What are sparse matrices?

Create a symmetric positive definite $n \times n = 500 \times 500$ matrix, denoted with `A`.

Compare (empirically) the time it takes to

(a) transpose of `A`

(b) `A + A` or `A + 1`

(c) `A %*% A`

(d) `A^(-1)`

(e) solve `Ax=b`, `b` an n-vector

What is the theoretical complexity of these operations?

Can you confirm this empirically?

How to work with sparse matrices?

Same questions as before but now for a sparse matrix

Create a covariance matrix.

Create a precision matrix based on a

(a) regular grid,

(b) irregular grid and each location has 4 neighbors,

(c) ...

Compare the structure of a Cholesky factor with and without permutation.

What is the speed-up when using `update`?

Sparse positive definite matrices in statistics.

Naively, an "optimal" taper is the hat taper. Check numerically, that this taper cannot be used, i.e., the resulting covariance matrix is not positive definite.

Take your favorite (spatial) dataset and assume your favorite statistical model

$$g(x) = T(x)c + h(x) + \epsilon.$$

What are the maximum likelihood estimates of your data?

Sparse matrices and `fields`.

Create a sparse covariance matrix based on great circle distance.

Take your favorite (spatial) dataset and assume your favorite statistical model

$$g(x) = T(x)c + h(x) + \epsilon.$$

Predict g on a fine lat/lon grid

(a) using the "correct" covariance function based on Euclidean distance

(b) using the "correct" covariance function based on great circle distance

(c) using a tapered covariance function

Compare the three surfaces.