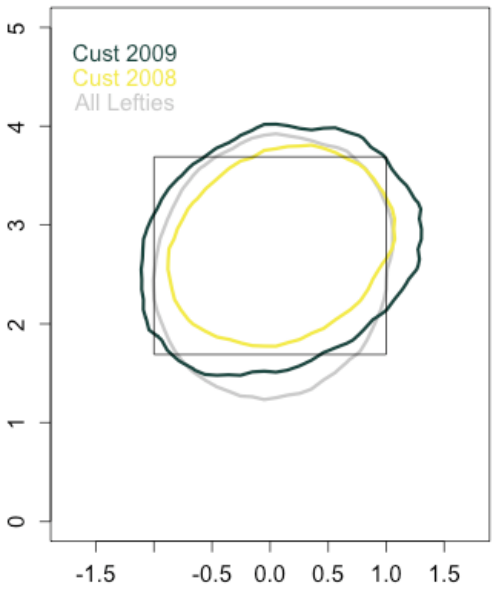
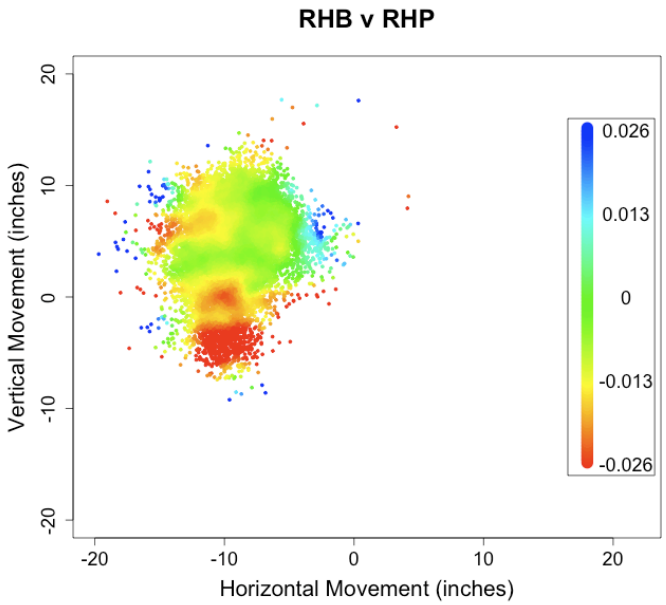
Creating contour and ‘heat map’ graphs to display PITCHf/x data

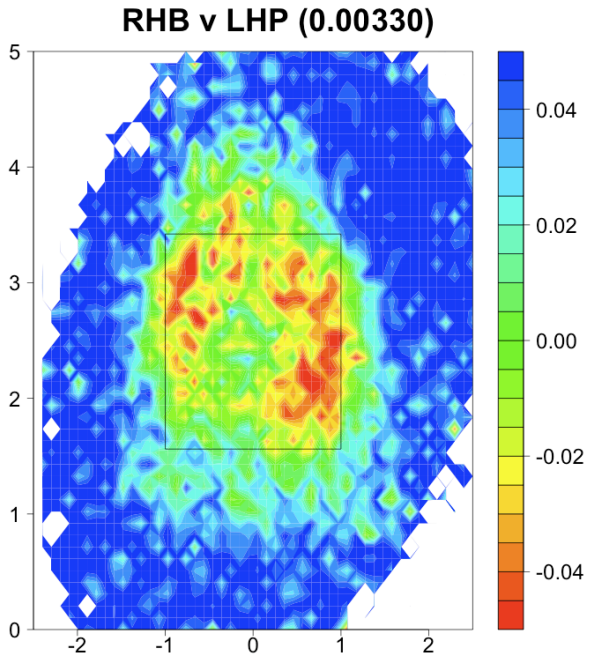
Dave Allen

PITCHf/x Summit

July 11, 2009







Plotting a value over two variables

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- Any of those rates by vertical and horizontal movement of a pitch.
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- Vertical angle of the ball off the bat by vertical location and vertical movement of a pitch.

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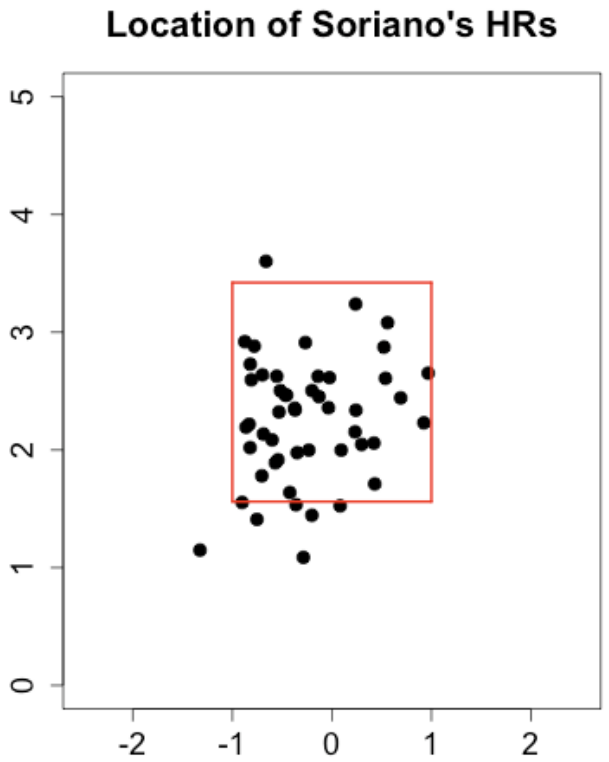

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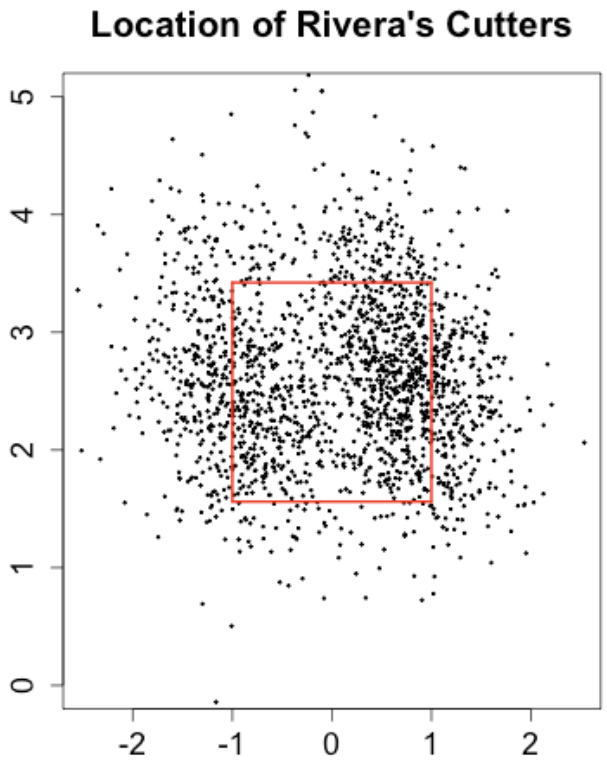

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- When they are well clustered.
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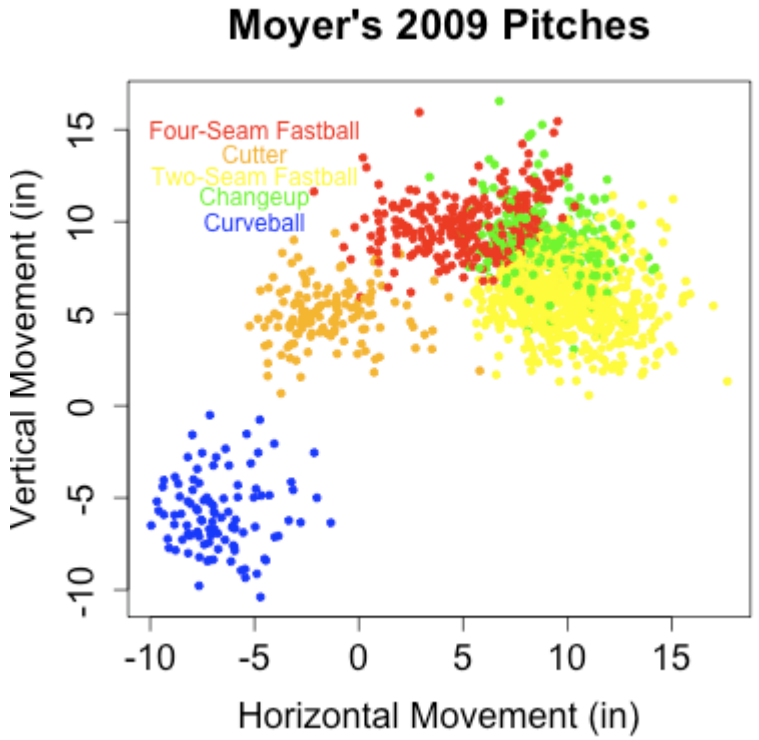

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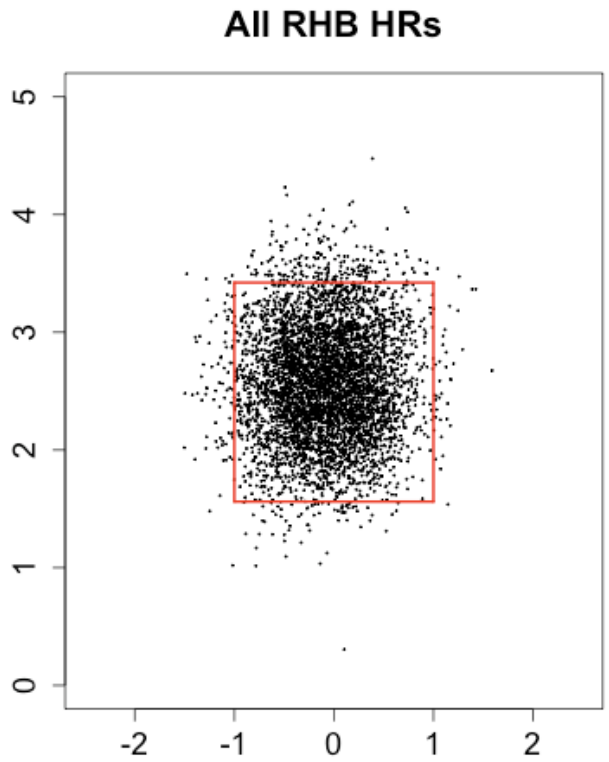

Plotting a value over two variables: Scatter plots not appropriate

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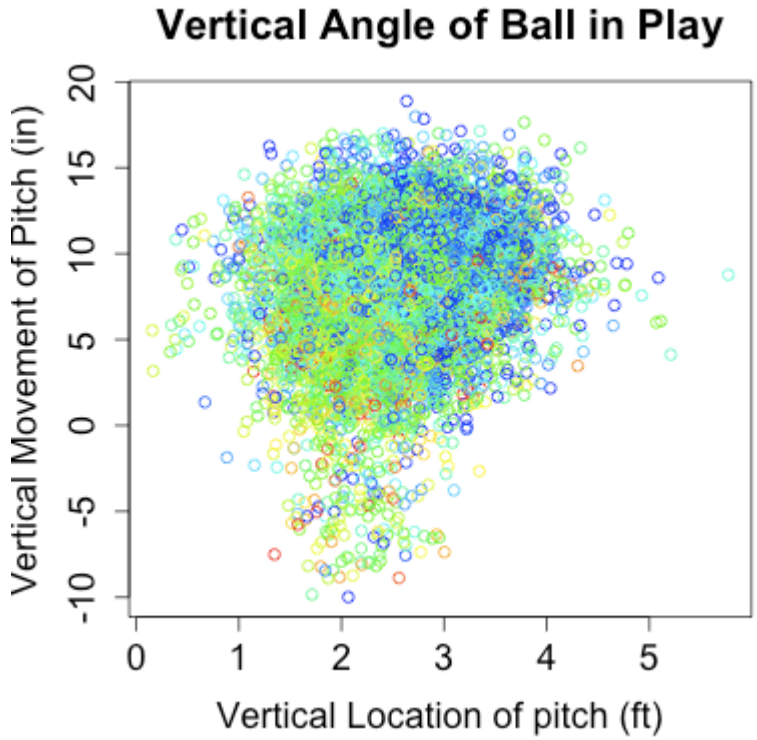
- Too many pitches
- Non-categorical value



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- These maps do not actually plot the data (pitches), but a surface fit to the data. As if you fit a curve to two dimensional data and then just plot curve, without the points.
- This talk will be broken into two parts:

  1) methods of fitting a surface

  2) creating the contour map once we have the surface.

Fitting a plane

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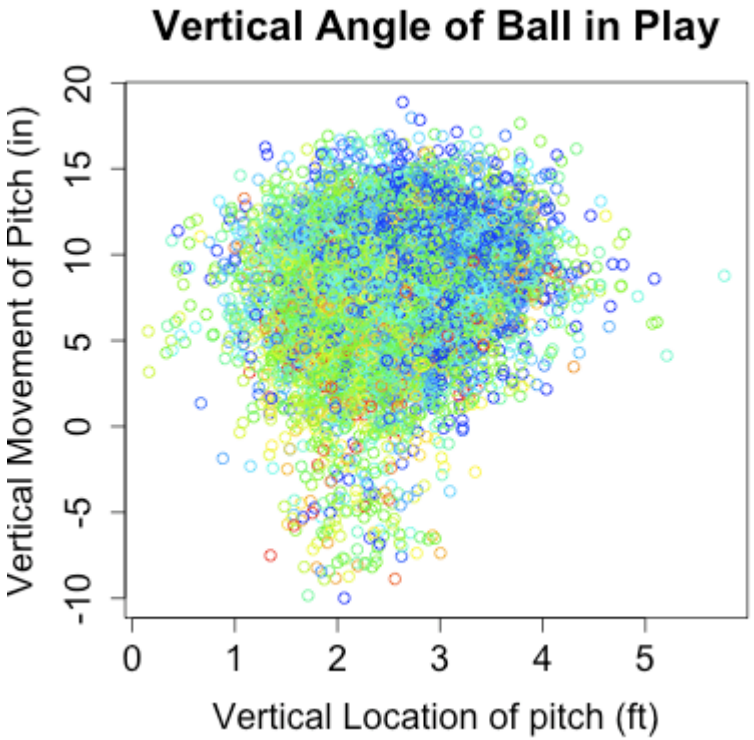
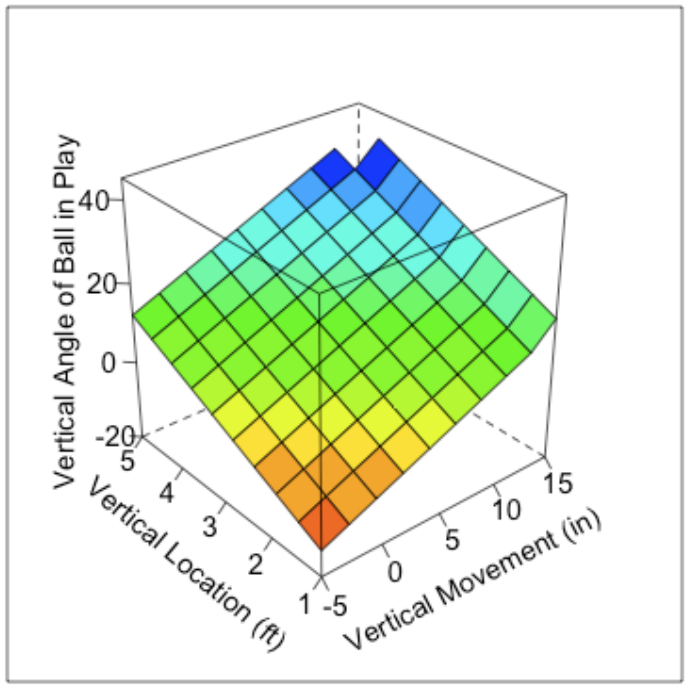
```
Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -13.55922    1.11985  -12.11   <2e-16 ***
p_z           6.59482    0.40371   16.34   <2e-16 ***
pfx_z         1.27491    0.07063   18.05   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 25.15 on 11168 degrees of freedom
Multiple R-squared: 0.06024,    Adjusted R-squared: 0.06007
F-statistic: 357.9 on 2 and 11168 DF,  p-value: < 2.2e-16
```

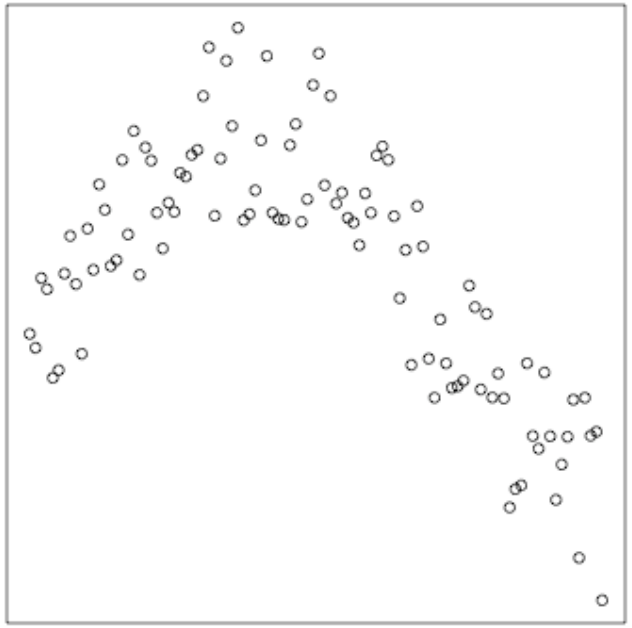
Fitting a plane





Fitting a ‘step’-surface by binning the data

- The plane is very limited, especially when looking at values of pitch location because the strike zone presents a ‘non-linearity.’
- A 2d step function provides more flexibility.



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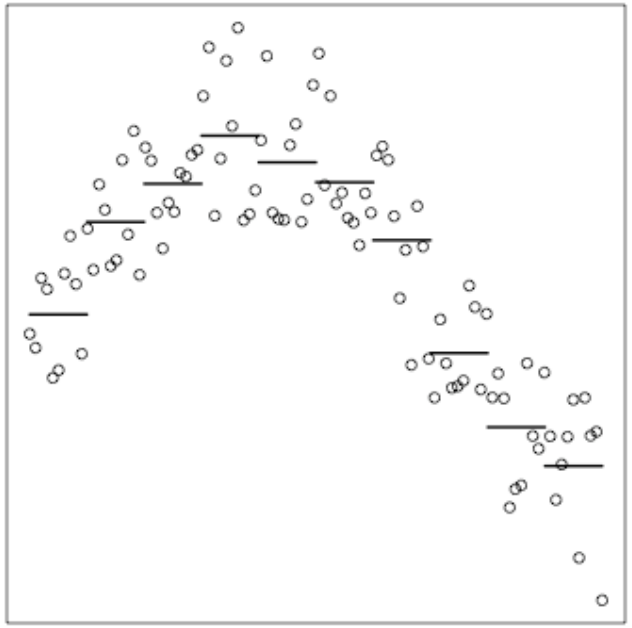

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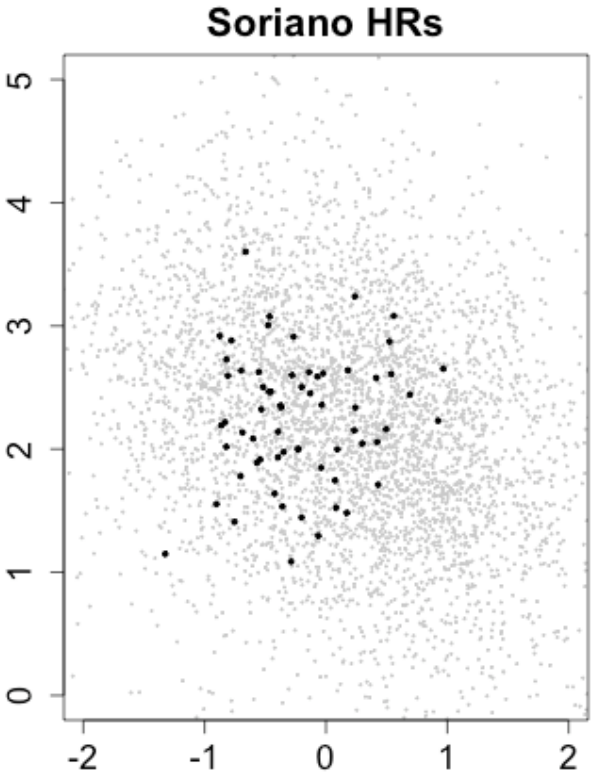

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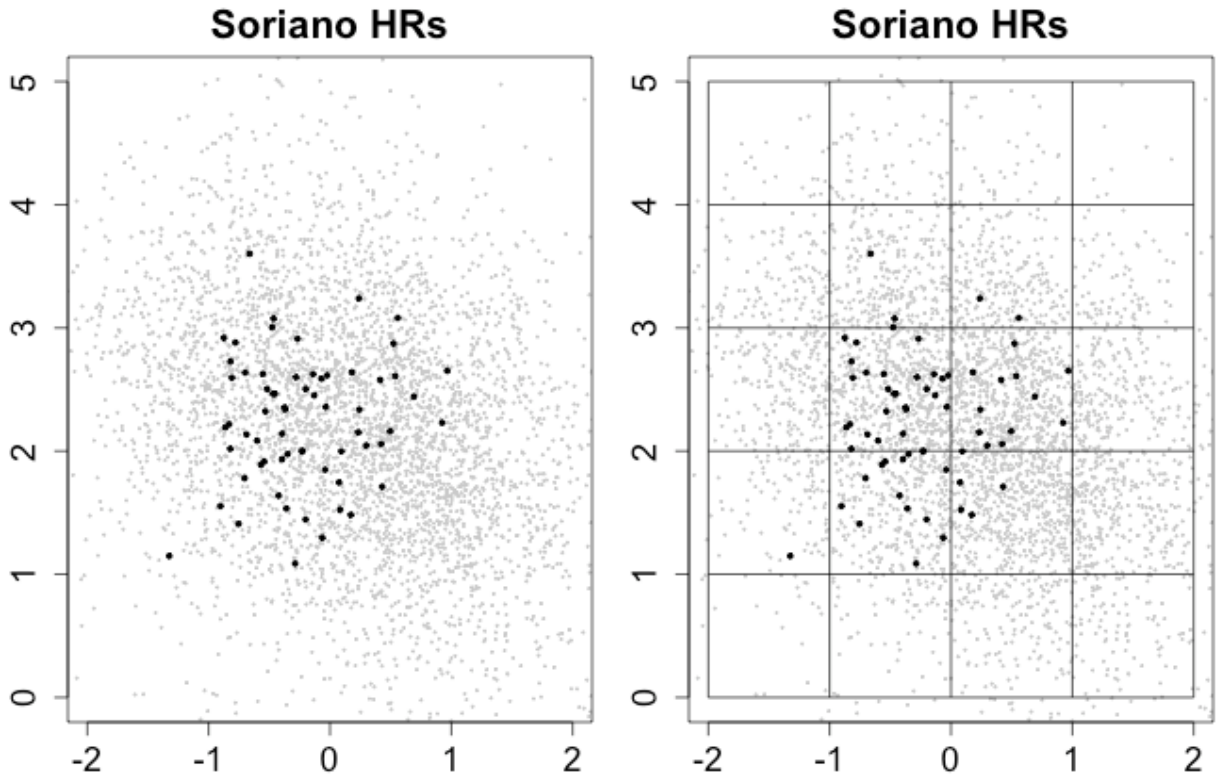

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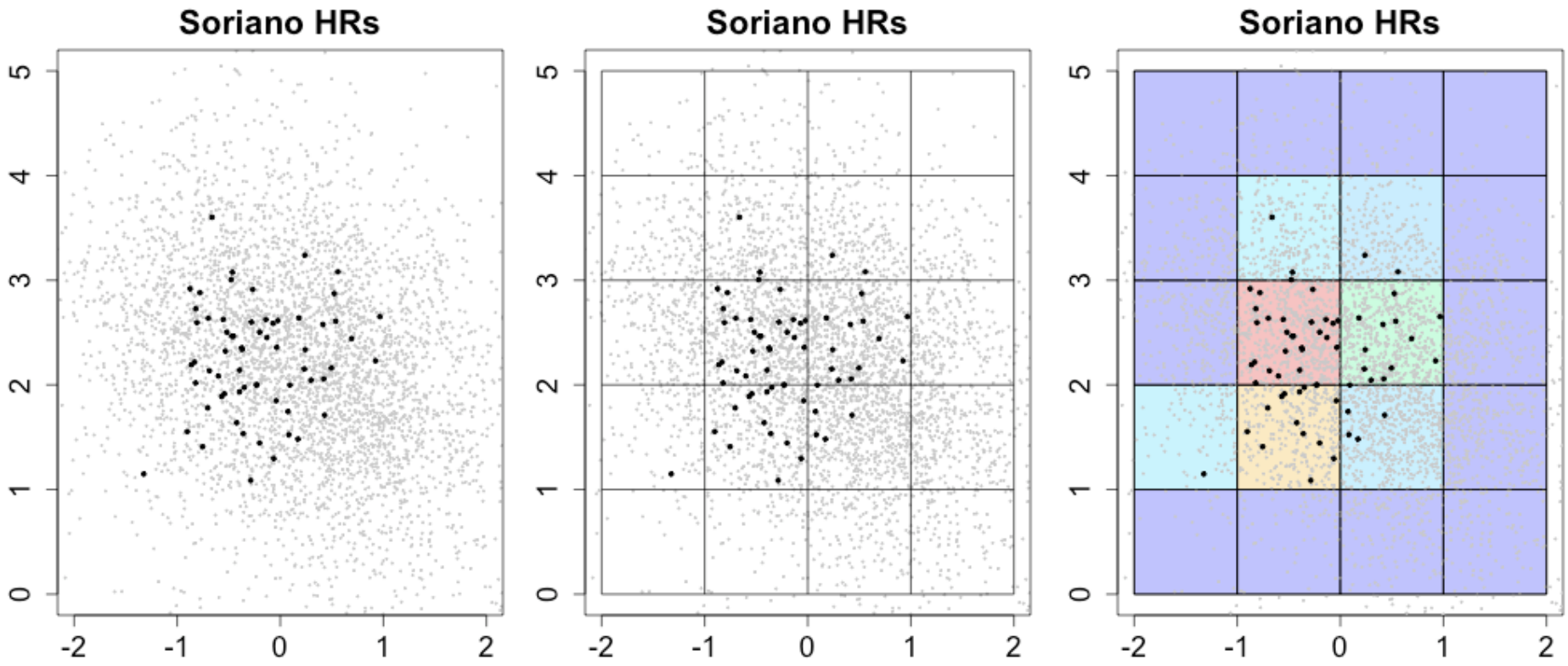

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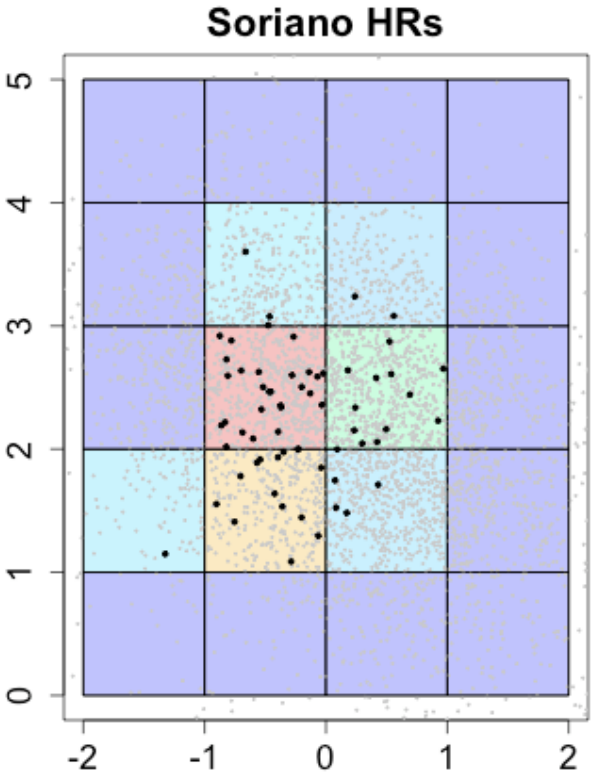

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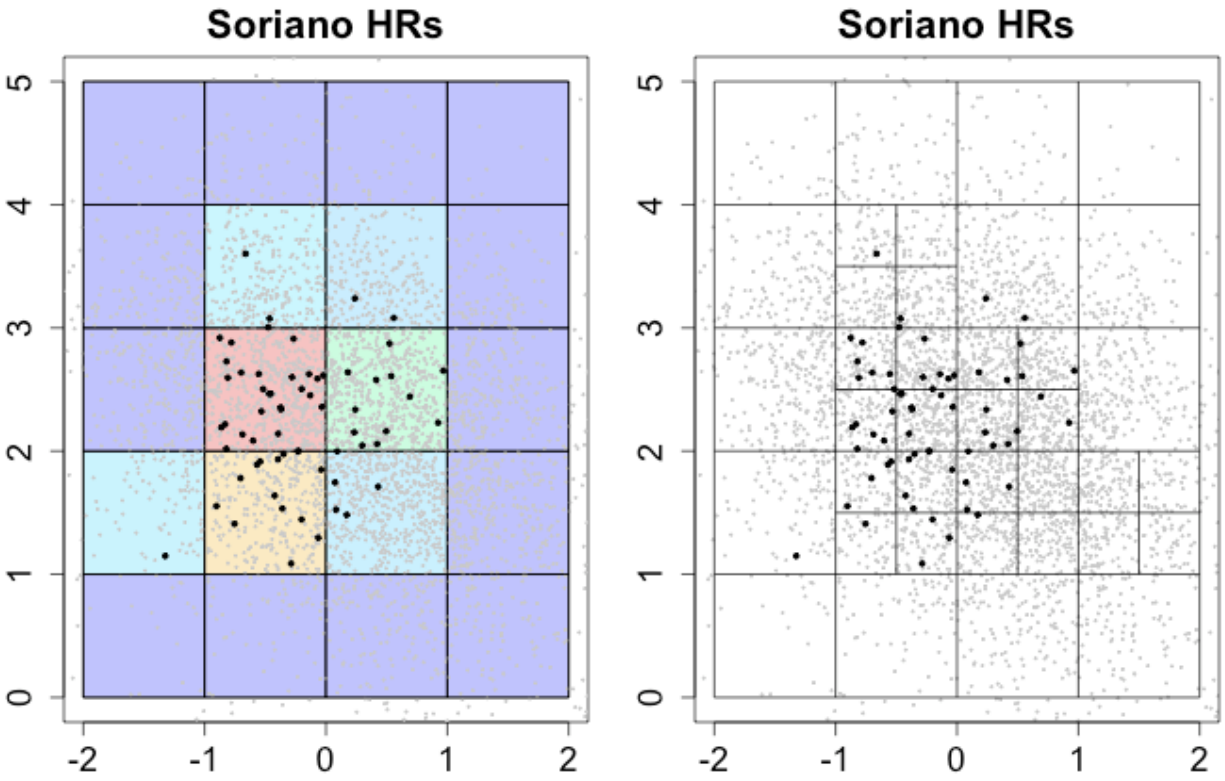

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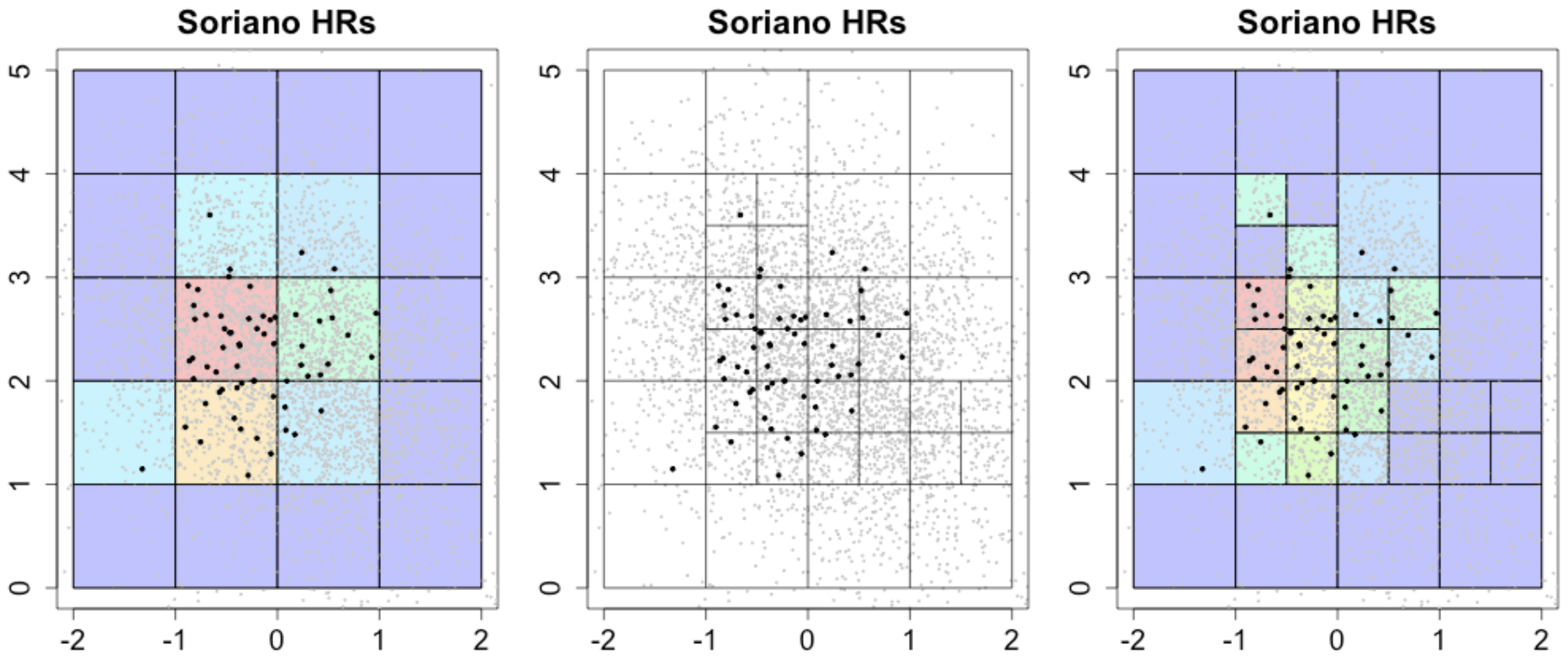

Fitting a smoother ‘step’-surface: distance weighted average

- Alternatively put a lattice over the area and find the distance weighted average for each point to the lattice.
- Creates a smoother surface
- With large data sets it can be very computationally intensive

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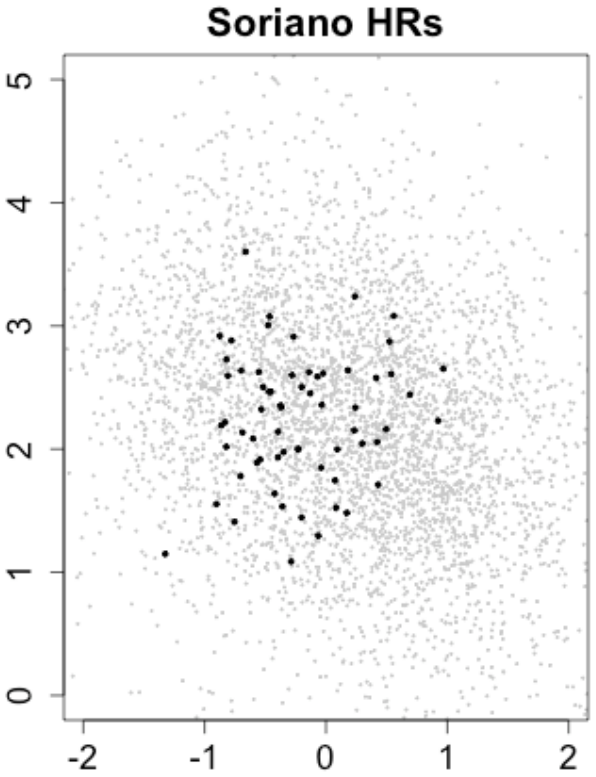

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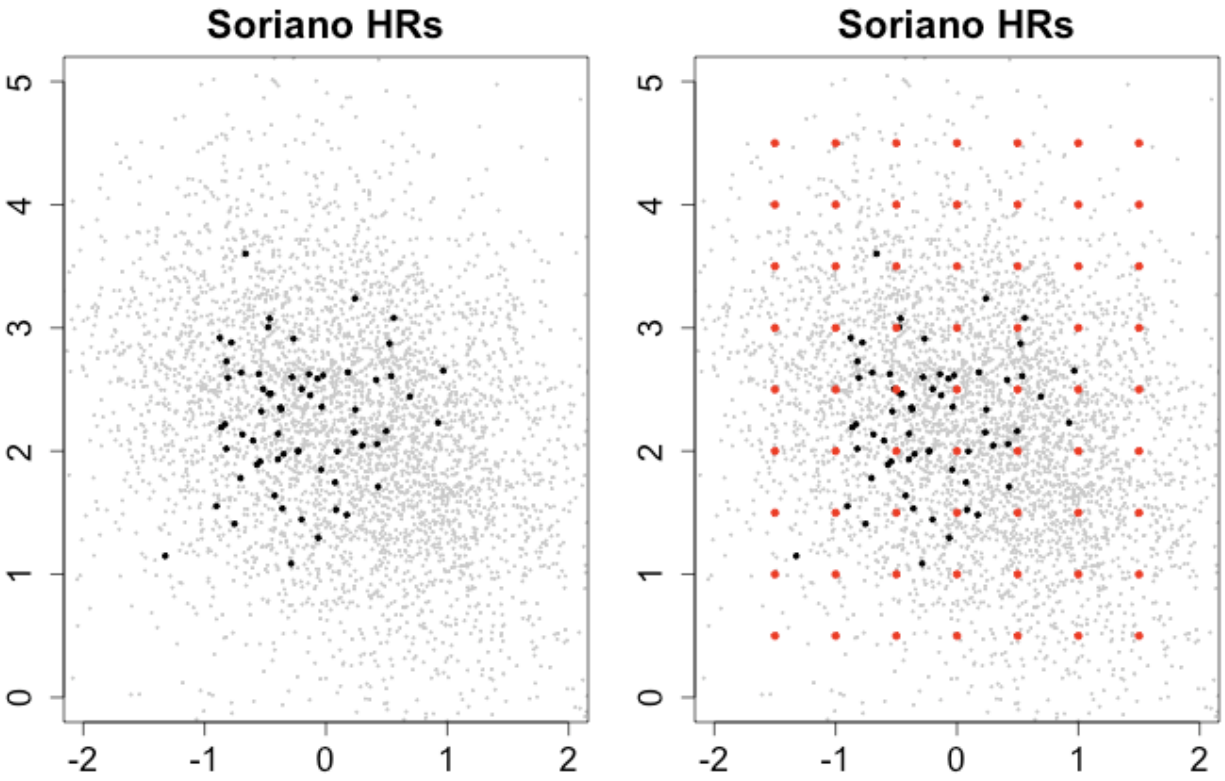

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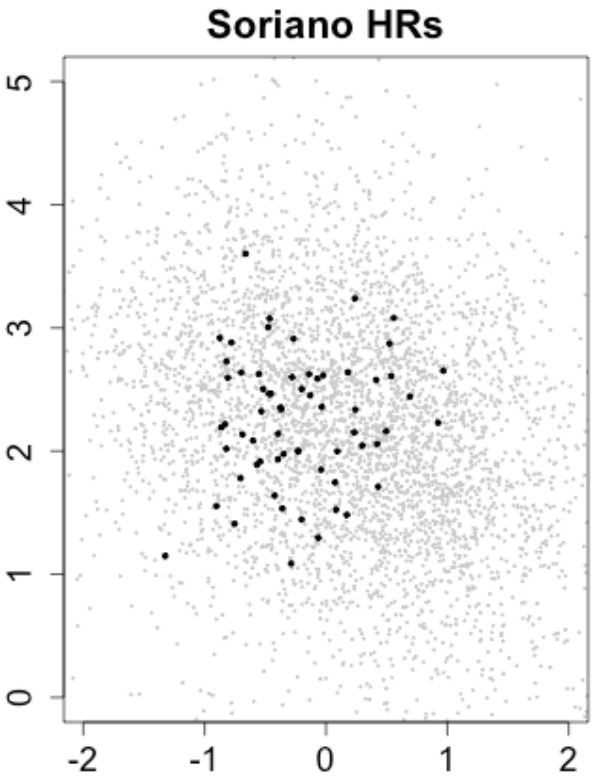

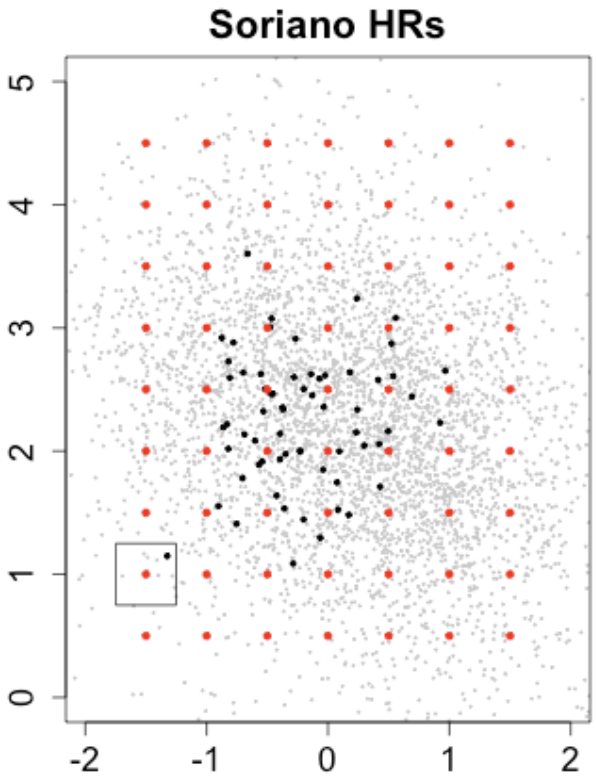

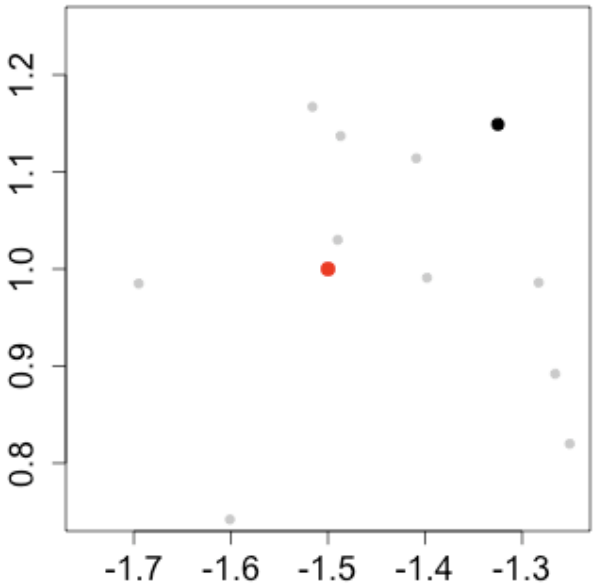

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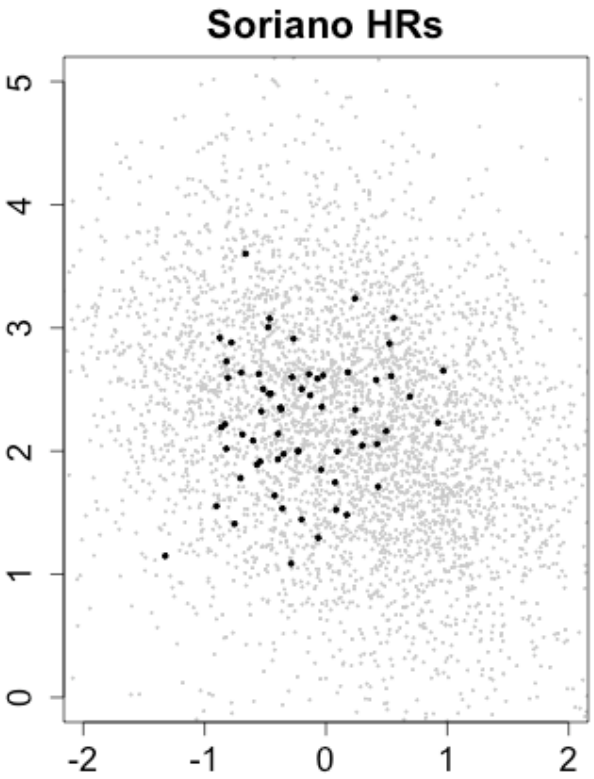

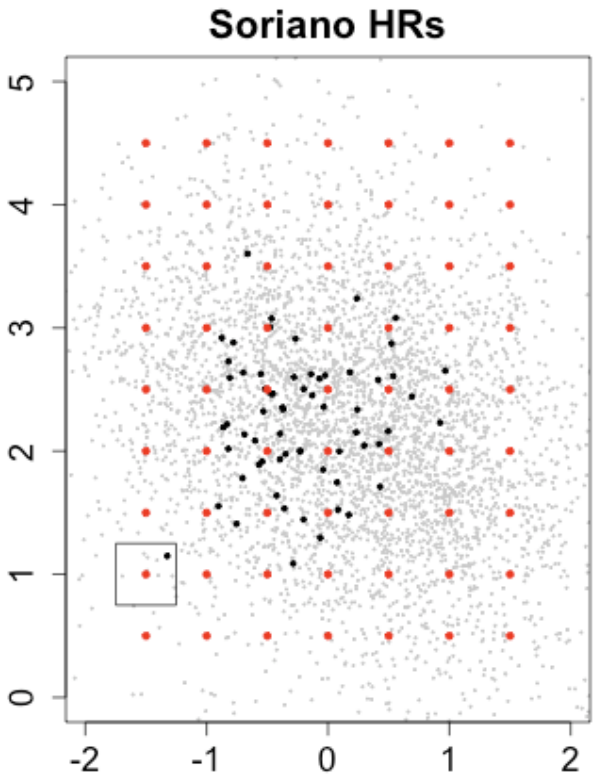

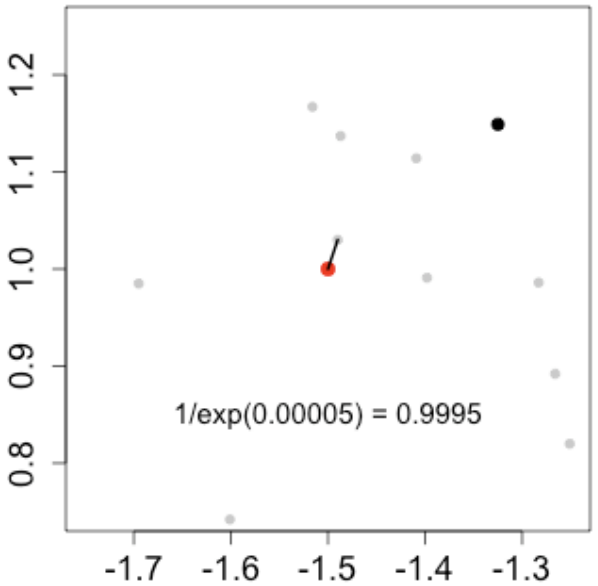

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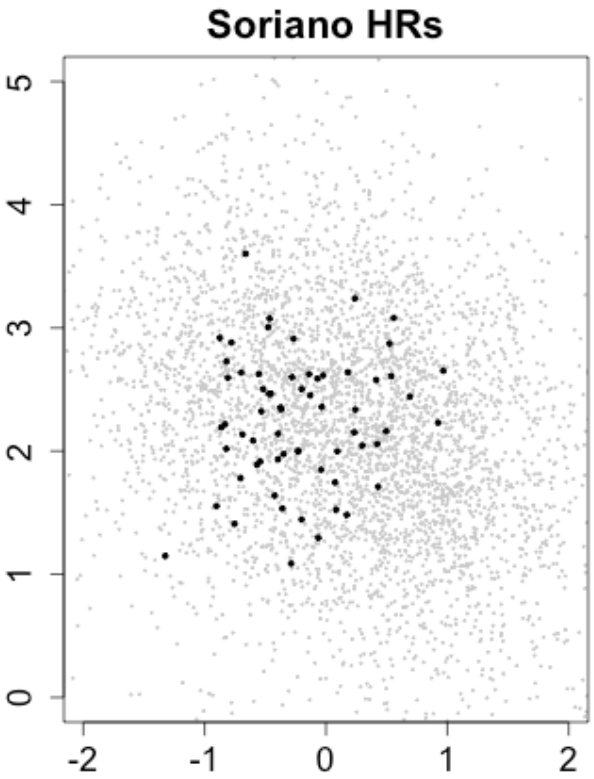

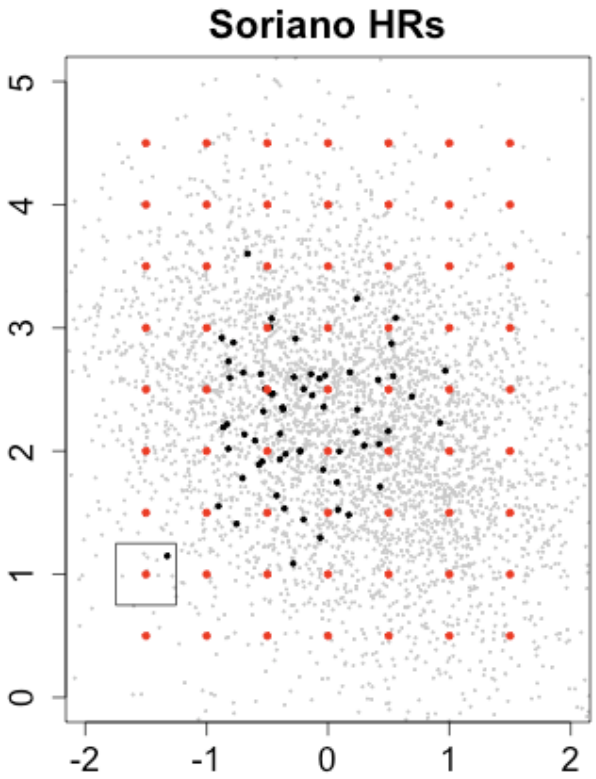

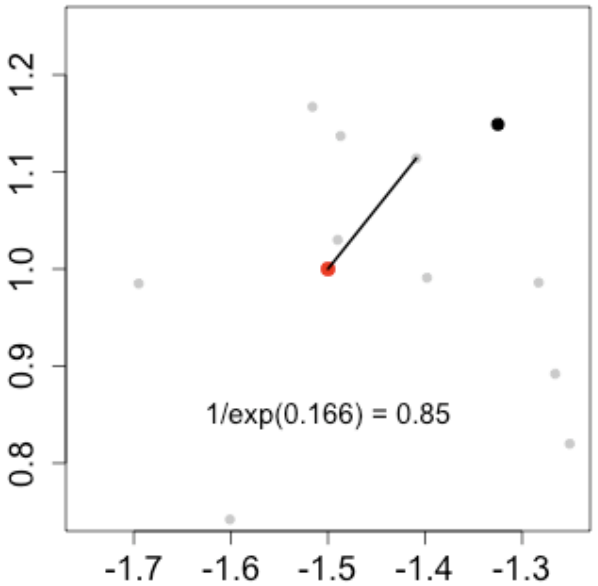

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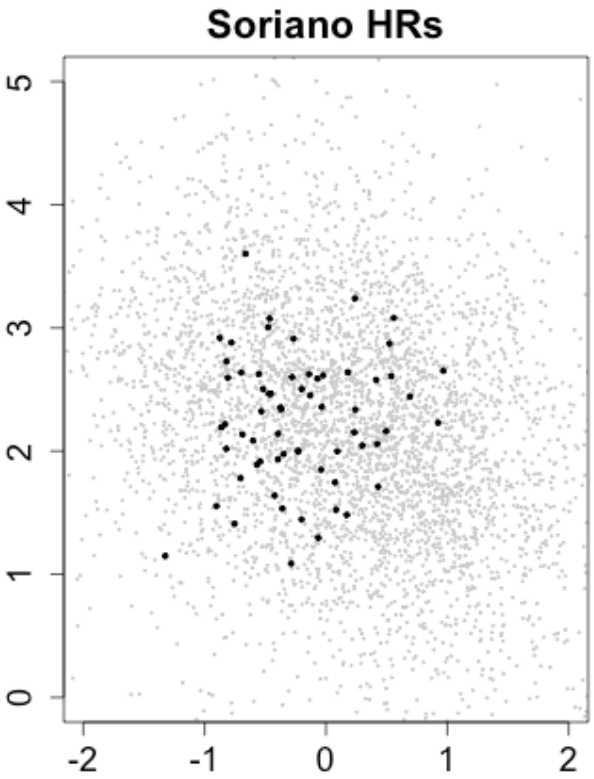

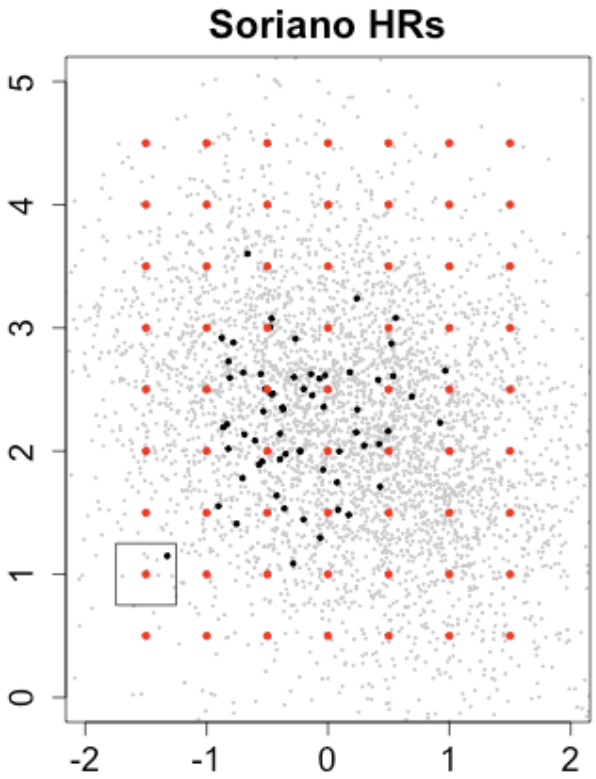

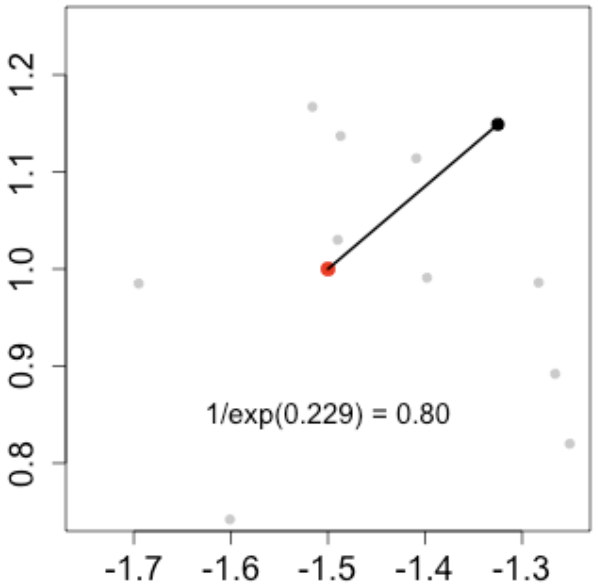

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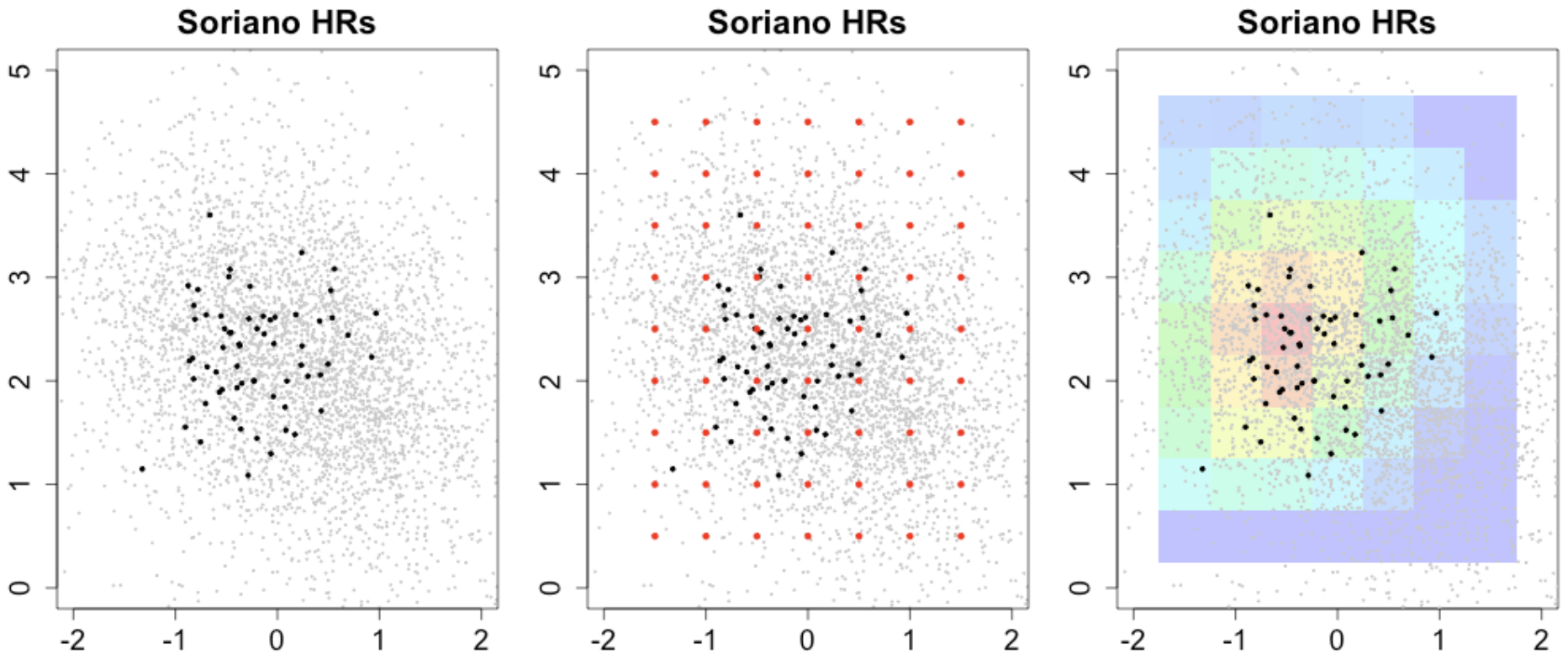
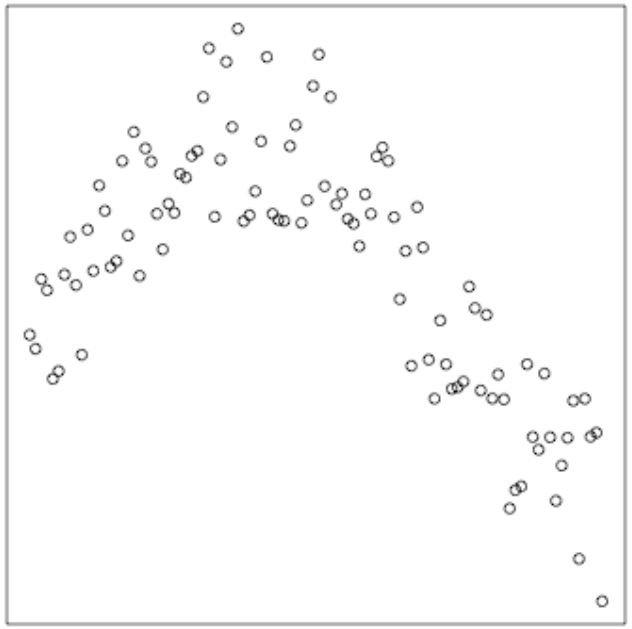


Fitting a surface by LOESS regression

- Modern regression method technique that fits a low-degree polynomial to each point in the data set. The polynomial is fit using a weighted least squares, giving more weight to neighboring points nearer the focal point.



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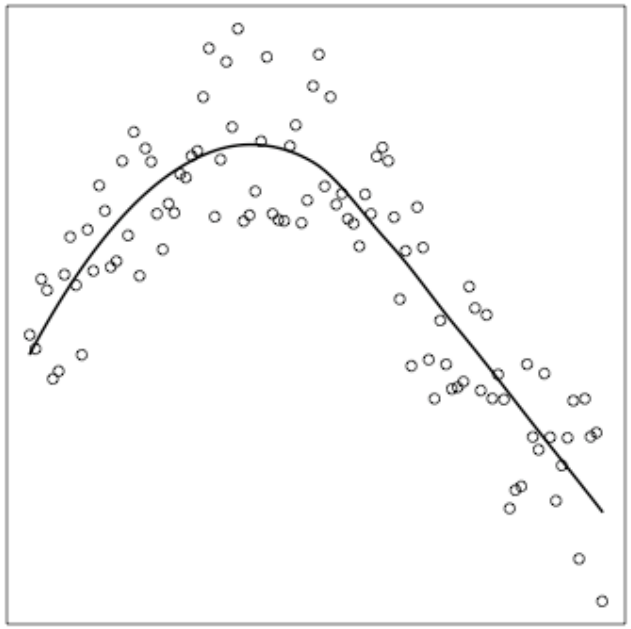

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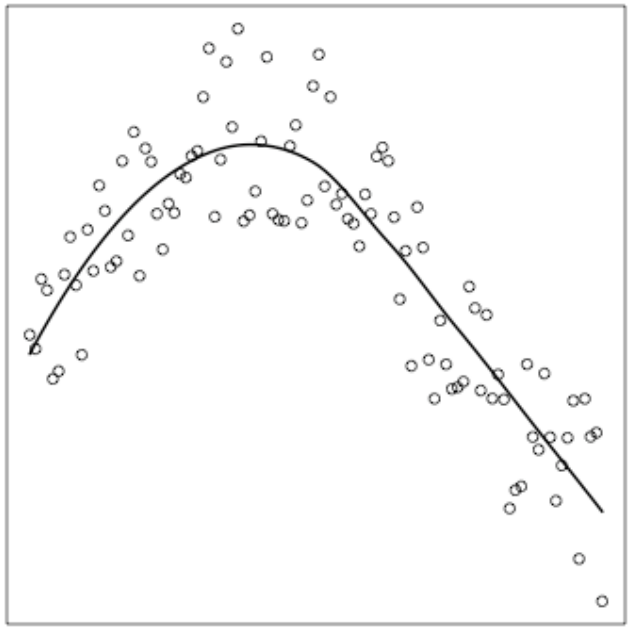

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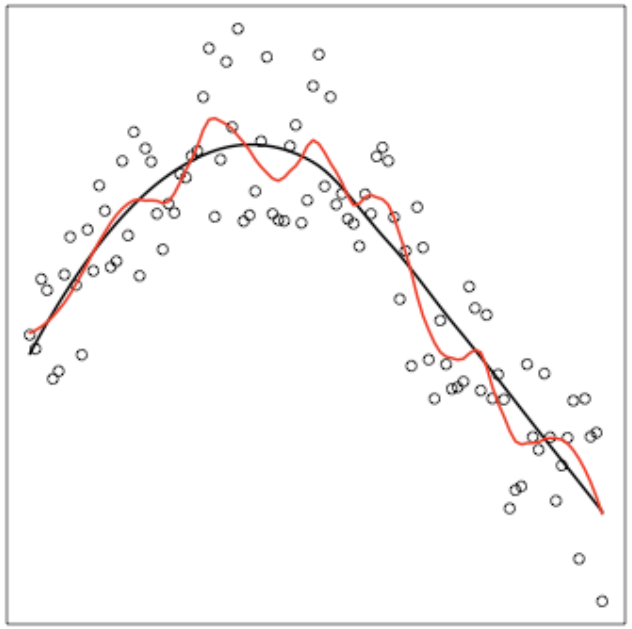

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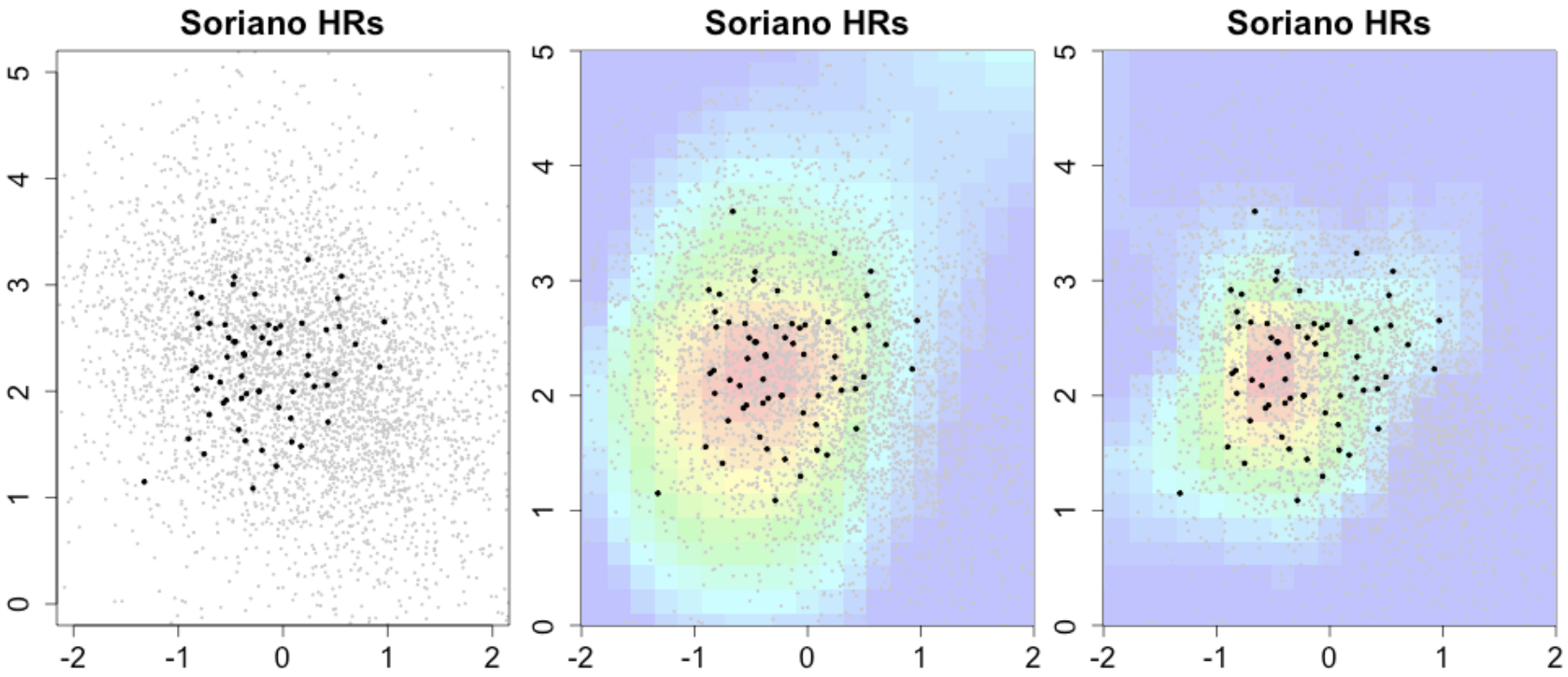
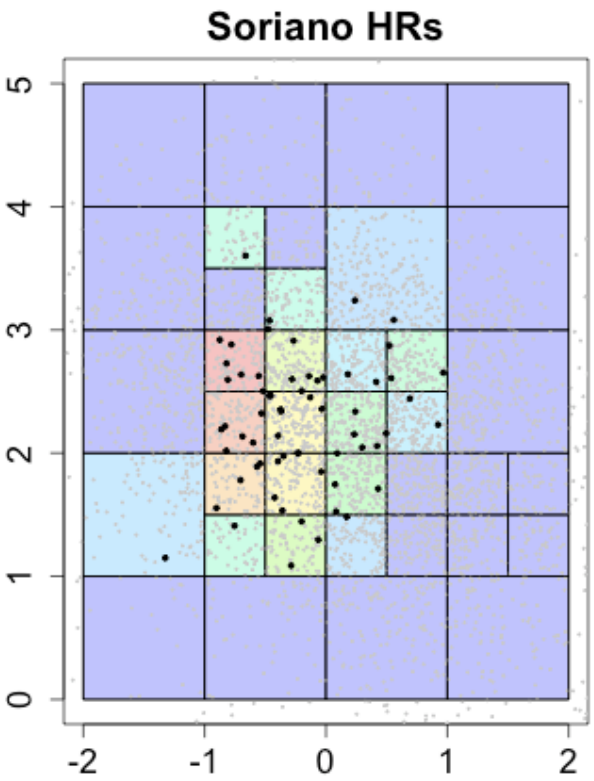
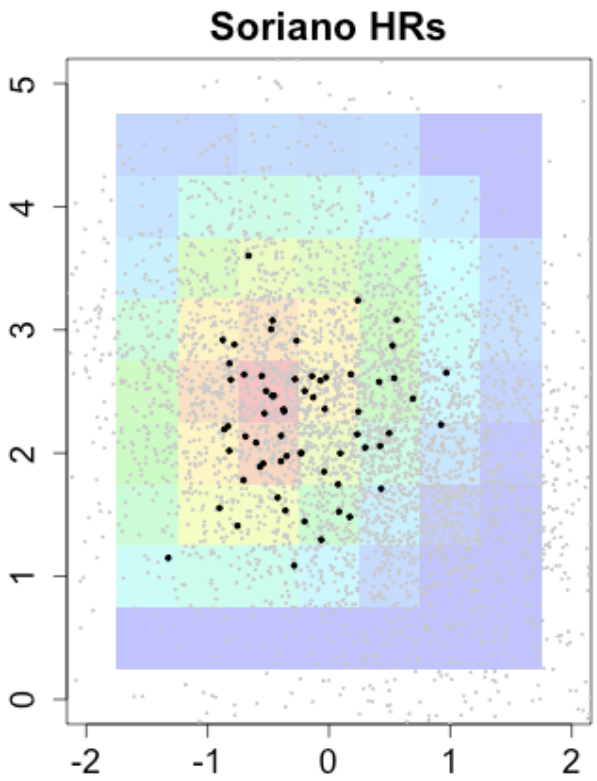


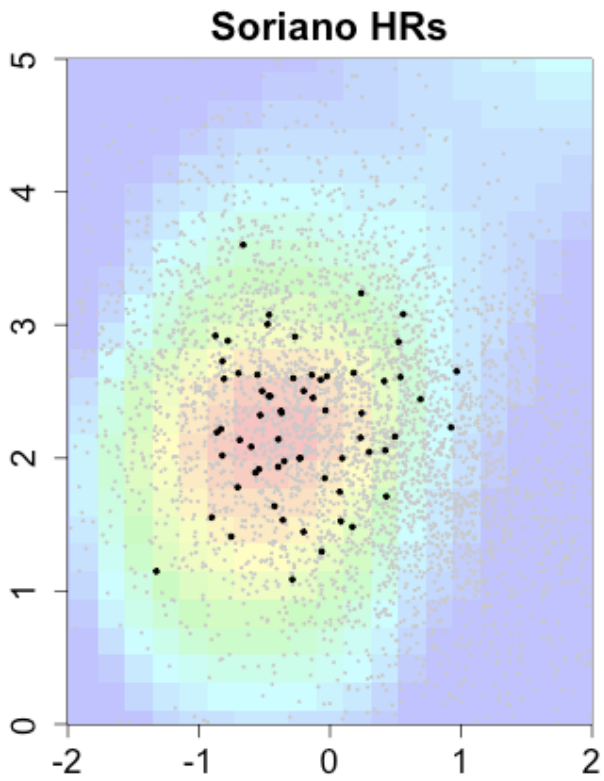
alpha = .75

alpha = .25

Comparison


Soriano HRs
0
1
2
3
4
5
-2
-1
0
1
2


Soriano HRs
0
1
2
3
4
5
-2
-1
0
1
2


Soriano HRs
0
1
2
3
4
5
-2
-1
0
1
2

Displaying the fit surface in R: `image`

Displaying the fit surface in R: `image`

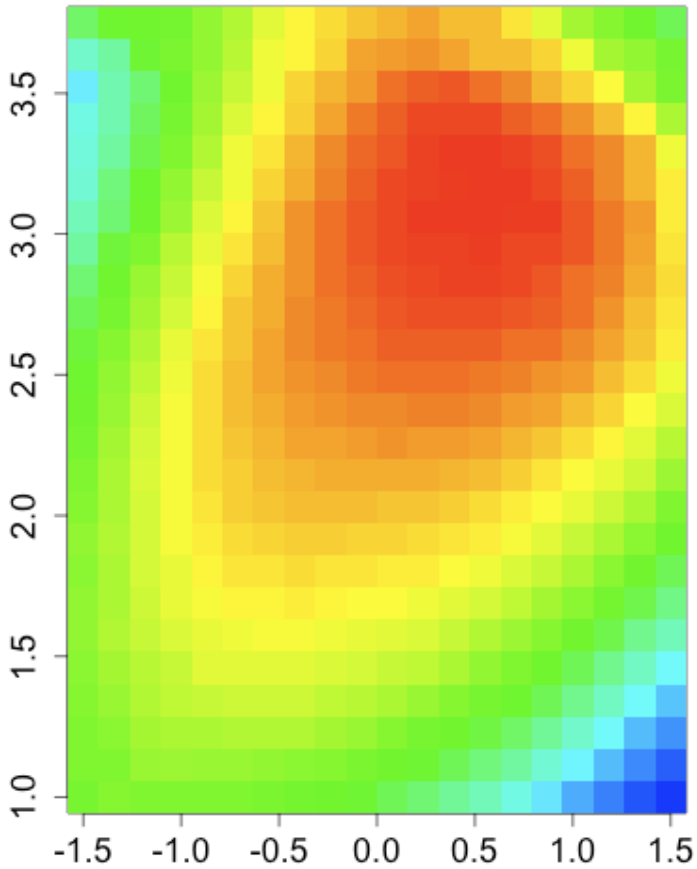
```
mysurface <- read.csv('~/Documents/pitchfx_pres/mysurface.csv',
                      header=FALSE)
mysurface <- as.matrix(mysurface)
```

Displaying the fit surface in R: image

```
mysurface <- read.csv('~/Documents/pitchfx_pres/mysurface.csv',
                      header=FALSE)
mysurface <- as.matrix(mysurface)

image(x=seq(from=-1.5,to=1.5,length=20),
      y=seq(from=1,to=3.75,length=25),
      z=mysurface,
      col=hsv(h=seq(from=2/3,to=0,length=20),s=1,v=1)
   )
```

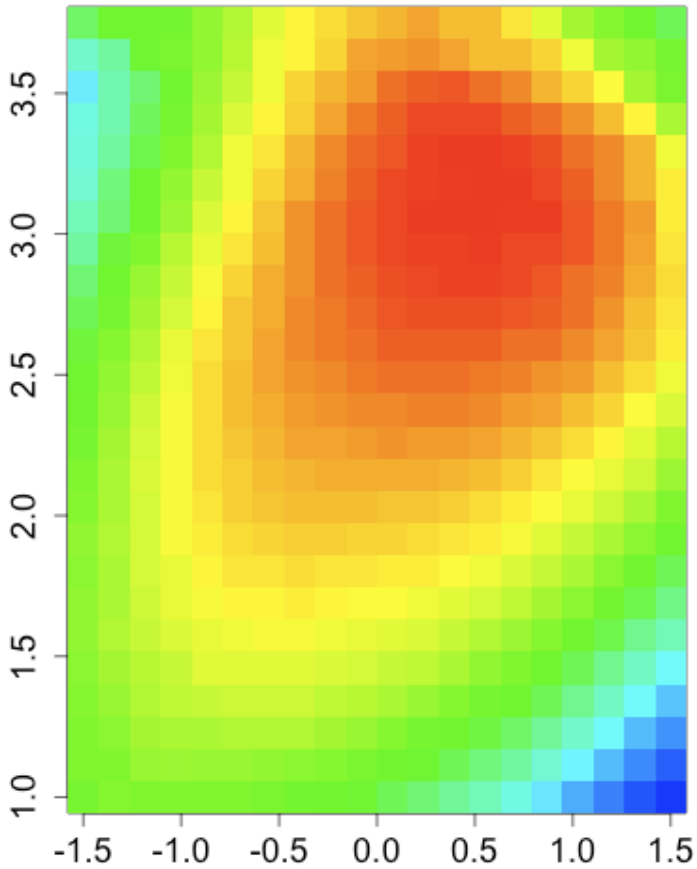
Displaying the fit surface in R: image

```
mysurface <- read.csv('~/Documents/pitchfx_pres/mysurface.csv',
                      header=FALSE)
mysurface <- as.matrix(mysurface)

image(x=seq(from=-1.5,to=1.5,length=20),
      y=seq(from=1,to=3.75,length=25),
      z=mysurface,
      col=hsv(h=seq(from=2/3,to=0,length=
   )
```



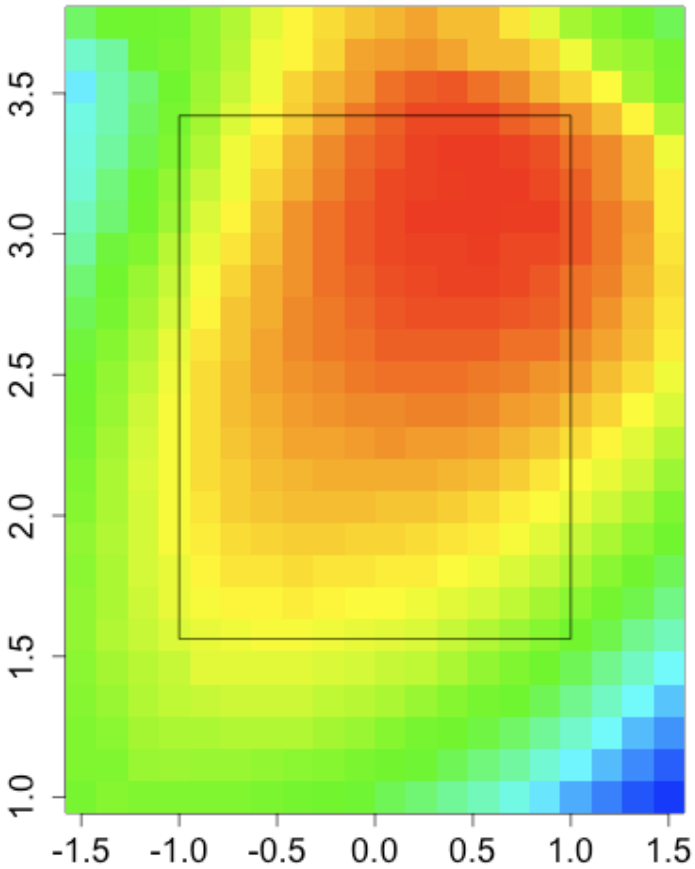
Displaying the fit surface in R: image

```
mysurface <- read.csv('~/Documents/pitchfx_pres/mysurface.csv',
                      header=FALSE)
mysurface <- as.matrix(mysurface)

image(x=seq(from=-1.5,to=1.5,length=20),
      y=seq(from=1,to=3.75,length=25),
      z=mysurface,
      col=hsv(h=seq(from=2/3,to=0,length=
   )
 top <- 3.42
 bot <- 1.56
 lines(c(-1,-1),c(bot,top))
 lines(c(1,1),c(bot,top))
 lines(c(-1,1),c(top,top)
 lines(c(-1,1),c(bot,bot))
 #points(…)
```



Displaying the fit surface in R: image

```
mysurface <- read.csv('~/Documents/pitchfx_pres/mysurface.csv',
                      header=FALSE)
mysurface <- as.matrix(mysurface)

image(x=seq(from=-1.5,to=1.5,length=20),
      y=seq(from=1,to=3.75,length=25),
      z=mysurface,
      col=hsv(h=seq(from=2/3,to=0,length=
   )
 top <- 3.42
 bot <- 1.56
 lines(c(-1,-1),c(bot,top))
 lines(c(1,1),c(bot,top))
 lines(c(-1,1),c(top,top)
 lines(c(-1,1),c(bot,bot))
 #points(…)
```



Displaying the fit surface in R: contour

```
mysurface <- read.csv('~/Documents/pitchfx_pres/mysurface.csv',
                      header=FALSE)
mysurface <- as.matrix(mysurface)
```

Displaying the fit surface in R: contour

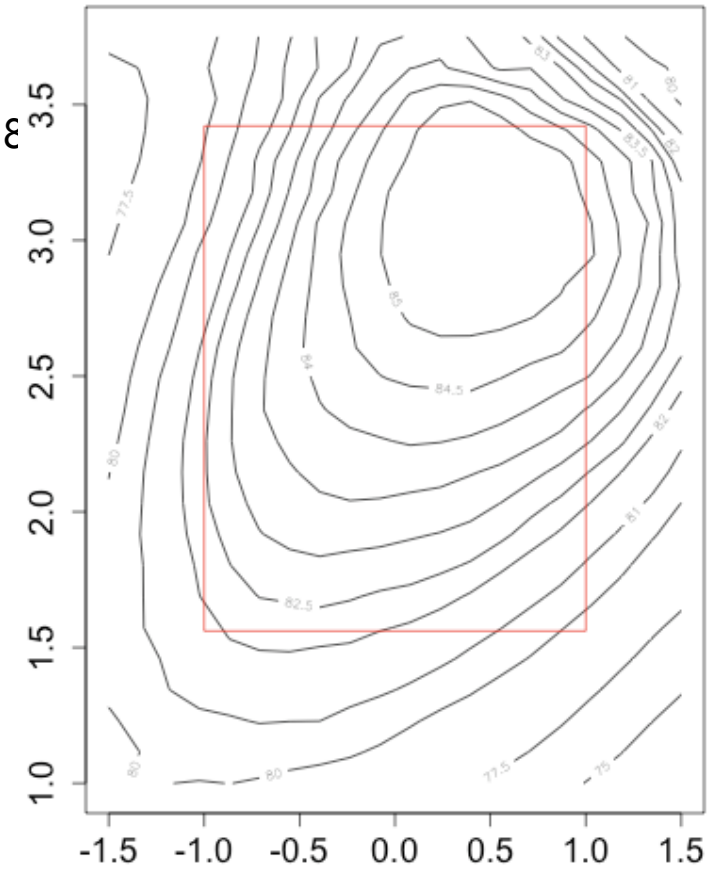
```
mysurface <- read.csv('~/Documents/pitchfx_pres/mysurface.csv',
                      header=FALSE)
mysurface <- as.matrix(mysurface)

contour(x=seq(from=-1.5,to=1.5,length=20),
        y=seq(from=1,to=3.75,length=25),
        z=mysurface,
        levels=c(75,77.5,80,81,82,82.5,83,83.5,84,84.5,85)
        #nlevels=15
    )
```

Displaying the fit surface in R: contour

```
mysurface <- read.csv('~/Documents/pitchfx_pres/mysurface.csv',
                      header=FALSE)
mysurface <- as.matrix(mysurface)

contour(x=seq(from=-1.5,to=1.5,length=20),
        y=seq(from=1,to=3.75,length=25),
        z=mysurface,
        levels=c(75,77.5,80,81,82,82.5,83,83.5,84,84.5,85)
        #nlevels=15
    )
top <- 3.42
bot <- 1.56
lines(c(-1,-1),c(bot,top),col='red')
lines(c(1,1),c(bot,top),col='red')
lines(c(-1,1),c(top,top),col='red')
lines(c(-1,1),c(bot,bot),col='red')
```

Displaying the fit surface in R: contour

```
mysurface <- read.csv('~/Documents/pitchfx_pres/mysurface.csv',
                      header=FALSE)
mysurface <- as.matrix(mysurface)

contour(x=seq(from=-1.5,to=1.5,length=20),
        y=seq(from=1,to=3.75,length=25),
        z=mysurface,
        levels=c(75,77.5,80,81,82,82.5,83,8
        #nlevels=15
    )
top <- 3.42
bot <- 1.56
lines(c(-1,-1),c(bot,top),col='red')
lines(c(1,1),c(bot,top),col='red')
lines(c(-1,1),c(top,top),col='red')
lines(c(-1,1),c(bot,bot),col='red')
```



Displaying the fit surface in R: `filled.contour`

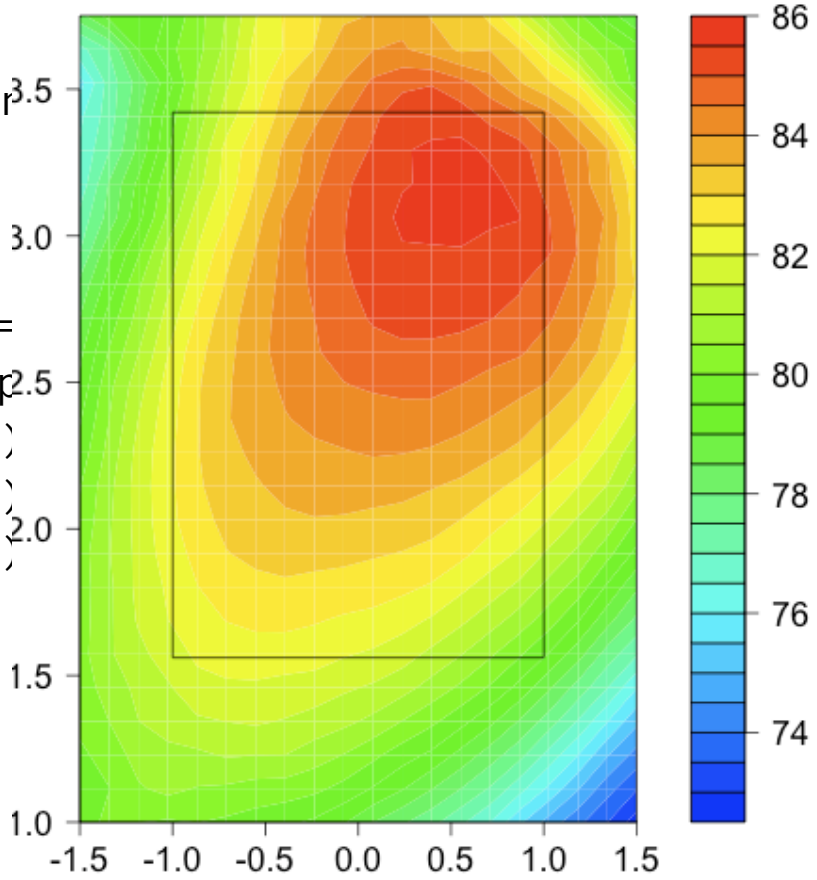
```
mysurface <- read.csv('~/Documents/pitchfx_pres/mysurface.csv',
                      header=FALSE)
mysurface <- as.matrix(mysurface)
top <- 3.42
bot <- 1.56
```

Displaying the fit surface in R: `filled.contour`

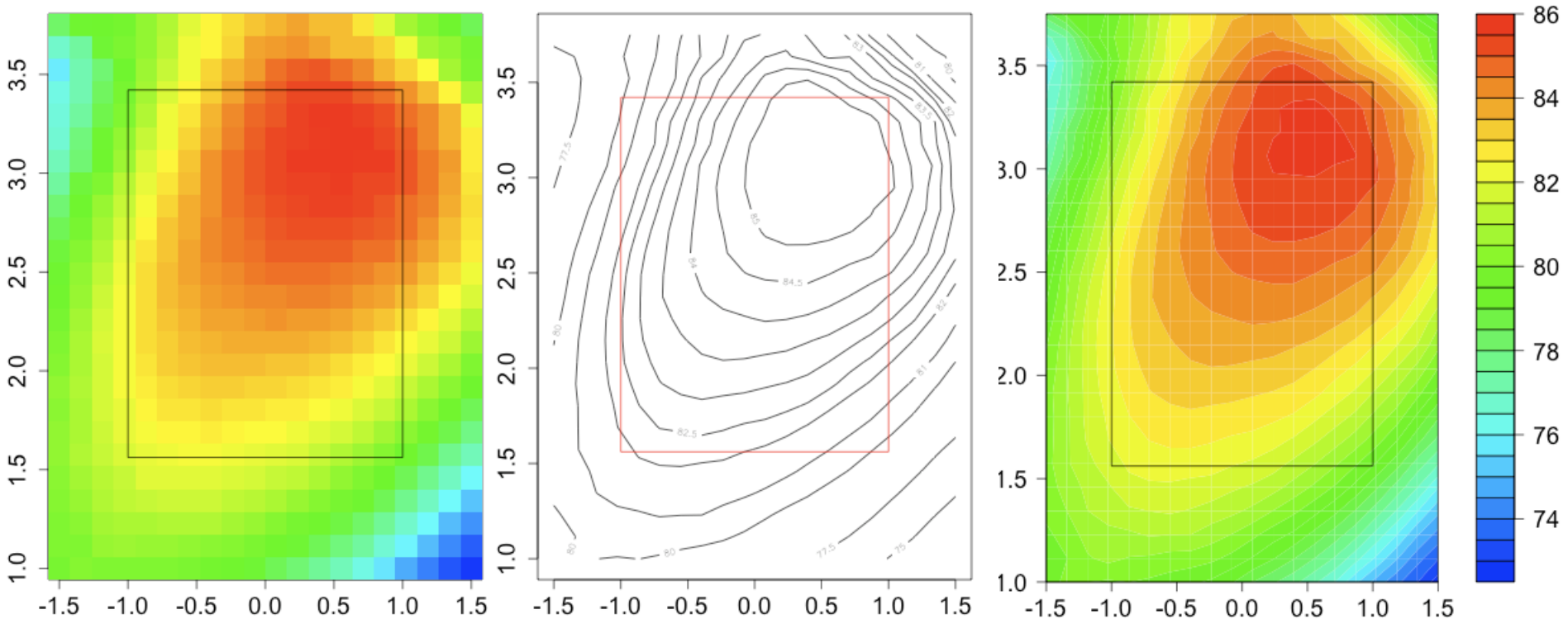
```
mysurface <- read.csv('~/Documents/pitchfx_pres/mysurface.csv',
                      header=FALSE)

mysurface <- as.matrix(mysurface)
top <- 3.42
bot <- 1.56

filled.contour(x=seq(from=-1.5,to=1.5,length=20),
      y=seq(from=1,to=3.75,length=25),
      z=mysurface,
      nlevels=27,
      col=hsv(h=seq(from=2/3,to=0,length=27),s=1,v=1),
      plot.axes={lines(c(-1,-1),c(bot,top)),
                 lines(c(1,1),c(bot,top)),
                 lines(c(-1,1),c(top,top))
                 lines(c(-1,1),c(bot,bot))
                }
   )
```

Displaying the fit surface in R: `filled.contour`

```
mysurface <- read.csv('~/Documents/pitchfx_pres/mysurface.csv',
                      header=FALSE)

mysurface <- as.matrix(mysurface)
top <- 3.42
bot <- 1.56

filled.contour(x=seq(from=-1.5,to=1.5,len
       y=seq(from=1,to=3.75,length=25),
       z=mysurface,
       nlevels=27,
       col=hsv(h=seq(from=2/3,to=0,length=
       plot.axes={lines(c(-1,-1),c(bot,top
                  lines(c(1,1),c(bot,top)
                  lines(c(-1,1),c(top,top
                  lines(c(-1,1),c(bot,bot
                  }
   )
```



Comparison

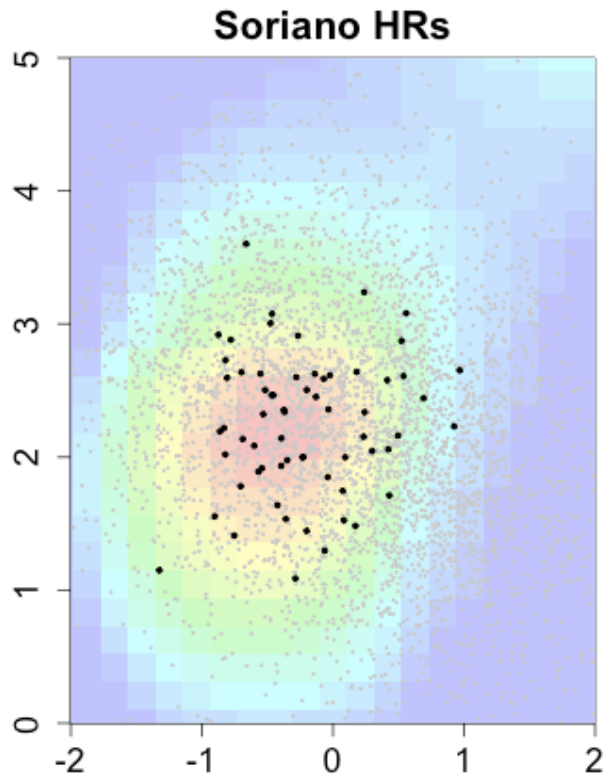


Displaying the fit models in R

```
mymodel <- loess( hr ~ p_x + p_z )
#mymodel <- lm(v_ang ~ p_z + pfx_z )
```

Displaying the fit models in R

```
mymodel <- loess( hr ~ p_x + p_z )
#mymodel <- lm(v_ang ~ p_z + pfx_z )

myx <- matrix(data=seq(from=-2,to=2,length=20),nrow=20,ncol=25)
myz <- t (matrix(data=seq(from=-2,to=2,length=20),nrow=20,ncol=25))
```



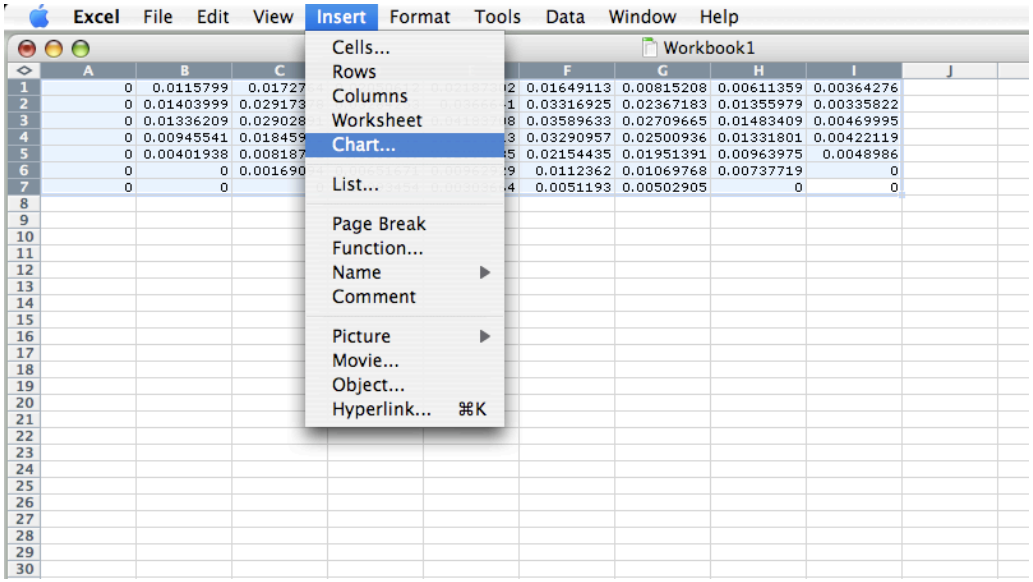
Displaying the fit models in R

```
mymodel <- loess( hr ~ p_x + p_z )
#mymodel <- lm(v_ang ~ p_z + pfx_z )

myx <- matrix(data=seq(from=-2,to=2,length=20),nrow=20,ncol=25)
myz <- t (matrix(data=seq(from=-2,to=2,length=20),nrow=20,ncol=25))

mypredict <- predict(object=mymodel,
                     newdata=data.frame(p_x=as.vector(myx),
                                        p_z=as.vector(myz)
                                        )
                      )
```

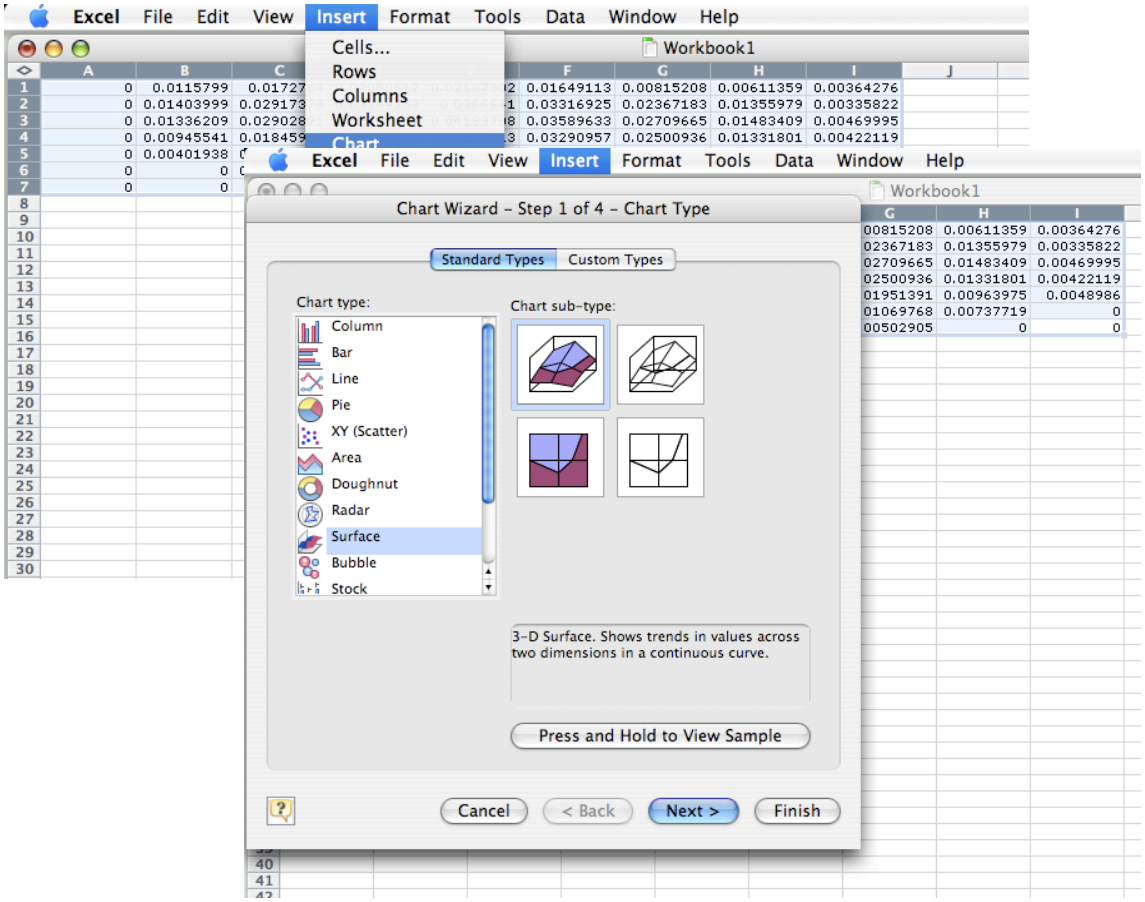
Displaying the fit models in R

```
mymodel <- loess( hr ~ p_x + p_z )
#mymodel <- lm(v_ang ~ p_z + pfx_z )

myx <- matrix(data=seq(from=-2,to=2,length=20),nrow=20,ncol=25)
myz <- t (matrix(data=seq(from=-2,to=2,length=20),nrow=20,ncol=25))

mypredict <- predict(object=mymodel,
                     newdata=data.frame(p_x=as.vector(myx),
                                        p_z=as.vector(myz)
                                        )
                     )
 mypredict<-matrix(data=mypredict,nrow=20,nrow=25)
 image(x=seq(from=-2,to=2,length=20),
       y=seq(from=0,to=5,length=25),
       z=mypredict,
       col=…
    )
```

Displaying the fit surface in Excel



Displaying the fit surface in Excel



Displaying the fit surface in Excel