Week 5: Geostatistics II

Notes on Assumption of Kriging

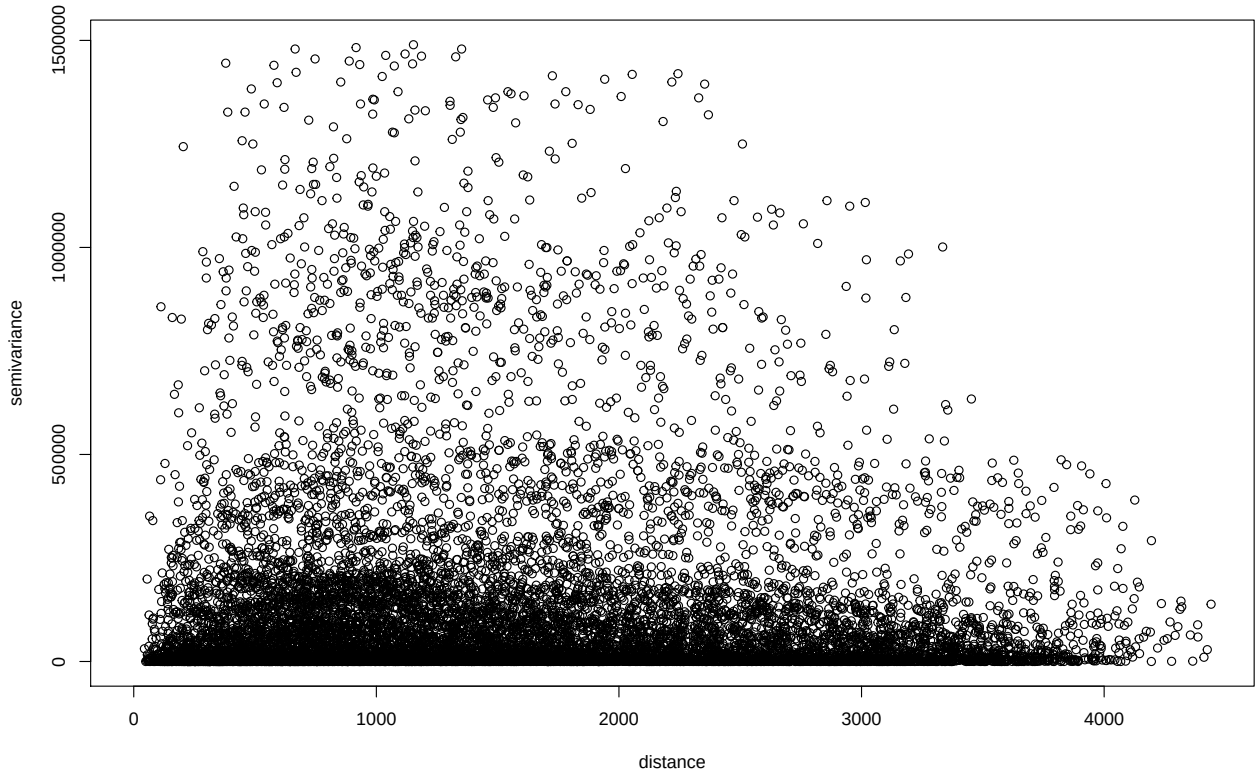
Stationarity

Consider a spatial process $z(s)$ with a mean $m(s)$ and variance $\sigma(s)$ exists $\forall s \in \mathcal{D}$.

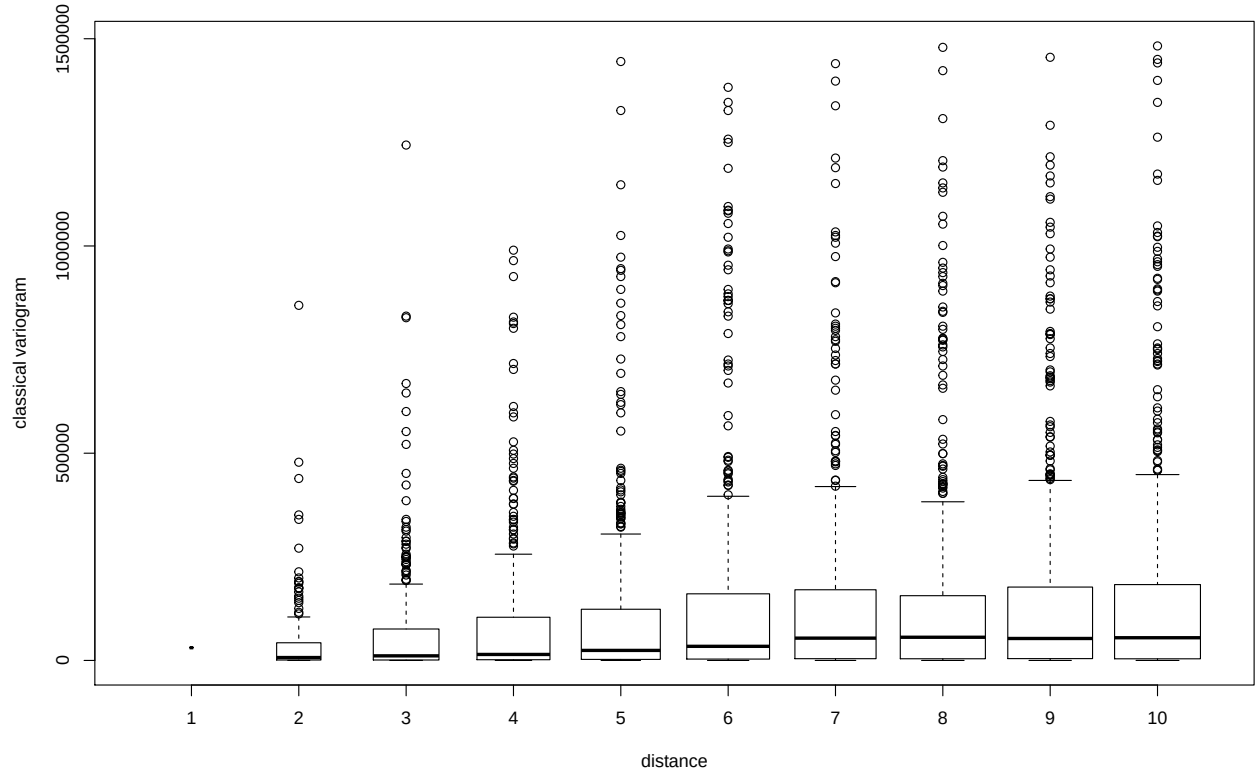
1. The process is `strictly stationary` or `strongly stationary` if, for any given $n \geq 1$, any set set of n sites and any $h \in \mathcal{R}^d$, the distribution of $z(s_i), \ldots, z(s_n)$ is the same as $z(s_i + h), \ldots, z(s_n + h)$
2. A less restrictive assumption is `weak stationarity` or `second-order stationarity`, which is to assume $m(s) \equiv \mu$ and $cov[z(s_i), z(s_i + h)] = C(h)$ for any $h \in \mathcal{R}^d$ s.t. both s_i and $s_i + h$ are within $\mathcal{D}$. $C(h)$ is `covariogram`.
    - $cov[z(s_i), z(s_i + h)] = E[z(s_i) - \mu][z(s_i + h) - \mu] = E[z(s_i)z(s_i + h)] - \mu^2 = C(h)$
    - $\sigma(z(s_i)) = E[z(s_i) - \mu]^2 = E[z(s_i)^2] - \mu^2 = C(0)$
    - $\rho(h) = \frac{C(h)}{\sigma(z(s_i)\sigma z(s_i+h)}$ is `correlogram`
3. The `second-order stationarity` assumes the existence of covariance. For cases where covariance and variance do not exist, we assume the stationarity of the difference.
    - $E[z(s)] = \mu, \forall s$
    - $\sigma[z(s_i + h) - z(s_i)] = E[z(s_i + h) - z(s_i)]^2 = 2\gamma(h)$
    - $\hat{\gamma(h)} = \frac{1}{2N(h)} \sum_{(s_i,s_j)\in N(h)}^{N(h)} [z(s_i) - z(s_j)]^2$
    - $2\gamma(h)$ is called `variogram` and $2\gamma(h)$ is therefore `semivariogram`
    - `intrinsic stationarity`

Variogram

```
data(meuse)
# convert it to a geodata object that geoR requires.
meuse=as.geodata(meuse,coords.col=1:2, data.col=6)
# generate variogram cloud. geoR provides two different ways for the sample
# variogram values, classical and modules. The classical one is the one we
# talked about in the class, and the modules one is the
cloud1 <- variog(meuse, option = "cloud", estimation.type='classical')
names(cloud1)
head(cloud1$u, n=20)
head(cloud1$v, n=20)
plot(cloud1)
```




```
#box-plot of the cloud
bin1 <- variog(meuse, breaks=seq(45, 1000, by = 100), estimation.type='classical',bin.cloud=T)
plot(bin1, bin.cloud=T)
```



```
#
```

Simple Kriging

Ordinary Kriging

Universal Kriging

Indicator Kriging