Equivalent kernels of Whittaker smoother with second order penalty
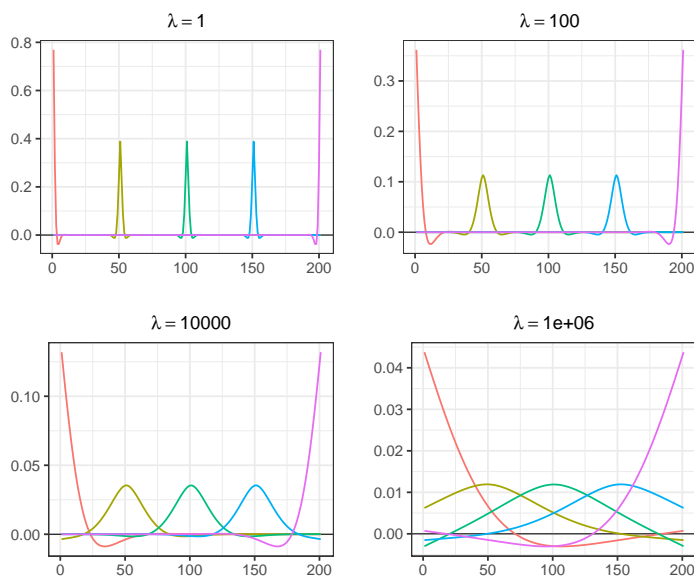

Illustration of equivalent kernels. The differently coloured curves show the values in row 1, 51, 101, 151 and 201 of the 201 by 201 hat matrix of the Whittaker smoother with penalty order 2. The titles of the panels show the value of λ. R code in `f-eff-kernels.R`

```
# Illustrate equivalent kernels of Whittaker smoother with second order penalty
# A graph in the book 'Practical Smoothing. The Joys of P-splines'
# Paul Eilers and Brian Marx, 2019

library(ggplot2)
library(JOPS)
library(gridExtra)

# Create the impulse
n = 201
y = rep(0, n)
y[n / 2] = 1
lambdas = c(1, 100, 1e4, 1e6)

# Apply the Whittaker smoother with a difference penalty
E = diag(n)
plts = list()
cols = rainbow(5)
for (jp in 1:4) {
  lambda = lambdas[jp]
  D = diff(E, diff = 2)
  P = lambda * t(D) %*% D
  H = solve(E + P)

  # Data frames for plotting
  h = as.vector(H[, seq(0, n - 1, length = 5) + 1])
  x = 1:n
  F1 = data.frame(x = rep(x, 5), y = h, id = as.factor(rep(1:5, each = n)))
  titl = bquote(lambda == .(lambda))

  # Make the plot
  plt = ggplot(F1, aes(x = x, y = y, color = id)) +
    geom_hline(yintercept = 0, size = 0.3) +
    geom_line() +
```

```
        ggtitle(titl) +
        xlab("") + ylab("") +
        JOPS_theme() +
        theme(plot.title = element_text(size = 11)) +
        theme(legend.position = "none")

    plts[[jp]] = plt
}

grid.arrange(grobs = plts, nrow = 2, ncol = 2)
```