EE660_HW4_Q3_Hardik_2678294168

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1 HW4-Hardik Prajapati-2678294168

[2]:
```
import numpy as np
import matplotlib.pyplot as plt
```

[6]:
```
def random_sampling(lv,hv,n):
    a=np.random.uniform(lv,hv,n)
    a_1=a[0]
    a_2=a[1]
    return a_1,a_2
```

[13]:
```
def g_d(x):
    x1,x2=random_sampling(-1,1,2)
    a=x1+x2
    b=-x1*x2
    g_x=a*x+b
    return g_x
```

[12]:
```
def average(arr):
    avg=np.mean(arr)
    return avg
```

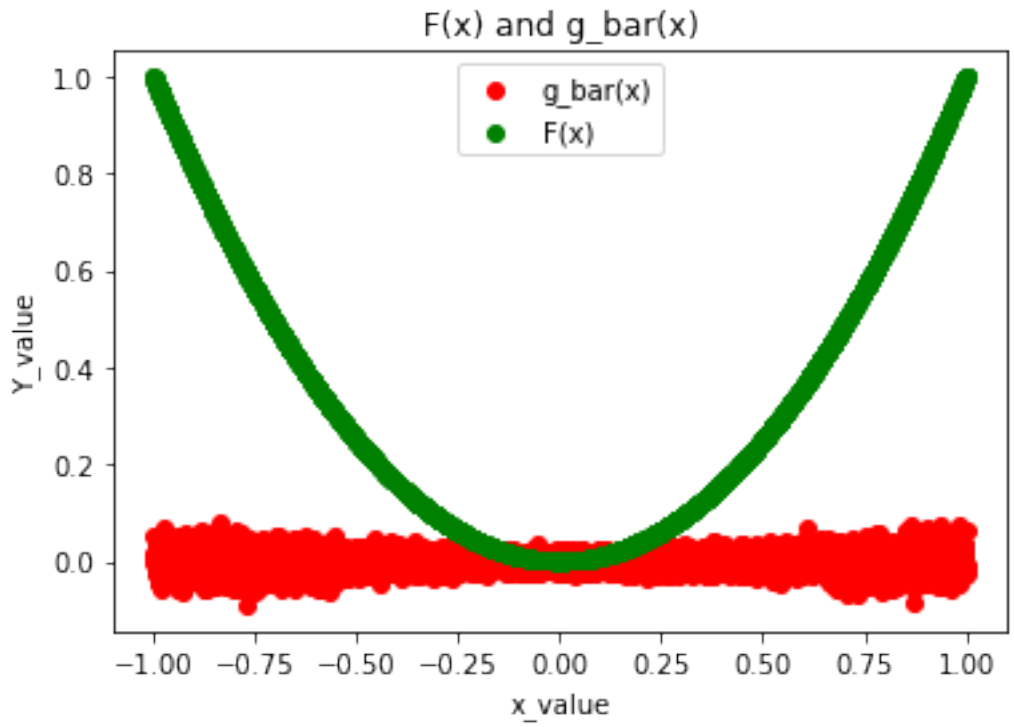
[20]:
```
def experiment(itr_data,itr_x):
    var=[]
    bias=[]
    out_of_sample_err=[]
    g_bar=[]
    f_x=[]
    x_sample=[]
    for i in range(itr_x):
        x_val=random_sampling(-1,1,1)
        x_sample.append(x_val)
        f_x_val=x_val*x_val
        f_x.append(f_x_val)
        g_d_x=[]
        for j in range(itr_data):
            gd_val=g_d(x_val)
```

```
            g_d_x.append(gd_val)
        g_bar_x=average(g_d_x)
        g_bar.append(g_bar_x)
        var_squar=[]
        out_of_sample_squar=[]
        for m in g_d_x:
            var_squared_err_val=(g_bar_x-m)*(g_bar_x-m)
            var_squar.append(var_squared_err_val)
            out_of_sample_sq_err_val=(m-(x_val*x_val))*(m-(x_val*x_val))
            out_of_sample_squar.append(out_of_sample_sq_err_val)
        var_sq_error_d=average(var_squar)
        bias_sq_error_d=(g_bar_x-(x_val*x_val))*(g_bar_x-(x_val*x_val))
        out_of_sample_sq_error_d=average(out_of_sample_squar)
        var.append(var_sq_error_d)
        bias.append(bias_sq_error_d)
        out_of_sample_err.append(out_of_sample_sq_error_d)

    var_final=average(var)
    bias_final=average(bias)
    out_of_sample_err_final=average(out_of_sample_err)
    print("Variance: {}".format(var_final))
    print("Bias: {}".format(bias_final))
    print("Out_of_Sample Error: {}".format(out_of_sample_err_final))
    plt.scatter(x_sample,g_bar,color='r',label='g_bar(x)')
    plt.scatter(x_sample,f_x,color='green',label='F(x)')
    plt.ylabel("Y_value")
    plt.xlabel("x_value")
    plt.title("F(x) and g_bar(x)")
    plt.legend()
    plt.show
```

[21]:
```
experiment(1000,5000)
```

```
Variance: 0.3305556035567033
Bias: 0.1970214510977582
Out_of_Sample Error: 0.5275770546544615
```


F(x) and g_bar(x)
g_bar(x)
F(x)
Y_value
x_value
1.0
0.8
0.6
0.4
0.2
0.0
−1.00
−0.75
−0.50
−0.25
0.00
0.25
0.50
0.75
1.00