

Handout 8 Binary Response Models

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1.1 The real seasonally adjusted GDP gap

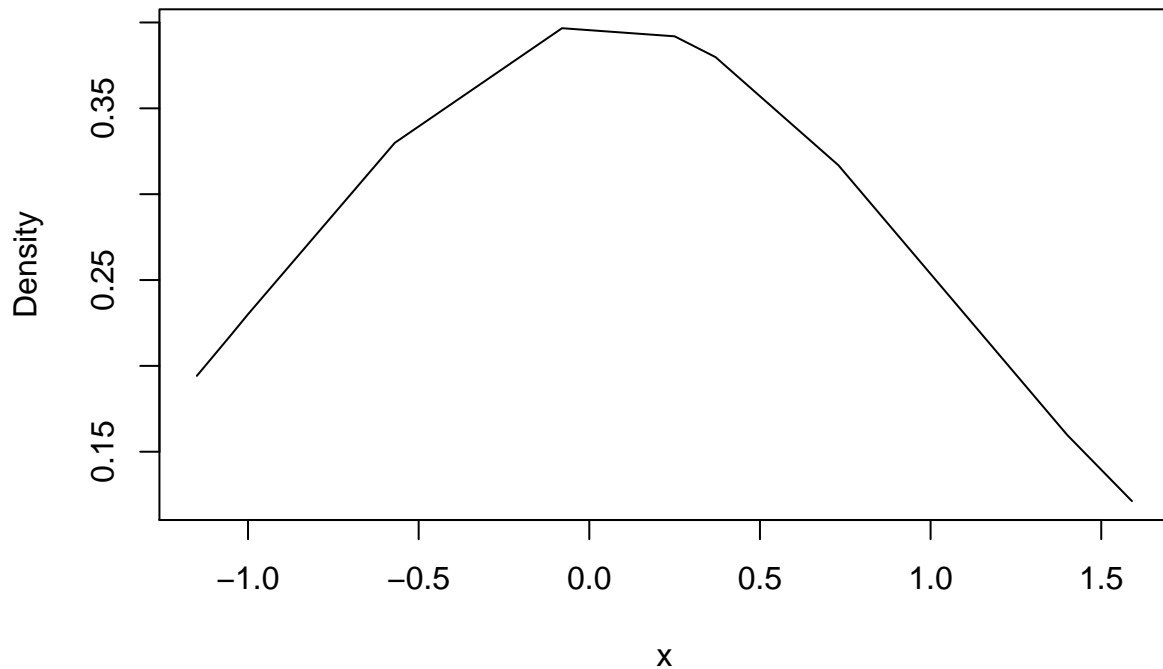
Consider the following sample of continuous data:

0.57, 0.25, -0.08, 1.40, -1.05, -1.00, 0.37, -1.15, 0.73, 1.59

which can be considered as the real seasonally adjusted GDP gap in trillions of dollars. Recall the parametric normal density function.

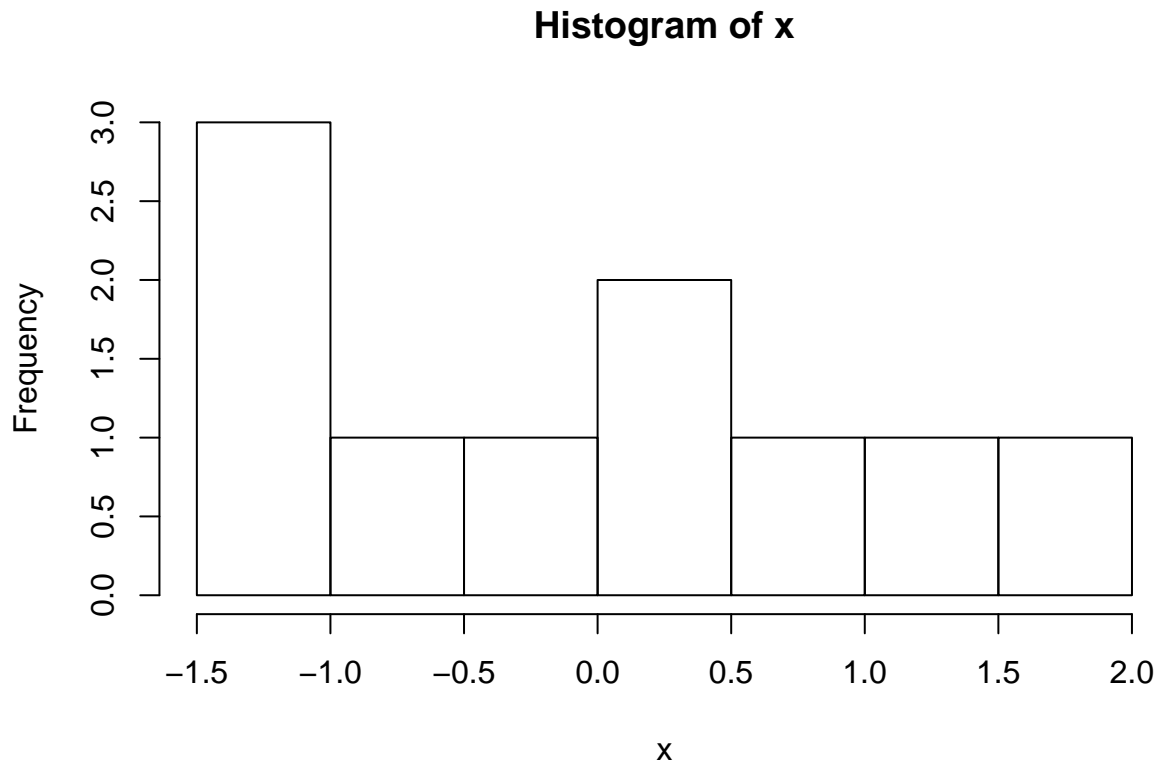
(i) Compute the graph and parametric density function for this data

```
x=c((-0.57),0.25,(-0.08),1.40,(-1.05), (-1.00), 0.37, (-1.15), 0.73, 1.59)
x=sort(x)
plot(x,dnorm(x,mean(x),sd=sd(x)),ylab = "Density",type = "l")
```



(ii) Compute and graph a histogram for this data using bin widths of 0.5 ranging from -1.5 through 2.0.

```
# note when we add prob=TRUE, it represents density, False represents frequency
hist(x)
```



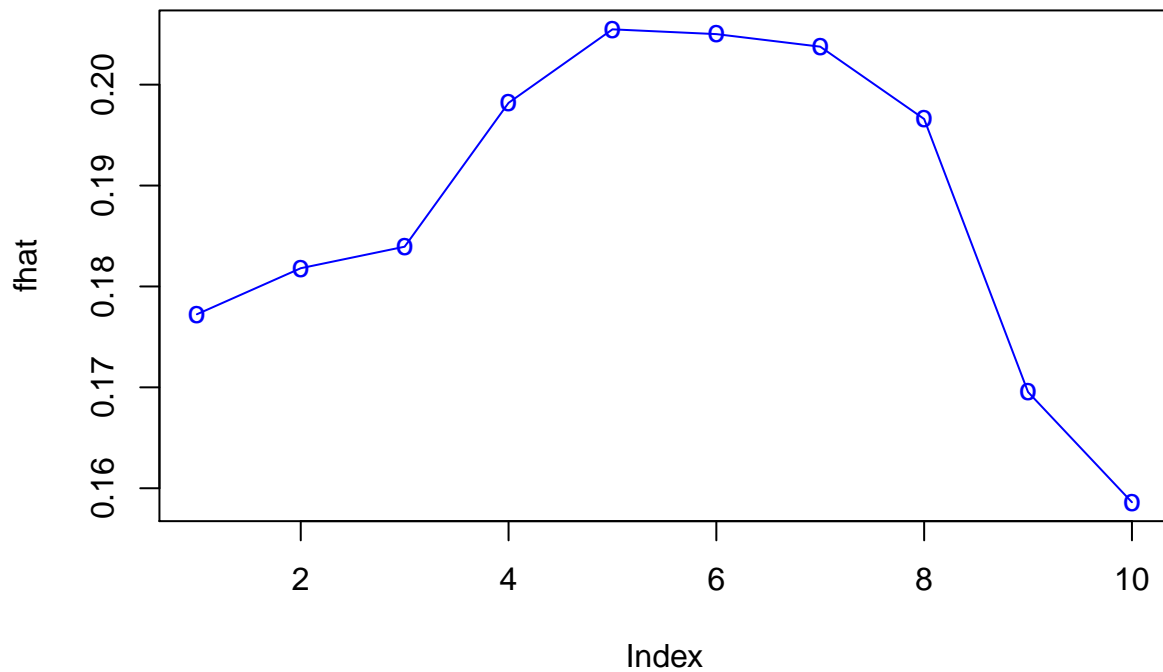
(iii) Using the same tiny sample of data, compute the kernel estimator of the density function for every sample realization using the bandwidth $h = 1.5$. Show all steps.

```
# First, we define the kernel function
kernel = function(x,y,h) {
  z = (x-y)/h
  ifelse(abs(z)<sqrt(5), (1-z^2/5)*(3/(4*sqrt(5))), 0)
}

# Then we compute estimated f with given equation by summing up the kernels with for loop, given h=1.5
h=1.5
fhat = numeric(length(x))
for(i in 1:length(x)) {
  fhat[i] <- sum(kernel(x,x[i],h)/(length(x)*h))
}
print(fhat)

## [1] 0.1772383 0.1818058 0.1839405 0.1981965 0.2054815 0.2050093 0.2037642
## [8] 0.1965945 0.1695343 0.1586127

plot(fhat, type="o", col="blue", pch="o" )
```

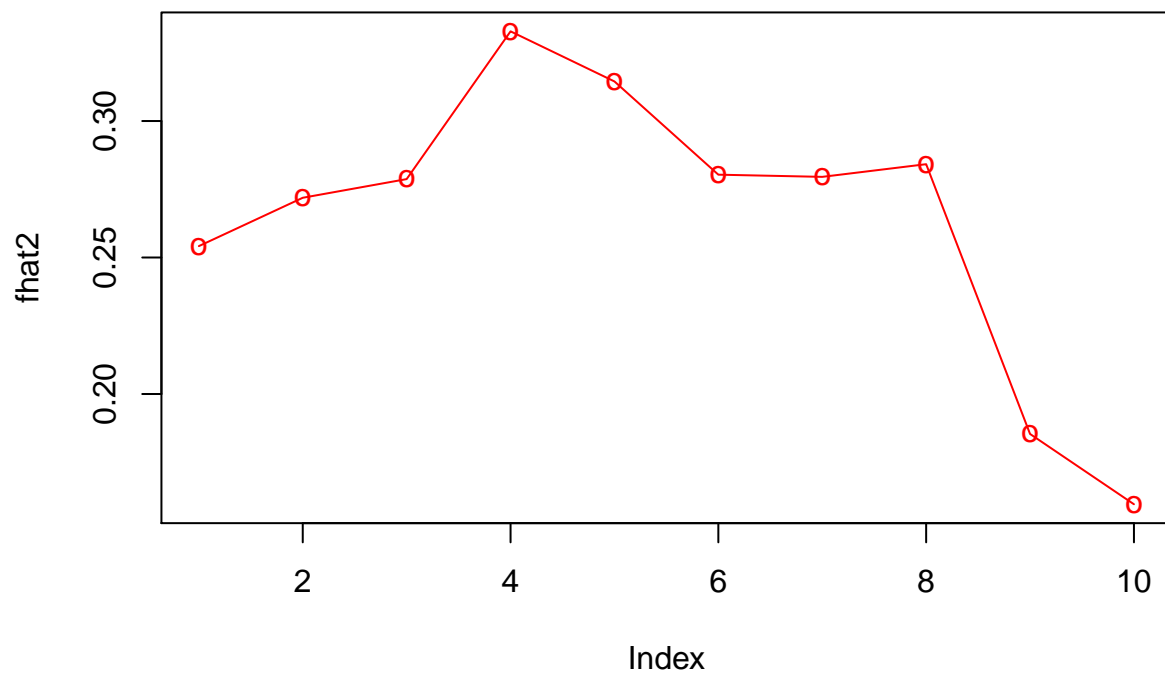


(iv) Using the same data, compute the kernel estimator of the density function for every sample realization using the bandwidth $h = 0.5$. Show all steps.

```
h=0.5
fhat2=numeric(length(x))
for(i in 1:length(x)) {
  fhat2[i] <- sum(kernel(x,x[i],h)/(length(x)*h))
}
print(fhat2)
```

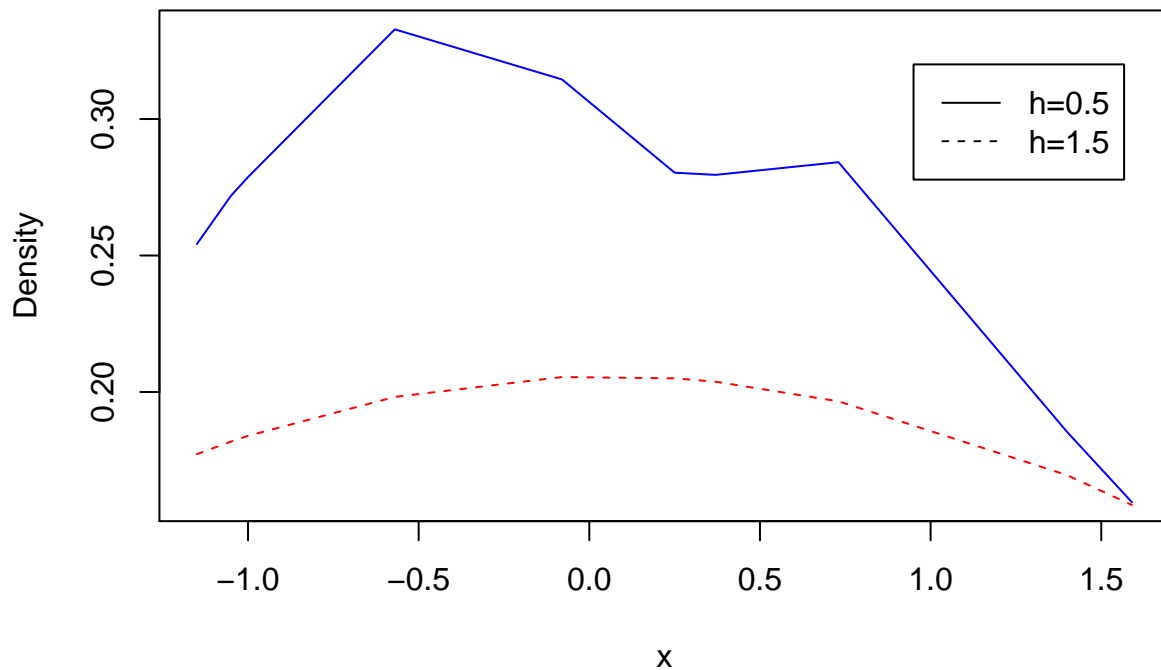
```
## [1] 0.2541712 0.2718808 0.2787232 0.3328450 0.3144913 0.2803439 0.2795443
## [8] 0.2841810 0.1853665 0.1596177
```

```
plot(fhat2, type="o", col="red", pch="o" )
```



- (v) On the same axes, graph your estimates of the density functions using a smooth curve to “connect the dots” for each function.

```
plot(x,fhat2,type="l",col="blue", ylab="Density",lty=1)
lines(x,fhat,lty=2, col="red")
legend(0.95,0.32,c("h=0.5","h=1.5"),lty=c(1,2))
```



(vi) Describe the effect of increasing the smoothing parameter on the estimated density function.

Answer

When we increase the bandwidth, the density estimate becomes smoother. Indeed, the curve become of less peak and closer to the x-axis.

```
h=2
fhat3=numeric(length(x))
for(i in 1:length(x)) {
  fhat3[i] <- sum(kernel(x,x[i],h)/(length(x)*h))
}
h=5
fhat5=numeric(length(x))
for(i in 1:length(x)) {
  fhat5[i] <- sum(kernel(x,x[i],h)/(length(x)*h))
}
plot(x,fhat2,type="l",col="blue", ylab="Density",lty=1)
lines(x,fhat,lty=2, col="red")
lines(x,fhat3,lty=2, col="green")
lines(x,fhat5,lty=2, col="yellow")
```

