```r
set.seed(444)
x1 = seq(1,3,length=100)
y1 = (x1-4)*(x1-2)*(x1-3)+ rnorm(100,sd=2)
x2 = seq(3,7,length=200)
y2=4-(x2-3)*(x2-5)*(x2-8) + rnorm(200,sd=2)
x=c(x1,x2)
y=c(y1,y2)

SimulatedData2 = data.frame(x,y)



# piecewise cubic (discontinuous)
model1 = lm(y ~ x+I(x^2)+I(x^3) , data=subset(SimulatedData2, x<=3))
pred1 = predict(model1)
model2 = lm(y ~ x+I(x^2)+I(x^3) , data=subset(SimulatedData2, x>3))
pred2 = predict(model2)

plot(y~x , cex.lab=1.5 , cex.axis=1.5 , data=SimulatedData2,
     main="discontinuous fit at the knot",
     col = adjustcolor("black",0.6))

abline(v=3 , lwd=1 , lty=3)
lines(pred1~SimulatedData2$x[SimulatedData2$x<=3] , lwd=2 , col="blue")
lines(pred2~SimulatedData2$x[SimulatedData2$x>3] , lwd=2, col="blue")
```
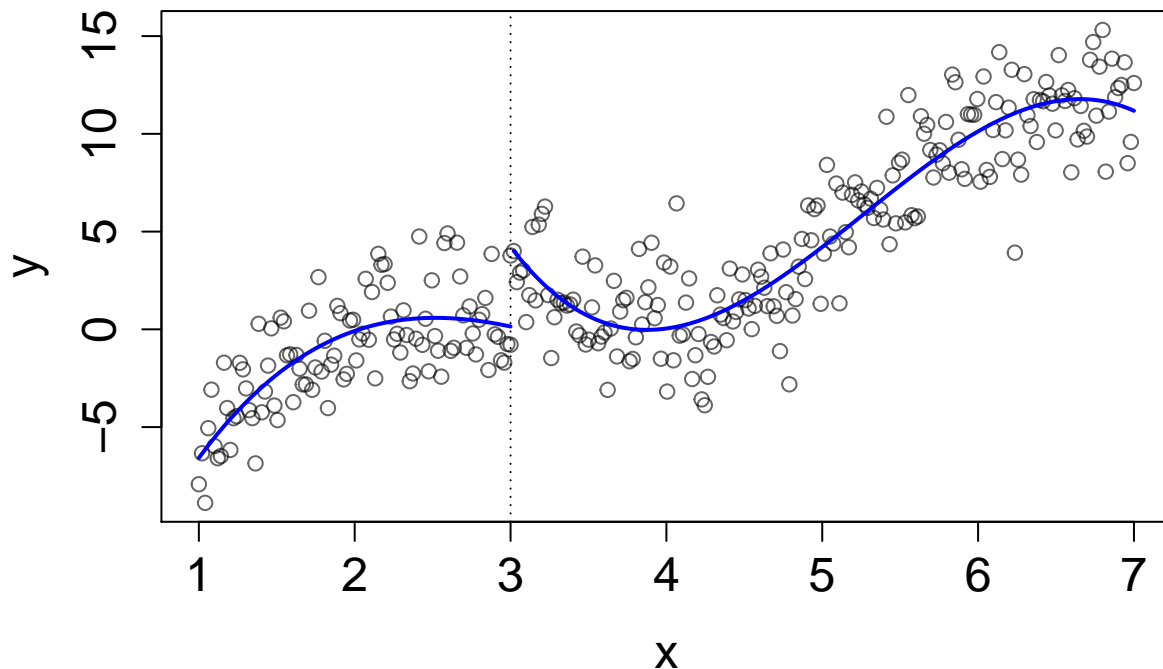
discontinuous fit at the knot
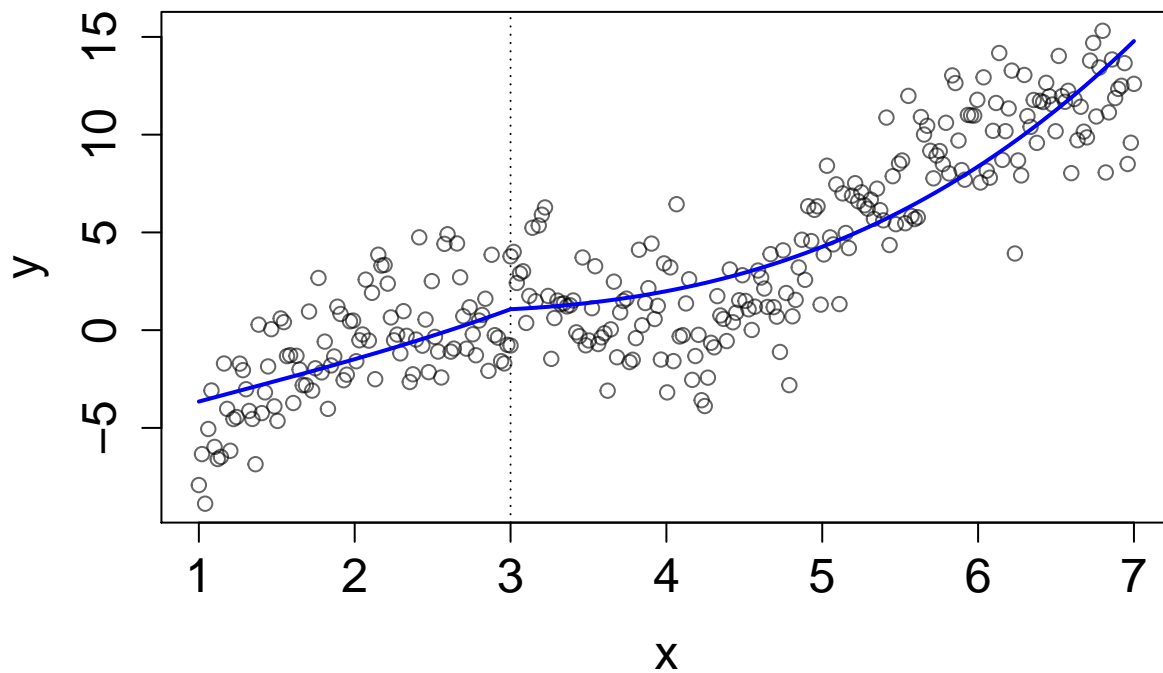
```r
## Looping through constraints.
title.graph = c("continuous fit at the knot",
                "continuous fit and 1st derivative at the knot",
                "continuous fit, 1st and 2nd derivatives at the knot"
                )

for(i in 1:3){
    SimulatedData2$D = ((SimulatedData2$x-3)^i)*(SimulatedData2$x>3)

    plot(y~x , cex.lab=1.5 , cex.axis=1.5 , data=SimulatedData2,
         col = adjustcolor("black",0.6),
         main = title.graph[i])
    abline(v=3 , lwd=1 , lty=3)

    model3 = lm(y ~ x+I(x^2)+I(x^3)+D , data=SimulatedData2)
    pred3 = predict(model3)
    lines(pred3~SimulatedData2$x , lwd=2, col="blue")

}
```
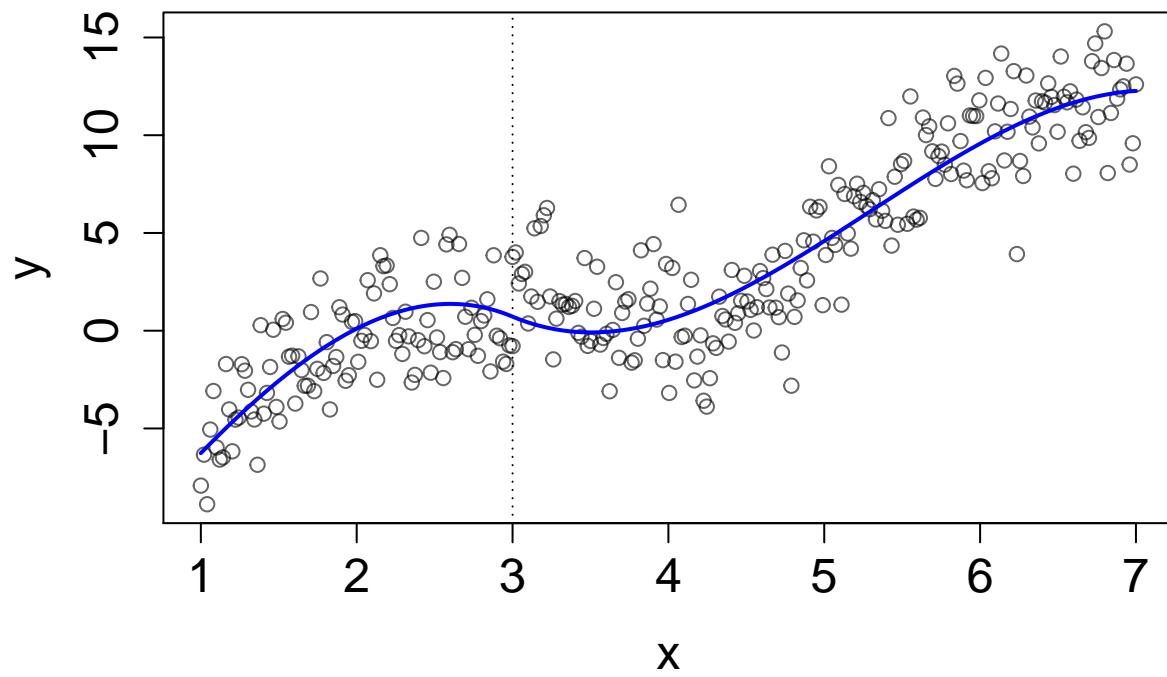
continuous fit at the knot

continuous fit and 1st derivative at the knot

continuous fit, 1st and 2nd derivatives at the knot