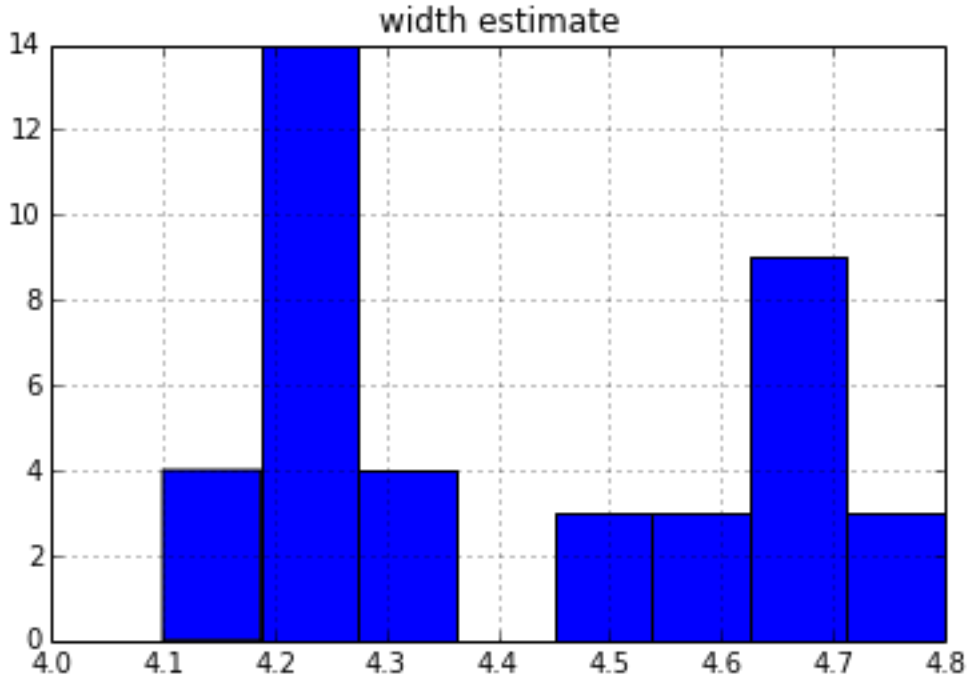
from PDFs to CDFs 2-9

February 11, 2016

In [47]:
```
%matplotlib inline

import numpy as np #matrices and data structures
import scipy.stats as ss #standard statistical operations
import pandas as pd #keeps data organized, works well with data
import matplotlib.pyplot as plt #plot visualization

#import same data as last time:
#https://weather-warehouse.com/WeatherHistory/PastWeatherData_NewYorkCentralPrkObsBelv_NewYork
nyw = pd.read_csv('NYC-CParkWeather.csv')
nyw = nyw.set_index('year') #represents observations
```

In [169]:
```
#inclass measurement data
classX = pd.DataFrame(np.array([4.5, 4.7, 4.6, 4.5,4.1,4.2,4.2,4.2,4.1,4.2,4.3,4.2,4.2,4.3,4.
classX.columns=['width estimate']
classX.hist(bins=8)
```

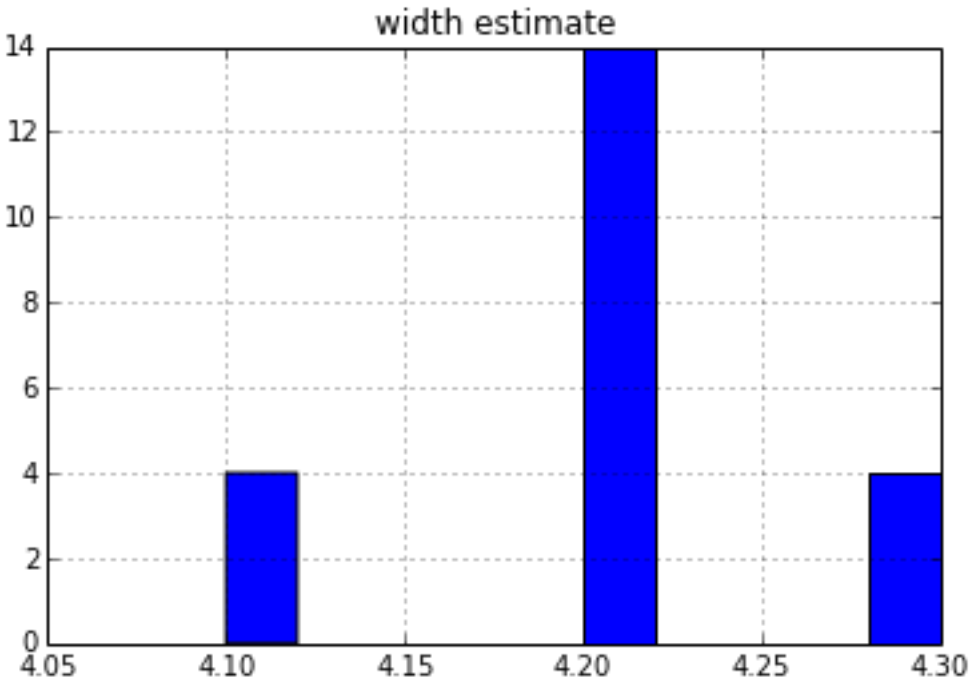
Out[169]:
```
array([[<matplotlib.axes.AxesSubplot object at 0x7fc32be6af10>]], dtype=object)
```



In [172]:
```
#X.describe()
newX = classX.loc[classX['width estimate']<4.4] #loc returns elements at the given locations
newX.hist()
newX.describe()
```

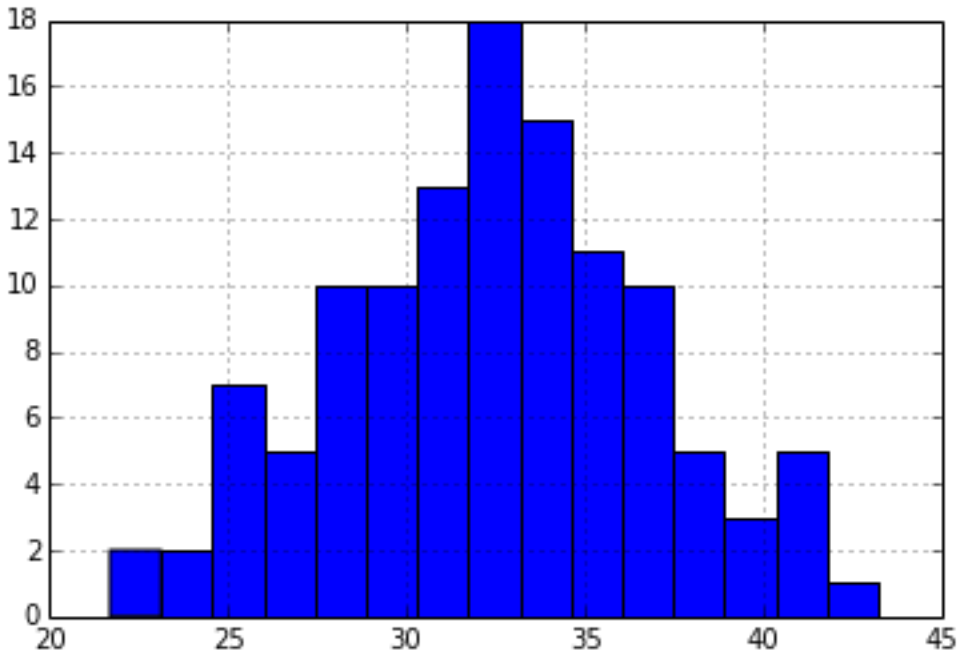
Out[172]:

	width estimate
count	22.000000
mean	4.200000
std	0.061721
min	4.100000
25%	4.200000
50%	4.200000
75%	4.200000
max	4.300000



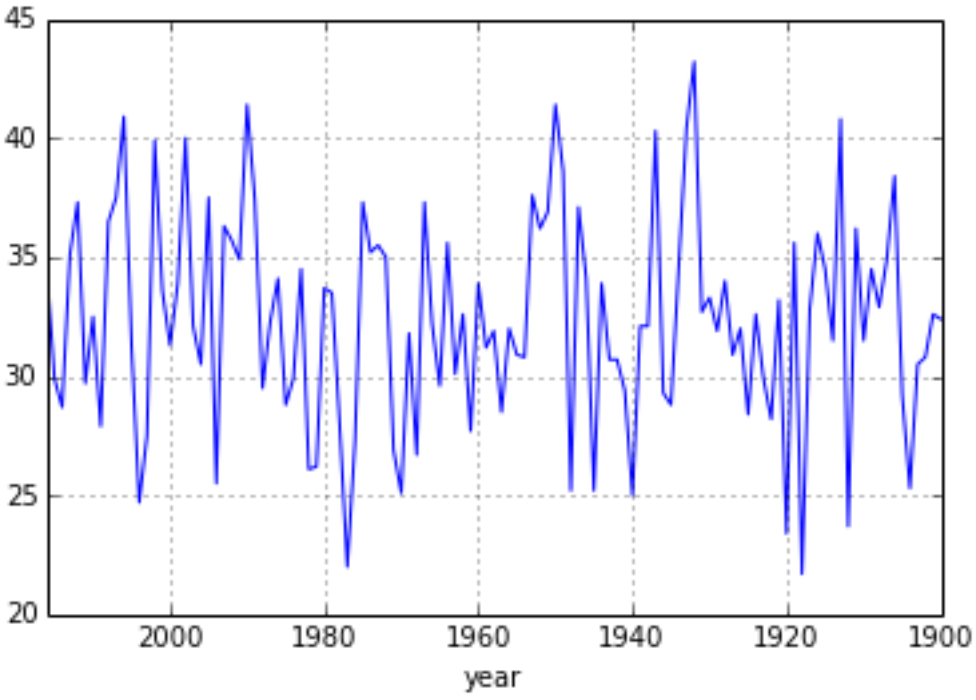
In [173]:
```
nyw_m=nyw['mean']
nyw_m.hist(bins=15)
```

Out[173]:
```
<matplotlib.axes.AxesSubplot at 0x7fc32b70a9d0>
```

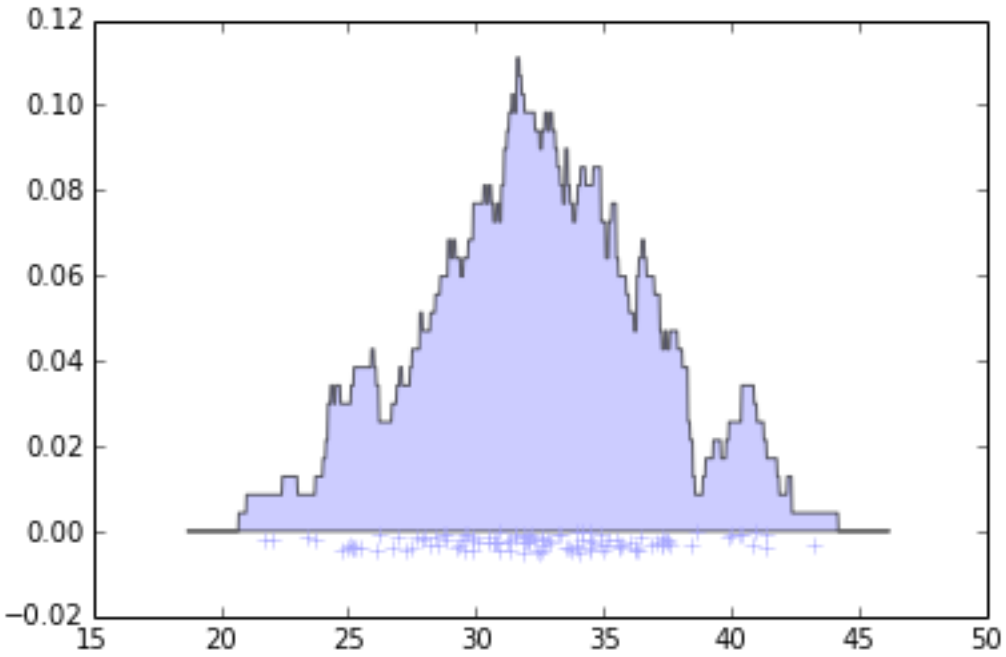


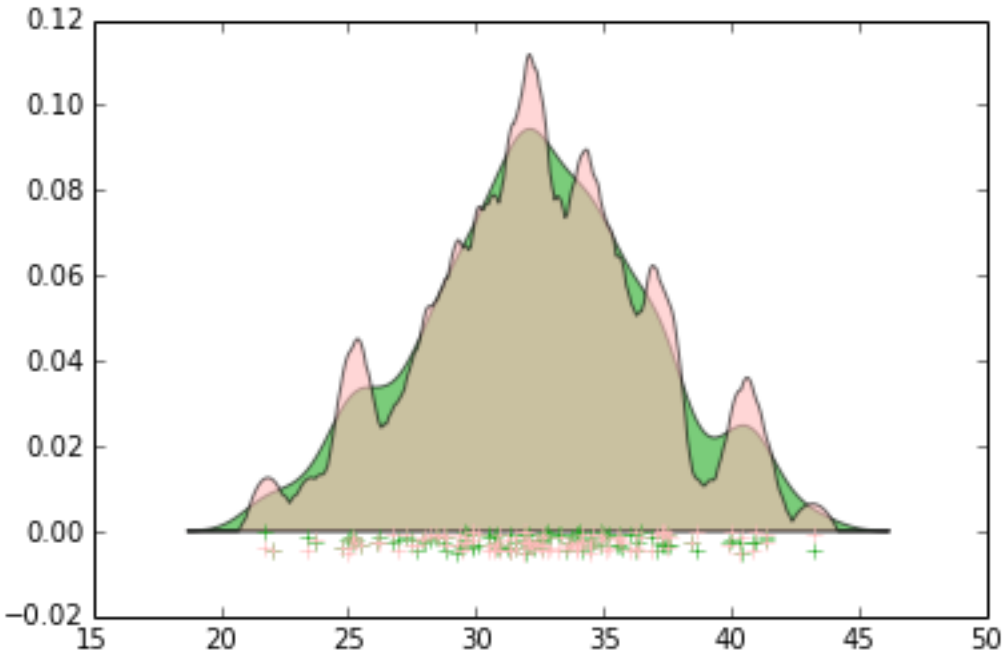
In [67]: nyw_m.plot()

Out[67]: <matplotlib.axes.AxesSubplot at 0x7fc32cac0b50>

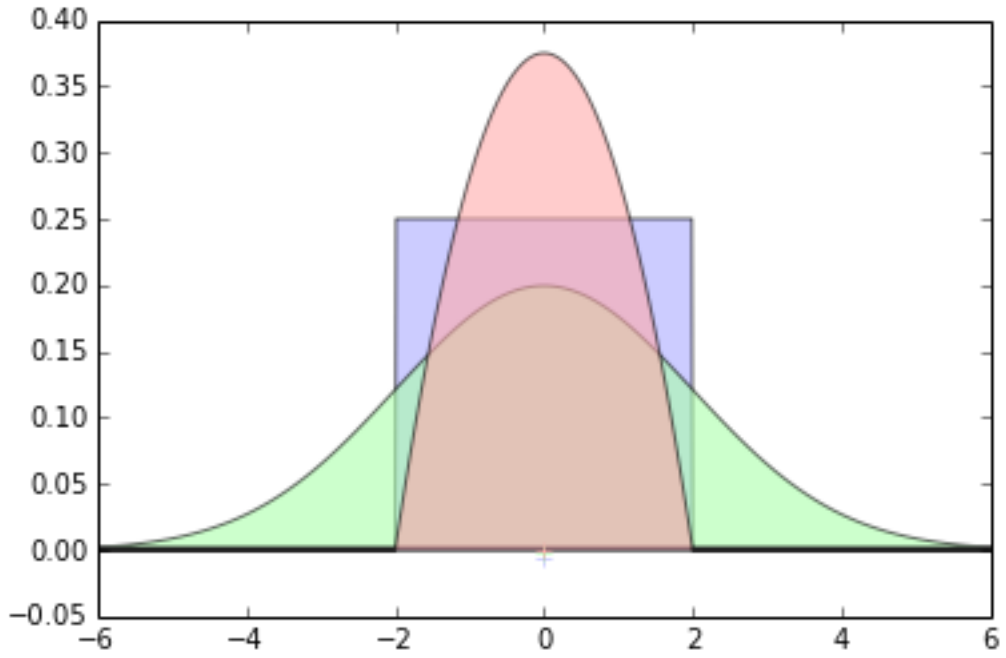


In [148]:
```
#import KDE
from sklearn.neighbors import KernelDensity

def kde_plot(kernel, X, color="#aaaaff", bw = 1):
    #create the estimator:
    kde_X = KernelDensity(kernel=kernel, bandwidth=bw).fit(X)

    #setup range:
    range = np.linspace(X.min()-bw*3, X.max()+bw*3, 1000)[:,np.newaxis]

    #plot:
    plt.fill(range[:,0], np.exp(kde_X.score_samples(range)), fc=color, alpha=.6)
    dots = [y-np.random.rand()*.005 for y in np.zeros(X.shape[0])] #all points, randomly jitt
    plt.plot(X[:,0], dots, '+k', color=color)

Xnyw_m = nyw_m.reshape(-1,1)
kde_plot('tophat', Xnyw_m)
plt.show()
kde_plot('gaussian', Xnyw_m, '#22aa22')
kde_plot('epanechnikov', Xnyw_m, '#ffbbbb')
```



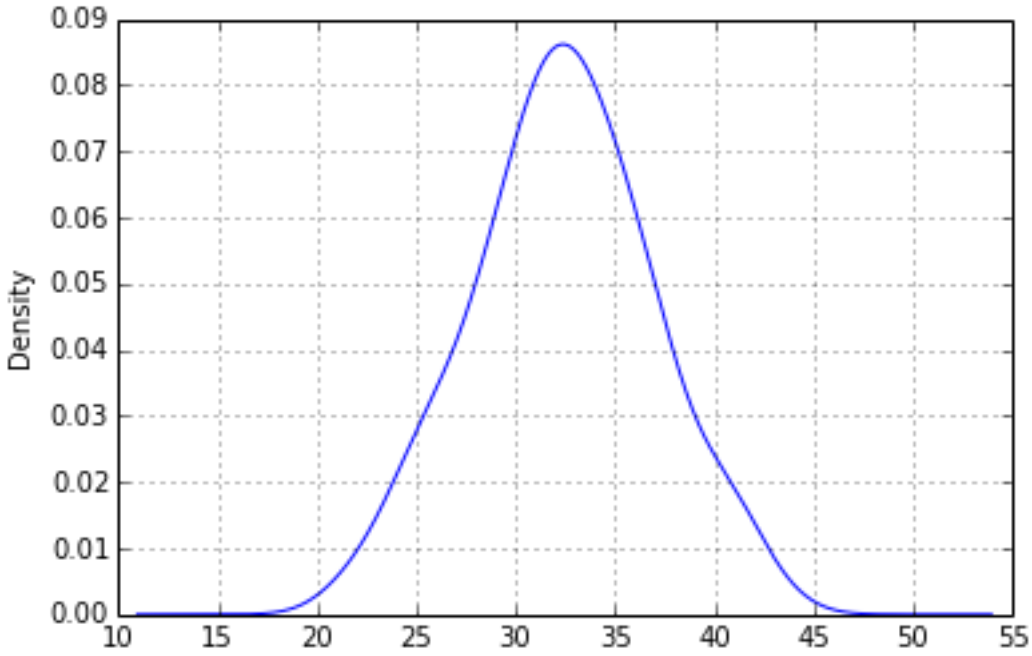


In [146]:
```
#lets see what each kernel looks like:
X = np.array([[0]])
kde_plot('tophat', X, bw=2)
kde_plot('gaussian', X, '#aaffaa', bw=2)
kde_plot('epanechnikov', X, '#ffaaaa',bw=2)
```

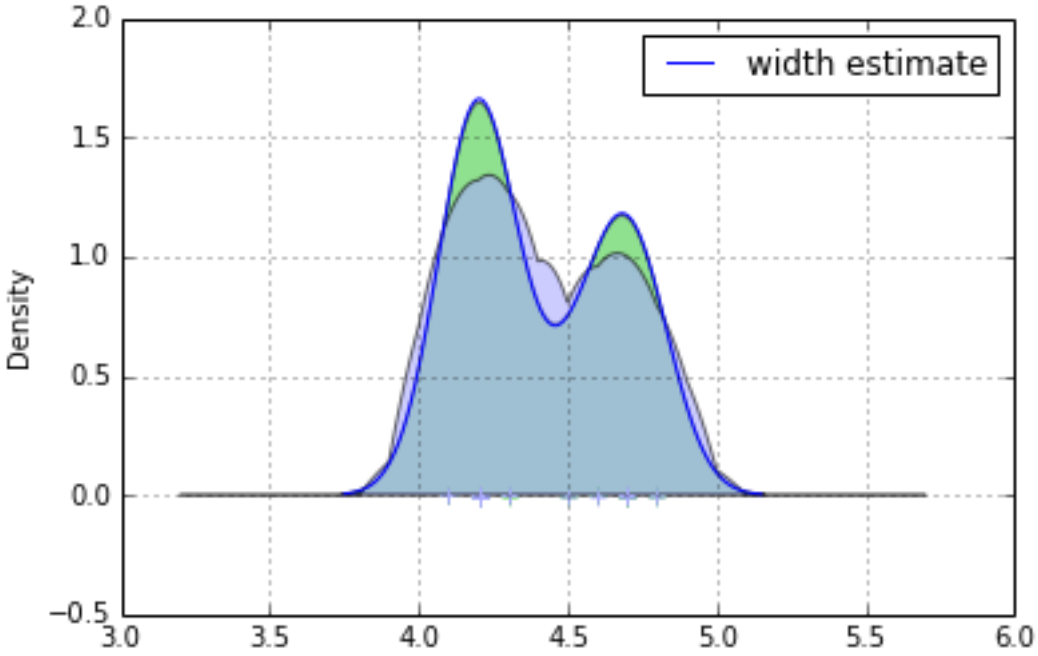


In [158]:
```
#Pandas also has KDE built in:
nyw_m.plot(kind='kde')
```

Out[158]:
```
<matplotlib.axes.AxesSubplot at 0x7fc32be56050>
```



In [180]:
```
#KDE on class measurement data.
# let's see whether pandas' KDE matches Gaussian or Epan
classX.plot(kind='kde')
kde_plot('gaussian', classX.as_matrix(), bw=0.12, color='#44cc44')
kde_plot('epanechnikov', classX.as_matrix(), bw=0.3)
#pandas seems to be using a Gaussian kernel with bandwidth optimized to .12
```


width estimate
Density
2.0
1.5
1.0
0.5
0.0
−0.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0