R package RandomFields

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Random fields

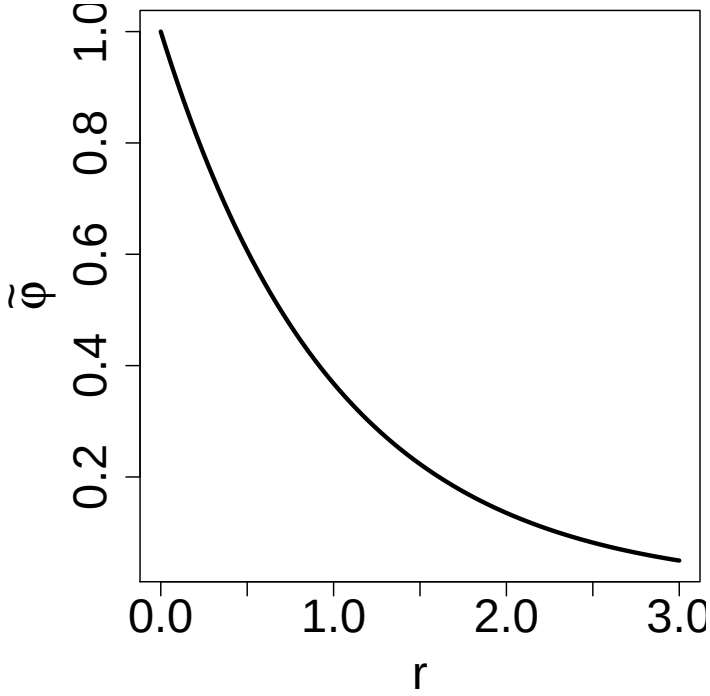
Z : random field on $\mathbb{R}^d$ = random function in space
= dependent random variables $Z(x)$ indexed by $x \in \mathbb{R}^d$

Applications

spatial data that can be measured at any location, e.g., temperature, moisture, ozon concentration,...
but also genetics: each SNP is a coordinate

Characteristics

- Expectation $\mathbb{E}\, Z(x)$
- Covariance function $C(x, y) = \mathrm{Cov}(Z(x) - Z(y))$
- Stationary and isotropic field: $C(x, y) = \varphi(\|x - y\|)$


φ̃
1.0
0.8
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0.4
0.2
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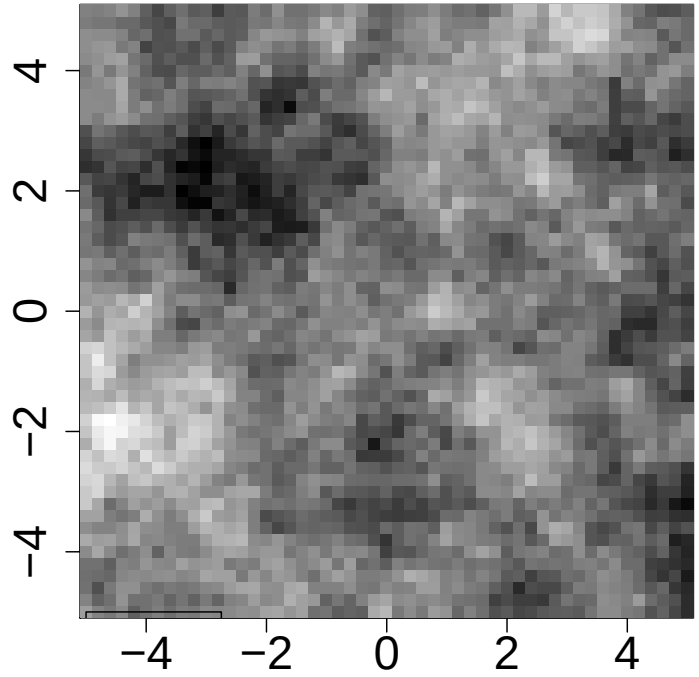
r


4
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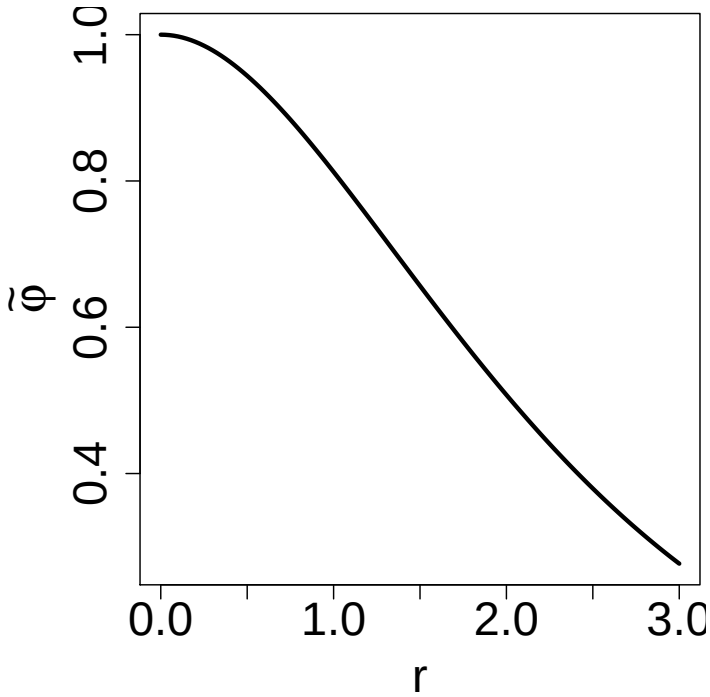
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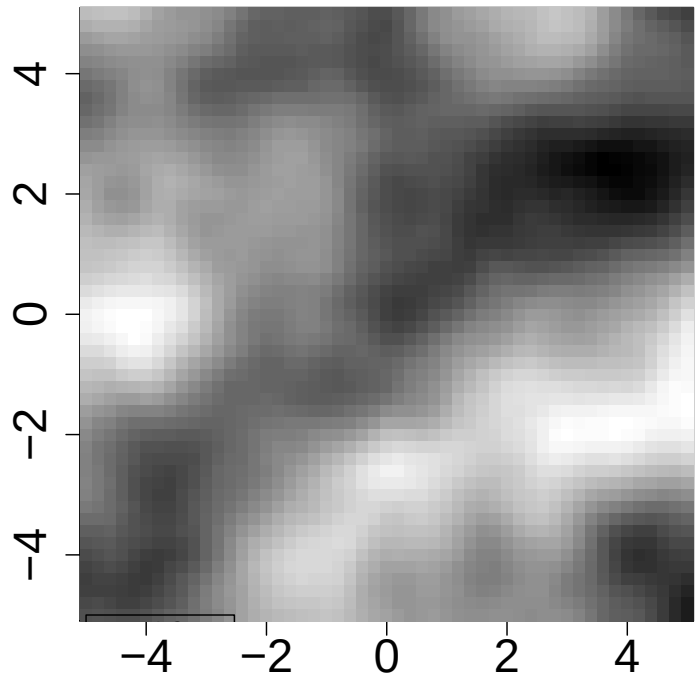
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Goal: simulation of and inference on random fields

History

- 1999: starting point for R package geoR;
- split up in geoR and RandomFields
  - geoR : Baysian; user friendly
  - RandomFields : research and speed oriented
  - future close cooperation reconsidered
- most code in C
- broad range of options
- necessity for own research work to have simulations out of the box

Original features

- Simulation of isotropic, spatial random fields

```
x <- c(-5, 5, 5 * 2 / lenx)
model <- list('exp', param=c(0,1,0,1))
z <- GaussRF(x,x, model=model, gridtriple=TRUE)
```

- various methods needed for different models (and parameter settings) and locations
  - automatic choice of the method
  - `RFparameters()` to influence choice and working of the methods
- Parameter estimation (MLE);
  - avoiding bugs in `optim` (parameter range, returned parameter set)
  - user friendly (starting values need not be given)
  - starting point with LSQ
- Kriging (spatial prediction)

Current state

- Complex model specification

```
model <- list('+',
     list('whittle', nu =5),
     list('$', var=3, list('gauss')),
     list('$', aniso=matrix(1:4, ncol=2), list('spher'))
     )
```

- simulation of space-time random fields
- simulation of multivariate fields
- arbitrary dimensions
- estimation of mixed models with geostatistical component (MLE / REML)

Future work

- extended manual
- customized interfaces
- Graphic card option
- C++