



Park Trails In Seattle

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Motivation -- Trails data

- Good outdoor activity resource
- Better access to people, mostly free
- Different types for people to choose, built in different environment -- user cares
- Different reaction to short/long term usage and the general natural environment -- planner cares
- Pay attention to trail conditions

2,624 trail segments from 71 city parks

Source: City of Seattle (Seattle.gov)

<https://data.seattle.gov/Parks-and-Recreation/Seattle-Parks-and-Recreation-GIS-Map-Layer-Shapefi/6jqd-qkut/data>

Grade type: flat, gradual,
moderate, steep

Surface type: soil, gravel, asphalt,
...

Width: 1-30 ft; shape length

Canopy: open, closed, low, high

Condition: worn/eroded, poor,
overgrown, good

'GRADE_PERC', unknown variable

Questions:

- Are there any relationships among the trail data attributes for different city parks in Seattle? Relationship with trail condition?
- GRADE_PERC and GRADE_TYPE
- Any parks share common trail features? Are they close to each other? What are their features?
- Any valuable information can be conveyed to trail users and city planners?

Analysis Plan - Exploratory Analysis

1. Principal Component Analysis

- Challenge: categorical variables to ordinal variables

1. Trail attribute representatives and visualization (for parks)

- Visualize patterns for each variable values on map
- Cluster the parks
- Use interesting variables to do a conditional thematic mapping (map matrix, three variables)

Data Preparation

- Grade type: flat--1, gradual--2, moderate--3, steep--4
- Canopy: open--1, low--2, high--3, closed--4,
- Condition: Worn and erode--1, poor--2, overgrown--3, good--4

Note

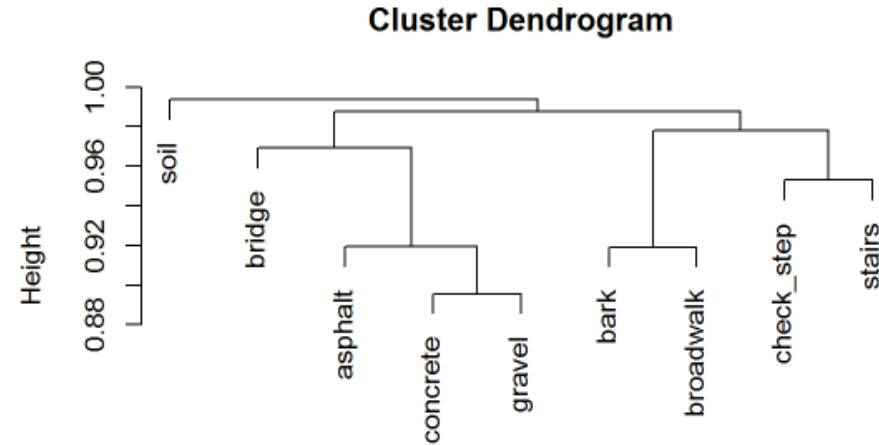
- Surface Type: "Asphalt", "Bark", "Boardwalk", "Bridge",
"Check Steps", "Concrete", "Grass", "Gravel", "Soil", "Stairs"
- Some with low cost, some more durable, some look natural

Surface Type Classification - Vector Space Model

- Search for 9 different trail surface type descriptions (exclude 'grass')
- Did not summarize the frequency counts for terms appear in surface type names, such as concrete, step, bark, bridge.

Lots of description seem to compare different surface types, might be misleading. More interested in the surface type properties to assign order.

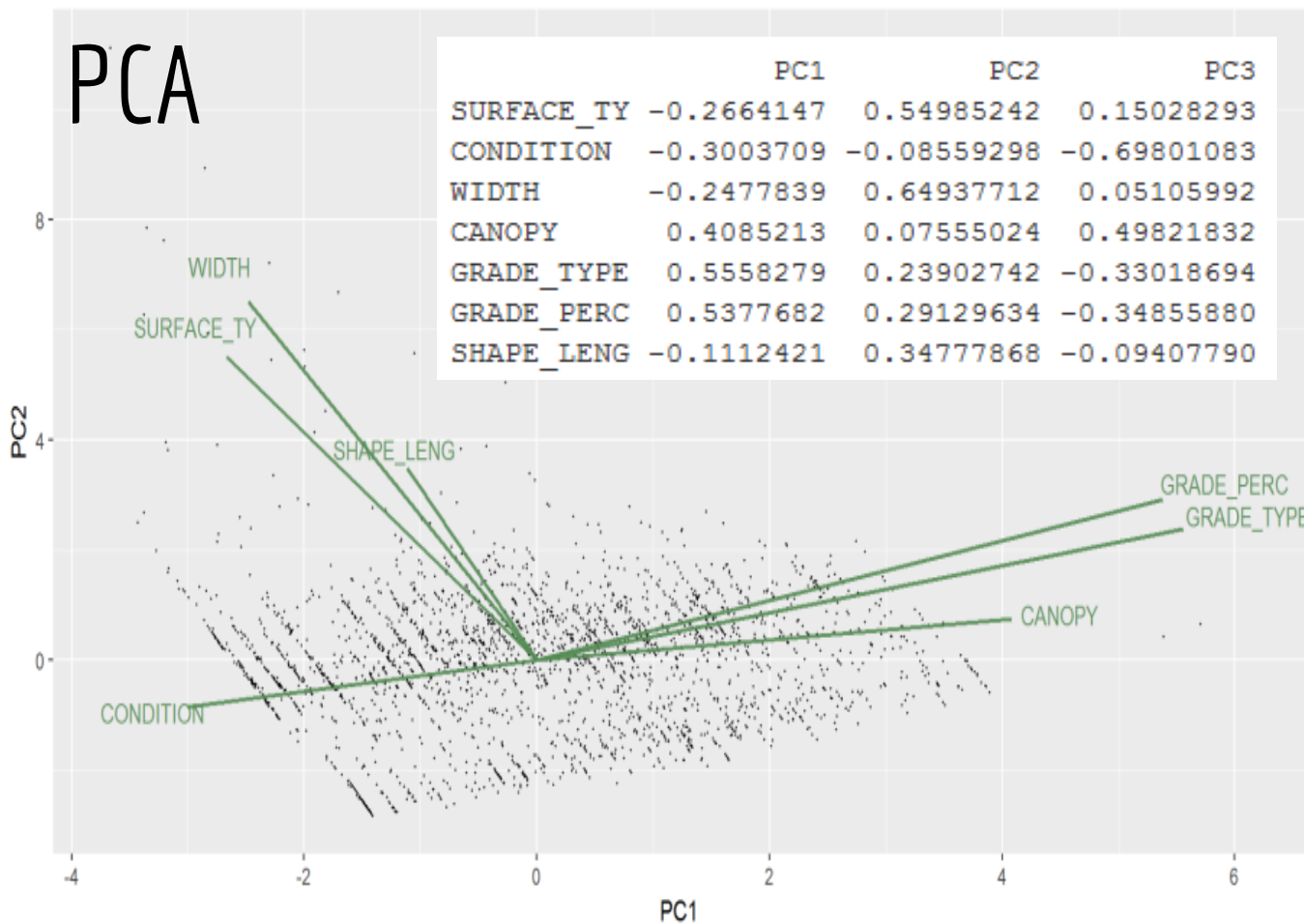
- Cluster1: Soil, grass (natural earth, soft, cheaper, level of human impact: low)
- Cluster2: bark, broadwalk, check step, stairs (neutral, relatively soft, smaller constructions, level of human impact: medium)
- Cluster3: bridge, asphalt, concrete, gravel (hard materials, larger constructions, least natural earth to look at, level of human impact: high)



Ordered surface type:

Cluster1: 1
Cluster2: 2
Cluster3: 3

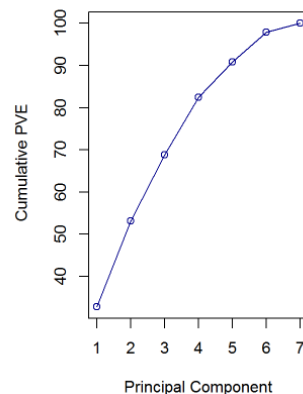
PCA



PC1: GRADE_TYPE and GRADE_PERC (topographic feature of the trail)

PC2: SURFACE TYPE, WIDTH and SHAPE_LENGTH (initial trail setup)

PC3: CONDITION and CANOPY (trail usage and maintenance)

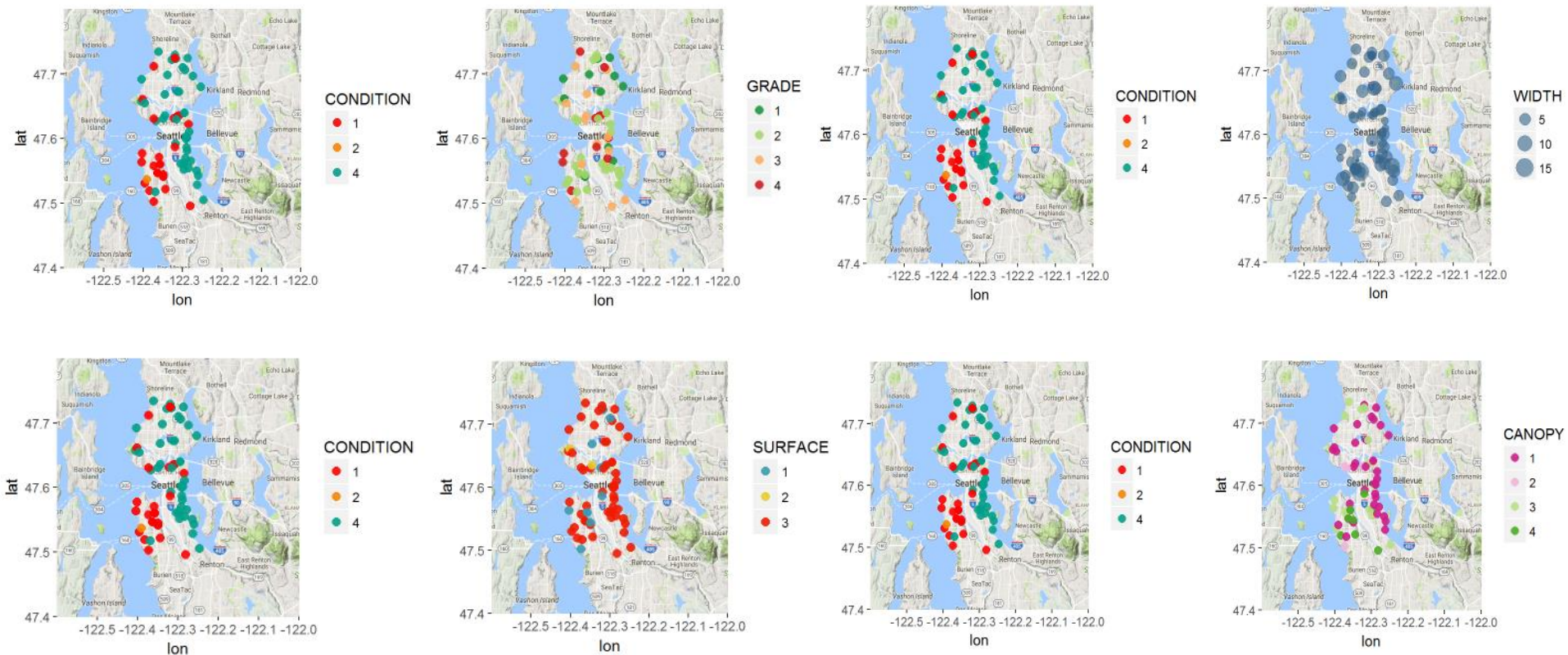


Representative Trail Features for Parks

- For each park choose one grade type, one surface type, one condition ...

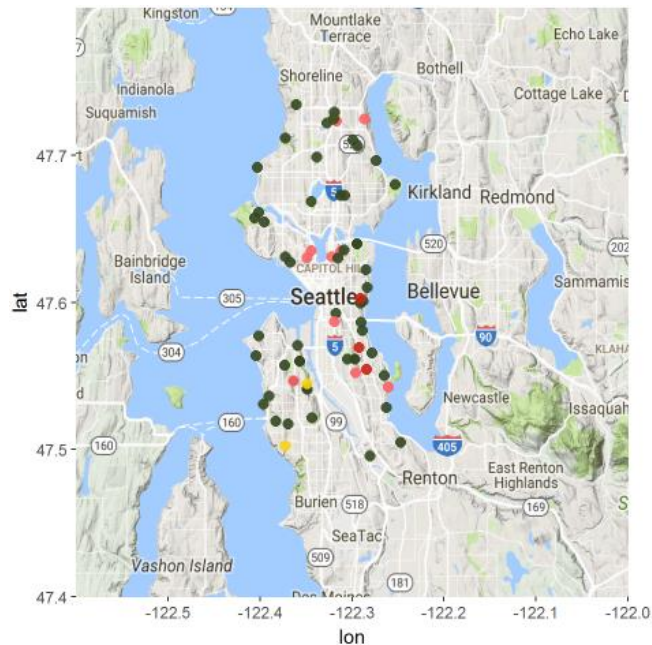
Based on the longest trail in that park.

- For each attribute variable, create a ggmp.
- Compare CONDITION with the rest of variables

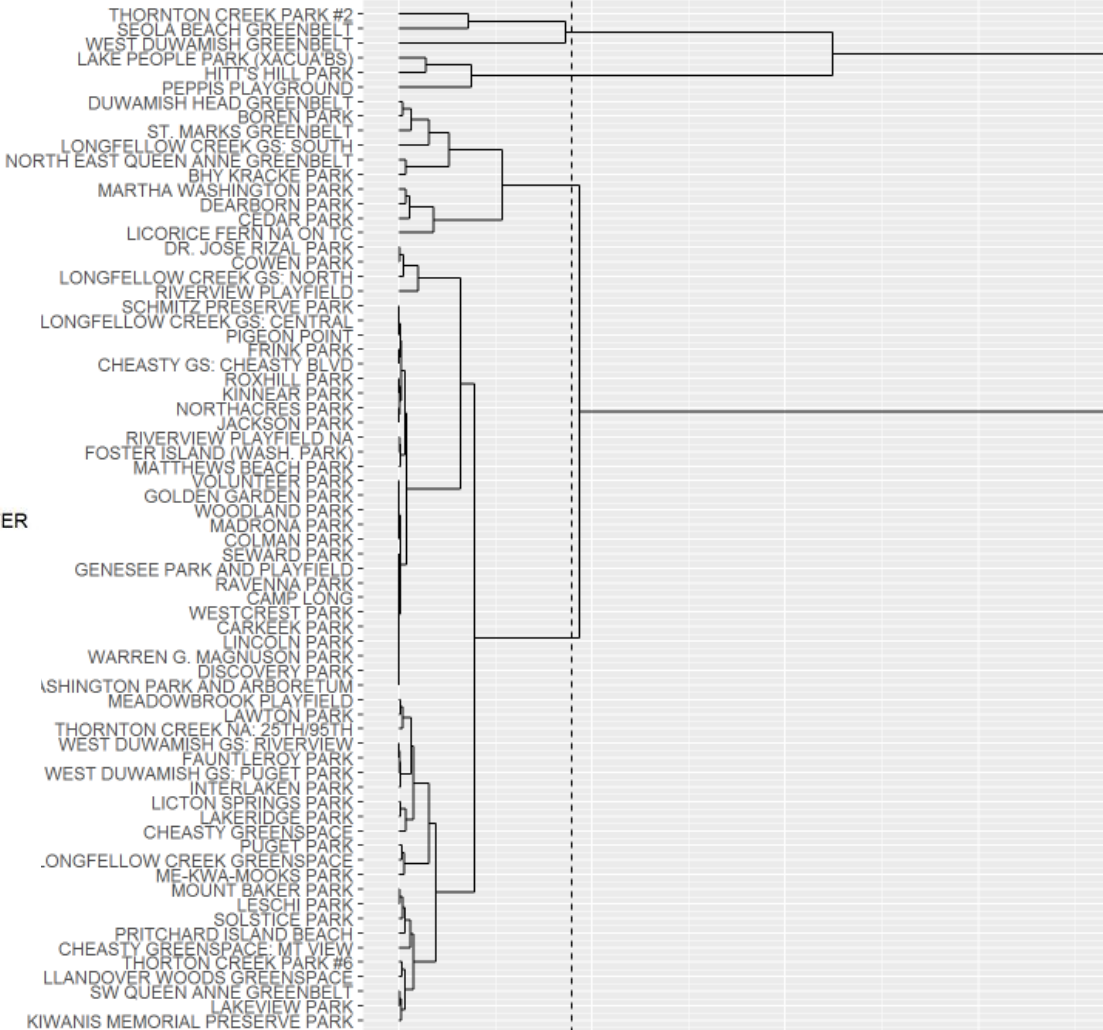
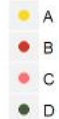


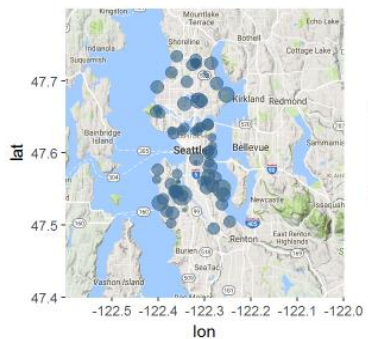
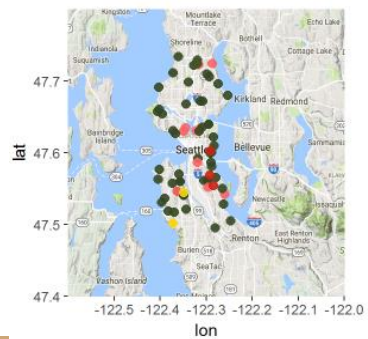
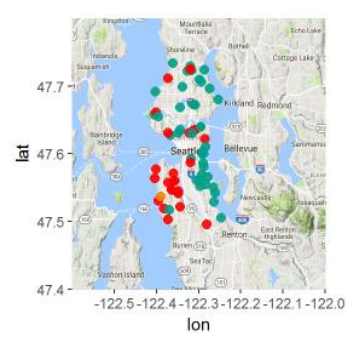
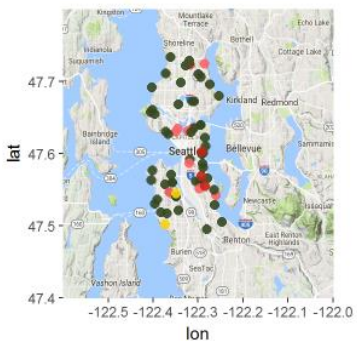
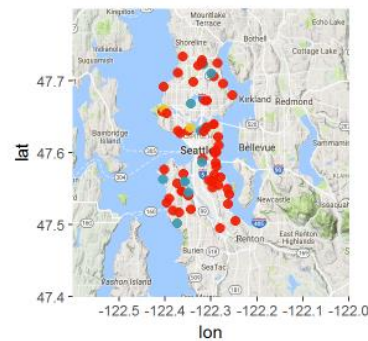
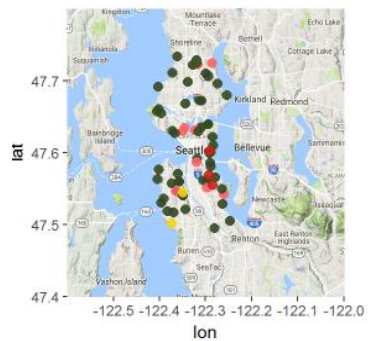
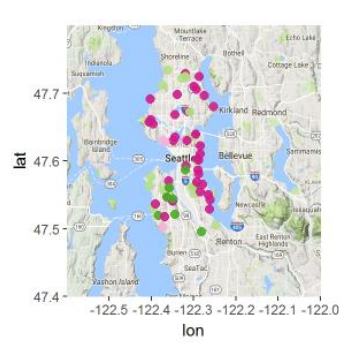
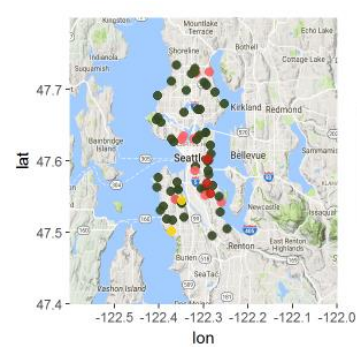
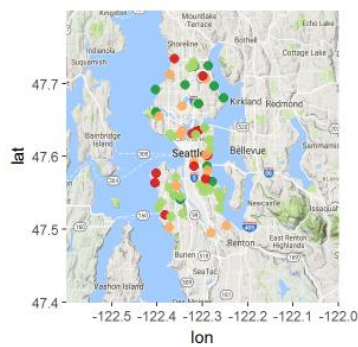
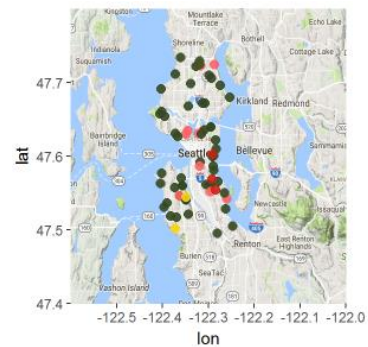
Steeper slopes, more tree canopy, natural earth surface type → worse condition
 No obvious relationship between condition and width was found.
 Northeast: good condition; southwest: worse condition

Park Clustering



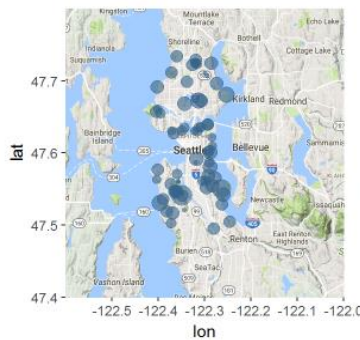
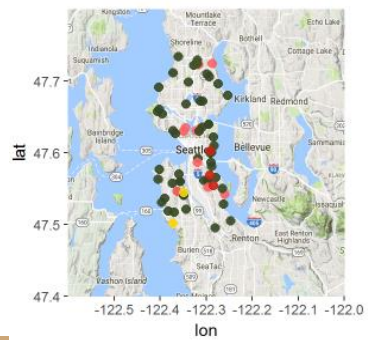
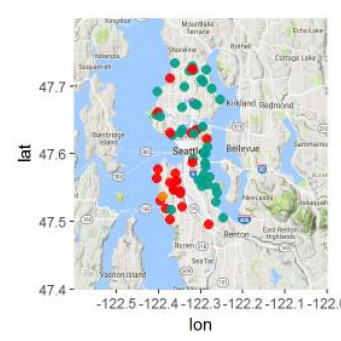
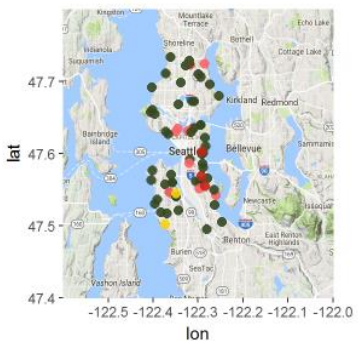
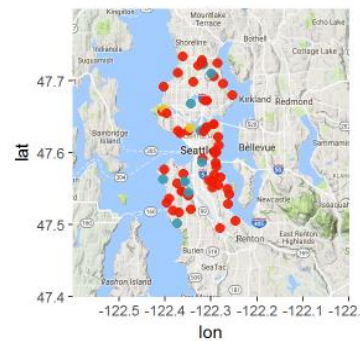
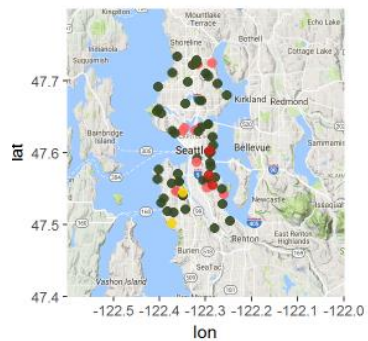
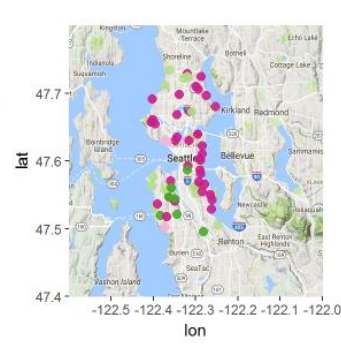
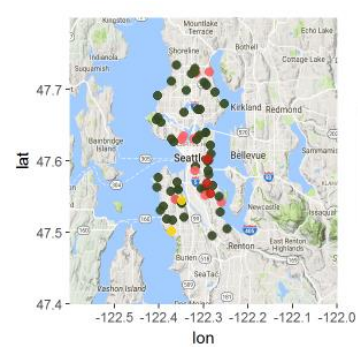
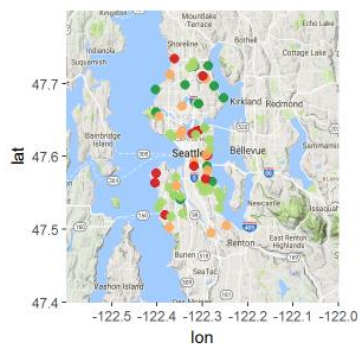
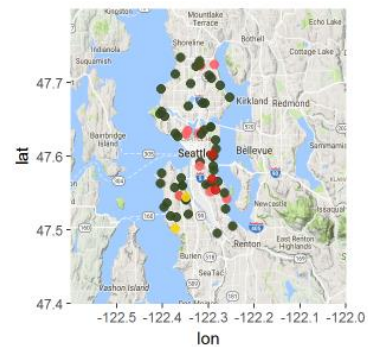
CLUSTER





A: gradual or moderate slopes, natural earth surface, narrow trail width, have canopy some with closed canopy, very bad trail condition.

B: non-flat topography, hard and durable constructed surface, moderate width, open canopy, very good trail condition.

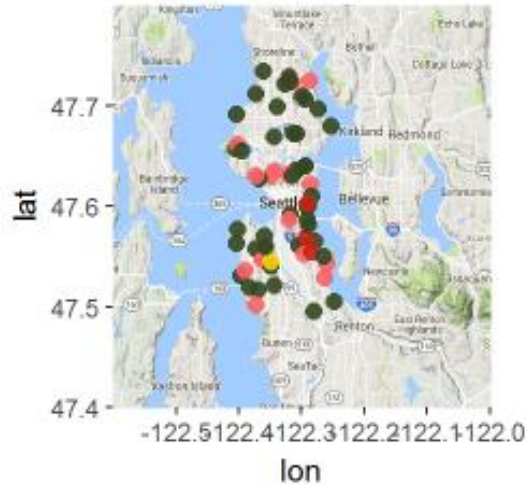


C and D: mixture of every type

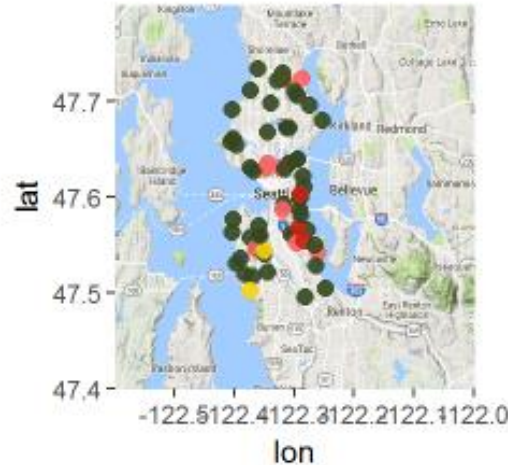
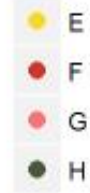
Hard to distinguish

Grade type, surface type and canopy

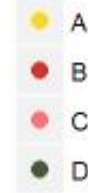
If add geographical position info



CLUSTER2



CLUSTER



No much difference, geographical features are explained by the attribute variables in this data set

Map Matrix

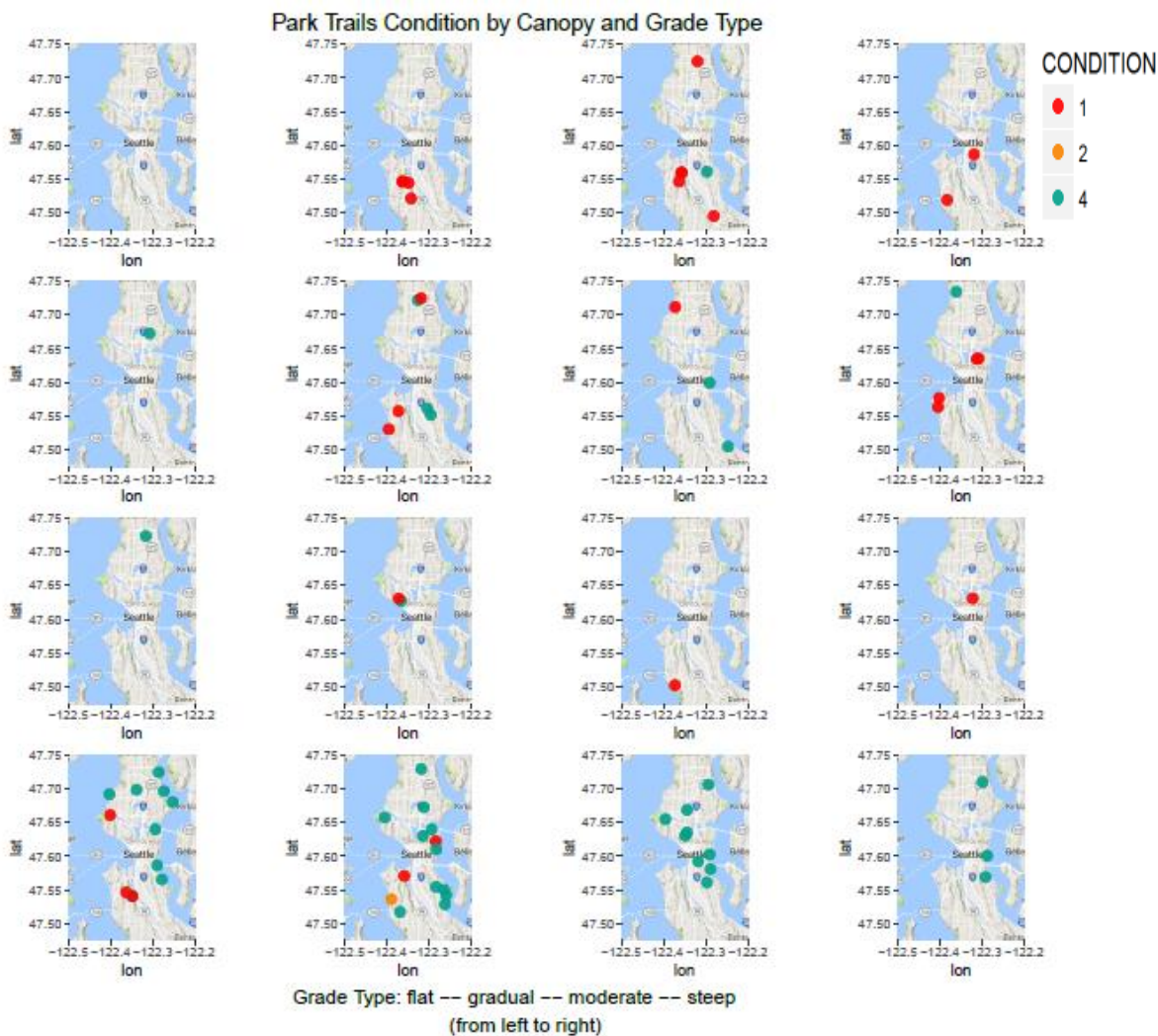
1 - worn/eroded

2 - poor

4 - good

- Most trails not steep
- Most trails with open canopy
- Steep with greater canopy
- Good condition:
Open canopy and flatter
- Bad condition:
Closed canopy and steeper
Slopes
- Very few: some canopy + flat
land; low canopy in all grade
types

Canopy: open --- low --- high --- closed (from bottom to top)



Useful Information

- Grade type, canopy most important based on PCA, plot visualization, park clusters comparison and map matrix. City planners might use them to predict the trail conditions so that can conduct proper maintenance and make upgrade plans.
- Northeast: good condition; southwest: worse condition
- Most flatter trails are in good condition but without tree canopy
- Most bad condition trails probably are in the forests with some hills
- Might consider plant some trees for those flat trails if possible or explore new trail routes in places with more trees

Some Thoughts

Surface type appeared to be less correlated with grade type, might be incorrect. The surface type classification need improvement.

May try assign different numeric values for the order levels to emphasize the important levels.

Visualizations help explore the relationship between the response variable and potential predictor variables.

Thank You!

Bridges: <https://www.railstotrails.org/build-trails/trail-building-toolbox/design/bridges/>

Bridges and Structures for trails:

<http://www.americantrails.org/resources/structures/ChooseBridgeBuild.html>

Choosing Multi Use Trail Surface Types: Gravel, Asphalt, Concrete

<https://www.permatrak.com/news-events/bid/102041/Choosing-Multi-Use-Trail-Surface-Types-Gravel-Asphalt-Concrete>

Choosing Right Trail Surface: <http://atfiles.org/files/pdf/ColumbiaMOsurface.pdf>

Locating your trail bridge for longevity: <http://atfiles.org/files/pdf/Locating-Trail-Bridge-Longevity-USFS.pdf>

Naturalizing Abandoned Trails (continued): <https://www.fs.fed.us/t-d/pubs/htmlpubs/htm00232839/page12b.htm>

Progressive Trail Design: <http://progressivetraildesign.com/services/trail/>

Recommended Standardized Trail Terminology for Use in Colorado:
<http://www.americantrails.org/resources/info/TrailTermCOTI.html#c>

Select Tread Surface:

<http://www.trailstobuild.com/Articles/BC%20Trail%20Standards/7-5.htm>

Soil Compaction: <https://trailism.com/soil-and-rock/soil-compaction/>

Surface Gravel: https://www.epa.gov/sites/production/files/2015-10/documents/2003_07_24_nps_gravelroads_sec3_0.pdf

Trail Design Guidelines: <https://www.portlandoregon.gov/parks/38306?a=250105>

Trail surfaces: <https://www.railstotrails.org/build-trails/trail-building-toolbox/design/surfaces/>

Which Multi Use Trail Materials Are Right for Your Project?

<https://www.permatrak.com/news-events/multi-use-trail-material-comparison>