Model on Montpellier rainfall

2025-01-08

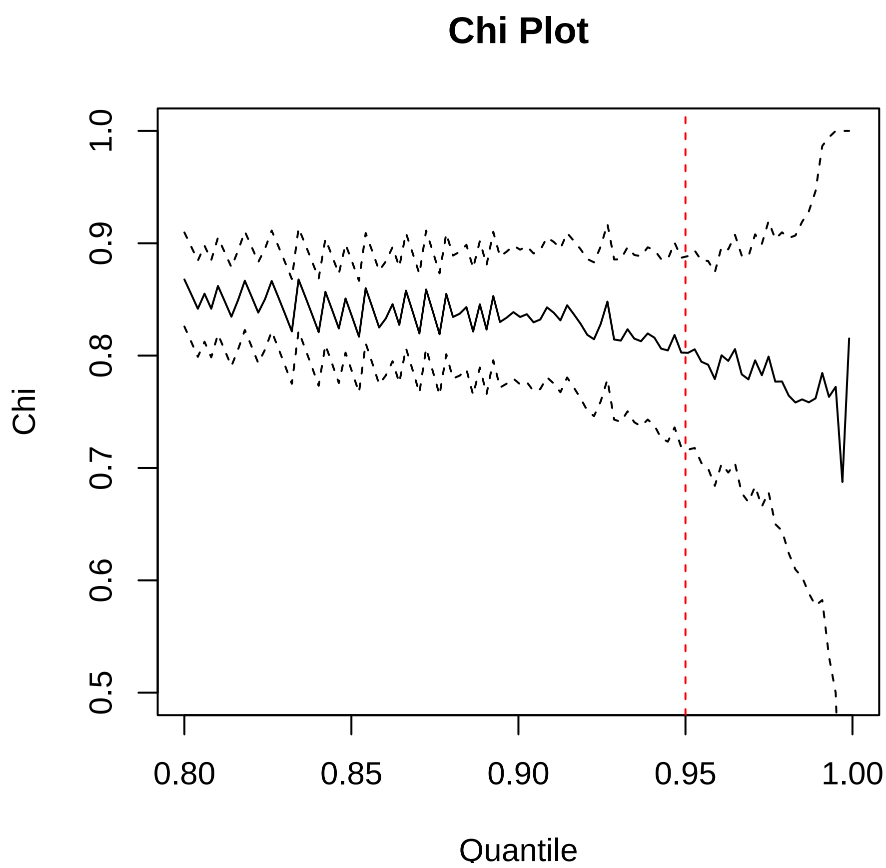
COMEPHORE data

An other dataset is considered, the COMEPHORE radar renalysis data from Météo France. We consider 59 pixels in the Montpellier area.

Quantile choice

```
# Remove lines with just zeros
comephore_nozeros <- comephore[rowSums(comephore) > 0, ]

# Choose two site and remove zeros
comephore_pair <- comephore_nozeros[, c(1,15)]
comephore_pair <- comephore_pair[rowSums(comephore_pair) > 0, ]
chiplot(comephore_pair, xlim = c(0.8, 1), ylim1 = c(0.5, 1), which = 1,
        qlim = c(0.8, 0.999))
abline(v = 0.95, col = "red", lty = 2)
```

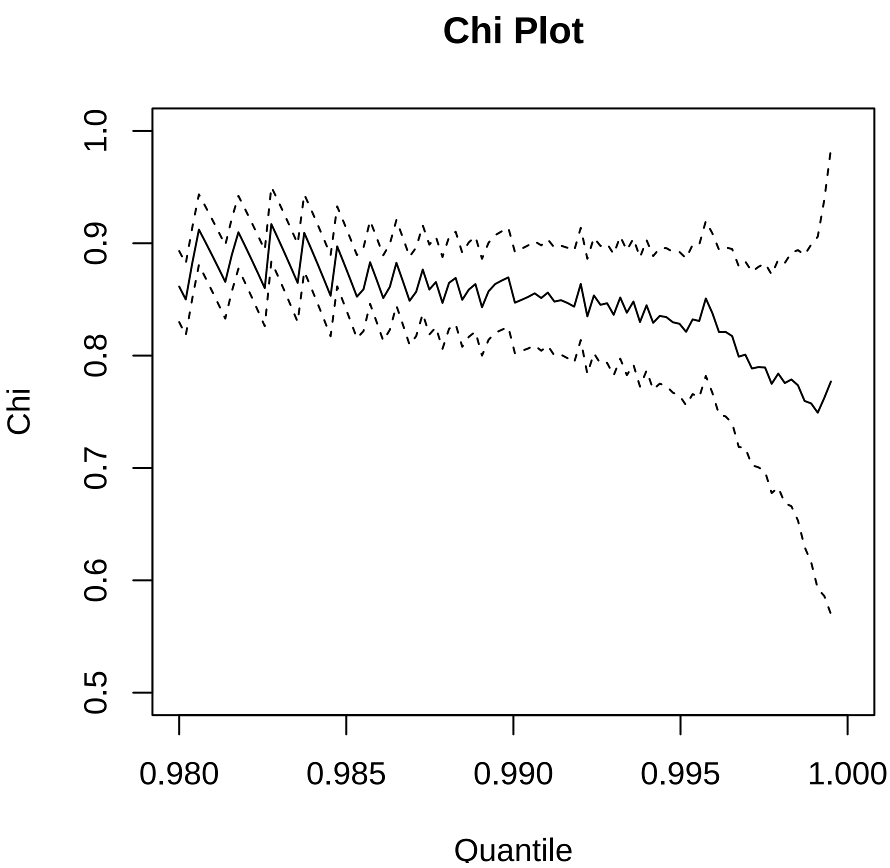



```
# count conjoint excesses
q <- 0.95
# uniformize the data
n <- nrow(comephore_pair)
data_unif <- cbind(rank(comephore_pair[, 1]) / (n + 1),
                   rank(comephore_pair[, 2]) / (n + 1))

count_excesses <- sum(data_unif[, 1] > q & data_unif[, 2] > q)
print(count_excesses)
```

```
## [1] 509
```

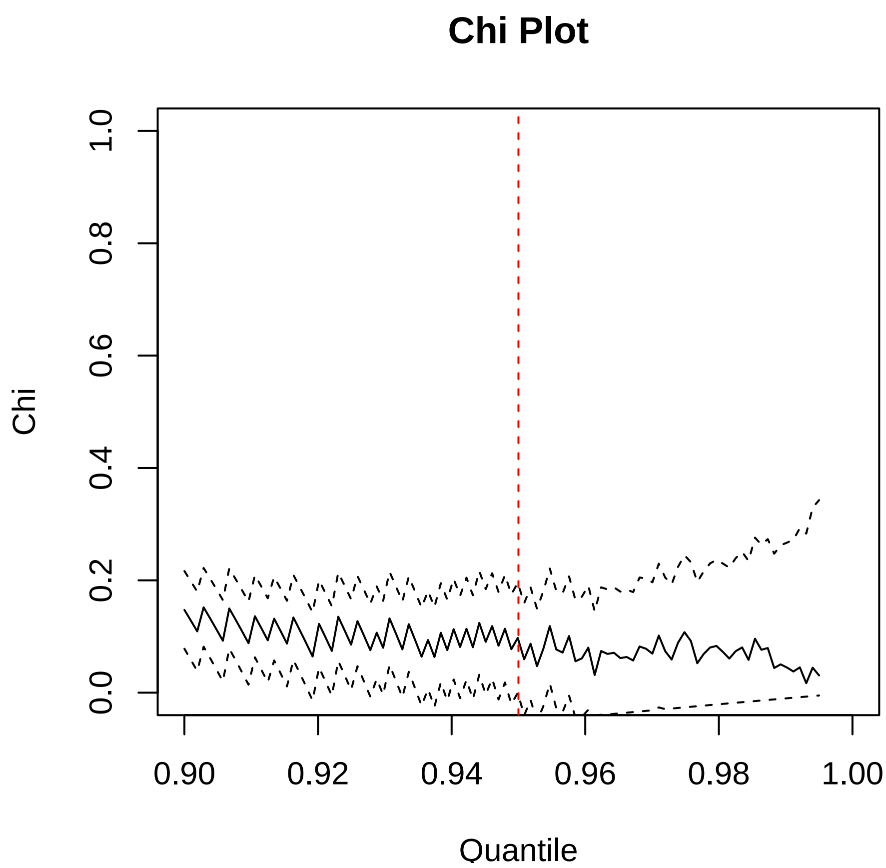
```
# With all zeros
comephore_pair <- comephore[, c(1,10)]
chiplot(comephore_pair, xlim = c(0.98, 1), ylim1 = c(0.5, 1), which = 1,
        qlim = c(0.98, 0.9995))
```




```r
threshold <- quantile(comephore$p102, probs = 0.998, na.rm = T)
# get the quantile from threshold in the data without 0 when the quantile is
# 0.998 with zeros inside data
empirical_cdf <- ecdf(comephore_pair$p102)
quantile_in_nozeros <- empirical_cdf(threshold)
print(quantile_in_nozeros)
```

```
## [1] 0.9980013
```

```r
# Temporal chi
rain_nolag <- comephore_nozeros$p142[1:(length(comephore_nozeros$p142) - 5)]
rain_lag <- comephore_nozeros$p142[6:length(comephore_nozeros$p142)]
comephore_pair <- cbind(rain_nolag, rain_lag)
comephore_pair <- comephore_pair[rowSums(comephore_pair) > 0, ]
chiplot(comephore_pair, xlim = c(0.9, 1), ylim1 = c(0, 1), which = 1,
        qlim = c(0.9, 0.995))
abline(v = 0.95, col = "red", lty = 2)
```




```
n <- nrow(comephore_pair)
data_unif <- cbind(rank(comephore_pair[, 1]) / (n + 1),
                   rank(comephore_pair[, 2]) / (n + 1))
q <- 0.95
count_excesses <- sum(data_unif[, 1] > q & data_unif[, 2] > q)
print(count_excesses)
```

```
## [1] 91
```

```
# We choose q = 0.95
q <- 0.95
```

Empirical chi and WLSE

Temporal chi

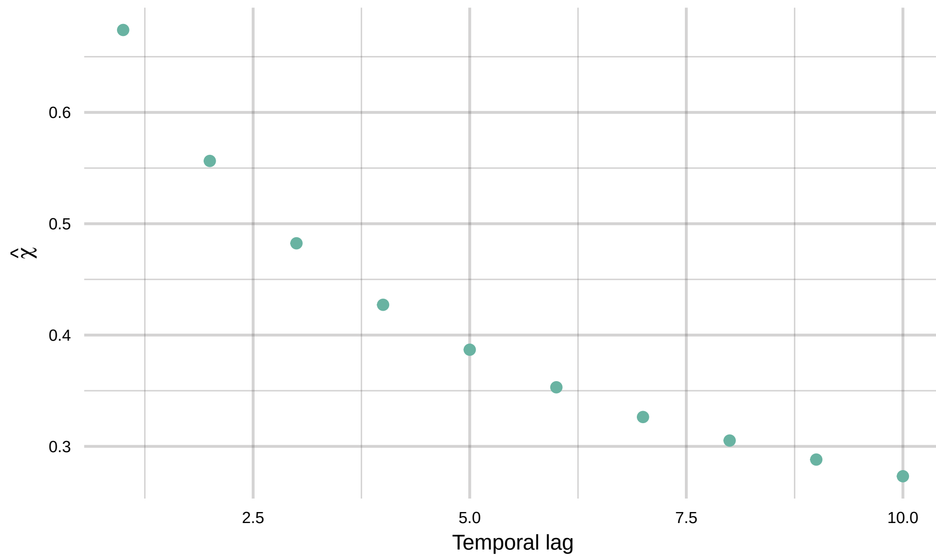


Figure 1: Empirical temporal extremogram

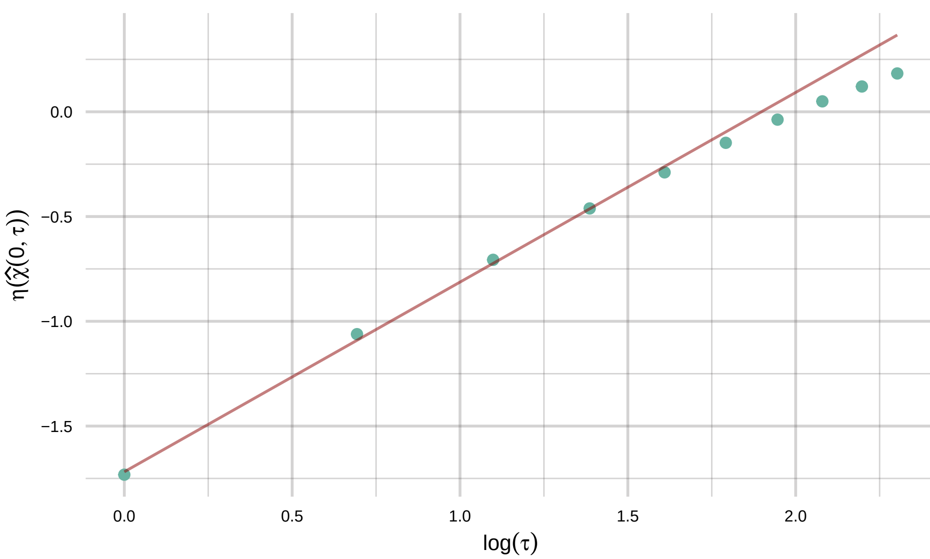


Figure 2: Empirical temporal extremogram with eta transformation and WLSE

Spatial chi

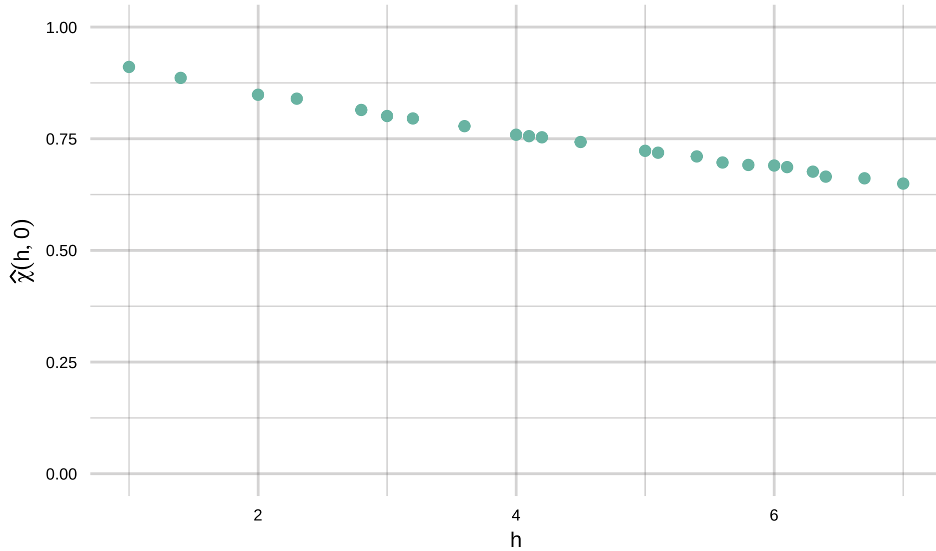


Figure 3: Empirical spatial extremogram

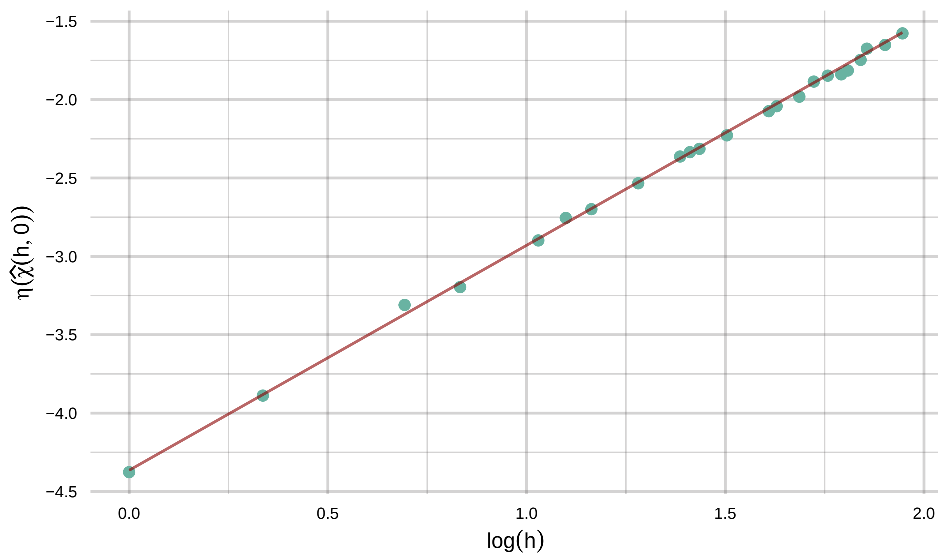


Figure 4: Empirical spatial extremogram with eta transformation and WLSE

Results of the WLSE method on the COMEPHORE data are:

beta1	beta2	alpha1	alpha2
0.0127182	0.1794025	1.435095	0.9052191

Optimization of the composite likelihood

Choose conditional points

```
# Get coords
sites_coords <- loc_px[, c("Longitude", "Latitude")]

# remove 0
rain_new <- comephore
quantile <- 0.998
min_spatial_dist <- 2 # in km
min_time_dist <- 5 # in hours

selected_points <- choose_conditional_points(
  sites_coords = sites_coords,
  data = rain_new,
  quantile = quantile,
  min_spatial_dist = min_spatial_dist,
  min_time_dist = min_time_dist
)

# Extract s0 and t0
s0_list <- lapply(selected_points, `[[`, "s0")
t0_list <- lapply(selected_points, `[[`, "t0")
```

We have 23 conditional points.

Get corresponding lags and excesses

Optimization results

We initialize the parameters with the values obtained from the WLSE method and without advection. It converges and the results of the optimization on the COMEPHORE data are:

beta1	beta2	alpha1	alpha2	adv1	adv2
1.652043	0.0002705	1.307467	0.6026213	0.0004664	0.0094159

Same but now we consider an advection of 0.1 for both directions. It converges and the results of the optimization on the COMEPHORE data are:

beta1	beta2	alpha1	alpha2	adv1	adv2
0.0241322	0.0775136	1.434925	0.836116	-0.038373	-0.0384274

Same but now we consider an advection of 0.01 for both directions. It converges and the results of the optimization on the COMEPHORE data are:

beta1	beta2	alpha1	alpha2	adv1	adv2
0.0456446	0.1199387	1.43489	0.8311259	-0.0097733	-0.0099501

Same but now we consider an initial advection of $(0.2, 0.1)$. It converges and the results of the optimization on the COMEPHORE data are:

beta1	beta2	alpha1	alpha2	adv1	adv2
0.0179213	0.1651067	1.435201	0.8954414	-0.1342604	-0.0671378

Variogram

Without initial advection

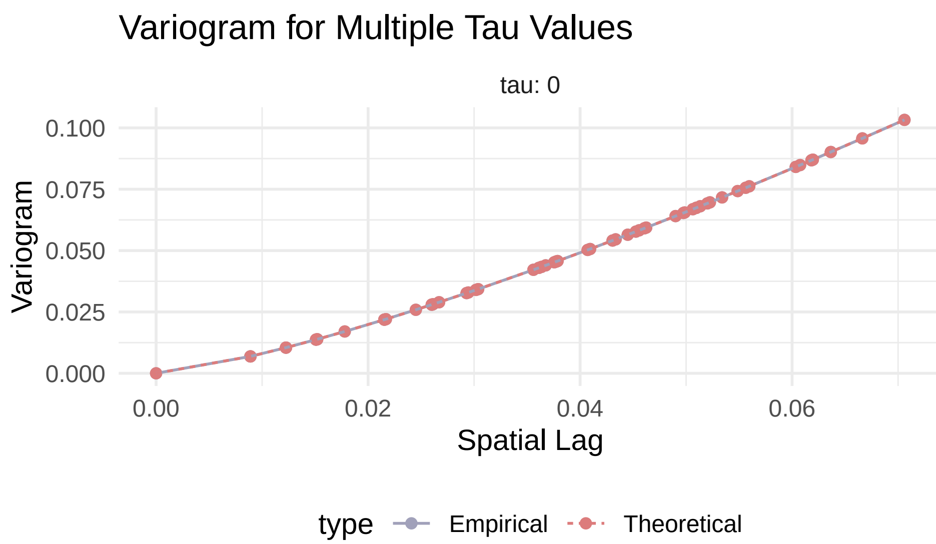


Figure 5: Variogram estimate with no initial advection in the optimization

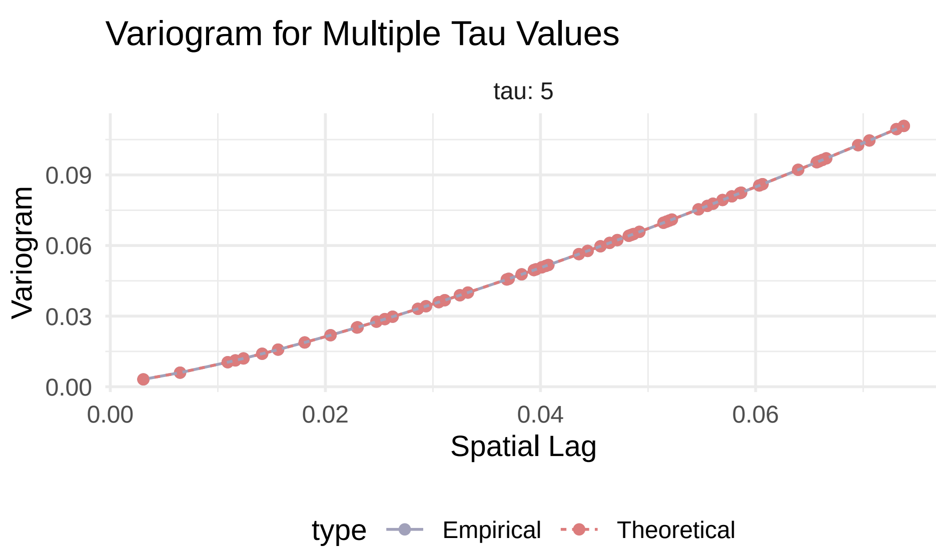


Figure 6: Variogram estimate with no initial advection in the optimization

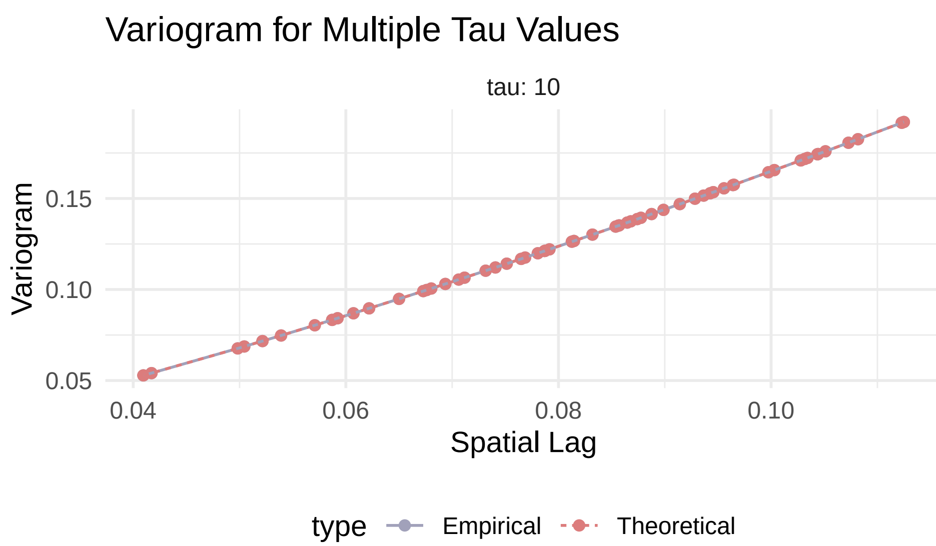


Figure 7: Variogram estimate with no initial advection in the optimization

With initial advection of 0.1

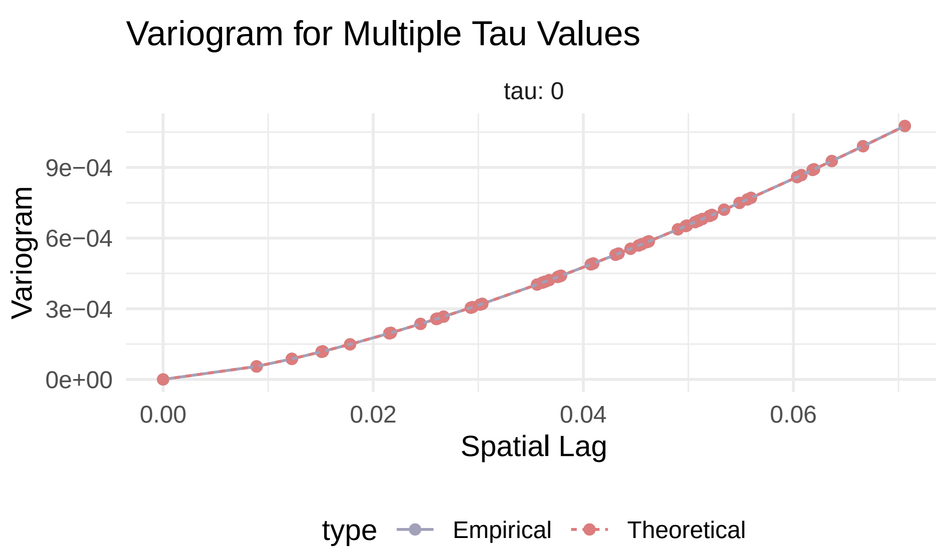


Figure 8: Variogram estimate with initial advection of 0.1 in the optimization

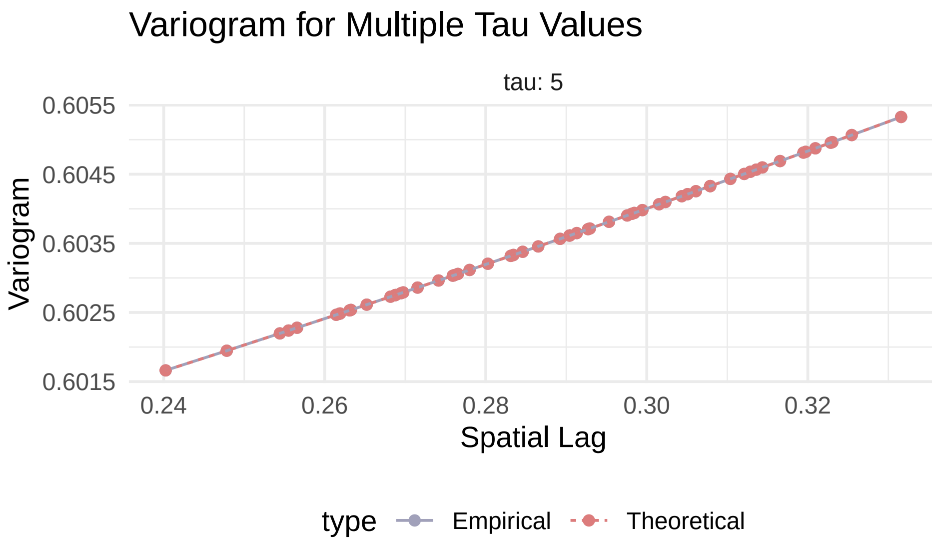


Figure 9: Variogram estimate with initial advection of 0.1 in the optimization

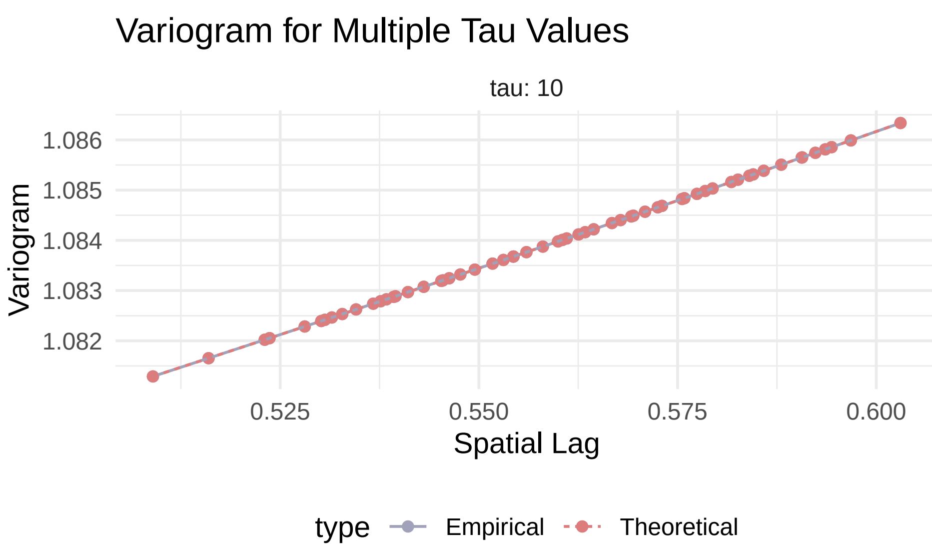


Figure 10: Variogram estimate with initial advection of 0.1 in the optimization