

# Bandwidth\_visualization

June 3, 2020

```
In [ ]: #@title Python imports
        # A bit of imports
        import numpy as np
        import pandas as pd
        import warnings
        warnings.filterwarnings('ignore')

        import numpy as np
        import pandas as pd
        import ipywidgets as widgets
        from ipywidgets import interact, interact_manual
        from matplotlib import pyplot as plt
        import seaborn as sns
        import warnings
        warnings.filterwarnings("ignore")
        from scipy import stats
        import geopandas as gpd
        from shapely.geometry import Point, Polygon
        %matplotlib inline
        sns.set(color_codes=True)
        from sklearn import linear_model
        from matplotlib.colors import LinearSegmentedColormap
        from matplotlib_scalebar.scalebar import ScaleBar
        import statsmodels.api as statm

        import libpysal as ps
        from mgwr.gwr import GWR
        from mgwr.gwr import MGWR
        from mgwr.sel_bw import Sel_BW
        from spglm.family import Gaussian, Binomial, Poisson
        import multiprocessing as mp
        pool = mp.Pool()
        import io

In [23]: df = pd.read_csv("example_dataset.csv")

In [24]: df.columns
```

```
Out[24]: Index(['the_geom', 'longitude', 'the_geom_webmercator', 'avg_tech', 'latitude',
               'houses', 'avg_unemp', 'cartodb_id', 'avg_index', 'avg_price',
               'avg_basement', 'avg_sqft', 'avg_water_dist', 'avg_age', 'ind'],
              dtype='object')
```

```
In [26]: df['ln_price']=np.log(df['avg_price'])
```

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In [29]: df['ln_price']
```

```
Out[29]: 0      12.611636
         1      12.312879
         2      12.563657
         3      12.715962
         4      12.619820
         ...
        354     12.936781
        355     12.733797
        356     12.839368
        357     13.007454
        358     13.426880
        Name: ln_price, Length: 359, dtype: float64
```

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In [40]: df=df.dropna()
```

```
In [42]: import statsmodels.api as statm
X=df[['avg_tech','avg_unemp','avg_index','avg_sqft','avg_basement','avg_water_dist','avg_age']]
X_std = (X-X.mean(axis=0))/X.std(axis=0)
X_std=statm.add_constant(X_std)
y=df['ln_price']
y_std = (y-y.mean(axis=0))/y.std(axis=0)
model = statm.OLS(y_std,X_std).fit()
predictions=model.predict(X_std)

model.summary()
```

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Out[42]: <class 'statsmodels.iolib.summary.Summary'>
```

```
"""
                                OLS Regression Results
=====
Dep. Variable:                  ln_price    R-squared:                0.898
Model:                            OLS      Adj. R-squared:           0.896
Method:                 Least Squares    F-statistic:                438.4
Date:                Wed, 20 May 2020    Prob (F-statistic):        1.15e-168
Time:                  12:47:31    Log-Likelihood:            -98.782
No. Observations:                  357    AIC:                       213.6
Df Residuals:                      349    BIC:                       244.6
Df Model:                            7
Covariance Type:                  nonrobust
=====
```

	coef	std err	t	P> t	[0.025	0.975]
-----	-----	-----	-----	-----	-----	-----
const	6.721e-15	0.017	3.93e-13	1.000	-0.034	0.034
avg_tech	0.2186	0.029	7.433	0.000	0.161	0.276
avg_unemp	-0.2990	0.028	-10.802	0.000	-0.353	-0.245
avg_index	-0.1231	0.030	-4.115	0.000	-0.182	-0.064
avg_sqft	0.5865	0.023	25.043	0.000	0.540	0.633
avg_basement	0.0984	0.023	4.212	0.000	0.052	0.144
avg_water_dist	-0.2106	0.034	-6.280	0.000	-0.277	-0.145
avg_age	0.1563	0.025	6.371	0.000	0.108	0.205
=====	=====	=====	=====	=====	=====	=====
Omnibus:		17.936	Durbin-Watson:		1.793	
Prob(Omnibus):		0.000	Jarque-Bera (JB):		44.569	
Skew:		0.139	Prob(JB):		2.10e-10	
Kurtosis:		4.708	Cond. No.		4.47	
=====	=====	=====	=====	=====	=====	=====

Warnings:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.  
 """

```
In [43]: import libpysal as ps
         from mgwr.gwr import GWR
         from mgwr.gwr import MGWR
         from mgwr.sel_bw import Sel_BW
         from spglm.family import Gaussian, Binomial, Poisson
         import multiprocessing as mp
         pool = mp.Pool()

In [44]: df.columns

Out[44]: Index(['the_geom', 'longitude', 'the_geom_webmercator', 'avg_tech', 'latitude',
               'houses', 'avg_unemp', 'cartodb_id', 'avg_index', 'avg_price',
               'avg_basement', 'avg_sqft', 'avg_water_dist', 'avg_age', 'ind',
               'ln_price'],
              dtype='object')

In [45]: coords = np.array(list(zip(df['longitude'],df['latitude'])))
         y = np.array(df['ln_price']).reshape((-1,1))
         y_std = (y-y.mean(axis=0))/y.std(axis=0)
         X=df[['avg_tech','avg_unemp','avg_index','avg_sqft','avg_basement','avg_water_dist','avg_age']]
         X_std=(X-X.mean(axis=0))/X.std(axis=0)
         selector_gwr = Sel_BW(coords, y_std, X_std)

In [48]: selector_mgwr = Sel_BW(coords, y_std, X_std, multi=True)

In [49]: selector_mgwr.search(pool=pool)

Out[49]: array([ 43., 164., 226., 191.,  45.,  81.,  45., 354.])
```

```
In [50]: %%time
        model_mgwr = MGWR(coords,y_std,X_std,selector_mgwr,fixed=False,kernel='bisquare',sigma=0.001)
        results_mgwr=model_mgwr.fit()
```

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

Wall time: 7.64 s

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In [51]: results_mgwr.R2
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Out[51]: 0.9775393617728864
```

```
In [147]: df2 = pd.read_csv("MGWR_session_results.csv")
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In [148]: df2['w_43']=results_mgwr.W[0][171]
          df2['w_164']=results_mgwr.W[1][171]
          df2['w_226']=results_mgwr.W[2][171]
          df2['w_81']=results_mgwr.W[5][171]
          df2['w_354']=results_mgwr.W[7][171]
```

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In [149]: df2.to_csv("MGWR_session_results.csv")
```