Figure 12.1. Summary of the SPDE approach. We specify a model with a spatial correlated random effect $u$. After making a series of assumptions ($u$ is Markovian, its covariance matrix $\Sigma$ is modelled with the Matérn correlation function) and numerical approximations (use SPDE for a GMRF defined on each vertex of a mesh) we end up with an approximation of $u$ and its covariance matrix.
Figure 12.2. Outline of the required steps to apply a model with a spatial correlated random intercept in R-INLA. Starting point is the mesh. The R code, which is at the outside of the trapezoid ring, is discussed in the next sections.

12.5 Adding spatial correlation to the model

```r
Il<-inla(f1, 
    family = "gaussian", 
    data = inla.stack.data(Stack), 
    control.predictor = list( 
        A = inla.stack.A(Stack))) 

f1<-y ~ -1 + Intercept + Alt + 
    f(w, model = spde) 

Stack<-inla.stack(tag = "Fit", 
    data = list(y = iPhSpH), 
    A = list(1, 1, A), 
    effects = list( 
        Intercept = rep(1, N), 
        X = X, 
        w = w.index)) 

mesh<-inla.mesh.2d(loc=Loc, 
    max.edge=c(a,b)) 

A<-inla.spde.make.A(mesh, Loc) 

spde<-inla.spde2.matern(mesh, 
    alpha = 2) 

w.index<-inla.spde.make.index(name = 'w', 
    n.spde = spde$n.spde, 
    n.group = 1, 
    n.repl = 1) 
```