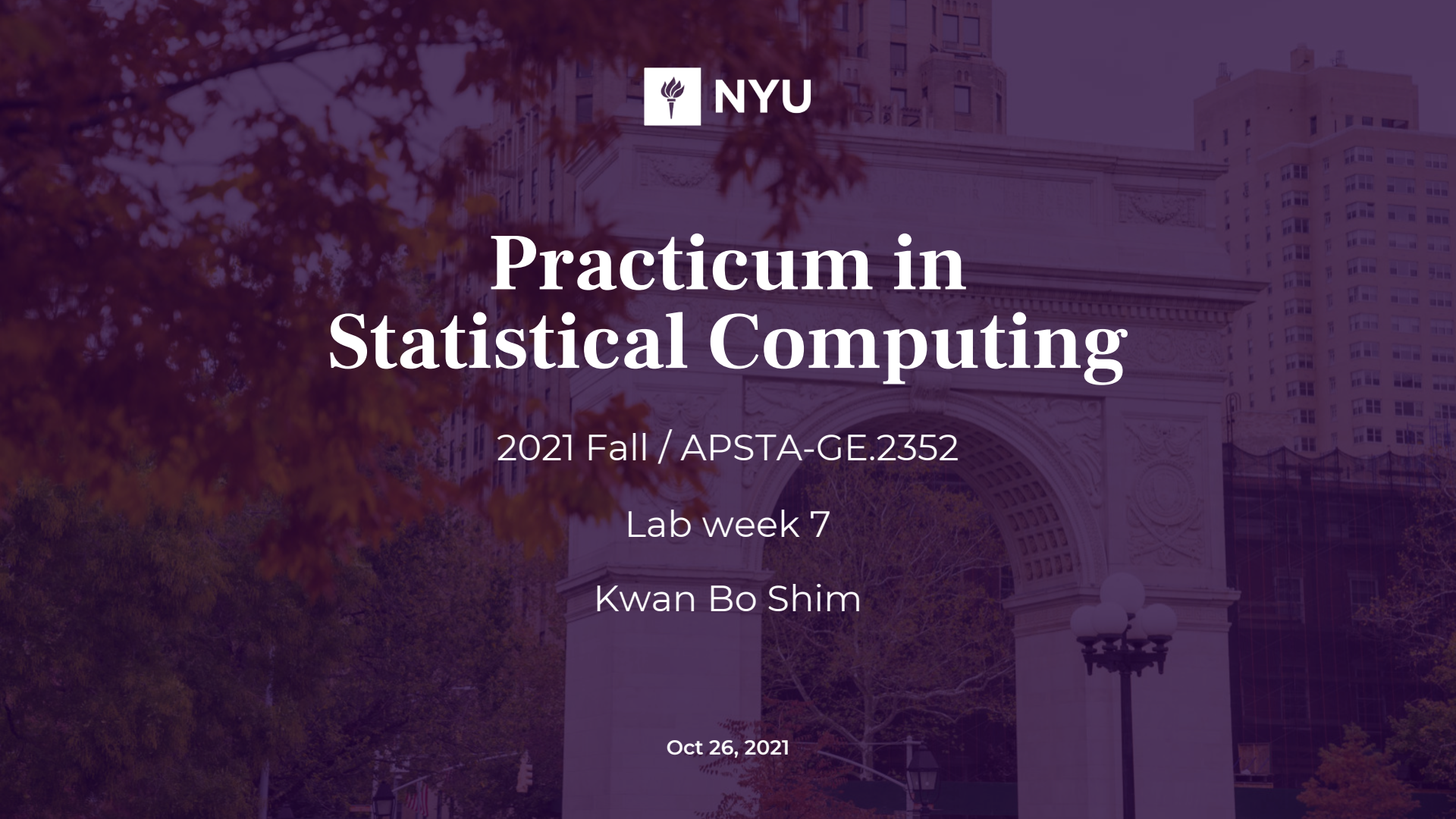


NYU

Practicum in Statistical Computing

2021 Fall / APSTA-GE.2352

Lab week 7

Kwan Bo Shim

Oct 26, 2021

PART 01

Week 7

PART 01

Week 7

1. Poll -> end of the class
2. Attendance
3. Homework due today

NYU

Week 7

Density estimate / review Lab_report 2

- Density estimate with mode
- Lab_report2 -> moving average

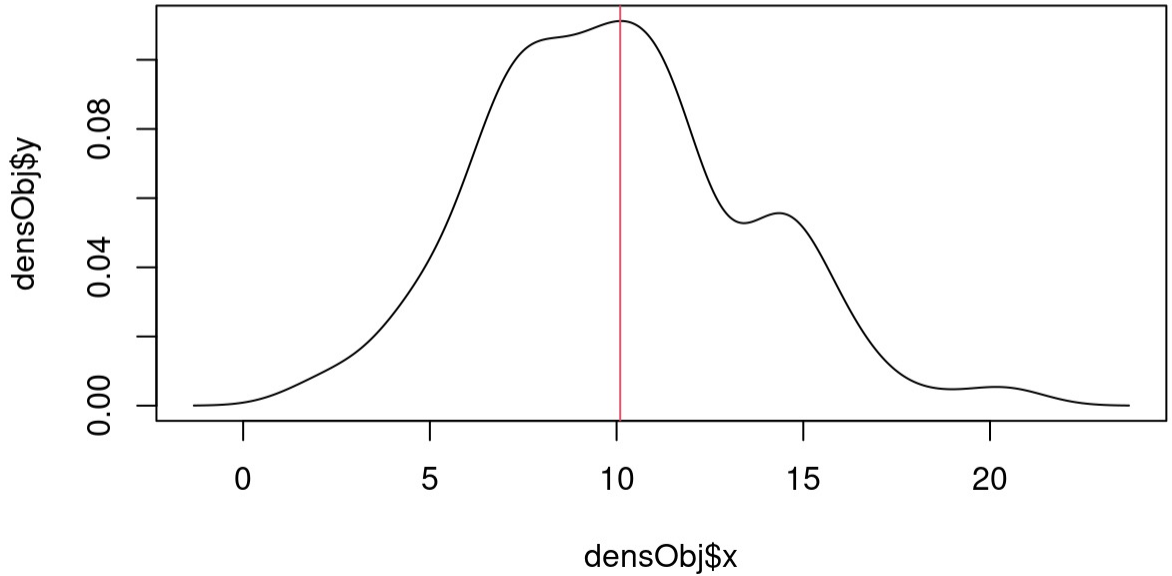
PART 02

Density

Density function

1. Density function -> density curve, “smooth estimate” -> so it allows us to find **a maximum value**
   (=the mode)
   (=most frequent value)
   (=most likely value)

Density estimate & max value



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PART 03

function

Make a function

```
# Function signature:

findMode <- function(x) {
  #call density on x; save result
  densObj <- density(   )
  #find maximum y location
  loc.max.y <-
  #return the x value at that location
  return(    )
}
```

Make a function

```
# Function signature:

findMode <- function(x) {
  #call density on x; save result
  densObj <- density( x )
  #find maximum y location
  loc.max.y <- which.max(    )
  #return the x value at that location
  return( densObj$x[     ] )
}
```

Remember -> densObj has x and y value (both)

Make a function

```
# Function signature:

findMode <- function(x) {
  #call density on x; save result
  densObj <- density( x )
  #find maximum y location
  loc.max.y <- which.max(densObj$y)
  #return the x value at that location
  return( densObj$x[loc.max.y] )
}
```

PART 04

practice

```
findMode <- function(x) {
  #call density on x; save result
  densObj <- density( x )
  #find maximum y location
  loc.max.y <- which.max(densObj$y)
  #return the x value at that location
  return( densObj$x[loc.max.y] )
}

# try run it
findMode( airquality$Wind )
-> error!

# why??
```

Fix the function

```
findMode <- function(x) {
```

Maybe use this area?

```
  #call density on x; save result
  densObj <- density( x )
  #find maximum y location
  loc.max.y <- which.max(densObj$y)
  #return the x value at that location
  return( densObj$x[loc.max.y] )
}
```

```
# for loop? Conditional? Direct imputation?
```

PART 05

Some ways

Fix the function

```
findMode <- function(x) {
  #call density on x; save result
  densObj <- density( x )


  #find maximum y location
  loc.max.y <- which.max(densObj$y)
  #return the x value at that location
  return( densObj$x[loc.max.y] )
}
```

```
# 1-a. add conditional

if( sum(is.na(x) ) != 0 ){
    densObj <- density(x, na.rm = T)
}
```

Fix the function

```
findMode <- function(x) {


  #call density on x; save result
  densObj <- density( x )
  #find maximum y location
  loc.max.y <- which.max(densObj$y)
  #return the x value at that location
  return( densObj$x[loc.max.y] )
}
```

```
# 1-b. Complete conditional

if( sum(is.na(x) ) != 0 ){
    densObj <- density(x, na.rm = T)
  } else {
    densObj <- density(x)
}
```

Fix the function

```
findMode <- function(x) {


  #call density on x; save result
  densObj <- density( x )
  #find maximum y location
  loc.max.y <- which.max(densObj$y)
  #return the x value at that location
  return( densObj$x[loc.max.y] )
}
```

```
# 2. direct imputation

densObj <- density(x, na.rm = T)
```

PART 06

Lab_report 2

Moving average function

1. Recommendation : Review R Shiny App: Week5

2. Smoothing using small moving window batches: In this lab we practice moving from a scripted solution to building a more **general function in the context of smoothing.**

Moving average function

```
moving_average <- function(x,y,k,na.rm=T){
ord <- order(x)
x <- x[ord]
y <- y[ord]
#establish the number of evaluation points from the data itself.
n <- length(x)
  # loop to create a moving window. Calculate median inside
  moving_average <- rep(NA, n) #placeholder for results of the median call
  for (i in 1:n) {
    if (i - k < 1) { #boundary condition
      lower <- 1
    } else {
      lower <- i - k #
    }
    upper <- min(n, i + k) #prevents going past the end of the series
    moving_average[i] <- mean(y[lower:upper], na.rm = na.rm)
  }
  return(list(x=x,y=moving_average))
}
```

1. Preprocessing

Moving average function

```
moving_average <- function(x,y,k,na.rm=T){
ord <- order(x)
x <- x[ord]
y <- y[ord]
#establish the number of evaluation points from the data itself.
n <- length(x)
  # loop to create a moving window. Calculate median inside
  moving_average <- rep(NA, n) #placeholder for results of the median call
  for (i in 1:n) {
    if (i - k < 1) { #boundary condition
      lower <- 1
    } else {
      lower <- i - k #
    }
    upper <- min(n, i + k) #prevents going past the end of the series
    moving_average[i] <- mean(y[lower:upper], na.rm = na.rm)
  }
  return(list(x=x,y=moving_average))
}
```

2. Loop for lower / upper bounds

Moving average function

```
moving_average <- function(x,y,k,na.rm=T){
ord <- order(x)
x <- x[ord]
y <- y[ord]
#establish the number of evaluation points from the data itself.
n <- length(x)
  # loop to create a moving window. Calculate median inside
  moving_average <- rep(NA, n) #placeholder for results of the median call
  for (i in 1:n) {
    if (i - k < 1) { #boundary condition
      lower <- 1
    } else {
      lower <- i - k #
    }
    upper <- min(n, i + k) #prevents going past the end of the series
    moving_average[i] <- mean(y[lower:upper], na.rm = na.rm)
  }
  return(list(x=x, y=moving_average))
}
```

3. Compute moving average

Scatter smoothing function

1. Recommendation : Review R Shiny App Week4 Lab section for boxcar weight + creating grid blocks: "The purpose of this lab is to create our own "rough" density estimation routine using boxcar weights."

2. **n: the number of grid points** (THE NUMBER OF GRID POINTS DETERMINES THE LEVEL OF PRECISION OF THE ESTIMATE). Example: if the data range from 4 to 10, you want to evaluate the density at n points in that range, so if n = 1000, then seq(4, 10, length.out = 1000) is the set of points being evaluated.

3. **frac:** the fraction of available data **on either side of evaluation point**. That is, if the data range from 4 to 10, then they span 10 - 4 = 6 units. The fraction of that range that is used in the boxcar is frac * 6. If frac <- 0.5, then the boxcar total width would be 3, with 1.5 on either side of each evaluation point.

Scatter smoothing function

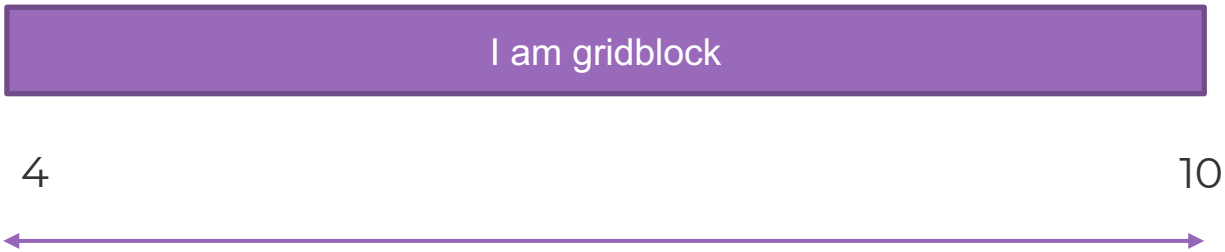
- Recall that **scatterplot smoothing** is different from **density estimation**.
- You are smoothing y values based on a moving window through x values.
- Think of it as "looking up" from the x to see the values of y that are associated with those x values.

Scatter smoothing function

4

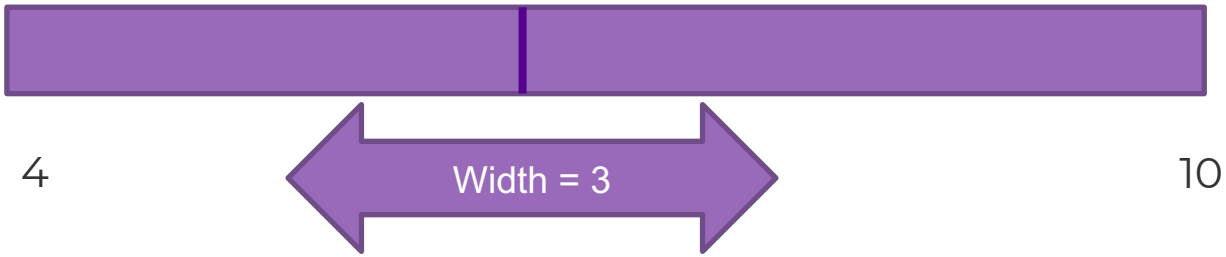
10

Scatter smoothing function



- Span = 10-4 = 6
  (difference between min, max)

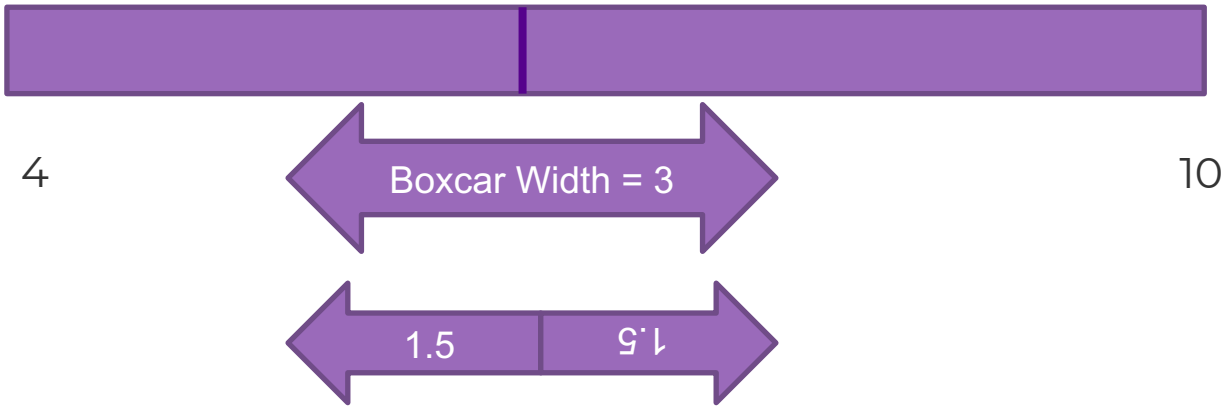
Scatter smoothing function



If frac=0.5

- Boxcar width = 6 * 0.5 = 3

Scatter smoothing function



If <u>frac=0.5</u>

- Boxcar width = 6*0.5 = 3
- Left=right=3/2 = 1.5 each

Think of it as <u>choosing # neighbors</u> (like choosing k value before)

scatterplot smoother function

```
moving_average <- function(x,y,frac=0.1,n=100,na.rm=T){
  rng <- range(x)
  gridLength <- diff(rng)
  boxcarLength <- frac*gridLength
  x.grid <- seq(rng[1],rng[2],length=n)

  # loop to create a moving window. Calculate mean inside
  movingAverage <- rep(NA, n) #placeholder for results of the mean calls
  for (i in 1:n) {
    #define a vector of `selected` points centered at x.grid[i]
    ###selPoints <-  ...
    selPoints <- x>=x.grid[i]-boxcarLength/2 & x <= x.grid[i]+boxcarLength/2
    # calculate and assign mean of y[selPoints]:
    ###movingAverage[i] <- ... #remember to average the y associated with x.

  }
  return(list(x=x.grid,y=movingAverage))
}
```

1. Preprocessing making grid block

- What range(x) do?

scatterplot smoother function

```
moving_average <- function(x,y,frac=0.1,n=100,na.rm=T){
  rng <- range(x)
  gridLength <- [illegible]rng)
  boxcarLength <- frac[illegible]ridLength
  x.grid <- seq(rng[1],rng[2],length=n)

  # loop to create a moving window. Calculate mean inside
  movingAverage <- rep(NA, n) #placeholder for results of the mean calls
  for (i in 1:n) {
    #define a vector of `selected` points centered at x.grid[i]
    ###selPoints <-  ...
    selPoints <- x>=x.grid[i]-boxcarLength/2 & x <= x.grid[i]+boxcarLength/2
    # calculate and assign mean of y[selPoints]:
    ###movingAverage[i] <- ... #remember to average the y associated with x.

  }
  return(list(x=x.grid,y=movingAverage))
}
```

1. Preprocessing making grid block

scatterplot smoother function

```
moving_average <- function(x,y,frac=0.1,n=100,na.rm=T){
  rng <- range(x)
  gridLength <- diff(rng)
  boxcarLength <- frac*gridLength
  x.grid <- seq(rng[1],rng[2],length=n)

  # loop to create a moving window. Calculate mean inside
  movingAverage <- rep(NA, n) #placeholder for results of the mean calls
  for (i in 1:n) {
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    ###selPoints <-  ...
    selPoints <- x>=x.grid[i]-boxcarLength/2 & x <= x.grid[i]+boxcarLength/2
    # calculate and assign mean of y[selPoints]:
    ###movingAverage[i] <- ... #remember to average the y associated with x.

  }
  return(list(x=x.grid,y=movingAverage))
}
```

1. Preprocessing making grid block

- boxcarLength?

scatterplot smoother function

```
moving_average <- function(x,y,frac=0.1,n=100,na.rm=T){
  rng <- range(x)
  gridLength <- diff(rng)
  boxcarLength <- frac*gridLength
  x.grid <- seq(rng[1],rng[2],
  # loop to create a moving wind      Calculat      n inside
  movingAverage <- rep(NA, n) #pl      holder for r      of the mean calls
  for (i in 1:n) {
    #define a vector of `selected`      nts centered at x.      i]
    ###selPoints <-  ...
    selPoints <- x>=x.grid[i]-boxcarLength/2 & x <= x.grid[i]+boxcarLength/2
    # calculate and assign mean of y[selPoints]:
    ###movingAverage[i] <- ... #remember to average the y associated with x.
}
  return(list(x=x.grid,y=movingAverage))
}
```

1. Preprocessing making grid block

- boxcarLength?
- Creating range for boxcar width

scatterplot smoother function

```
moving_average <- function(x,y,frac=0.1,n=100,na.rm=T){
  rng <- range(x)
  gridLength <- diff(rng)
  boxcarLength <- frac*gridLength
  x.grid <- seq(rng[1],rng[2],length=n)

  # loop to create a moving window. Calculate mean inside
  movingAverage <- rep(NA, n) #placeholder for results of the mean calls
  for (i in 1:n) {
    #define a vector of `selected` points centered at x.grid[i]
    ###selPoints <-  ...
    selPoints <- x>=x.grid[i]-boxcarLength/2 & x <= x.grid[i]+boxcarLength/2
    # calculate and assign mean of y[selPoints]:
    ###movingAverage[i] <- ... #remember to average the y associated with x.

  }
  return(list(x=x.grid,y=movingAverage))
}
```

# of blocks = n

- Define how many room (=grid point) you want to build
- Benefit of having more room?

scatterplot smoother function

```
moving_average <- function(x,y,frac=0.1,n=100,na.rm=T){
  rng <- range(x)
  gridLength <- diff(rng)
  boxcarLength <- frac*gridLength
  x.grid <- seq(rng[1],rng[2],length=n)

  # loop to create a moving window. Calculate mean inside
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    #define a vector of `selected` points centered at x.grid[i]
    ###selPoints <-  ...
    selPoints <- x>=x.grid[i]-boxcarLength/2 & x <= x.grid[i]+boxcarLength/2
    # calculate and assign mean of y[selPoints]:
    ###movingAverage[i] <- ... #remember to average the y associated with x.

  }
  return(list(x=x.grid,y=movingAverage))
}
```

selpoint ?
Who are u ?

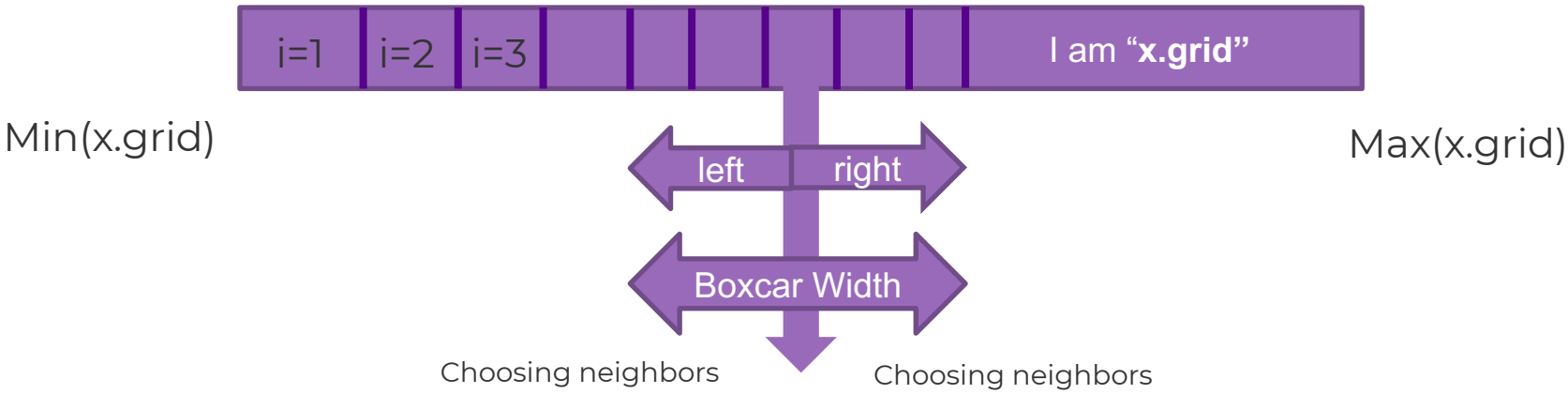
scatterplot smoother function

```
moving_average <- function(x,y,frac=0.1,n=100,na.rm=T){
  rng <- range(x)
  gridLength <- diff(rng)
  boxcarLength <- frac*gridLength
  x.grid <- seq(rng[1],rng[2],length=n)

  # loop to create a moving window. Calculate mean inside
  movingAverage <- rep(NA, n) #placeholder for results of the mean calls
  for (i in 1:n) {
    #define a vector of `selected` points centered at x.grid[i]
    ###selPoints <-  ...
    selPoints <- x>=x.grid[i]-boxcarLength/2 & x <= x.grid[i]+boxcarLength/2
    # calculate and assign mean of y[selPoints]:
    ###movingAverage[i] <- ... #remember to average the y associated with x.

  }
  return(list(x=x.grid,y=movingAverage))
}
```

“selpoint”

- all selected points of **x**
- vector format

Scatterplot smoother



- For some room i= 1, 2, 3, …. n, (because we made n rooms -> we defined already)
  select all points located inside this room!
  Where each **length = boxcar width = left + right**
  So **grid length != boxcar width**

scatterplot smoother function

```
moving_average <- function(x,y,frac=0.1,n=100,na.rm=T){
  rng <- range(x)
  gridLength <- diff(rng)
  boxcarLength <- frac*gridLength
  x.grid <- seq(rng[1],rng[2],length=n)

  # loop to create a moving window. Calculate mean inside
  movingAverage <- rep(NA, n) #placeholder for results of the mean calls
  for (i in 1:n) {
    #define a vector of `selected` points centered at x.grid[i]
    ###selPoints <-  ...
    selPoints <- x>=x.grid[i]-boxcarLength/2 & x <= x.grid[i]+boxcarLength/2
    # calculate and assign mean of y[selPoints]:
    movingAverage[i] <- ...   #remember to average the y associated with x.
  }
  return(list(x=x.grid, y=movingAverage))
}
```

Since we found all x values located in each room (box width that we defined), what we have to do? **-> average**

scatterplot smoother function

```
moving_average <- function(x,y,frac=0.1,n=100,na.rm=T){
  rng <- range(x)
  gridLength <- diff(rng)
  boxcarLength <- frac*gridLength
  x.grid <- seq(rng[1],rng[2],length=n)

  # loop to create a moving window. Calculate mean inside
  movingAverage <- rep(NA, n) #placeholder for results of the mean calls
  for (i in 1:n) {
    #define a vector of `selected` points centered at x.grid[i]
    ###selPoints <-  ...
    selPoints <- x>=x.grid[i]-boxcarLength/2 & x <= x.grid[i]+boxcarLength/2
    # calculate and assign mean of y[selPoints]:
    ###movingAverage[i] <- ... #remember to average the y associated with x.
 }
  return(list(x=x.grid,y=movingAverage))
}
```

Print out the result as list form

X = each grid point

Y = mean of all y value with x value's location in each grid point

scatterplot smoother function

Grid = 1	X=1,2,3	**Mean(c(y[1], y[2] , y[3]))**
Grid = 2	X=3,4,5,6	**Mean(c(y[3], y[4] , y[5], y[6]))**
Grid = 3	X=6,7,8,9,10	Guess ?

End of class Poll

We really appreciate the feedback!

See you next week!

Please review R Shiny App Week 4 and Week 5 materials