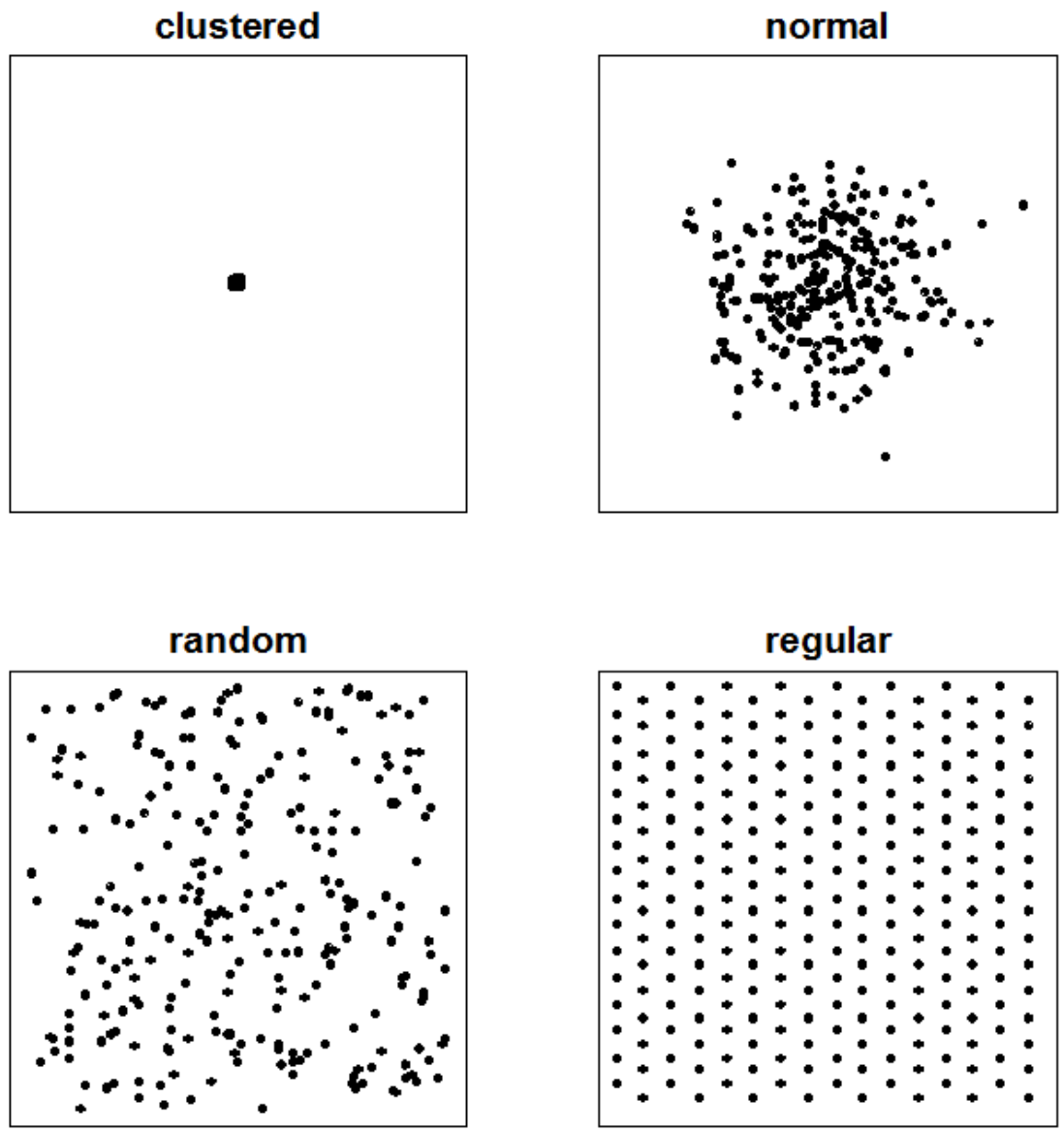
Principles of Spatial Analysis

SHORT LECTURE 01, WEEK 06: POINT PATTERN ANALYSIS

UCL

point pattern analysis

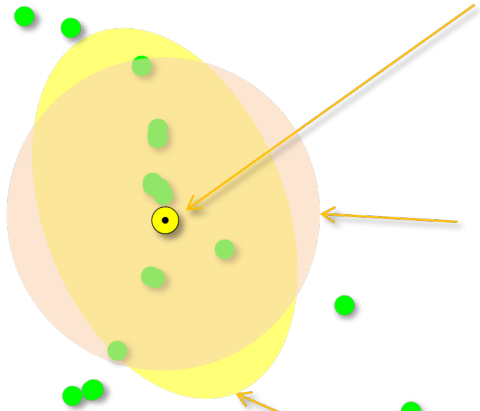
what is it all about


clustered
normal
random
regular

3 ways

of thinking about patterns in your points

descriptive statistics



Mean center is the computed average X and Y coordinate values.

$$\bar{s} = \left(\frac{\sum_{i=1}^{n} x_i}{n}, \frac{\sum_{i=1}^{n} y_i}{n} \right)$$

Standard distance is a measure of the variance between the average distance of the features to the mean center.

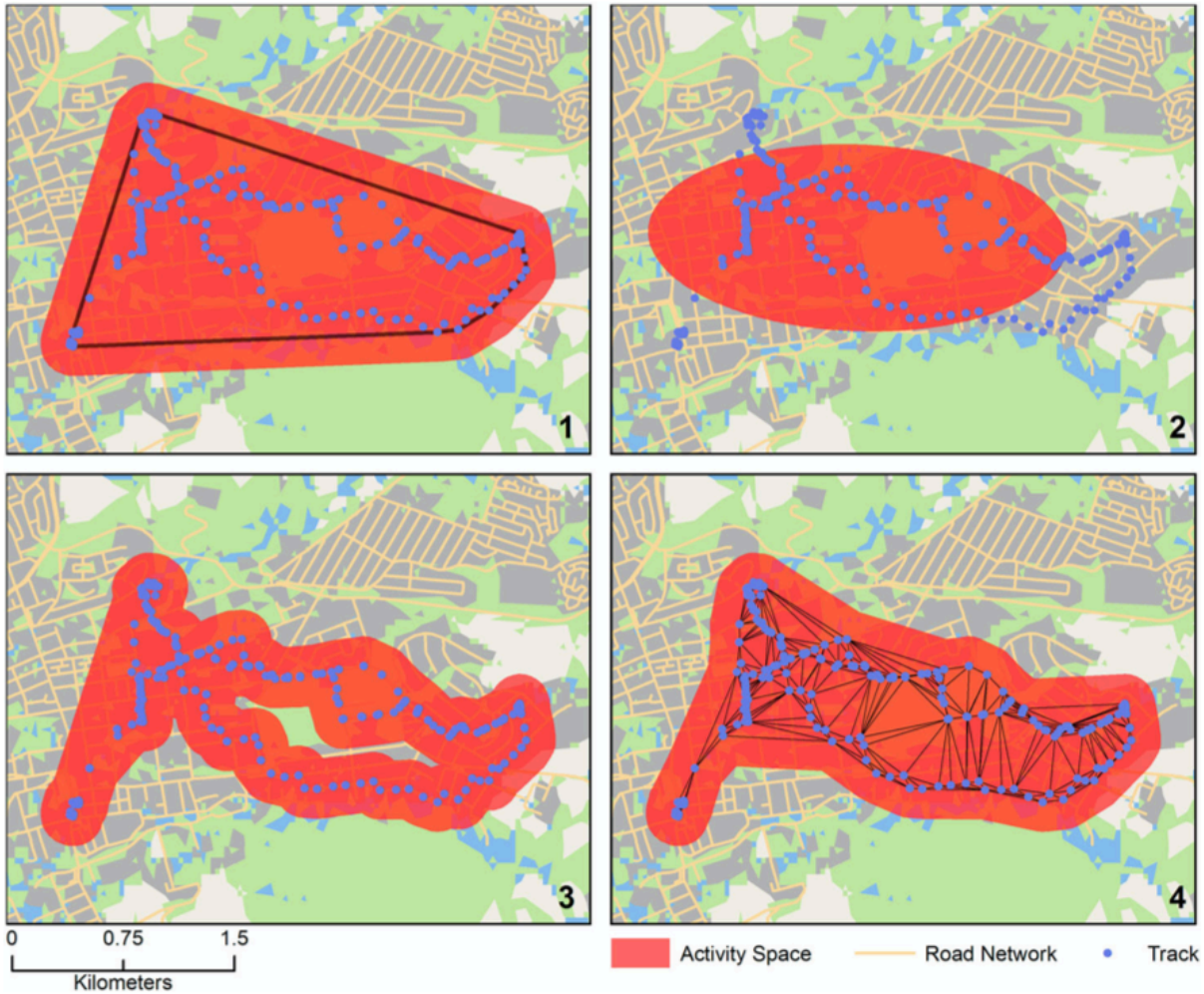
$$d = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \mu_x)^2 + (y_i - \mu_y)^2}{n}}$$

Standard deviational ellipse computes separate standard distances for each axis.

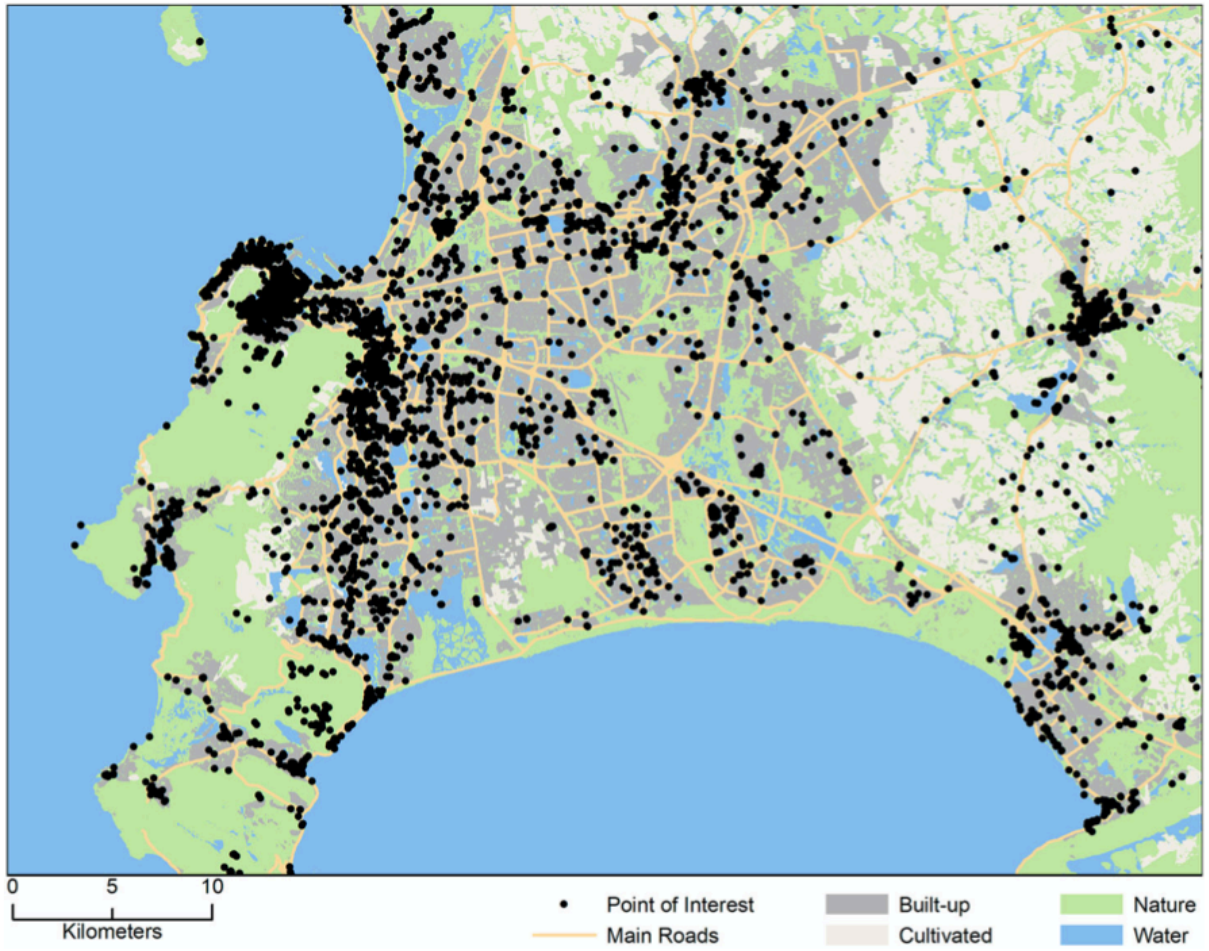
$$d_x = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \mu_x)^2}{n}}$$

$$d_y = \sqrt{\frac{\sum_{i=1}^{n} (y_i - \mu_y)^2}{n}}$$

Gimond, M. 2020. *Geodesic geometry*. [online] https://mgimond.github.io/Spatial/index.html



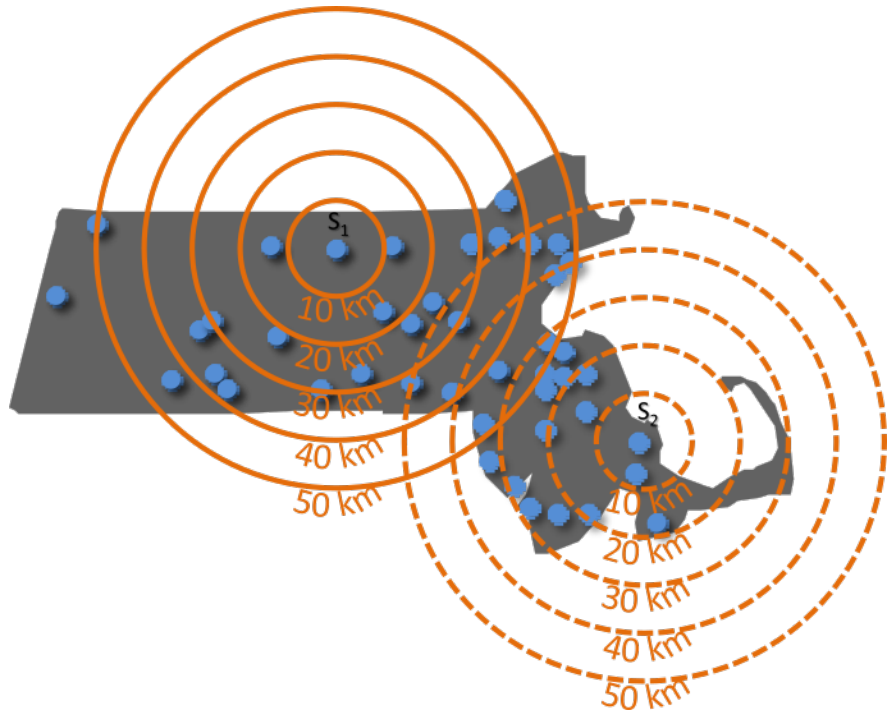
Van Dijk, J. T. & S. Krygsman. 2017. Analyzing Travel Behavior by Using GPS-Based Activity Spaces and Opportunity Indicators. *Journal of Urban Technology* 25(2): 102-124



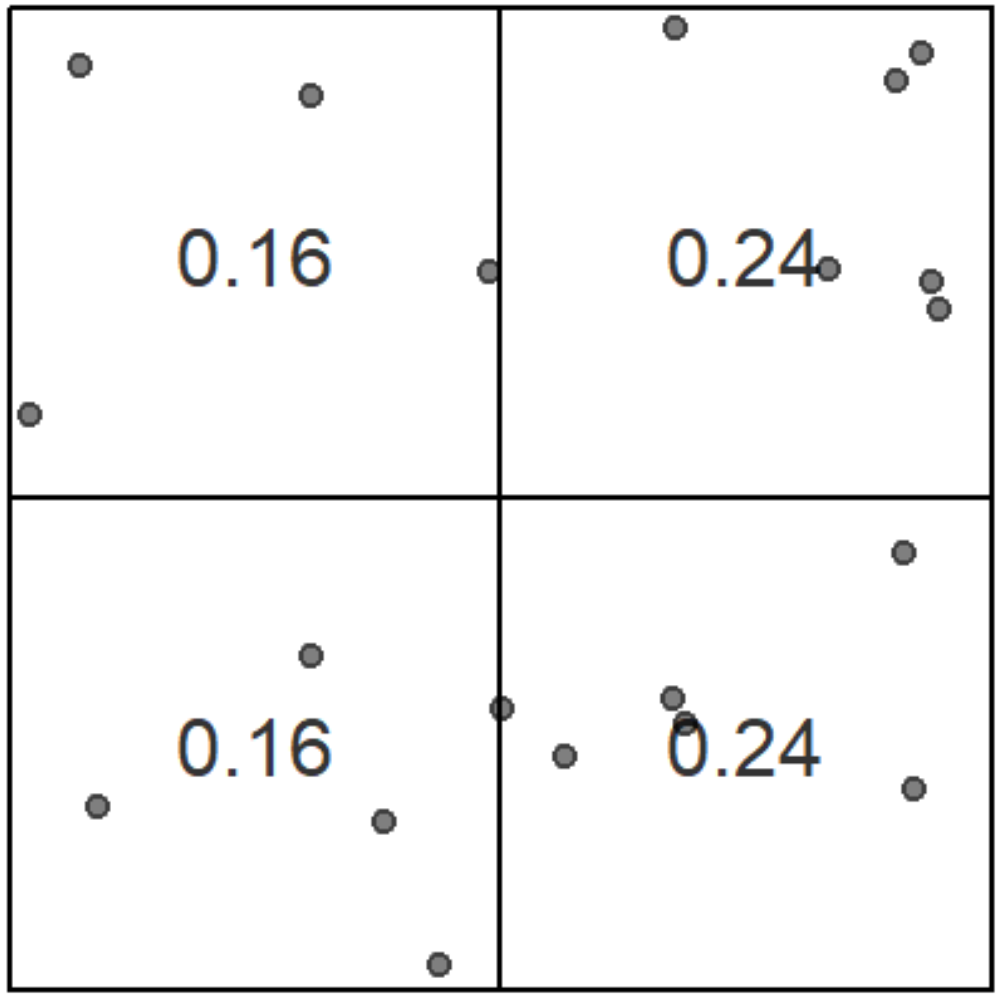
Van Dijk, J. T. & S. Krygsman. 2017. Analyzing Travel Behavior by Using GPS-Based Activity Spaces and Opportunity Indicators. *Journal of Urban Technology* 25(2): 102-124

distance based methods

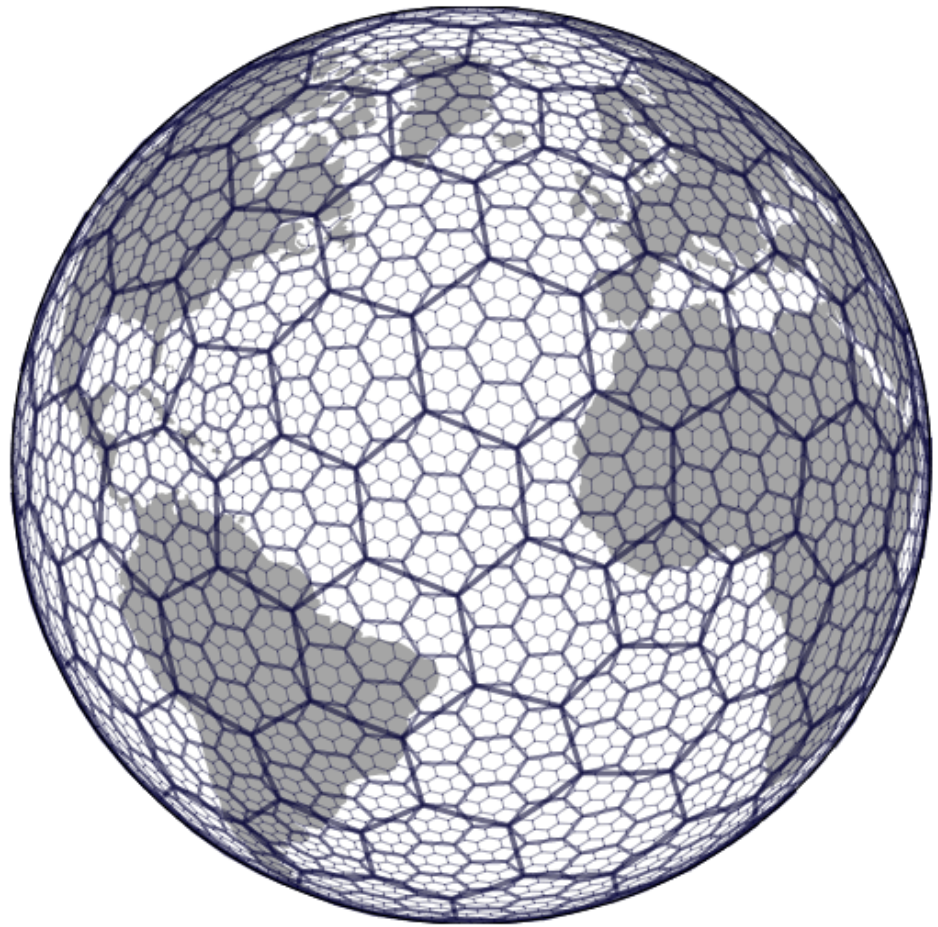
average nearest neighbour


S1
10 km
20 km
30 km
40 km
50 km
S2
10 km
20 km
30 km
40 km
50 km

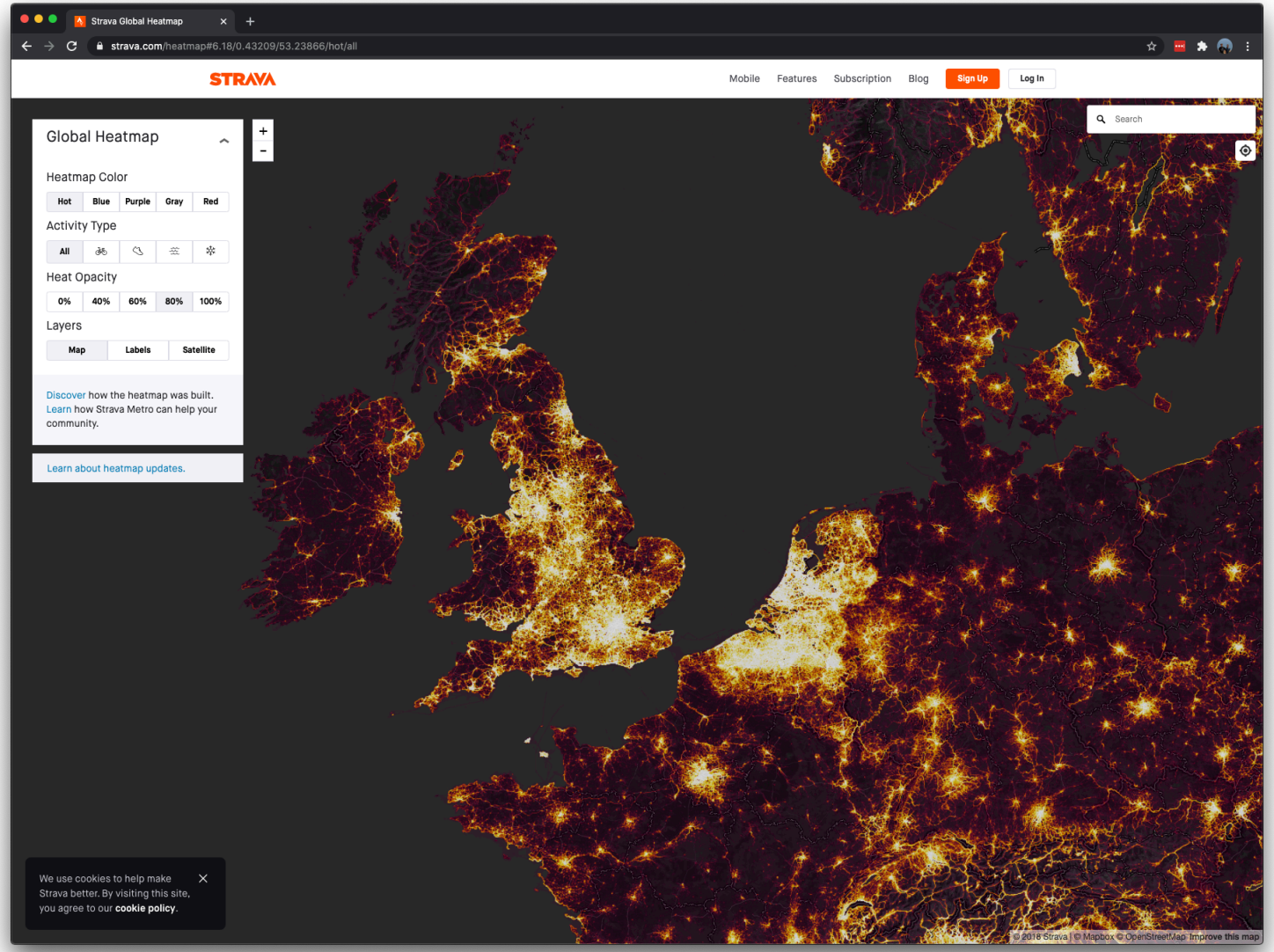
density based methods



Gimond, M. 2020. *Geodesic geometry*. [online] https://mgimond.github.io/Spatial/index.html



Uber. 2018. *H3: Uber's Hexagonal Hierarchical Spatial Index*. [online] https://eng.uber.com/h3/


Strava Global Heatmap
strava.com/heatmap#6.18/0.43209/53.23866/hot/all
STRAVA
Mobile
Features
Subscription
Blog
Sign Up
Log In
Global Heatmap
Heatmap Color
Hot
Blue
Purple
Gray
Red
Activity Type
All
Heat Opacity
0%
40%
60%
80%
100%
Layers
Map
Labels
Satellite
Discover how the heatmap was built.
Learn how Strava Metro can help your community.
Learn about heatmap updates.
Search
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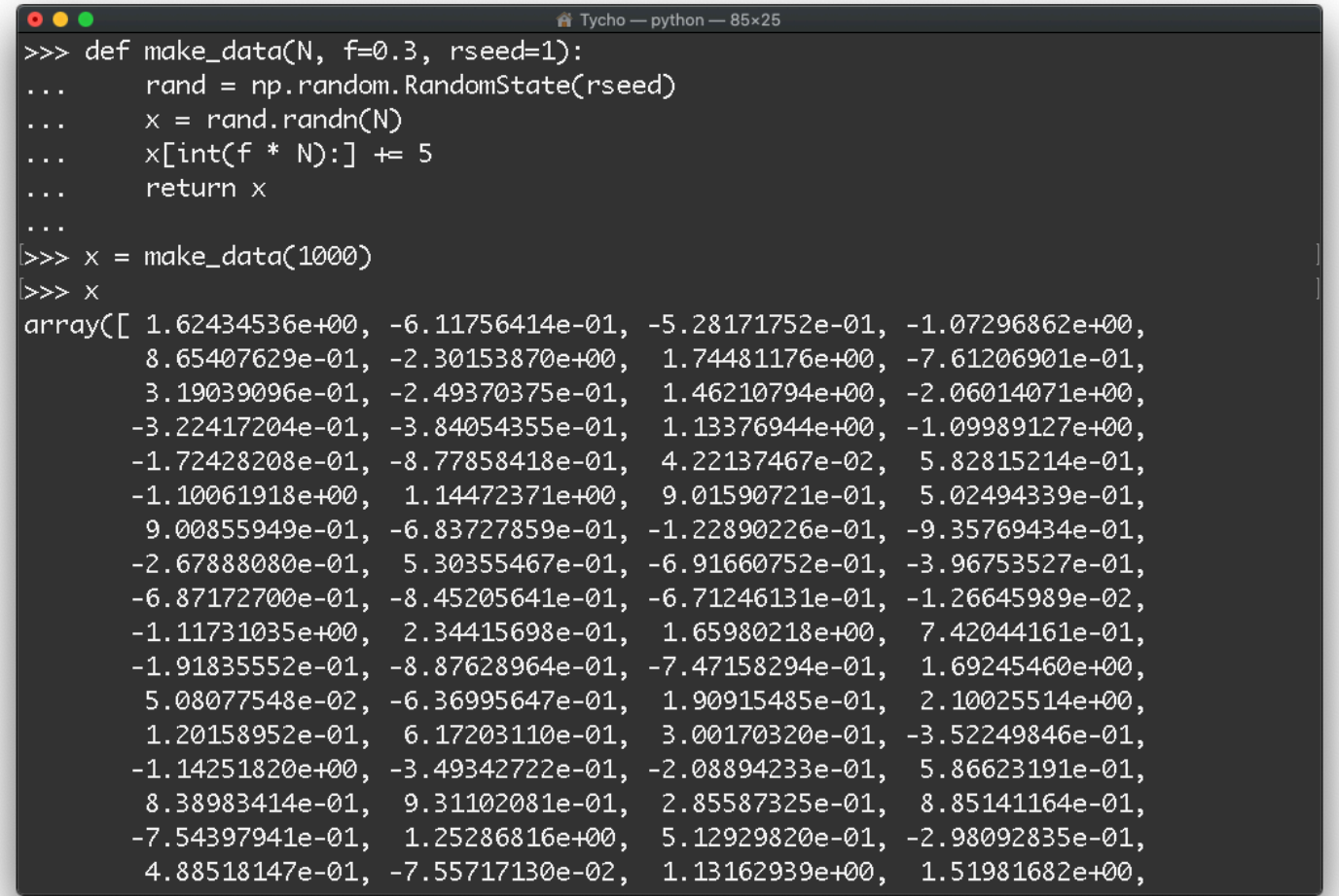
Tycho — python — 85×25
>>> def make_data(N, f=0.3, rseed=1):
...   rand = np.random.RandomState(rseed)
...   x = rand.randn(N)
...   x[int(f * N):] += 5
...   return x
...
>>> x = make_data(1000)
>>> x
array([1.62434536e+00, -6.11756414e-01, -5.28171752e-01, -1.07296862e+00,
        8.65407629e-01, -2.30153870e+00, 1.74481176e+00, -7.61206901e-01,
        3.19039096e-01, -2.49370375e-01, 1.46210794e+00, -2.06014071e+00,
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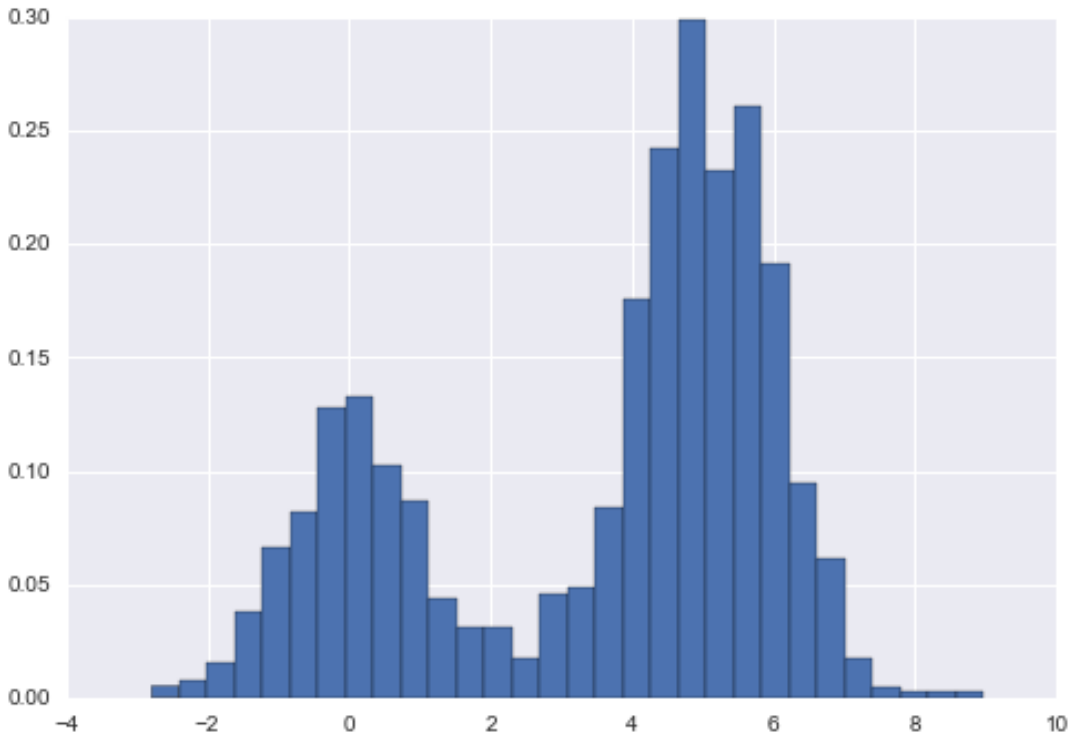
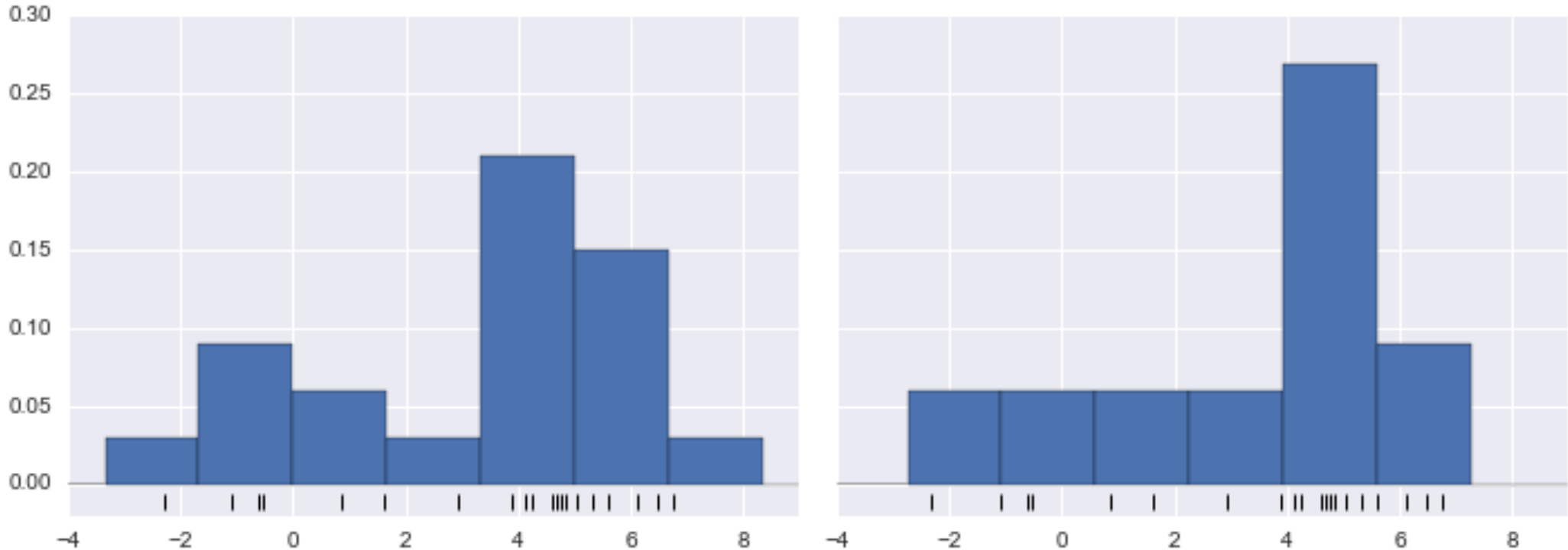


VanderPlas, J. 2016. *Python data science handbook: essential tools for working with data*. O'Reilly Media, Inc.



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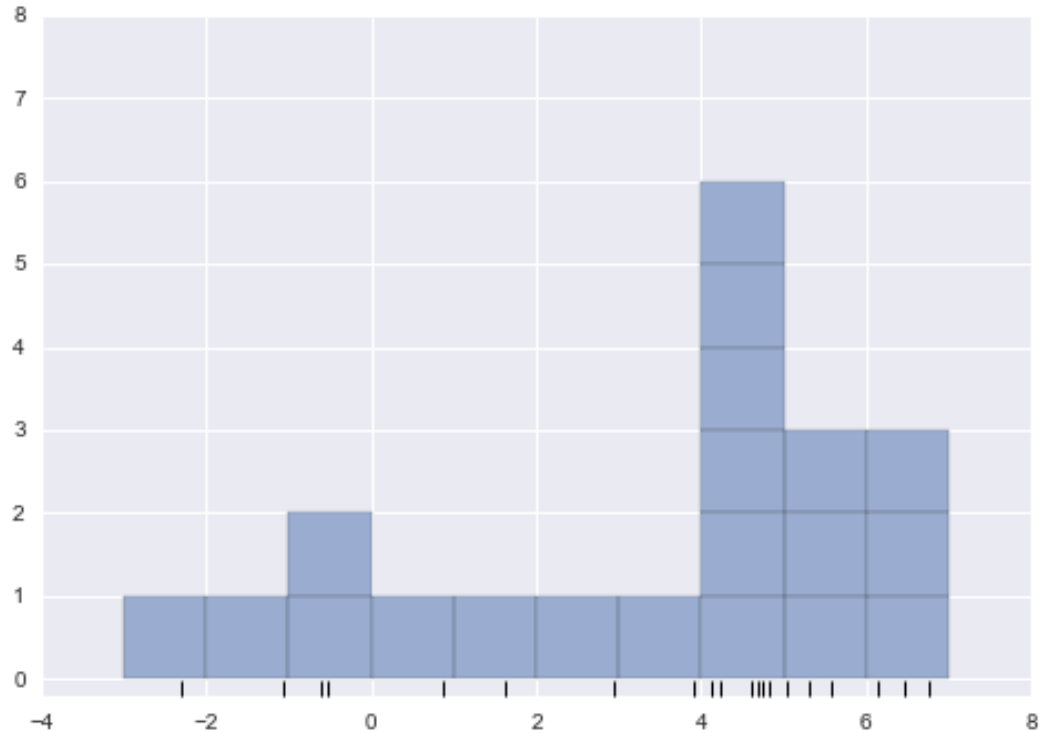

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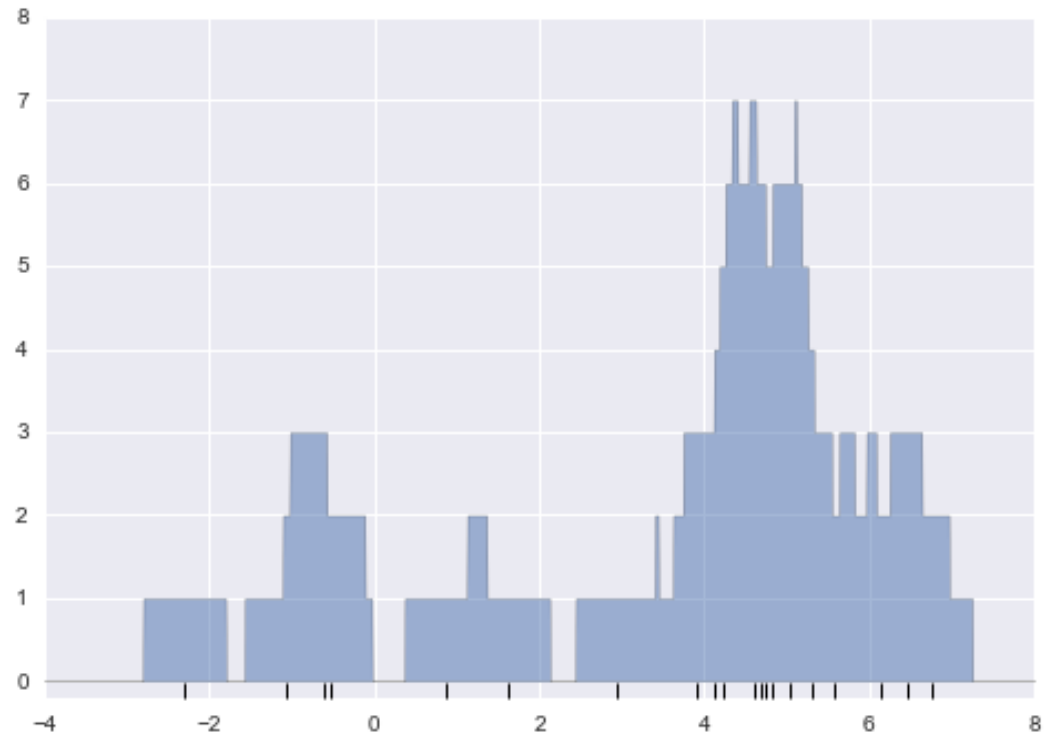

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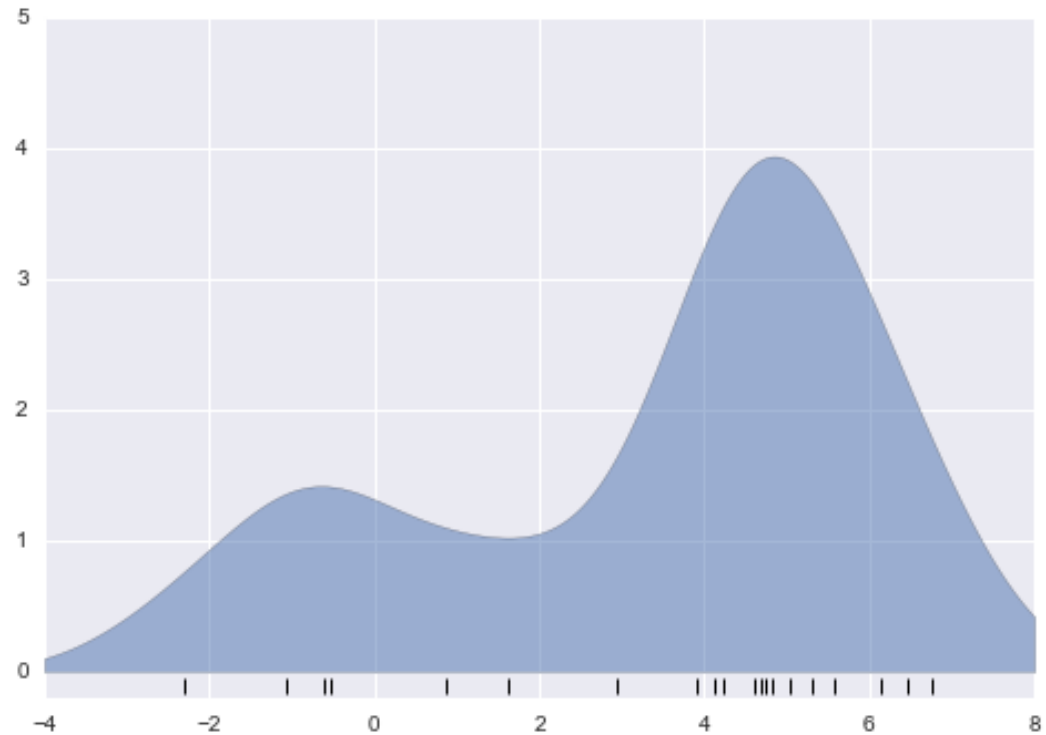
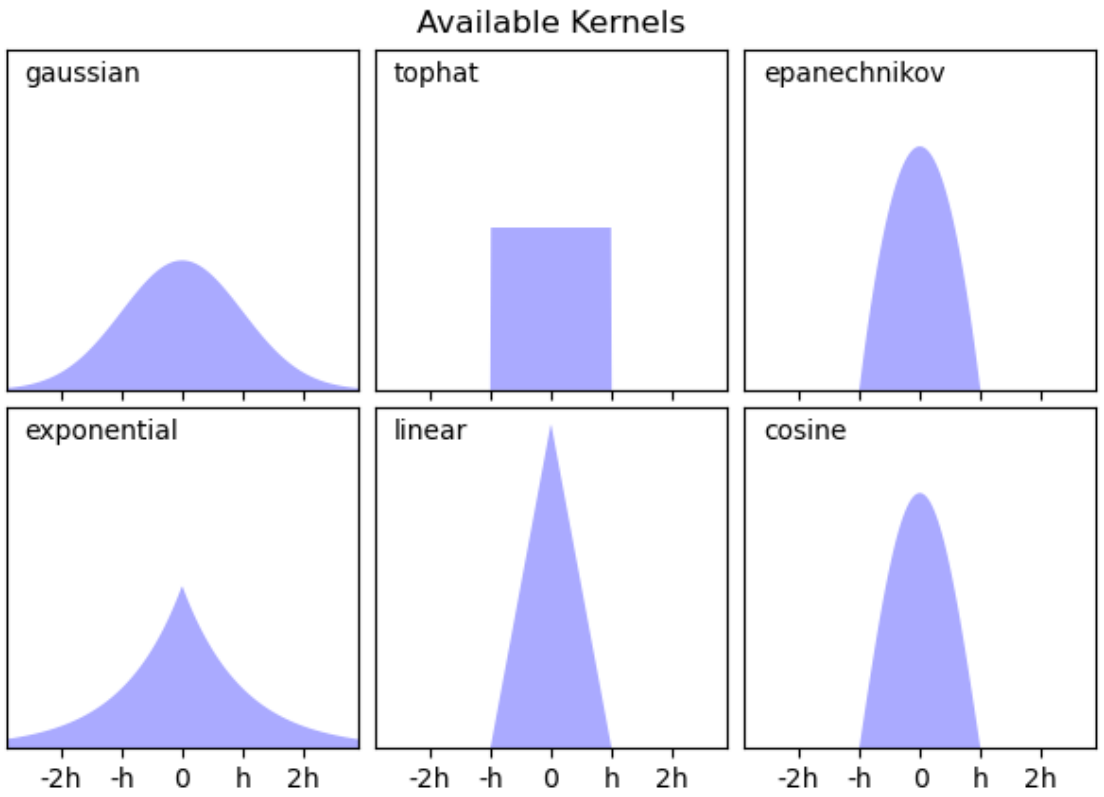


VanderPlas, J. 2016. *Python data science handbook: essential tools for working with data*. O'Reilly Media, Inc.



Scikit-learn. 2020. *Density estimation.* [online] https://scikit-learn.org/stable/modules/density.html

Shi, X. 2010. Selection of bandwidth type and adjustment side in kernel density estimation over inhomogeneous backgrounds. *International Journal of Geographical Information Science* 24(5): 643-660

$$\hat{f}(x,y) = \frac{1}{nh^2} \sum_{i=1}^{n} K\left(\frac{d_{i,(x,y)}}{h}\right)$$

Shi, X. 2010. Selection of bandwidth type and adjustment side in kernel density estimation over inhomogeneous backgrounds. *International Journal of Geographical Information Science* 24(5): 643-660

$$\hat{f}(x,y) = \frac{1}{nh^2} \sum_{i=1}^{n} K\left(\frac{d_{i,(x,y)}}{h}\right)$$

Intensity at point (x,y)

Shi, X. 2010. Selection of bandwidth type and adjustment side in kernel density estimation over inhomogeneous backgrounds. *International Journal of Geographical Information Science* 24(5): 643-660

$$\hat{f}(x,y) = \boxed{\frac{1}{nh^2}} \sum_{i=1}^{n} K\left(\frac{d_{i,(x,y)}}{h}\right)$$

Points within bandwidth

Shi, X. 2010. Selection of bandwidth type and adjustment side in kernel density estimation over inhomogeneous backgrounds. *International Journal of Geographical Information Science* 24(5): 643-660

$$\hat{f}(x,y) = \frac{1}{nh^2} \sum_{i=1}^{n} K\left(\frac{d_{i,(x,y)}}{h}\right)$$

Kernel function

let’s put it into practice