguments:

The following code shows the function called **with arguments**:

```
fdim_matrix = fdim::mb_dim(directory = system.file(package = "fdim"), shapefile = "madhya_pradesh")
```

```
## OGR data source with driver: ESRI Shapefile
## Source: "C:/Users/Pramit/AppData/Local/Temp/RtmpOAXoxL/Rinst1f64184d2b64/fdim", layer: "madhya_prades
## with 1 features
```

```
## It has 2 fields
## Integer64 fields read as strings:  ID_0
```

The following points should be noted when calling the function with arguments:

- The first argument (`directory`) should evaulate to the directory path where the shapefile is located without the last trailing slash.
- The second argument (`shapefile`) should name the shapefile in *that* directory without the extension.

So, for example, if the location of the shapefile is: `C:\abc\def\xyz.shp`, then the `mb_dim` function should be called in the following manner:

```
fdim_matrix = mb_dim(directory = "C:\abc\def", shapefile = "xyz")
```

`mb_dim` without arguments:

`mb_dim` can also be called without passing arguments. When called in this mode, it will prompt the user for the two arguments one-by-one.

```
fdim_matrix = mb_dim()
```

The program will prompt the user to enter the directory as follows:

```
Please enter the directory without the trailing slash:
```

The user needs to enter the directory path in the same manner described above and press return. At this point, the program will prompt for a filename within that directory:

```
Please enter the directory without the trailing slash: C:\abc\def
Please enter the filename without the extension:
```

After entering the filename (in the same manner), the user should hit return.

```
Please enter the directory without the trailing slash: C:\abc\def
Please enter the filename without the extension: xyz
```

If a valid file was given, the user should see some statistics regarding the shapefile.

Calculating the fractal dimension:

To view the fractal dimension of the polygon, the result from calling `mb_dim` needs to be passed to the generic method `summary`. The following piece of code illustrates the use:

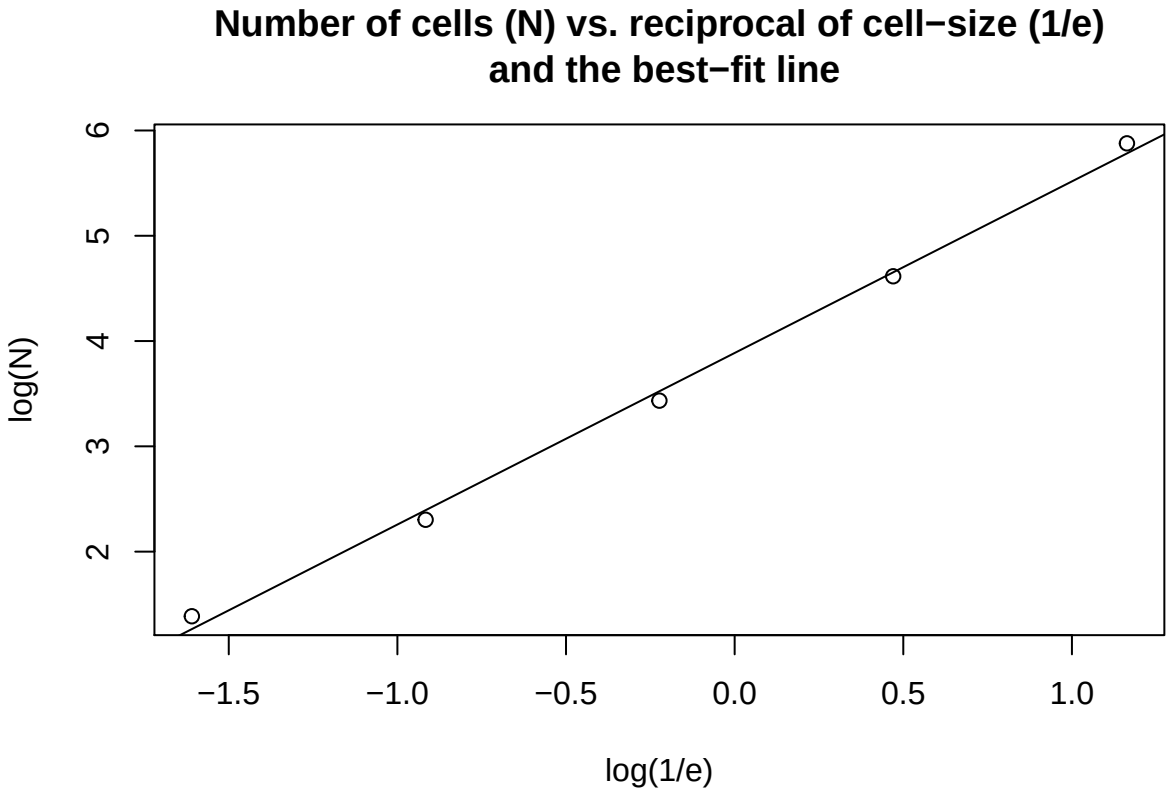
```
summary(fdim_matrix)
```

```
## The fractal dimension of the polygon is:  1.629584 .
```

Viewing the scatterplot and the best-fit line (optional):

The best-fit line to the log-log scatterplot can be seen by calling the generic `plot`. It is to be called with the result from `mb_dim` as its argument, as shown below:

```
plot(fdim_matrix)
```



In the above scatter-plot, the x- and y-axes represent the reciprocal of cell-size (1/e) and the number of cells needed to cover the polygon (N), both on a (natural) logarithmic scale. A best-fit line is also seen for the discrete points that were calculated. The slope of this best-fit line essentially represent the fractal dimension of the polygon.