Engr421:Homework 4

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In [509]:
```
import math
import matplotlib.pyplot as plt
import numpy as np
import scipy.stats as stats
```

Data

In [510]:
```
data_set=np.genfromtxt("hw04_data_set.csv",delimiter=",",skip_header=1)
X=data_set[:,0]
Y=data_set[:,1]
```

In [511]:
```
xtrain=X[:100]
xtest=X[100:133]
```

In [512]:
```
ytrain=Y[:100]
ytest=Y[100:133]
```

Regressogram

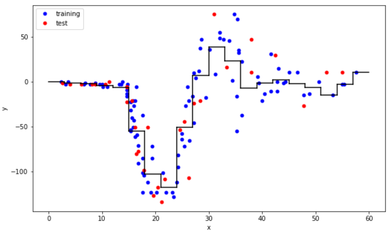
In [513]:
```
xMax=np.max(X)
xMin=np.min(X) if np.min(X) < 0 else 0
xline=np.linspace(xMin,xMax,1600)
h=3#bin width
```

In [514]:
```
leftBoundaries=np.arange(xMin,xMax,h)
rightBoundaries=np.arange(xMin+h,xMax+h,h)
numberOfBins=leftBoundaries.shape[0]
```

In [515]:
```
y_hat=[ytrain[(leftBoundaries[b]<xtrain) & (rightBoundaries[b]>=xtrain)] for b in range(numberOfBins)]
g1=[np.mean(y_hat[b]) for b in range(numberOfBins)]
```

Plot

In [516]:
```
plt.figure(figsize = (10, 6))
plt.plot(xtrain,ytrain,".b",markersize=10,label="training")
plt.plot(xtest,ytest,".r",markersize=10,label="test")
for b in range(numberOfBins):
    plt.plot([leftBoundaries[b], rightBoundaries[b]], [g1[b], g1[b]], "k-")
for b in range(numberOfBins - 1):
    plt.plot([rightBoundaries[b], rightBoundaries[b]], [g1[b], g1[b + 1]], "k-")
plt.legend(loc=2)
plt.xlabel("x")
plt.ylabel("y")
plt.show()
```



RMSE of Regressogram

In [517]:
```
count=np.asarray([np.sum((leftBoundaries[b]<xtest) & (rightBoundaries[b]>=xtest)) for b in range(numbe
rOfBins)])
RMSE=np.sqrt(
    np.sum(
        (ytest[np.argsort(xtest)]
        -np.concatenate([np.repeat(g1[b],count[b]) for b in range(numberOfBins)])
        )**2

        /ytest.shape[0]))

round(RMSE,4)
```

Out[517]: 24.726

Running Mean Smoother

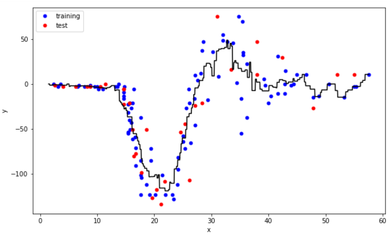
In [518]:
```
h=3
xline=np.linspace(h*0.5,xMax,1601)
y_hat=[ytrain[((x - 0.5 * h) < xtrain) & (xtrain <= (x + 0.5 * h))] for x in xline]
g2line=np.array([np.mean(y_hat[x]) for x in range(1601)])
```

Plot

In [519]:
```
plt.figure(figsize = (10, 6))
plt.plot(xtrain,ytrain,".b",markersize=10,label="training")
plt.plot(xtest,ytest,".r",markersize=10,label="test")

plt.plot(xline,g2line, "k-")

plt.legend(loc=2)
plt.xlabel("x")
plt.ylabel("y")
plt.show()
```



RMSE of RMS

In [520]:
```
g2=np.asarray([np.mean(ytrain[((x - 0.5 * h) < xtrain) & (xtrain <= (x + 0.5 * h))]) for x in xtest])

RMSE=np.sqrt(
    np.sum(
        (ytest
        -g2
        )**2

        /ytest.shape[0]))

round(RMSE,4)
```

Out[520]: 23.8403

Kernel Smoother

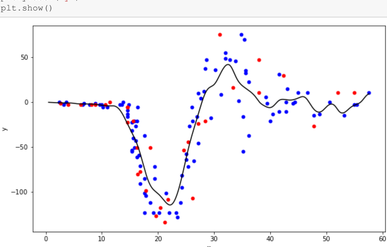
In [521]:
```
h=1
xline=np.linspace(h*0.5,xMax,1601)
y_hat = np.asarray([np.sum(1 / np.sqrt(2 * math.pi) * np.exp(-0.5 * (x - xtrain)**2 / h**2)*ytrain)/
                    np.sum(1 / np.sqrt(2 * math.pi) * np.exp(-0.5 * (x - xtrain)**2 / h**2))
                    for x in xline])
g3line=y_hat
```

Plot

In [522]:
```
plt.figure(figsize = (10, 6))
plt.plot(xtrain,ytrain,".b",markersize=10,label="training")
plt.plot(xtest,ytest,".r",markersize=10,label="test")

plt.plot(xline, g3line, "k-")

plt.xlabel("x")
plt.ylabel("y")
plt.show()
```



RMSE of Kernel Smoother

In [523]:
```
g3 = np.asarray([np.sum(1 / np.sqrt(2 * math.pi) * np.exp(-0.5 * (x - xtrain)**2 / h**2)*ytrain)/
                    np.sum(1 / np.sqrt(2 * math.pi) * np.exp(-0.5 * (x - xtrain)**2 / h**2))for x in xt
est])

RMSE=np.sqrt(
    np.sum(
        (ytest
        -g3
        )**2

        /ytest.shape[0]))

round(RMSE,4)
```

Out[523]: 24.1672