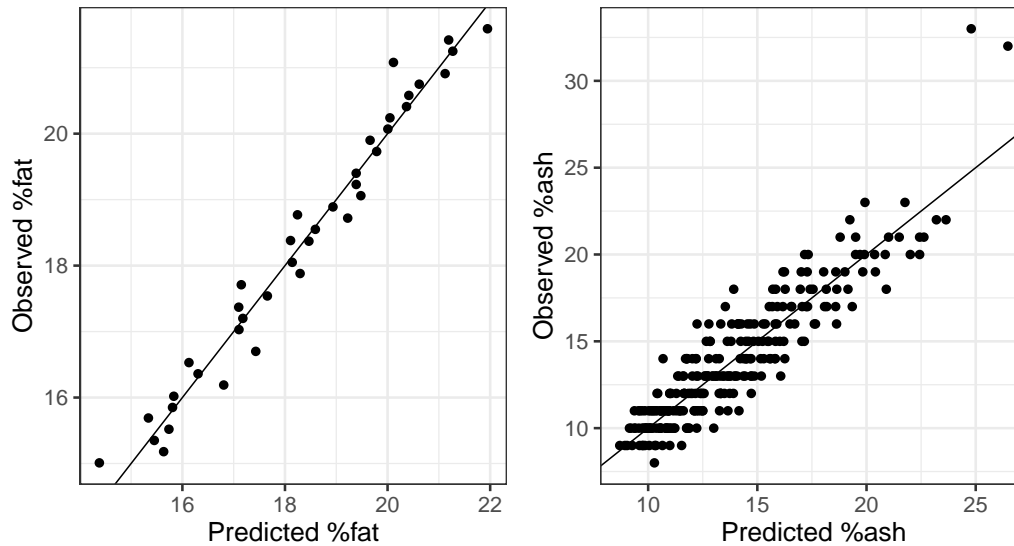# External prediction performance plot (Biscuit and Sugar data)

Externally predicted vs. observed response for two different models %fat (1D PSR, left), %ash (2D PSR, right)), using optimal λ based on LOOCV. R code in `f-LOOCVpsr.R`

```r
# External prediction performance plot (Biscuit and Sugar data)
# A graph in the book 'Practical Smoothing. The Joys of P-splines'
# Paul Eilers and Brian Marx, 2019

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

# Get the data
library(fds)
data(nirc)

iindex = nirc$x
X = nirc$y
sel = 50:650   #1200 <= x & x<= 2400
X = X[sel, ]
iindex = iindex[sel]
dX = diff(X)
diindex = iindex[-1]
y = as.vector(labc[1, 1:40])   #fat
oout = 23   # Denoted as outlier by Brown et al. (2001)
dX = t(dX[, -oout])
y = y[-oout]

# Optimal fit
fit1 = psSignal(y, dX, diindex, nseg = 25, lambda = 3.2e-07, pord = 3)
cor1=cor(fit1$press_mu, y)
# Dataframes and ggplot
F1=data.frame(x=fit1$press_mu, y=y)
plt1 = ggplot(F1, aes(x = x, y = y)) +
  geom_point(size = 1.2) +
  geom_abline(intercept = 0, slope=1, size = 0.3) +
  xlab("Predicted %fat") +
  ylab("Observed %fat") +
  theme(
```

```r
    axis.title.x = element_text(size=16),
    axis.title.y = element_text(size=16)) +
  ggtitle(" ") +
  JOPS_theme()
# Get the data
x0 = Sugar$X
x0 = x0 - apply(x0, 1, mean)  #center Signal
y = as.vector(Sugar$y[, 3])   #Response is Ash

# Inputs for two-dimensional signal regression
nseg = c(7, 37)
pord = c(3, 3)
min_ = c(230, 275)
max_ = c(340, 560)
M1_index = rev(c(340, 325, 305, 290, 255, 240, 230))
M2_index = seq(from = 275, to = 560, by = 0.5)
p1 = length(M1_index)
p2 = length(M2_index)
int <- T  # intercept in model

# Fit optimal model based on LOOCV, found via ucminf
opt_lam=c(81110, 52275)
Pars_opt=rbind(c(min_[1],max_[1],nseg[1],3,opt_lam[1],pord[1]),
               c(min_[2],max_[2],nseg[2],3,opt_lam[2],pord[2]))
fit=fit_opt=ps2DSignal(y, x0, p1, p2, "unfolded", M1_index, M2_index, Pars_opt,
                       int=int, ridge_adj=1e-6)

cor2=cor(fit_opt$press_mu, y)
# Set up dataframes for ggplot
F1=data.frame(x=fit_opt$press_mu, y=y)
plt2 = ggplot(F1, aes(x = x, y = y)) +
  geom_point(size = 1.2) +
  geom_abline(intercept = 0,slope=1,size = 0.3) +
  xlab("Predicted %ash") + ylab("Observed %ash") +
  ggtitle(" ") +
  JOPS_theme()

grid.arrange(plt1, plt2, ncol = 2, nrow = 1)
```