How can I generate a variogram for spatial data in R?

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Generating a variogram for spatial data in R involves a statistical analysis technique that is used to measure the spatial dependency or correlation between data points in a particular area. This method is commonly used in geostatistics to understand the spatial patterns and variability of a specific phenomenon. In R, the process of generating a variogram involves importing the spatial data, defining the spatial coordinates, and calculating the pairwise distances between data points. This information is then used to plot a variogram, which visually displays the relationship between the spatial distance and the difference in values of the data points. This allows for the identification of any spatial trends or patterns, as well as the estimation of the spatial variability of the data. By generating a variogram in R, researchers and analysts can gain valuable insights into the behavior and distribution of spatial data, aiding in the understanding and prediction of future trends.

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When analyzing geospatial data, describing the spatial pattern of a measured variable is of great importance. A common way of visualizing the spatial autocorrelation of a variable is a variogram plot. This can be done in R. There are several libraries with variogram capabilities. We will show how to generate a variogram using the geoR library. To install, enter `install.packages("geoR")` and then `library(geoR)` in R.

Let's look at an example. Our dataset, ozone, contains ozone measurements from

thirty-two locations in the Los Angeles area aggregated over one month. The dataset includes the station number (Station), the latitude and longitude of the station (Lat and Lon), and the average of the highest eight hour daily averages (Av8top). This data, and other spatial datasets, can be downloaded from the University of Illinois's Spatial Analysis Lab. By generating a variogram, we will be able to look at the variance of the differences of Av8top among pairs of stations at different distances. We can look at a sample of our data and then a summary of the distances between the stations.

```
ozone<-
read.table("https://stats.idre.ucla.edu/stat/r/faq/ozone.csv", sep=",", header=T)
head(ozone, n=10)
```

```
Station Av8top Lat Lon
1 60 7.225806 34.13583 -117.9236
2 69 5.899194 34.17611 -118.3153
3 72 4.052885 33.82361 -118.1875
4 74 7.181452 34.19944 -118.5347
```

5 75 6.076613 34.06694 -117.7514
6 84 3.157258 33.92917 -118.2097
7 85 5.201613 34.01500 -118.0597
8 87 4.717742 34.06722 -118.2264
9 88 6.532258 34.08333 -118.1069
10 89 7.540323 34.38750 -118.5347

dists <- dist(ozone)
summary(dists)

Min. 1st Qu. Median Mean 3rd Qu. Max.
0.07267 0.39550 0.64660 0.73670 0.99190 2.39700

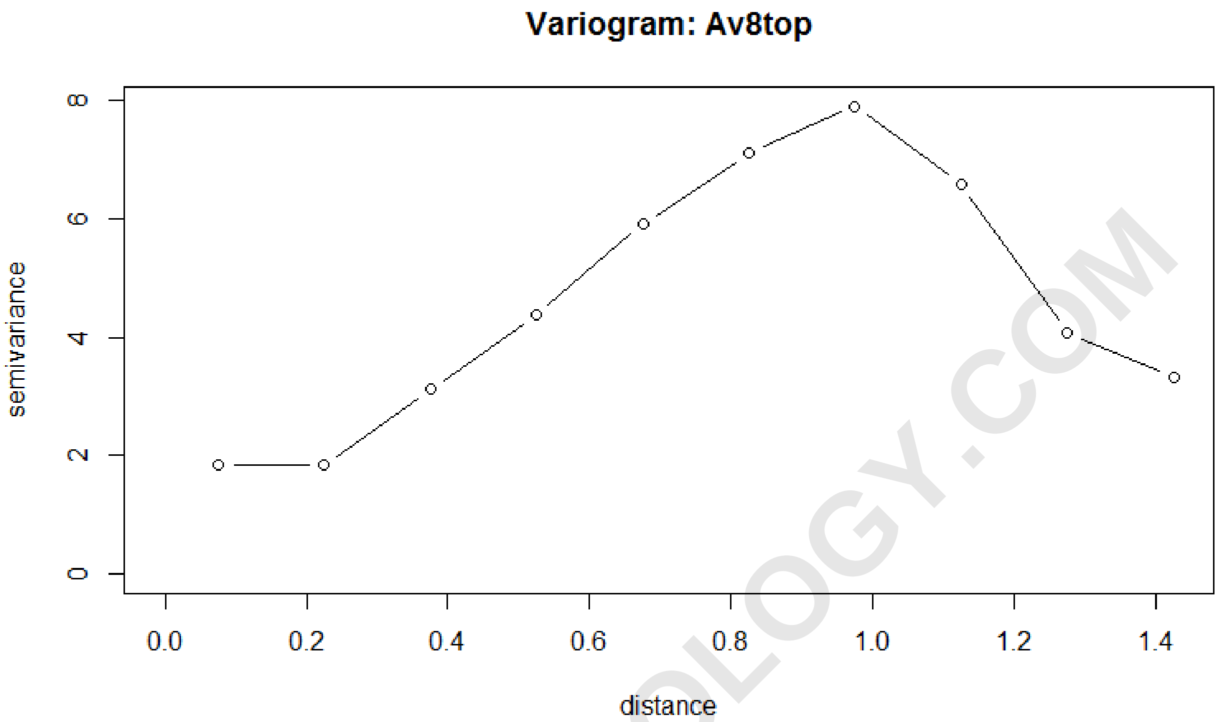
Next, we can calculate a variogram using the latitude and longitude of the stations. For this, we will use the variog command.
We will indicate the distance intervals we wish to consider. Based on the
summary of distances, we can look at 10 lag intervals of .15. To do this,
we will first create a breaks vector of the endpoints of our intervals.
To variog, we provide our coordinate variables and the "data", the variable of

interest. Then, we can look at the variog output that we will be
plotting, the semi-variance, and the number of pairs counted in each interval.
We want to check that our variogram is not calculating the semi-variance on
small numbers of pairs.

```
breaks = seq(0, 1.5, l = 11)
v1
lag semi-variance # of pairs
1 1.848505 21
2 1.841220 57
3 3.120452 74
4 4.375926 67
5 5.910725 71
6 7.097913 55
7 7.896033 44
8 6.571356 37
9 4.071090 23
10 3.317602 16
```

Now, we can plot the variogram:

plot(v1, type = "b", main = "Variogram: Av8top")



In the summary, we can see lag distances up to 10*.15 = 1.5, the number of pairs that are this far apart in the dataset, and the semi-variance.

As we can see from the plot, the semi-variance increases until the lag distance exceeds 1.

Variograms in other packages:

References: