

# Binomial\_MGWR\_module\_GAM

May 19, 2020

```
In [17]: import sys
         sys.path.append("/Users/msachde1/Downloads/Research/Development/mgwr/")

In [18]: import warnings
         warnings.filterwarnings("ignore")

In [19]: from mgwr.gwr import GWR
         import pandas as pd
         import numpy as np
         from spglm.family import Gaussian, Binomial, Poisson
         from mgwr.gwr import MGWR
         from mgwr.sel_bw import Sel_BW
         import multiprocessing as mp
         pool = mp.Pool()
         from scipy import linalg
         import numpy.linalg as la
         from scipy import sparse as sp
         from scipy.sparse import linalg as spla
         from spreg.utils import spdot, spmultiply
         from scipy import special
         import libpysal as ps
         import seaborn as sns
         import matplotlib.pyplot as plt
         import numpy as np
         from copy import deepcopy
         import copy
         from collections import namedtuple
```

## 0.0.1 IWLS convergence loop

```
In [84]: data_p = pd.read_csv("C:/Users/msachde1/Downloads/logistic_mgwr_data/landslides.csv")
         coords = list(zip(data_p['X'], data_p['Y']))
         y = np.array(data_p['Landslid']).reshape((-1,1))
         elev = np.array(data_p['Elev']).reshape((-1,1))
         slope = np.array(data_p['Slope']).reshape((-1,1))
         SinAspct = np.array(data_p['SinAspct']).reshape((-1,1))
         CosAspct = np.array(data_p['CosAspct']).reshape((-1,1))
         X = np.hstack([elev, slope, SinAspct, CosAspct])
```

```

x = CosAspct

X_std = (X-X.mean(axis=0))/X.std(axis=0)
x_std = (x-x.mean(axis=0))/x.std(axis=0)
y_std = (y-y.mean(axis=0))/y.std(axis=0)

```

## 0.0.2 Initialization with GWPR

```

In [85]: sel=Sel_BW(coords,y,x,family=Binomial(),constant=False)
        bw_in=sel.search()
        def gwr_func(y,X,bw):
            return GWR(coords,y,X,bw,family=Binomial(),fixed=False,kernel='bisquare',constant=False)
        optim_model = gwr_func(y=y,X=x,bw=bw_in)
        om_p=optim_model.params

```

```

In [87]: bw_in

```

```

Out[87]: 238.0

```

## 0.0.3 Starting values

```

In [88]: n_iter=0
        n=x.shape[0]

```

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In [89]: diff = 1.0e+06
        tol = 1.0e-06
        max_iter=200
        betas=om_p

```

```

In [90]: XB =np.sum( np.multiply(optim_model.params,optim_model.X),axis=1)
        mu = 1 / ( 1 + np.exp (-1 * XB))
        ni_old = np.log((mu)/(1-mu))

```

```

In [91]: while diff> tol and n_iter < max_iter:
        n_iter +=1
        w = mu*(1-mu)
        z = (ni_old + ((optim_model.y - mu)/mu*(1-mu))).reshape(-1,1)

        wx = spmultiply(x.reshape(-1),w.reshape(-1),array_out=False)

        x_std=((wx-wx.mean(axis=0))/wx.std(axis=0)).reshape(-1,1)
        print(x_std.shape)

        selector=Sel_BW(coords,z,x_std,multi=True,constant=False)
        selector.search(pool=pool)
        print(selector.bw[0])
        mgwr_model=MGWR(coords,z,x_std,selector,family=Gaussian(),constant=False).fit()

        n_betas=mgwr_model.params

```

```

XB =np.sum( np.multiply(n_betas,mgwr_model.X),axis=1)
mu = 1 / ( 1 + np.exp (-1 * XB))
ni_old = np.log((mu)/(1-mu))

diff=min(min(abs(betas-n_betas).reshape(1,-1).tolist()))
print("diff = "+str(diff))
betas = n_betas

#print (betas, w, z, n_iter)

(239, 1)
[43.]

HBox(children=(IntProgress(value=0, description='Inference', max=1), HTML(value='')))

diff = 0.026595634232452814
(239, 1)
[43.]

HBox(children=(IntProgress(value=0, description='Inference', max=1), HTML(value='')))

diff = 0.0004412778302481657
(239, 1)
[43.]

HBox(children=(IntProgress(value=0, description='Inference', max=1), HTML(value='')))

diff = 0.0006897708549534753
(239, 1)
[43.]

HBox(children=(IntProgress(value=0, description='Inference', max=1), HTML(value='')))

diff = 4.9275951381710925e-05
(239, 1)
[43.]

```

```
HBox(children=(IntProgress(value=0, description='Inference', max=1), HTML(value='')))
```

```
diff = 0.00012256812688138385  
(239, 1)  
[43.]
```

```
HBox(children=(IntProgress(value=0, description='Inference', max=1), HTML(value='')))
```

```
diff = 2.9542772679969076e-05  
(239, 1)  
[43.]
```

```
HBox(children=(IntProgress(value=0, description='Inference', max=1), HTML(value='')))
```

```
diff = 1.126605167245387e-05  
(239, 1)  
[43.]
```

```
HBox(children=(IntProgress(value=0, description='Inference', max=1), HTML(value='')))
```

```
diff = 3.6961727373385767e-05  
(239, 1)  
[43.]
```

```
HBox(children=(IntProgress(value=0, description='Inference', max=1), HTML(value='')))
```

```
diff = 2.606459520659854e-06  
(239, 1)  
[43.]
```

```
HBox(children=(IntProgress(value=0, description='Inference', max=1), HTML(value='')))
```

```
diff = 1.125952122371654e-06  
(239, 1)  
[43.]
```

```
HBox(children=(IntProgress(value=0, description='Inference', max=1), HTML(value='')))
```

```
diff = 4.6469079716116024e-08
```

```
In [35]: bw=Sel_BW(coords,y,x_std,family=Binomial(),constant=False)
```

```
In [36]: bw=bw.search()
```

```
In [37]: bw
```

```
Out[37]: 100.0
```

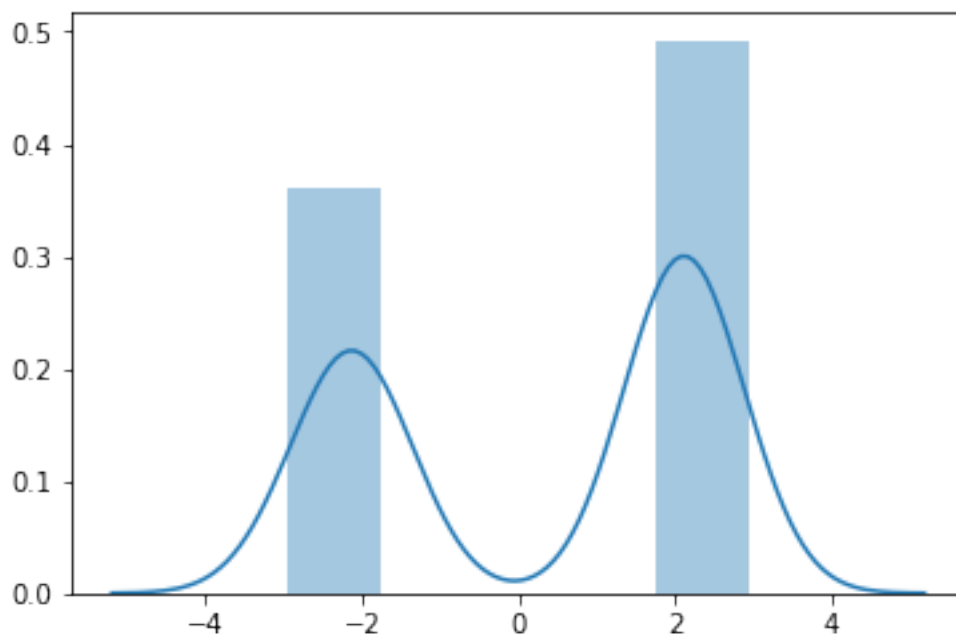
```
In [42]: gwr_mod = GWR(coords,y,x_std,bw,family=Binomial(),constant=False).fit()
```

```
In [43]: gwr_mod.aic
```

```
Out[43]: 330.2296364641693
```

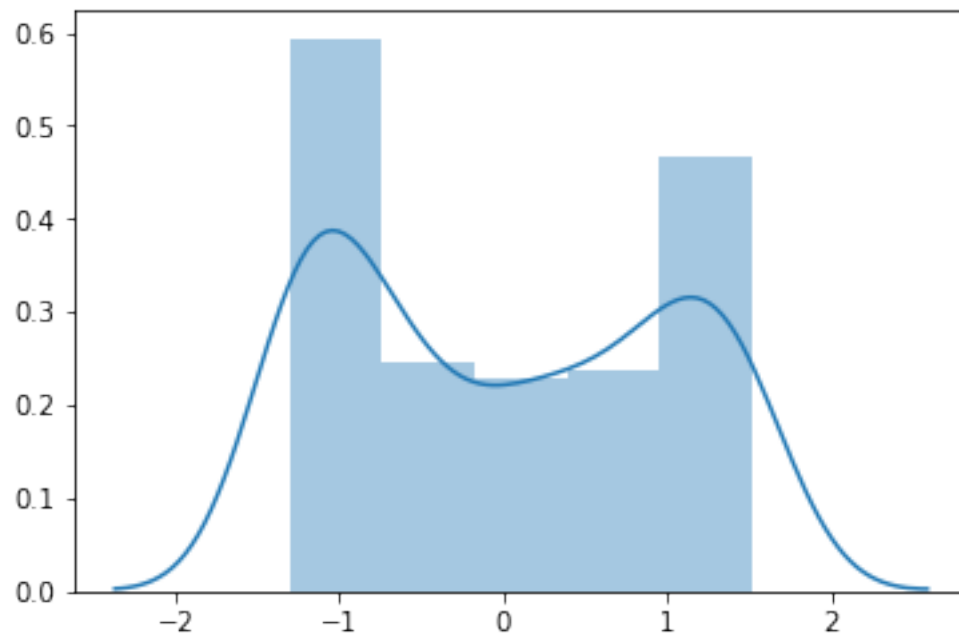
```
In [44]: sns.distplot(z)
```

```
Out[44]: <matplotlib.axes._subplots.AxesSubplot at 0x25b986059b0>
```



```
In [45]: sns.distplot(x_std)
```

```
Out[45]: <matplotlib.axes._subplots.AxesSubplot at 0x25b986cbac8>
```



```
In [47]: mgwr_model.aic
```

```
Out[47]: 1037.4901938225476
```

```
In [48]: optim_model.aic
```

```
Out[48]: 331.3125681122599
```