The Robustness of Mapper as a Topological Data Analytic Tool
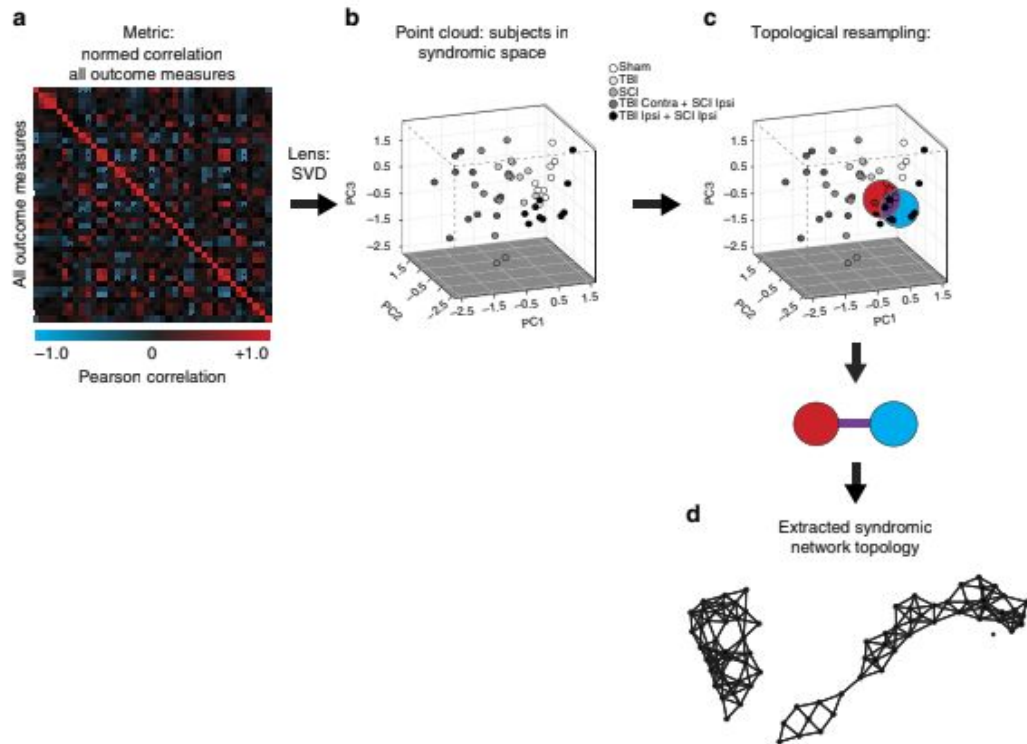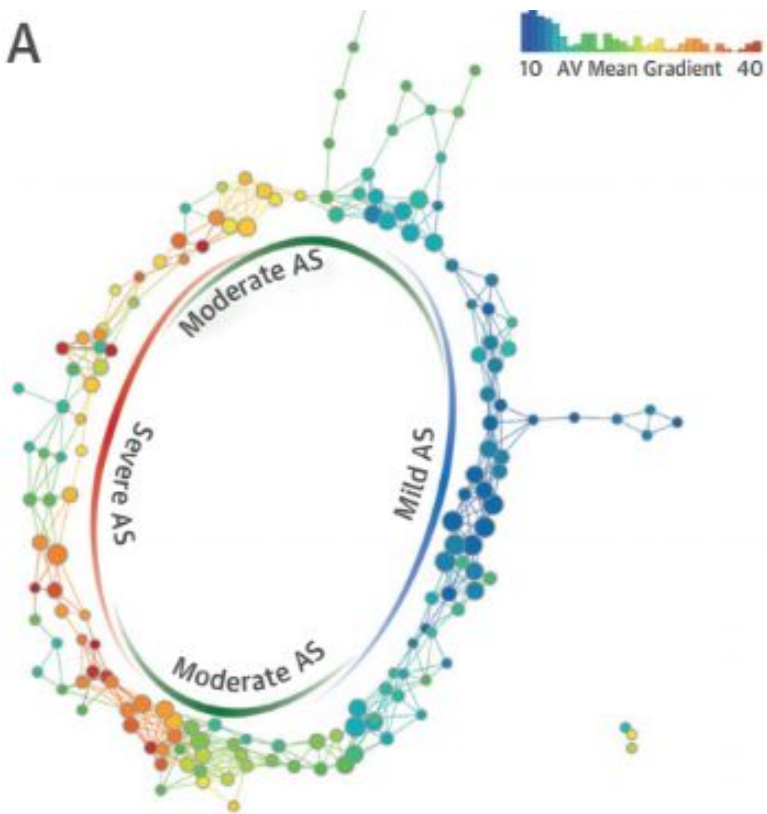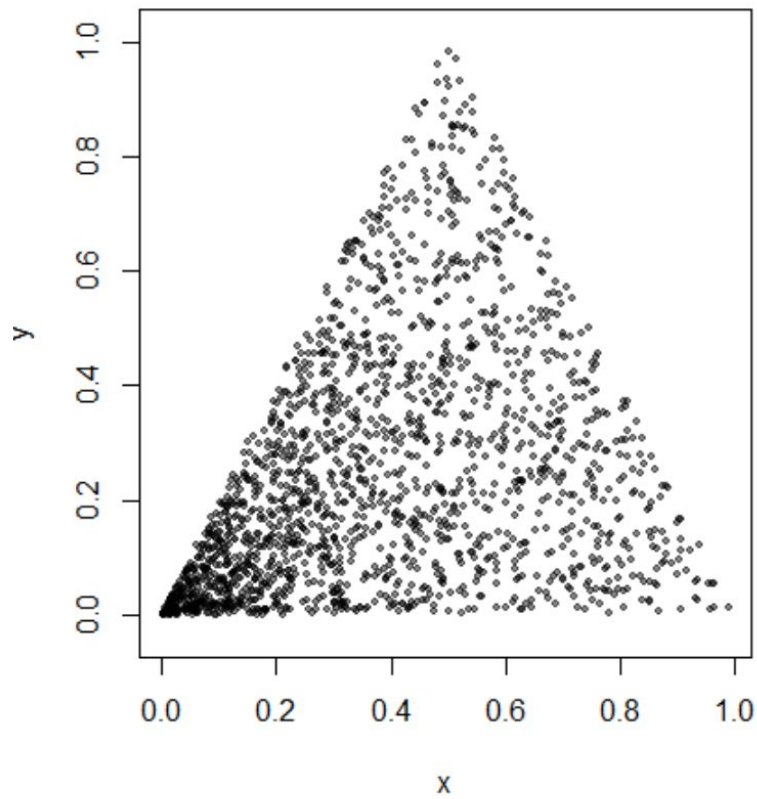
Big Picture
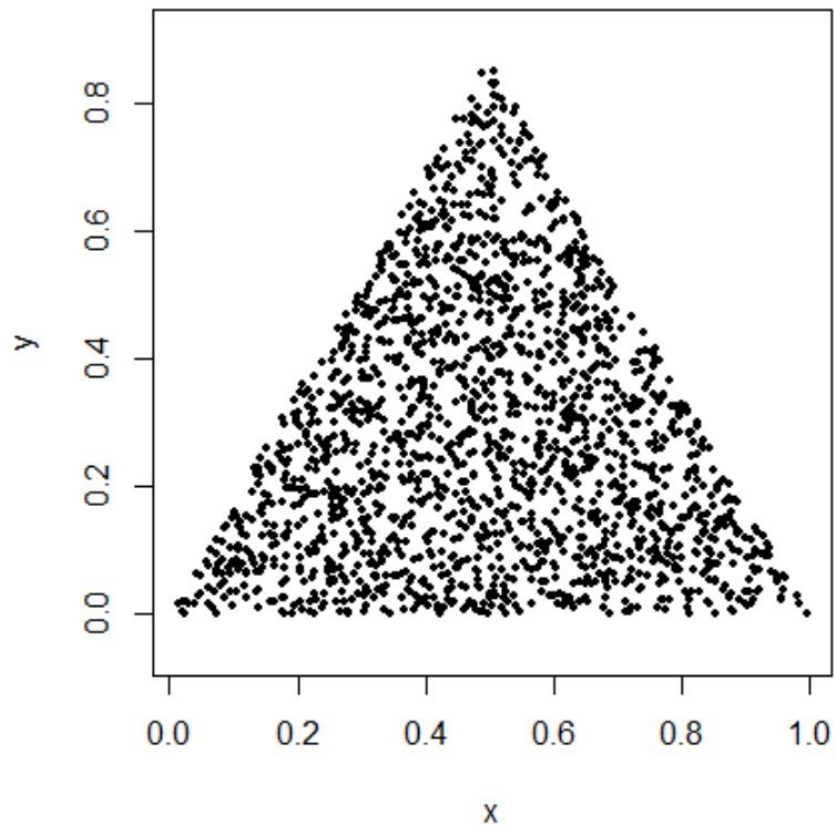

a Metric: normed correlation all outcome measures

All outcome measures

−1.0   0   +1.0

Pearson correlation

Lens: SVD

b Point cloud: subjects in syndromic space

○ Sham
○ TBI
◐ SCI
◑ TBI Contra + SCI Ipsi
● TBI Ipsi + SCI Ipsi

PC3
PC2
PC1

c Topological resampling:

PC3
PC2
PC1

d Extracted syndromic network topology

A

10 AV Mean Gradient 40

Moderate AS

Severe AS

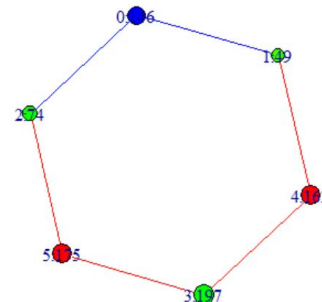Mild AS

Moderate AS

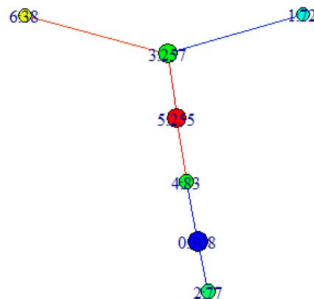**Before**   **After**
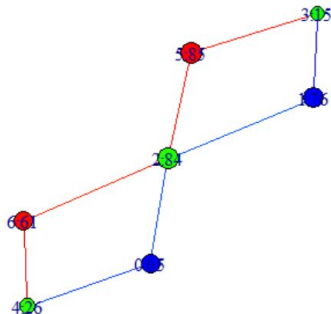
Understanding the Mapper
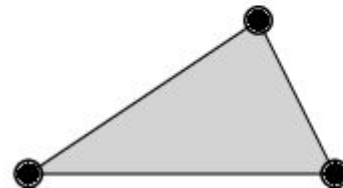
Point: 0-Simplex

Line Segments: 1-Simplex

Faces: 2-Simplex

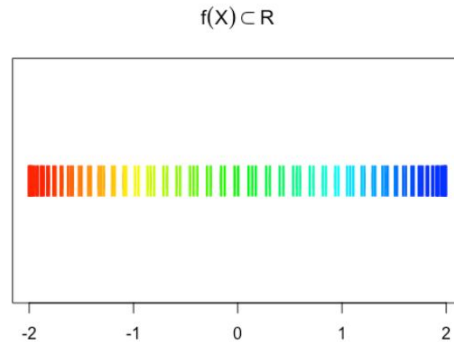# Mapper Construction

Applying a Filter:

Figure Eight Parametrization:

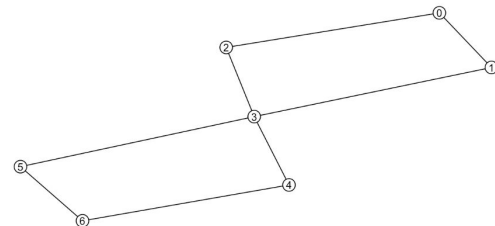$X \subset R^2$

$f(X) \subset R$

Create a Cover:

```
Fixed Interval Cover:

    (number intervals = [5],

    percent overlap = [20]%)
```
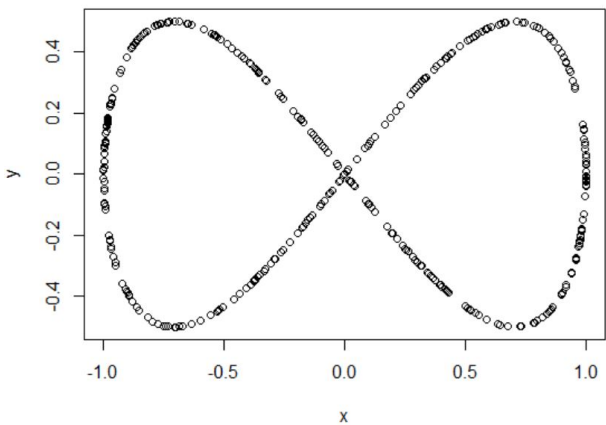
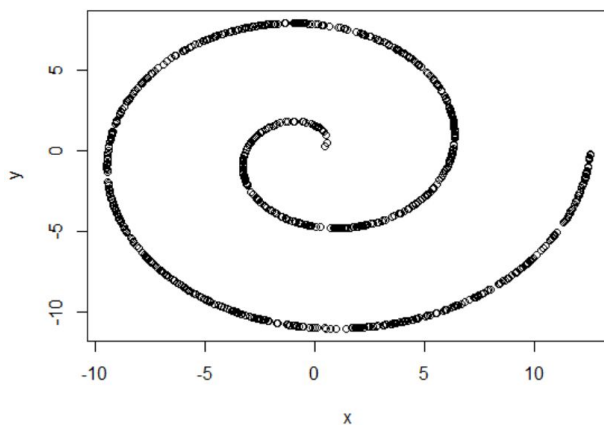Perform Single Linkage Clustering and Plot the Simplicial Complex:
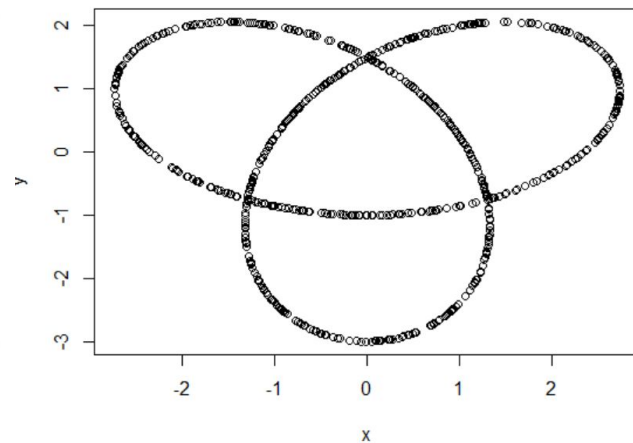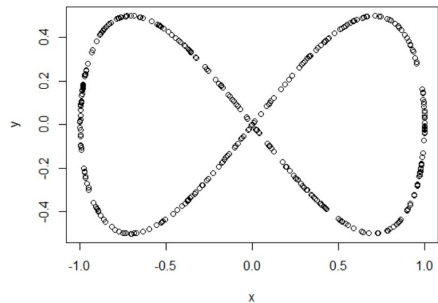
Explorative Case Study
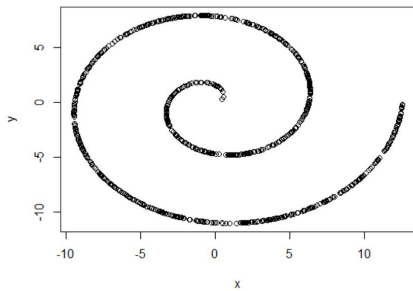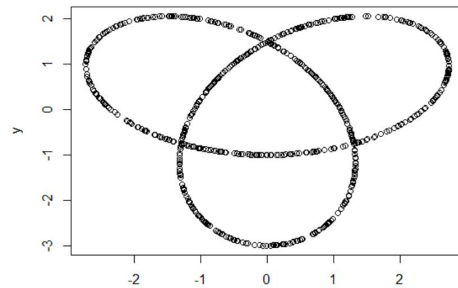

Figure Eight
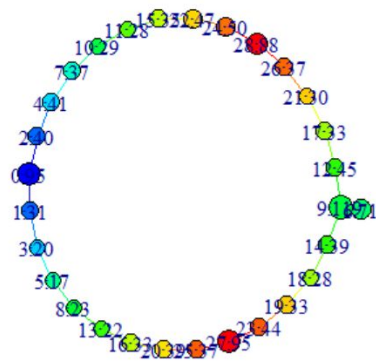
Spiral

Trefoil Knot

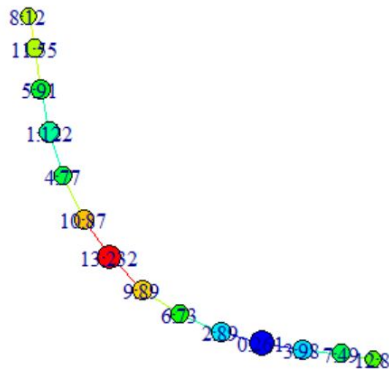# Results

Figure Eight

Spiral

Trefoil Knot

Mapper
Constructions:

Euler Characteristic and Automated Summary Statistics

$$\chi = V - E + F$$

Figure Eight

Vertices: 13
Edges: 14
Chi: -1

```
# A tibble: 406 x 3
   interval percent    chi
      <int>   <dbl>  <dbl>
 1        3      20     -2
 2        3      30     -1
 3        3      40     -1
 4        3      50      0
 5        3      60     -1
 6        3      70     -2
 7        3      80     -1
 8        4      20     -1
 9        4      30      0
10        4      40      0
# ... with 396 more rows
```

Citations

1. Matt Piekenbrock, Mapper, (2019), GitHub repository, https://github.com/peekxc/Mapper
2. Nielson, J. L., Cooper, S. R., Yue, J. K., Sorani, M. D., Inoue, T., Yuh, E. L., . . . Ferguson, A. R. (2017). Uncovering precision phenotype-biomarker associations in traumatic brain injury using topological data analysis. Plos One, 12(3). doi:10.1371/journal.pone.0169490
3. Casaclang-Verzosa, G., Shrestha, S., Khalil, M. J., Cho, J. S., Tokodi, M., Balla, S., . . . Sengupta, P. P. (2019). Network Tomography for Understanding Phenotypic Presentations in Aortic Stenosis. JACC: Cardiovascular Imaging, 12(2), 236-248. doi:10.1016/j.jcmg.2018.11.025