MATH895hw4

December 2, 2018

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In [1]: import numpy as np
        import pandas as pd
        import matplotlib.pyplot as pl

In [2]: from patsy import dmatrix
        import statsmodels.api as sm
        import statsmodels.formula.api as smf

In [19]: x = np.random.uniform(0, 1, 50)
         x = -np.sort(-x)
         predict_glinear = list()
         predict_gcubic = list()
         predict_cs2 = list()
         predict_cs6 = list()

In [20]: for i in range(100):
             y = np.random.normal(0, 1, 50)

             # Global linear
             coe_linear = np.polyfit(x, y, 1)
             linear = np.poly1d(coe_linear)
             predict_linear = linear(x)
             predict_glinear.append(predict_linear.tolist())

             # Global cubic
             coe_cubic = np.polyfit(x, y, 3)
             cubic = np.poly1d(coe_cubic)
             predict_cubic = cubic(x)
             predict_gcubic.append(predict_cubic.tolist())

             # Cubic spline 2 knots
             transformed_x = dmatrix("bs(x, knots=(0.33, 0.66), degree=3, include_intercept=Fa
             fit1 = sm.GLM(y, transformed_x).fit()
             predict_cs = fit1.predict(dmatrix("bs(x, knots=(0.33, 0.66), degree=3, include_in
             predict_cs2.append(predict_cs)

             #Natural cubic spline
             transformed_x = dmatrix("cr(x, df = 6, lower_bound = 0.1, upper_bound = 0.9, knot
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        fit1 = sm.GLM(y, transformed_x).fit()
        predict_ncs = fit1.predict(dmatrix("cr(x, df = 6, lower_bound = 0.1, upper_bound =
        predict_cs6.append(predict_ncs)
```

In [21]:
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var_glieanr = np.var(predict_glinear,0)
var_gcubic = np.var(predict_gcubic,0)
var_cs2 = np.var(predict_cs2,0)
var_cs6 = np.var(predict_cs6,0)
```

In [22]:
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fig, ax = pl.subplots()
ax.plot(x,var_glieanr,'b.-', label = 'Global Linear')
ax.plot(x,var_gcubic,'g.-', label = 'Global Cubic')
ax.plot(x,var_cs2,'r.-', label = 'Cubic Spline - 2 knots')
ax.plot(x,var_cs6,'k.-', label = 'Natural Cubic Spline - 6 knots')
legend = ax.legend(loc='upper center', shadow=True, fontsize='x-small')
pl.xlabel('X')
pl.ylabel('Pointwise Variance')
```

Out[22]:
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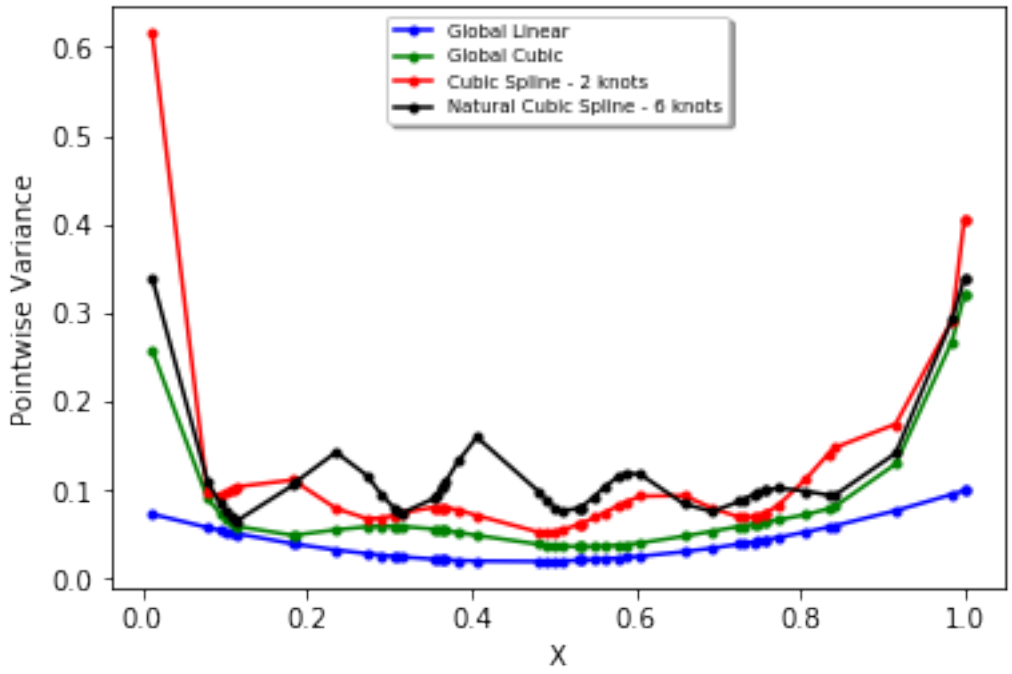
Text(0,0.5,'Pointwise Variance')
```



In [20]:
```
from sklearn import tree
from sklearn import cross_validation
from random import randrange
```

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In [95]: x = np.random.choice([0, 1], size=(100,))
         y = np.random.choice([0, 1], size=(100,))
         dataset = np.column_stack((x,y))

In [96]: def cross_validation_split(dataset, n_folds):
             dataset_split = list()
             dataset_copy = list(dataset)
             size = int(len(dataset)/n_folds)
             for i in range(n_folds):
                 fold = list()
                 while len(fold) <  size:
                     index = randrange(len(dataset_copy))
                     fold.append(dataset_copy.pop(index))
                 dataset_split.append(fold)
             return dataset_split

In [106]: def evaluate_cv(dataset, n_folds):
              folds = cross_validation_split(dataset, n_folds)
              scores = list()
              for fold in folds:
                  train_set = list(folds)
                  train_set.remove(fold)
                  train_set = sum(train_set,[])

                  actual = [row[-1] for row in fold]
                  tree_model = tree.DecisionTreeClassifier(max_depth=1)

                  train_x = [[row[0]] for row in train_set]
                  train_y = [[row[-1]] for row in train_set]

                  model = tree_model.fit(train_x,train_y)
                  test_x = [[row[0]] for row in fold]
                  prediction = model.predict(test_x)
                  error = sum(abs(prediction - actual))/float(20)
              scores.append(error)
              return scores

In [108]: evaluate_cv(dataset.tolist(), 5)

Out[108]: [0.5]
```