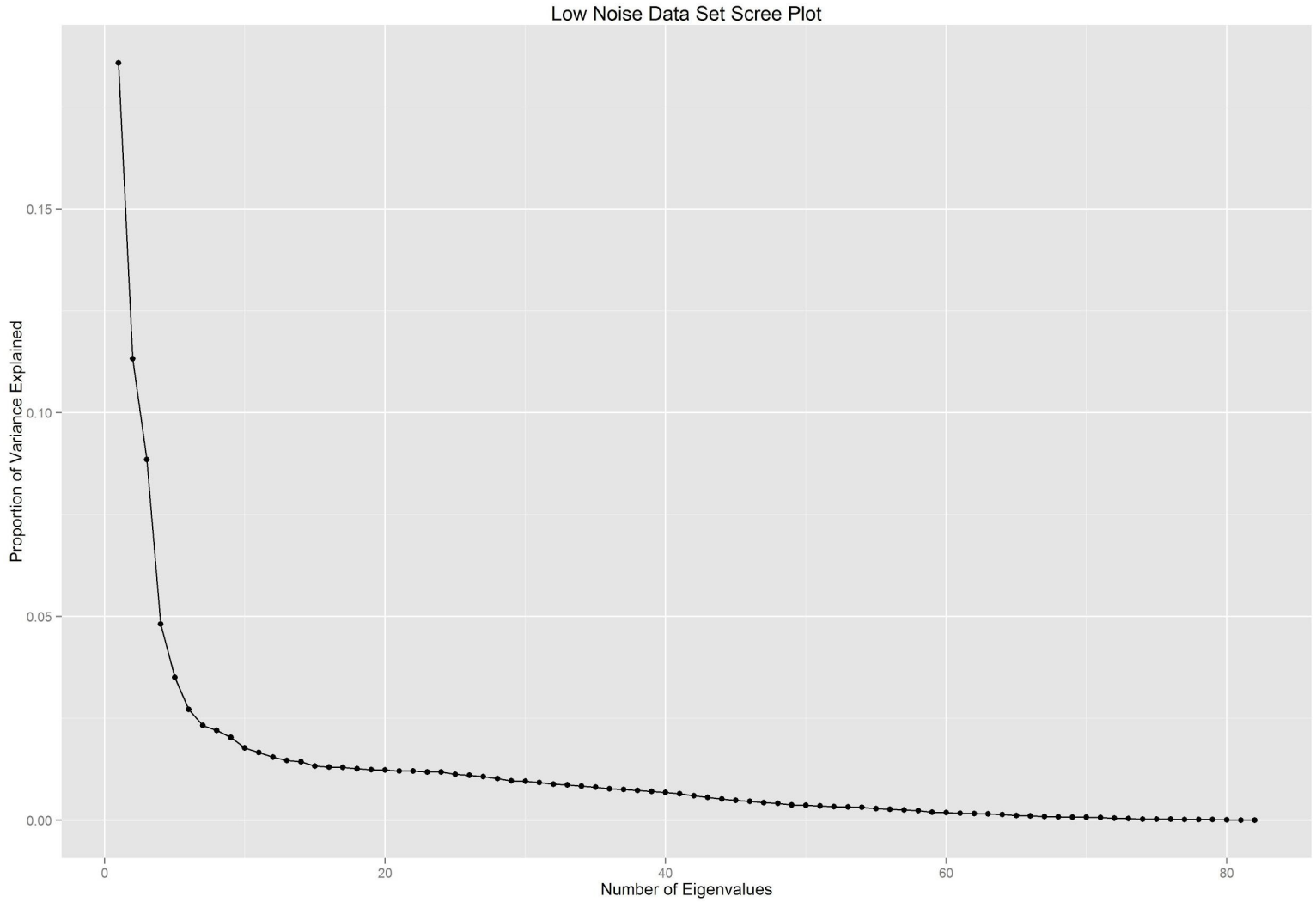
Clustering Astronomy Data

Katherine Eng, Jie Hu, Vanessa Lepe, Kalbi Zongo

QUESTIONS OF INTEREST

1. How does the principal component analysis (PCA) for low noise data compare to the PCA for the full test data set?
2. How do clustering methods (k-means vs hierarchical) differ in the low noise data set?
3. How do clustering methods (k-means vs hierarchical) differ in the test data set?

RESULTS


Low Noise Data Set Scree Plot
Proportion of Variance Explained
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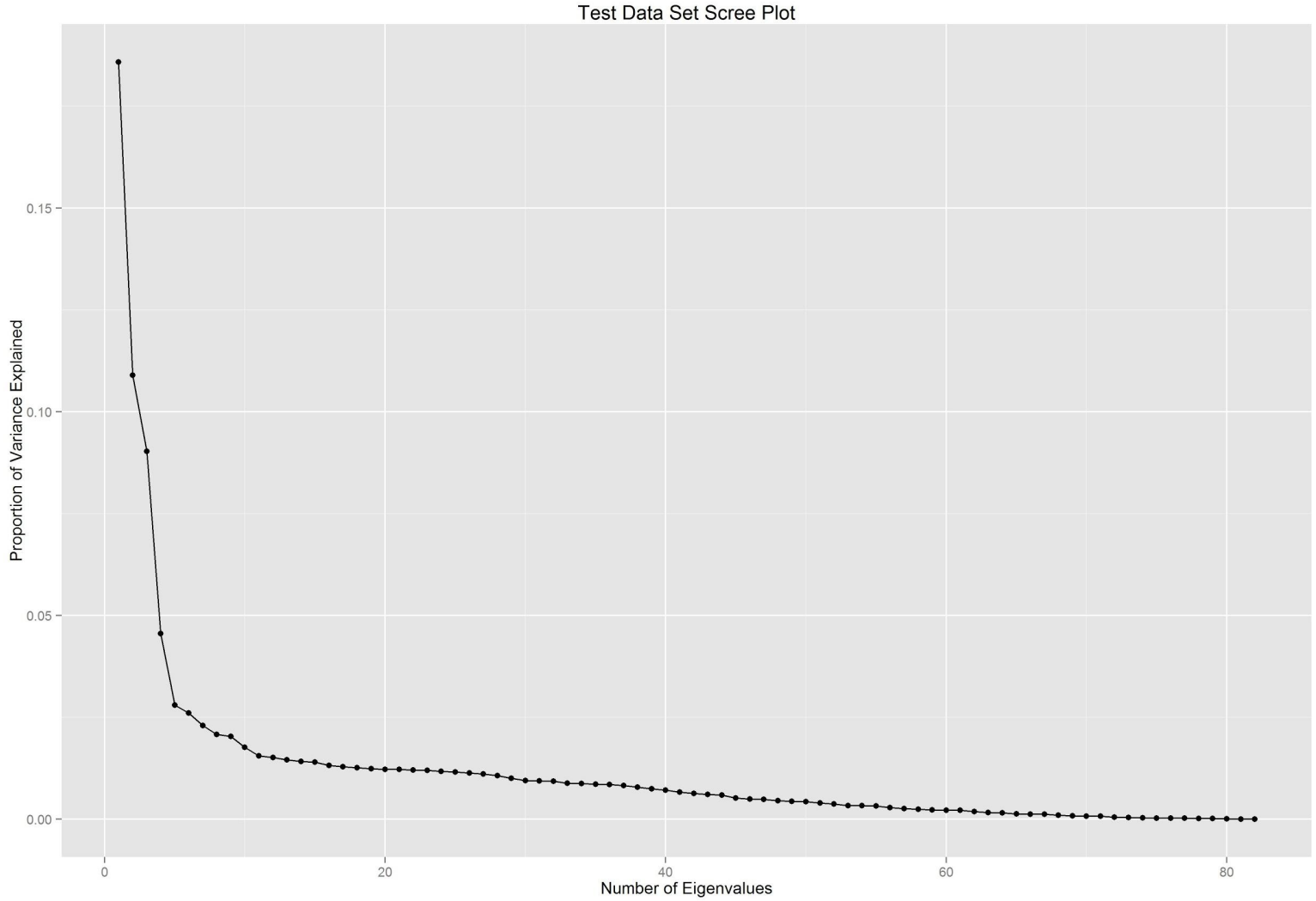
0.05
0.00
0
20
40
60
80
Number of Eigenvalues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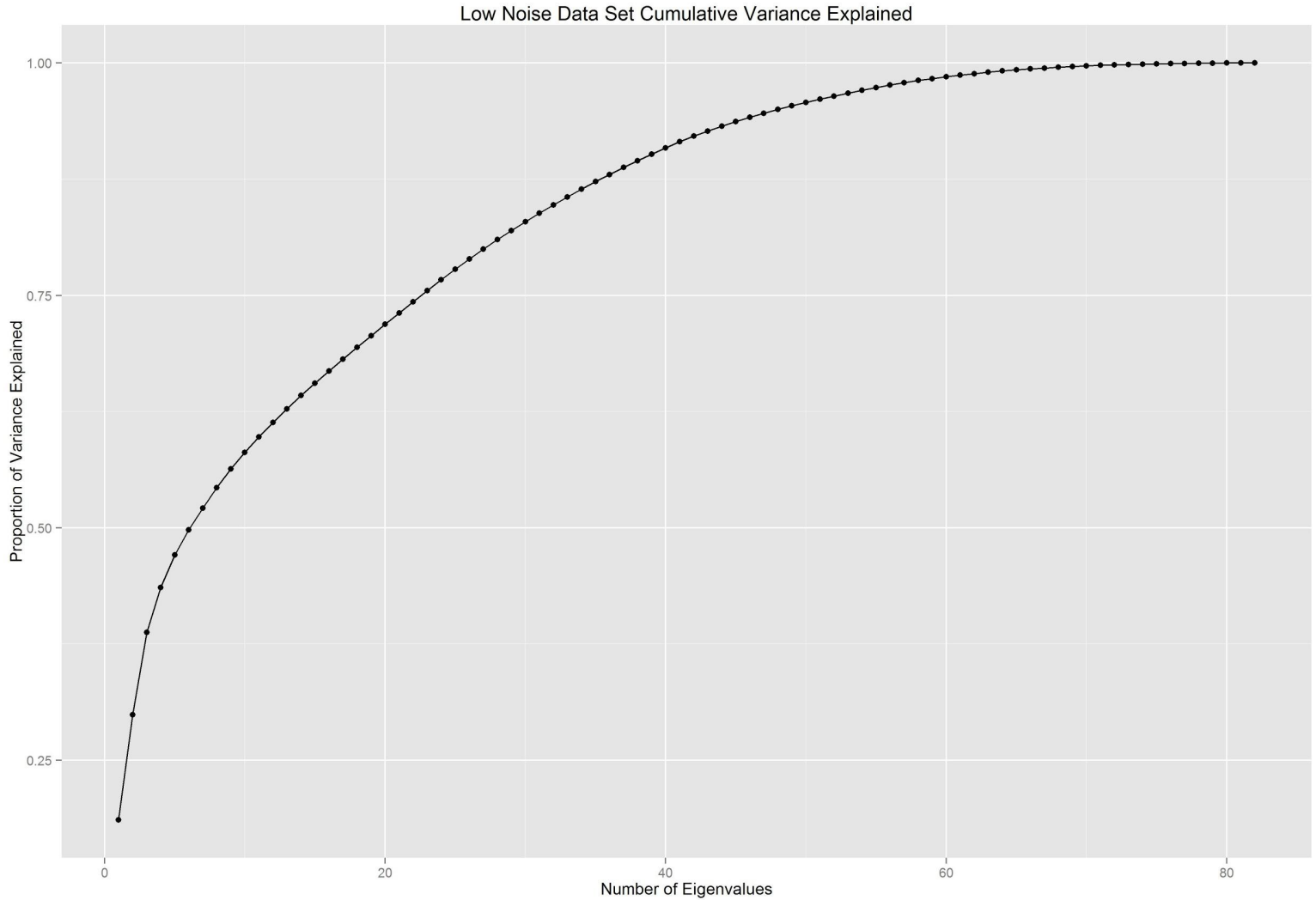
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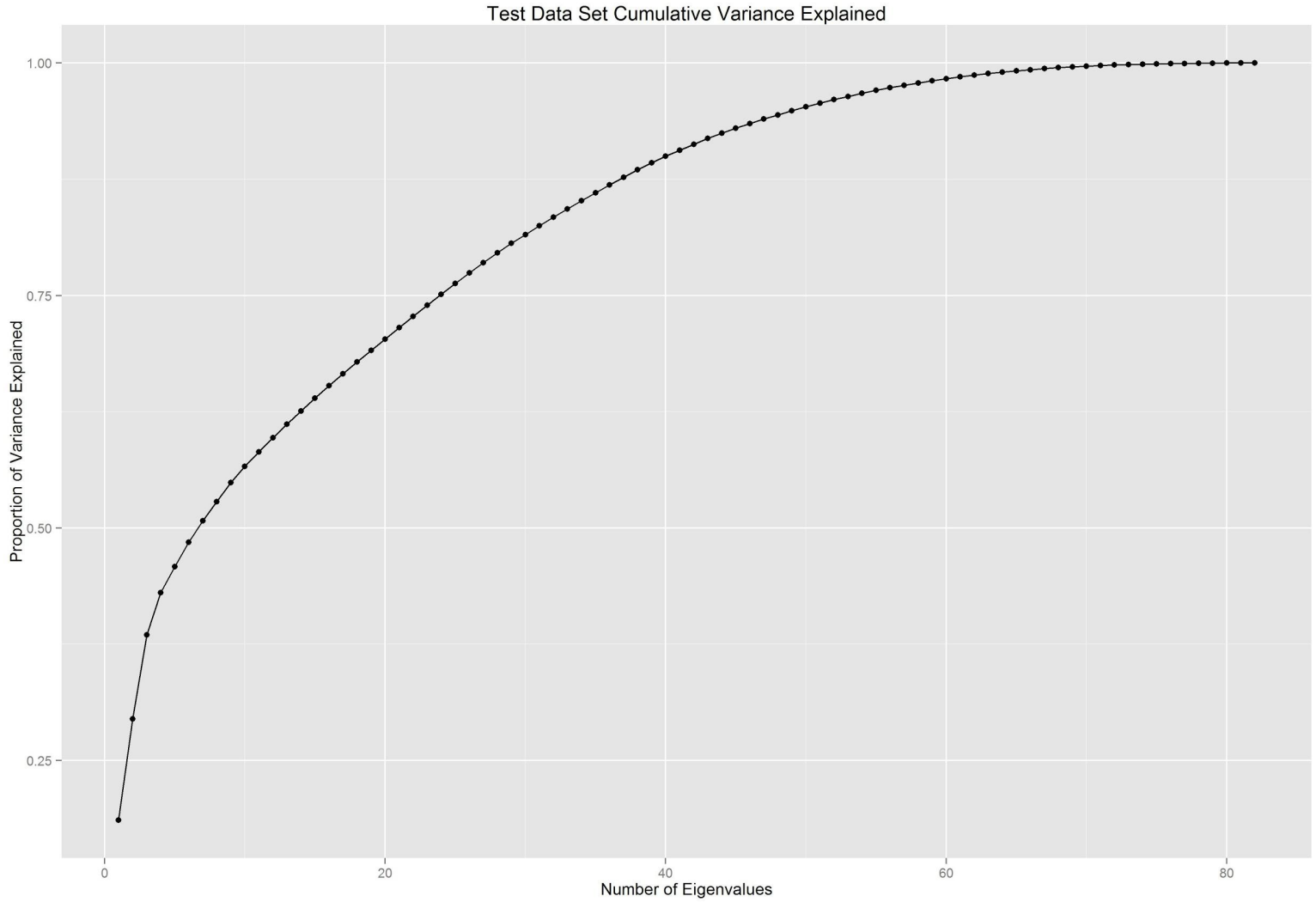
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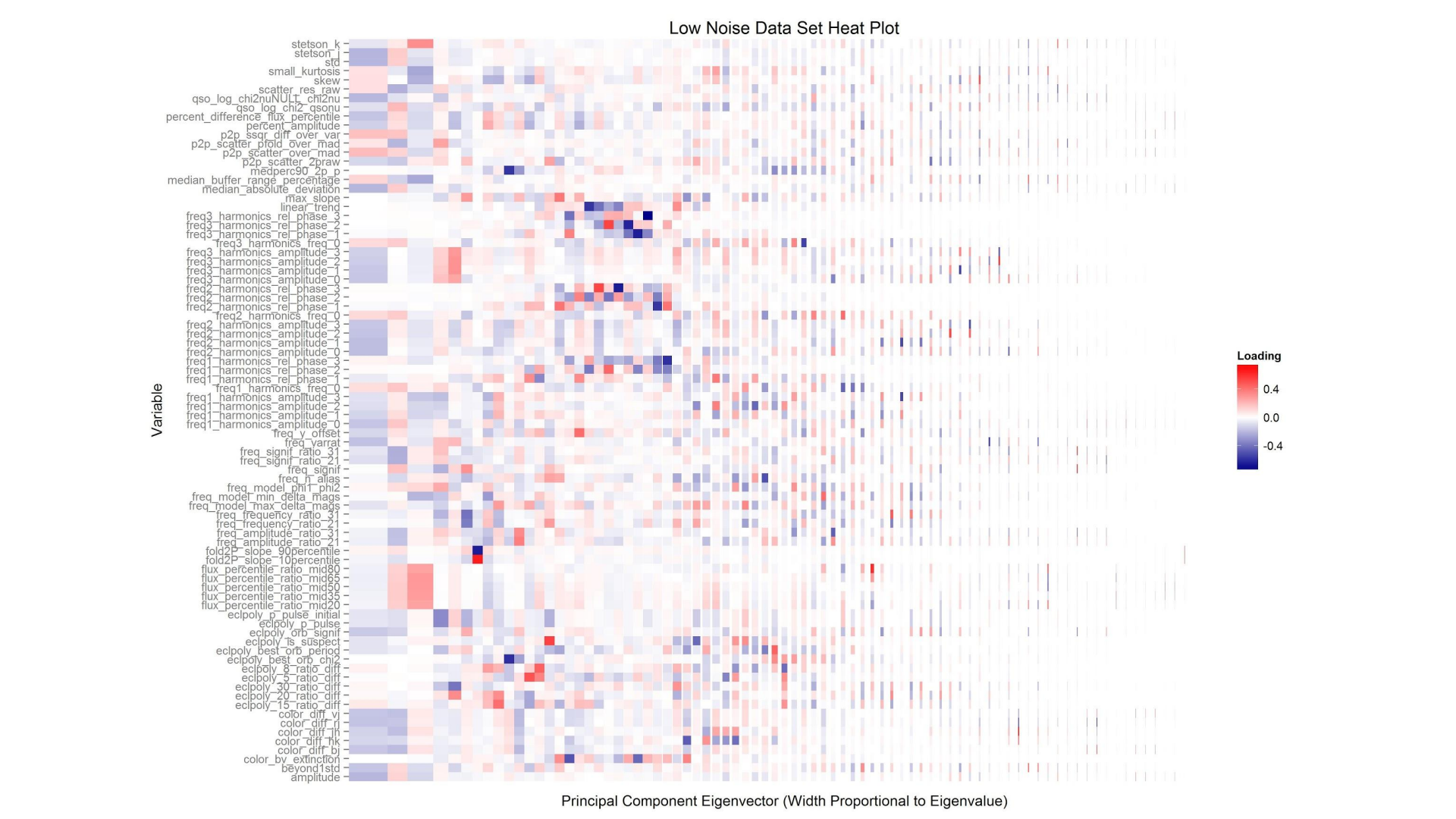
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Loading
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Principal Component Eigenvector (Width Proportional to Eigenvalue)


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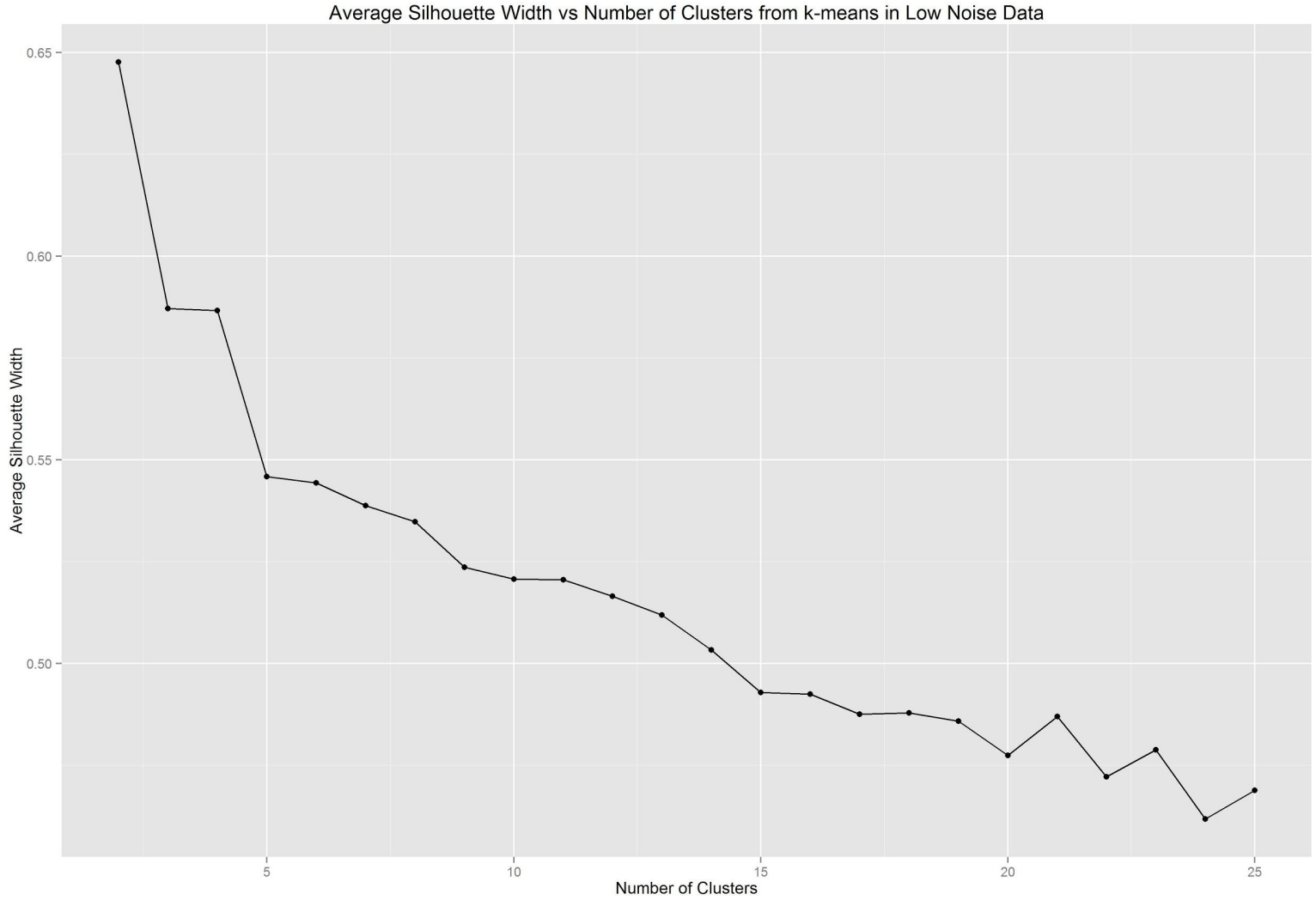
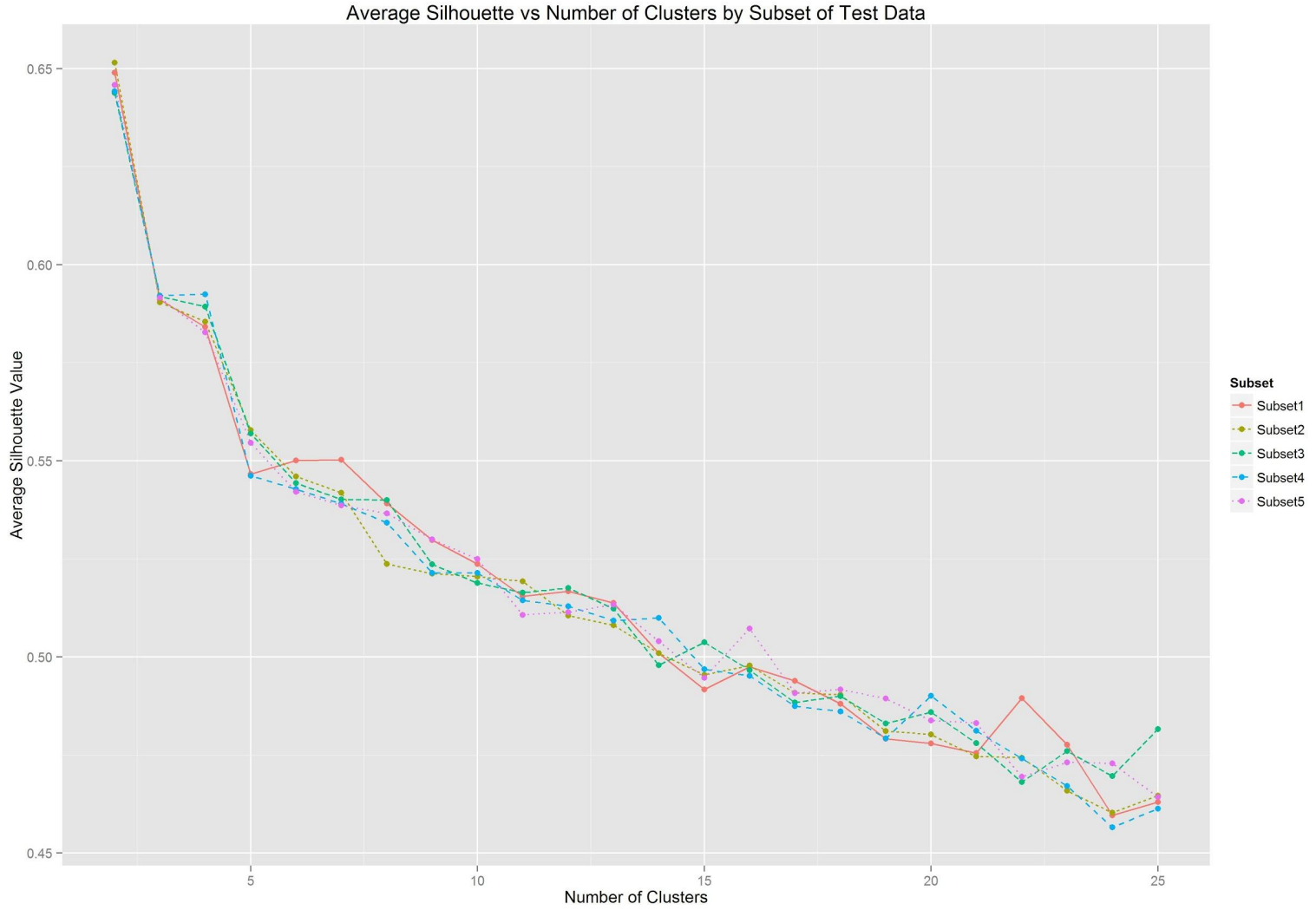
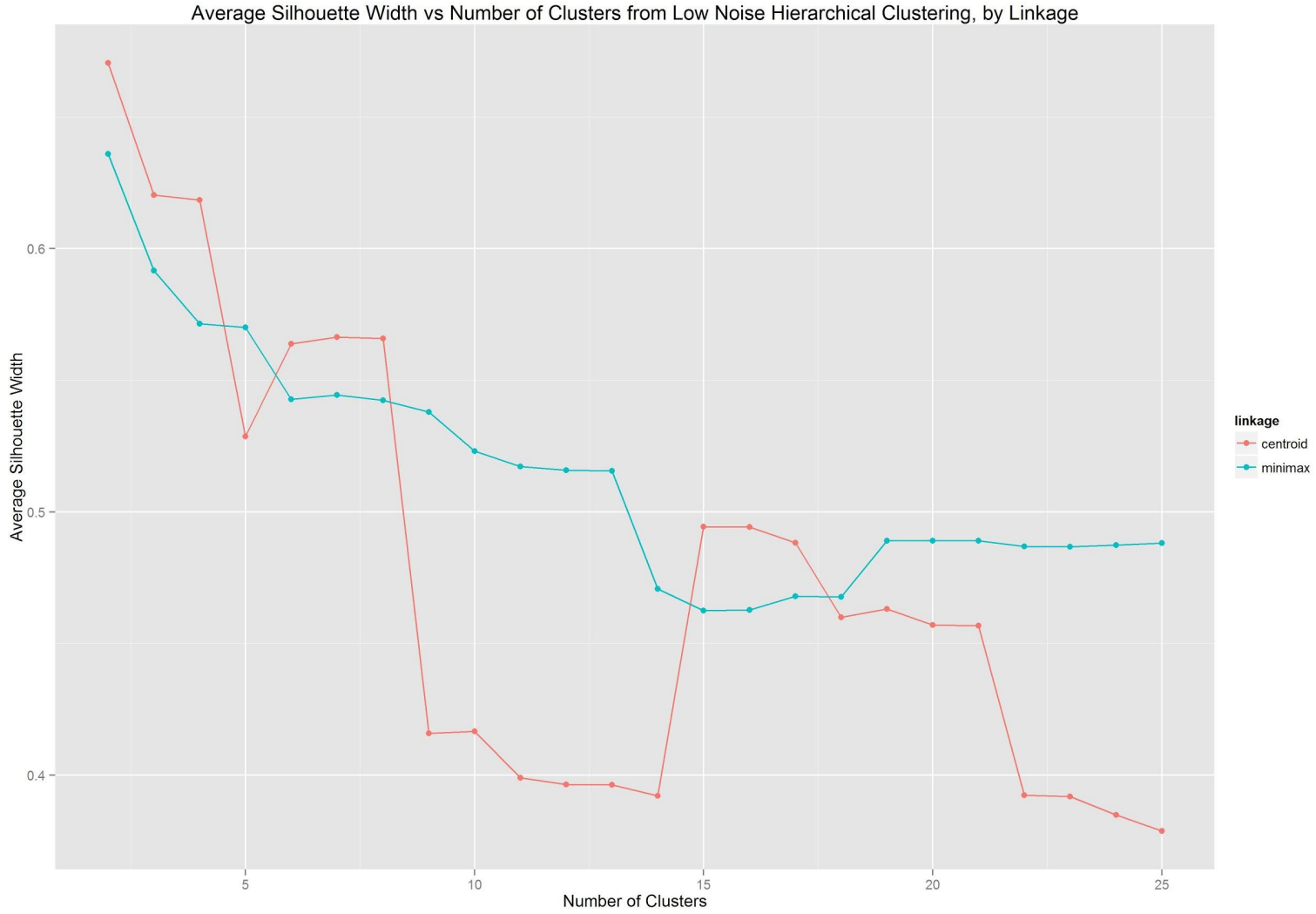
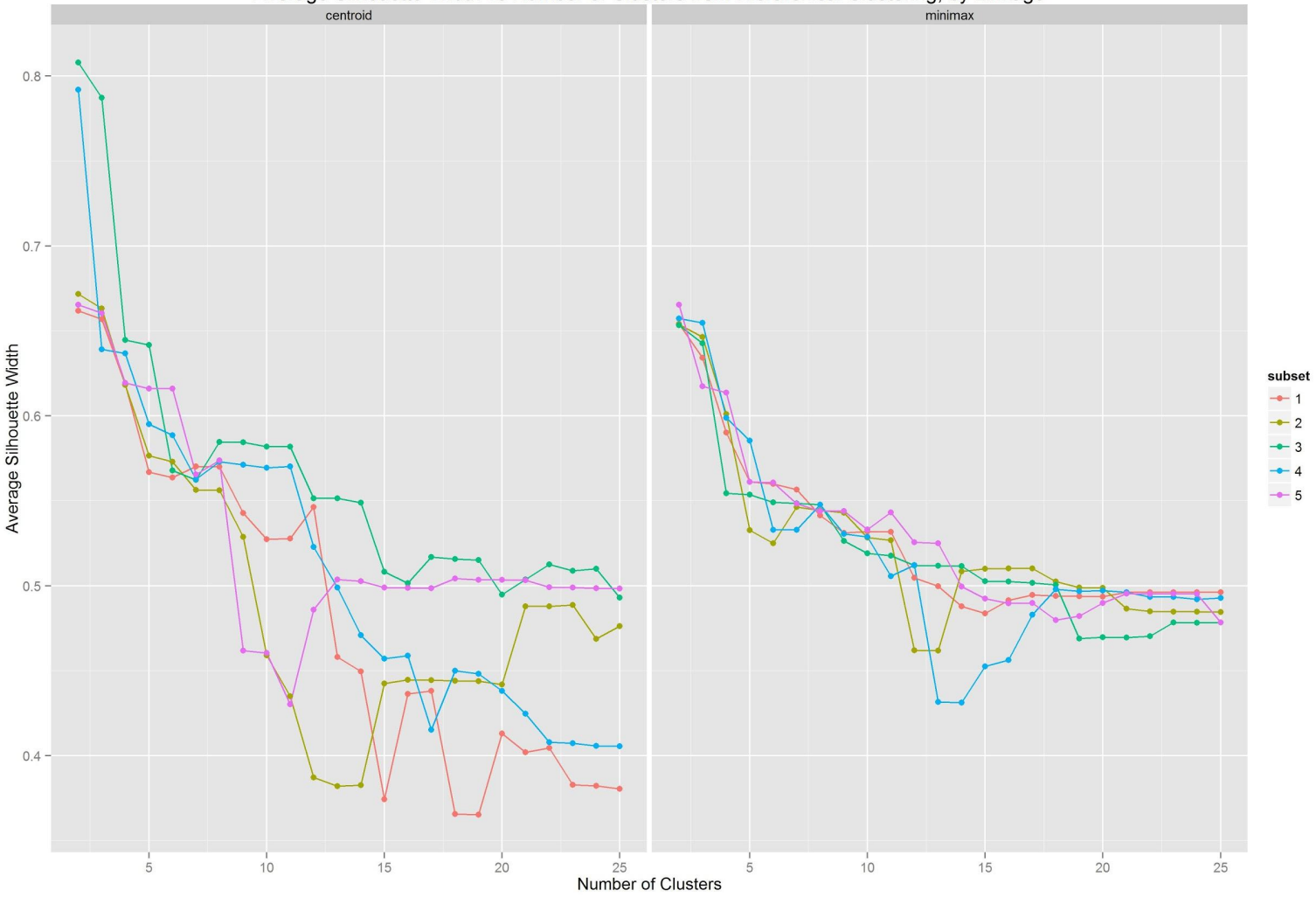

Average Silhouette Width vs Number of Clusters from k-means in Low Noise Data
Average Silhouette Width
0.65
0.60
0.55
0.50
5
10
15
20
25
Number of Clusters


Average Silhouette vs Number of Clusters by Subset of Test Data
Average Silhouette Value
0.65
0.60
0.55
0.50
0.45
5
10
15
20
25
Number of Clusters
Subset
Subset1
Subset2
Subset3
Subset4
Subset5


Average Silhouette Width vs Number of Clusters from Low Noise Hierarchical Clustering, by Linkage
Average Silhouette Width
0.6
0.5
0.4
5
10
15
20
25
Number of Clusters
linkage
centroid
minimax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centroid
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Average Silhouette Width
0.8
0.7
0.6
0.5
0.4
5
10
15
20
25
Number of Clusters
subset
1
2
3
4
5

OBSTACLES

1) Many observations had at least one missing feature

2) Some variables were constant across all observations

3) Clustering on all observations and features was computationally expensive

4) Visualizing clusters difficult (PCA, dendrograms)

FUTURE QUESTIONS/WORK

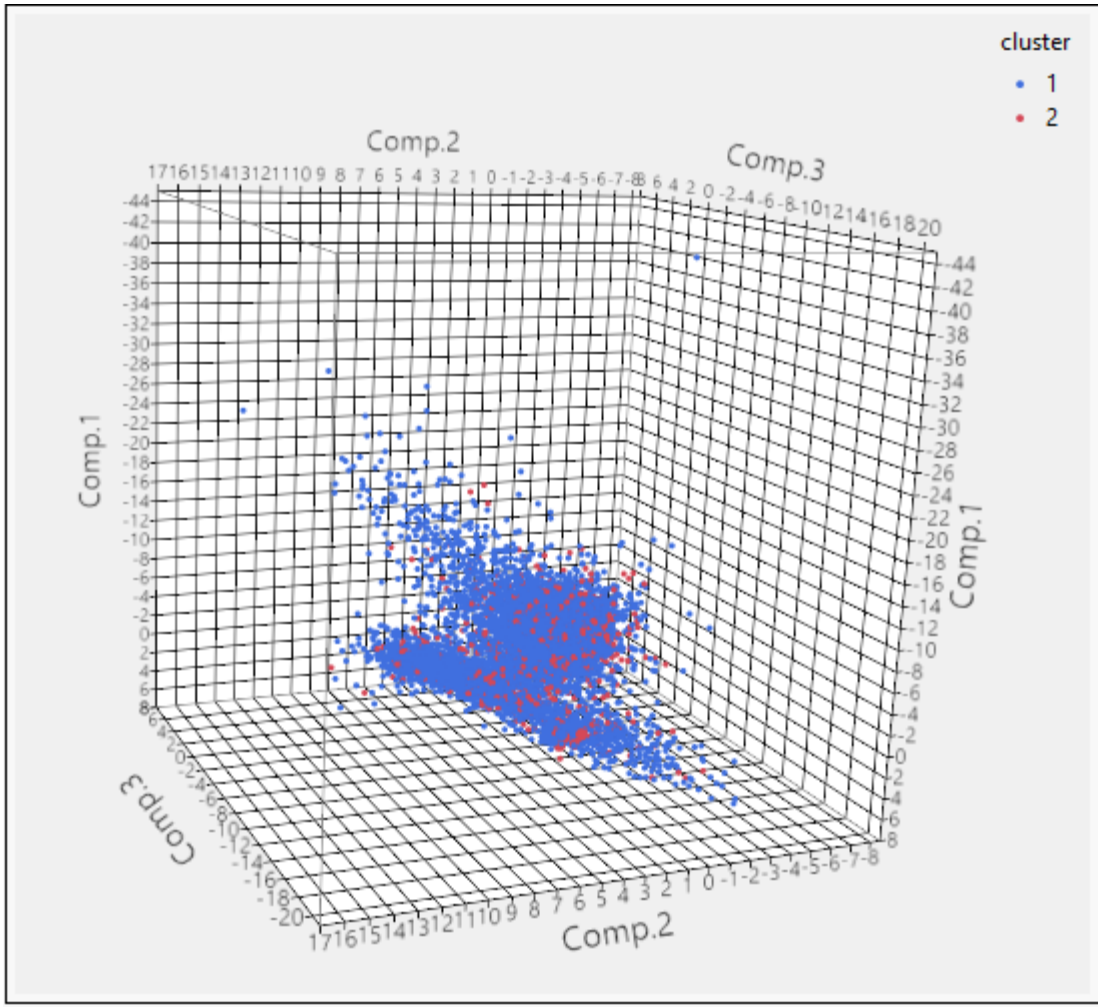
1) Other clustering methods (e.g., model-based)

2) Impute missing values

3) Find better ways to visualize data (e.g., use 3-d plots to display clustering forms)

4) Use COS Computing Cluster

End

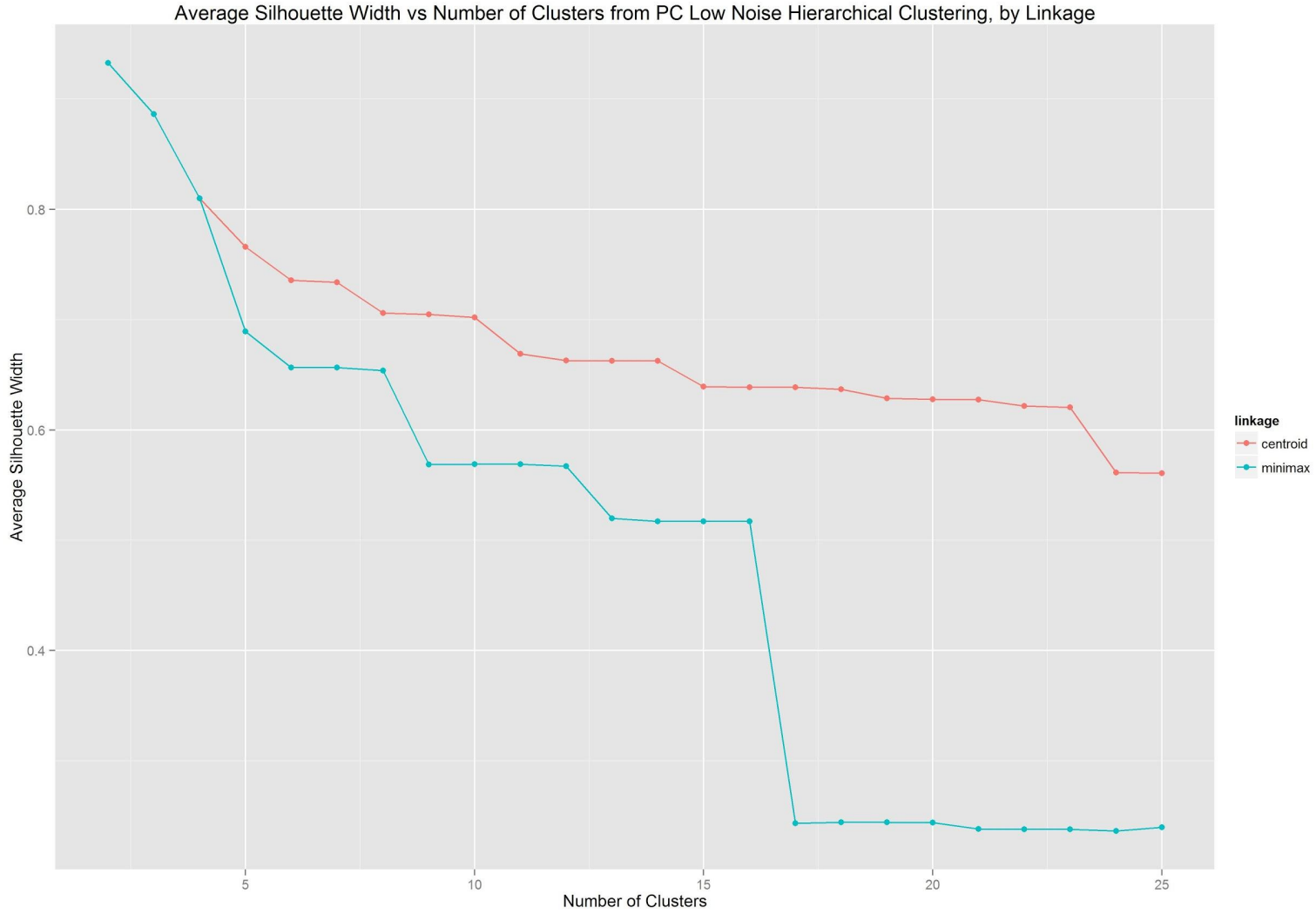


Low Noise data set

First three principal components

k = 2
cluster assignment from hierarchical clustering (28 features), minimax linkage

Cluster	1	2
Count	8759	1108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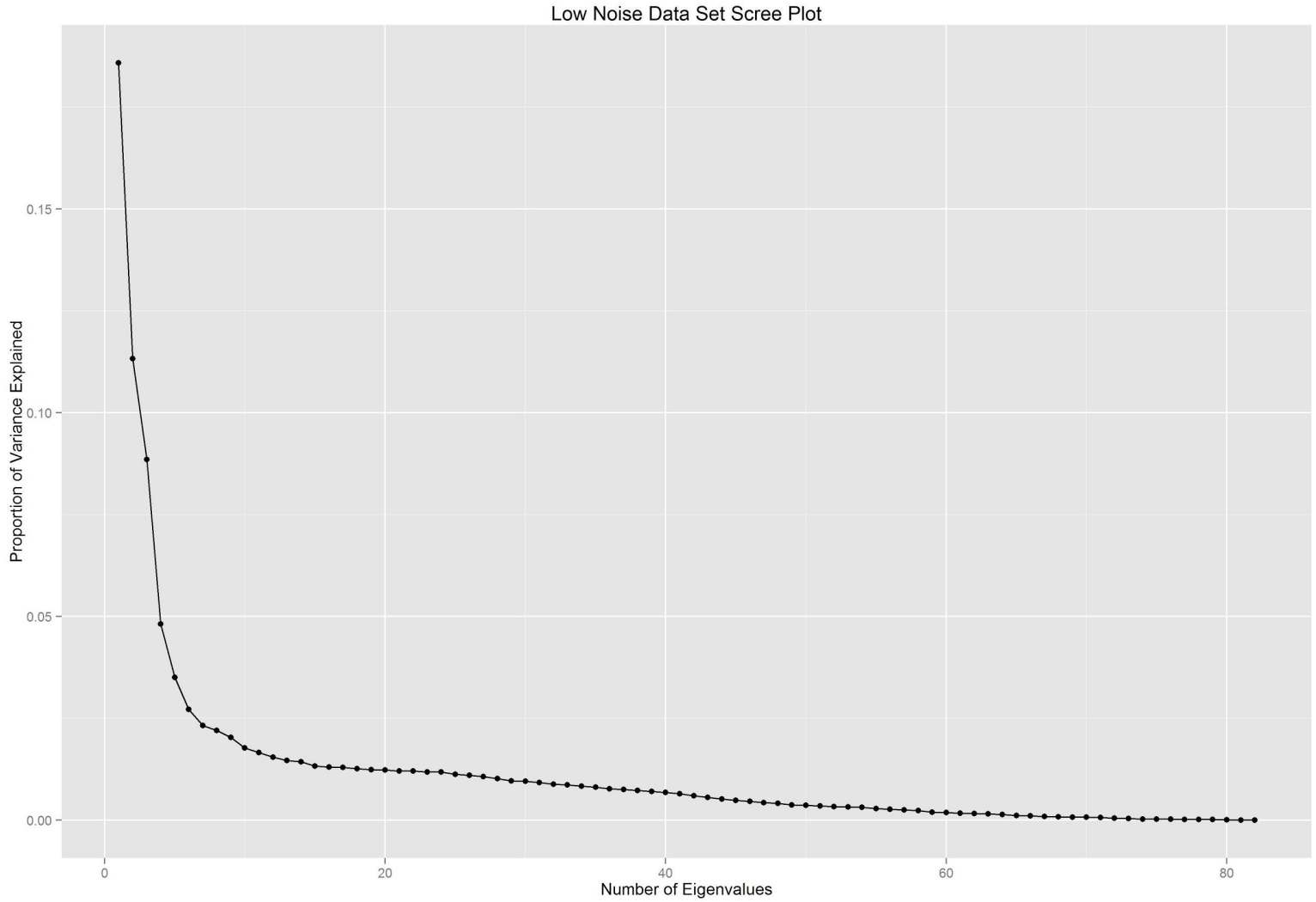
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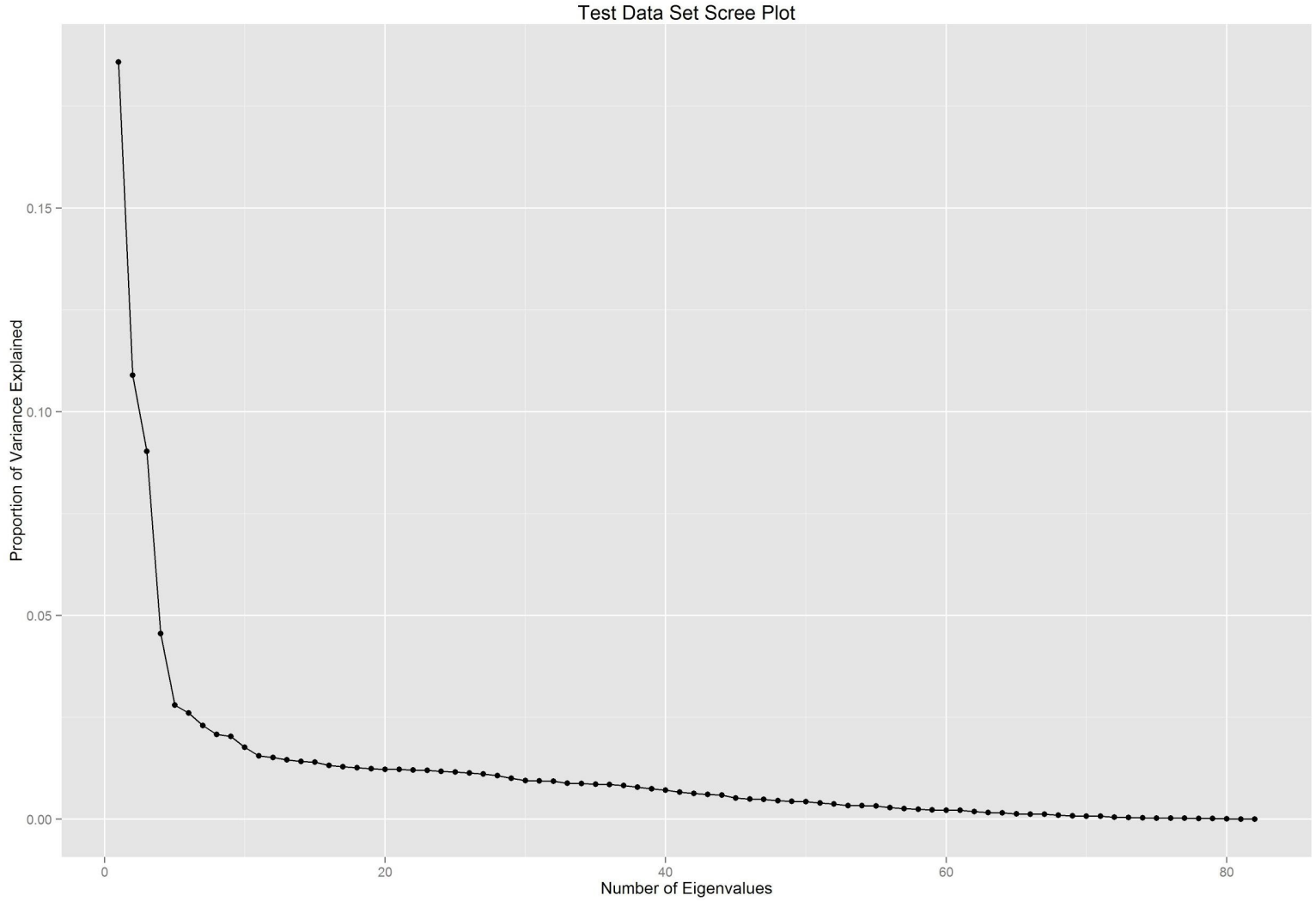
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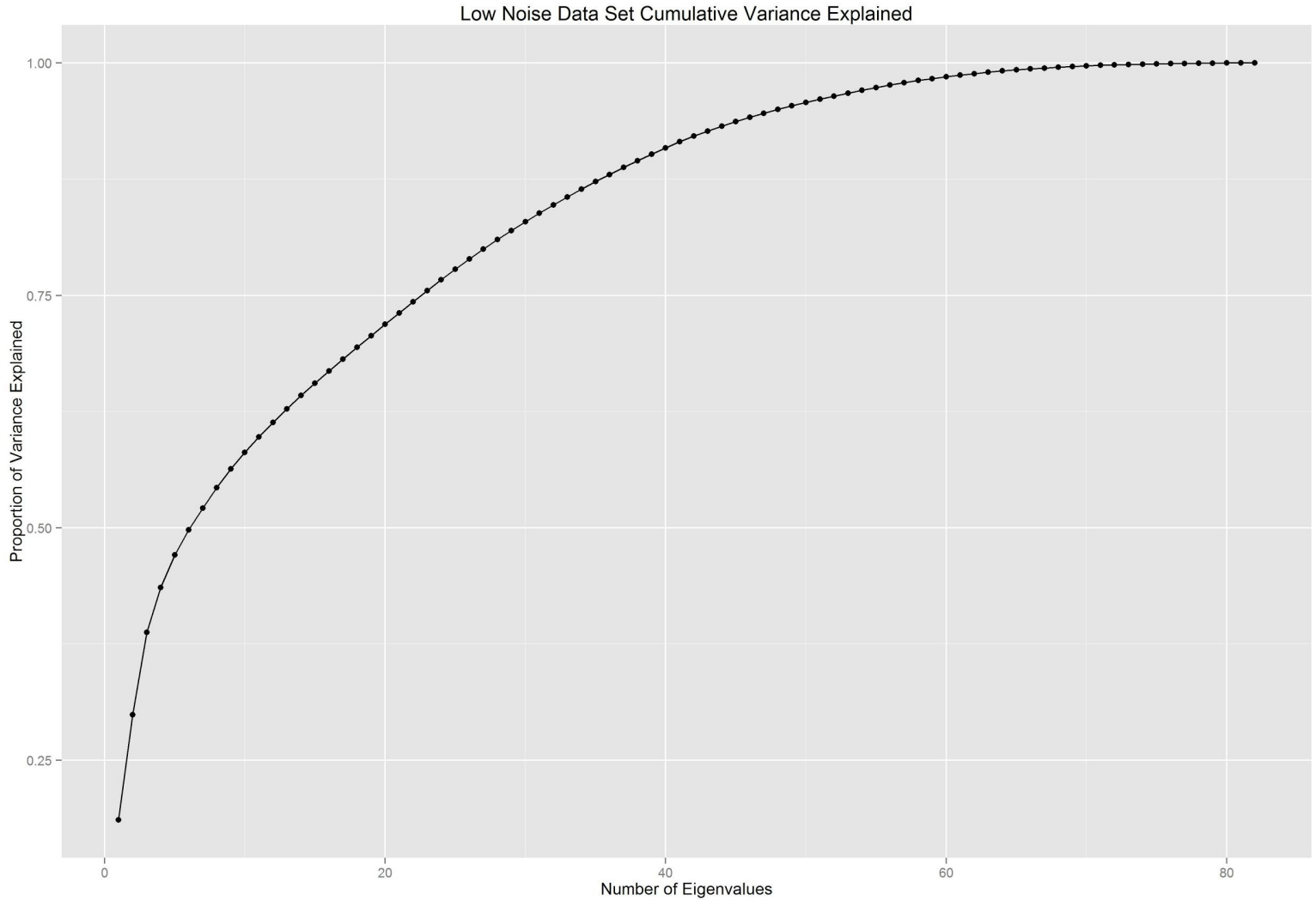
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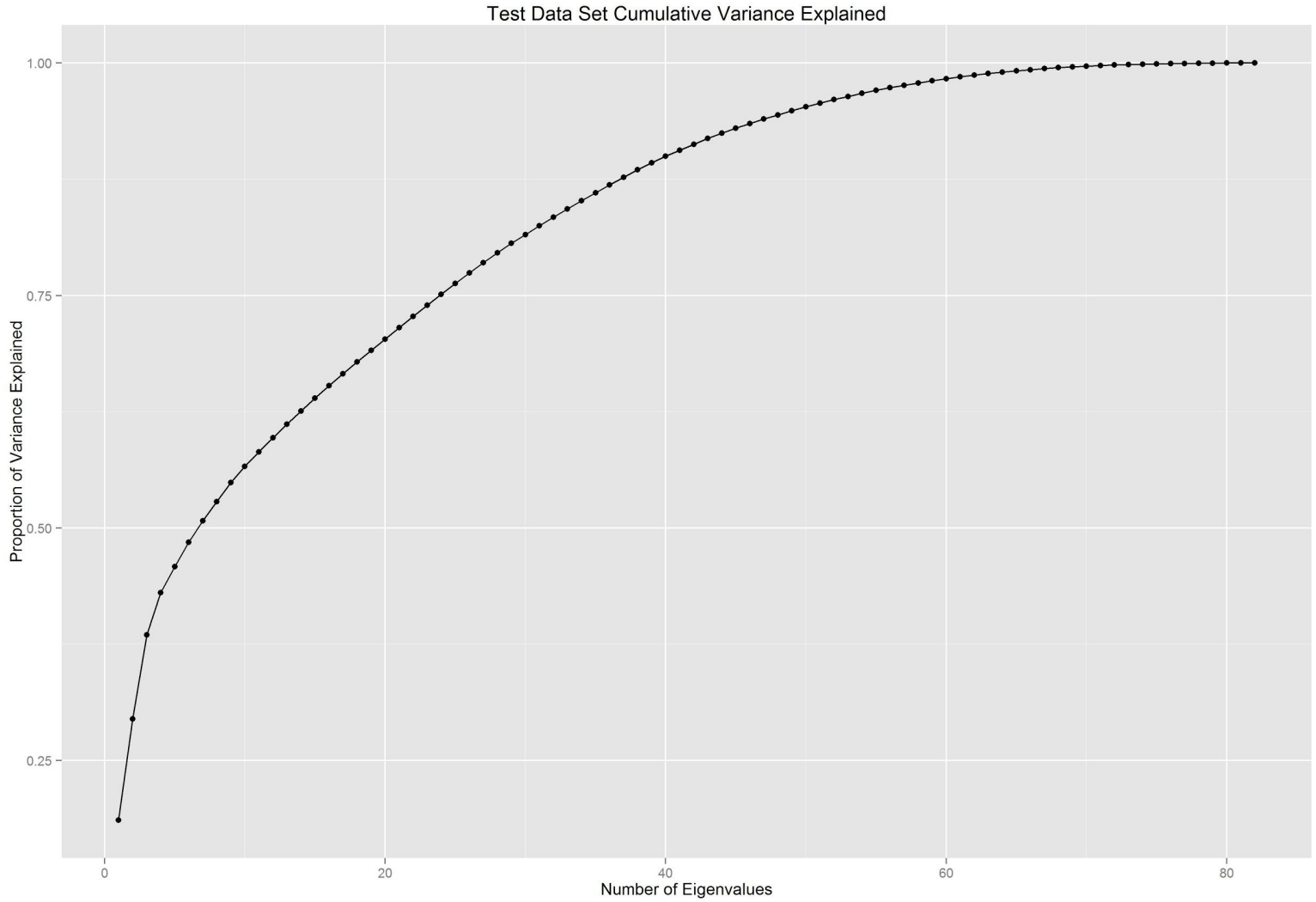
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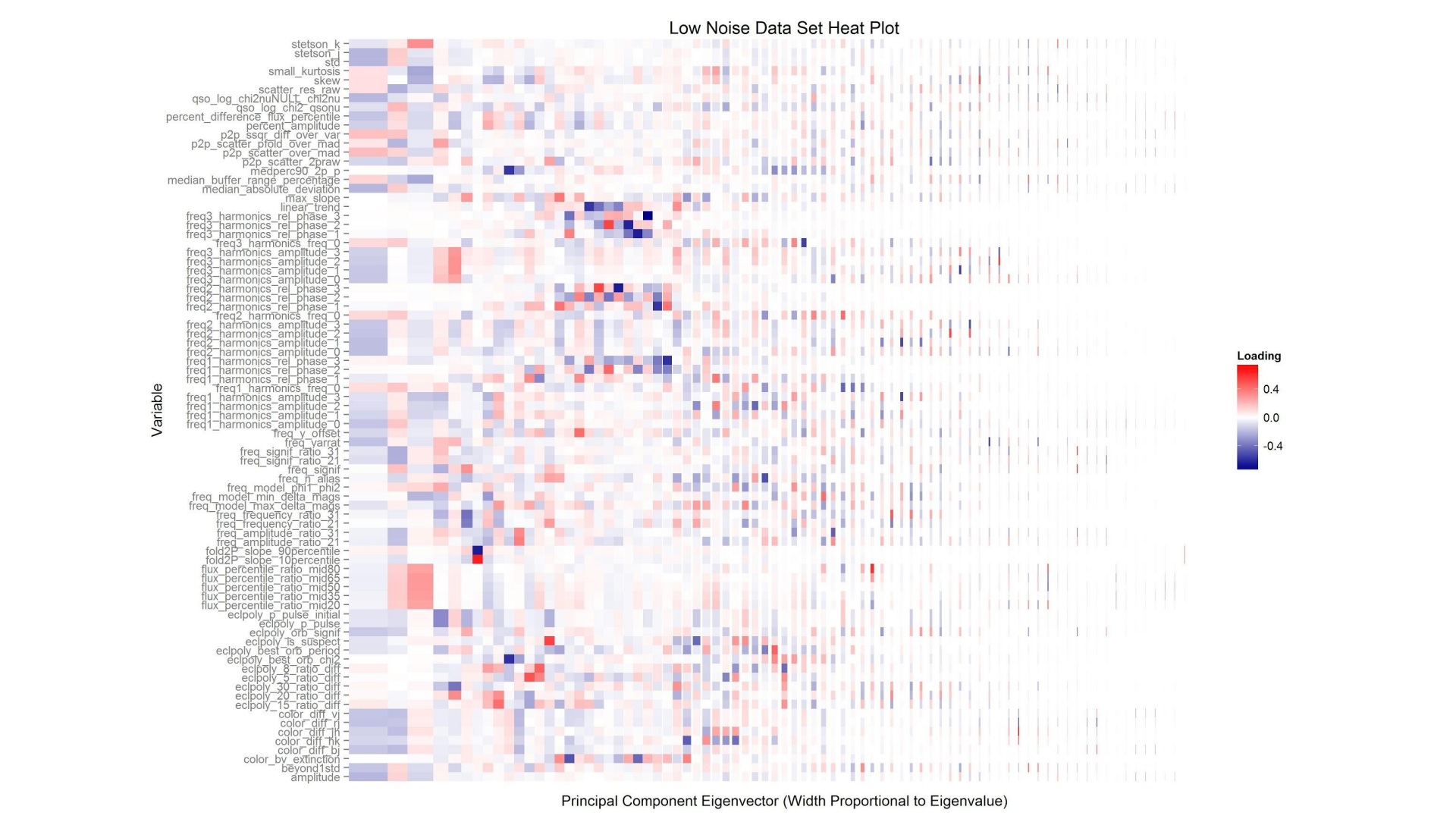
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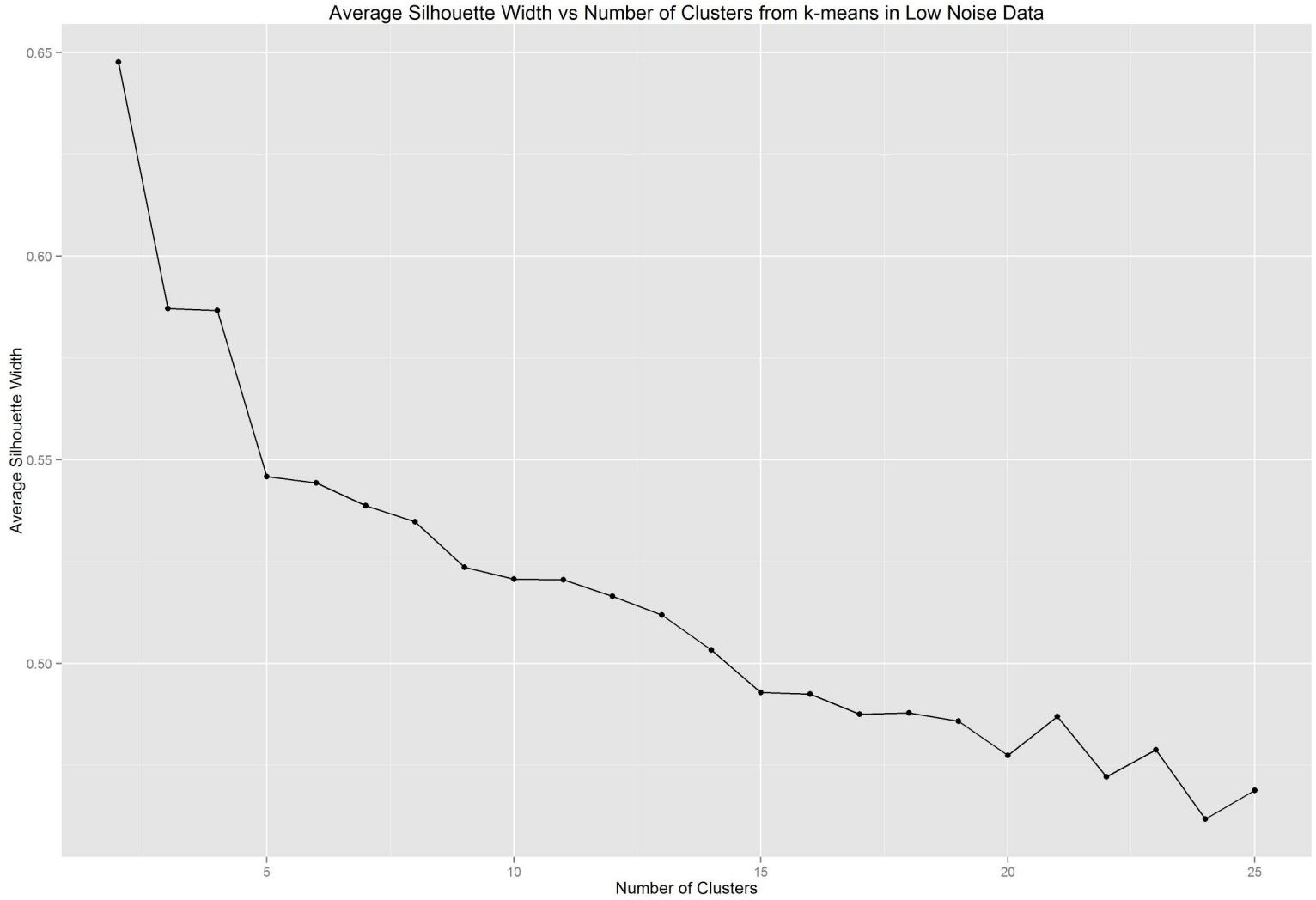
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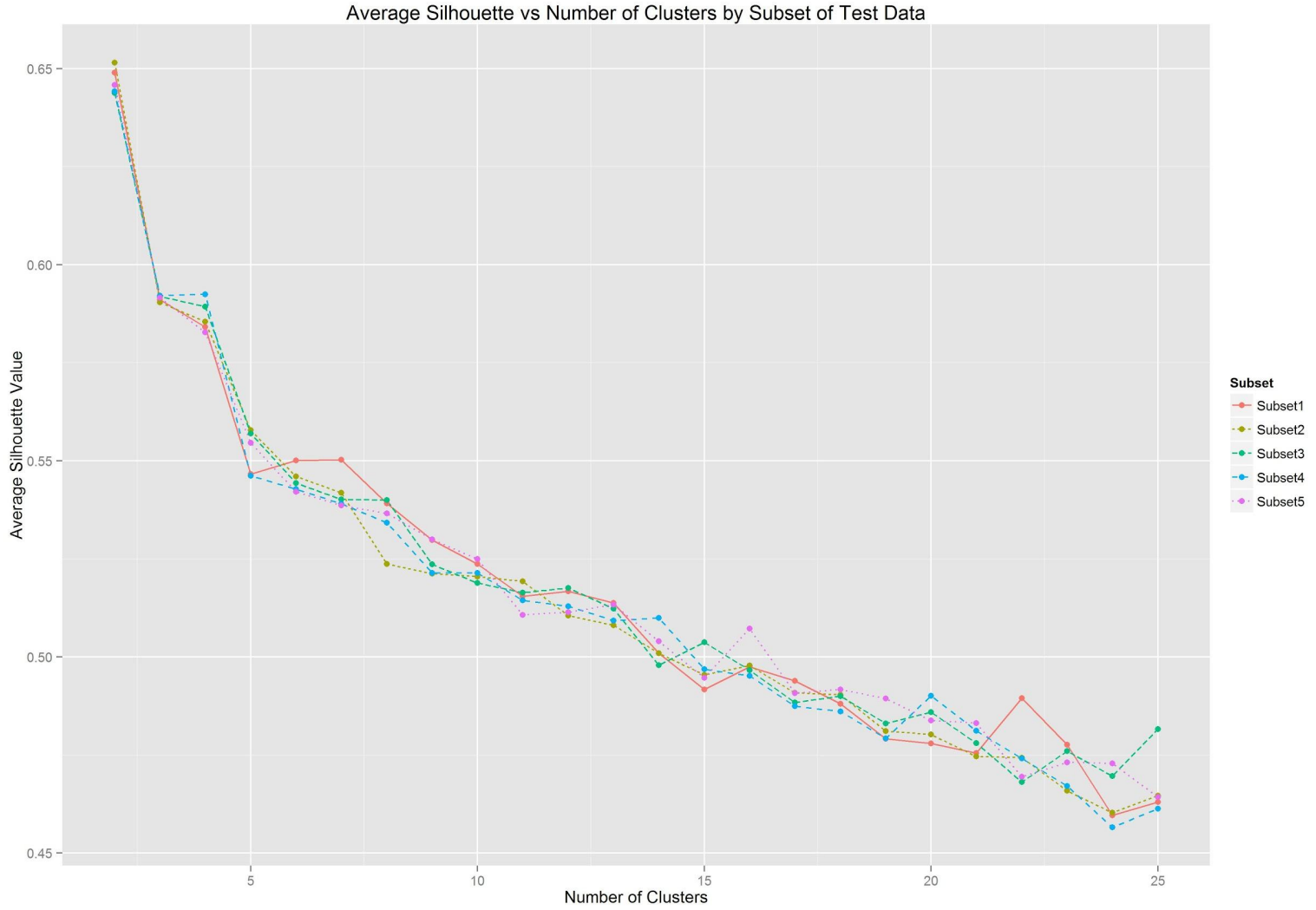
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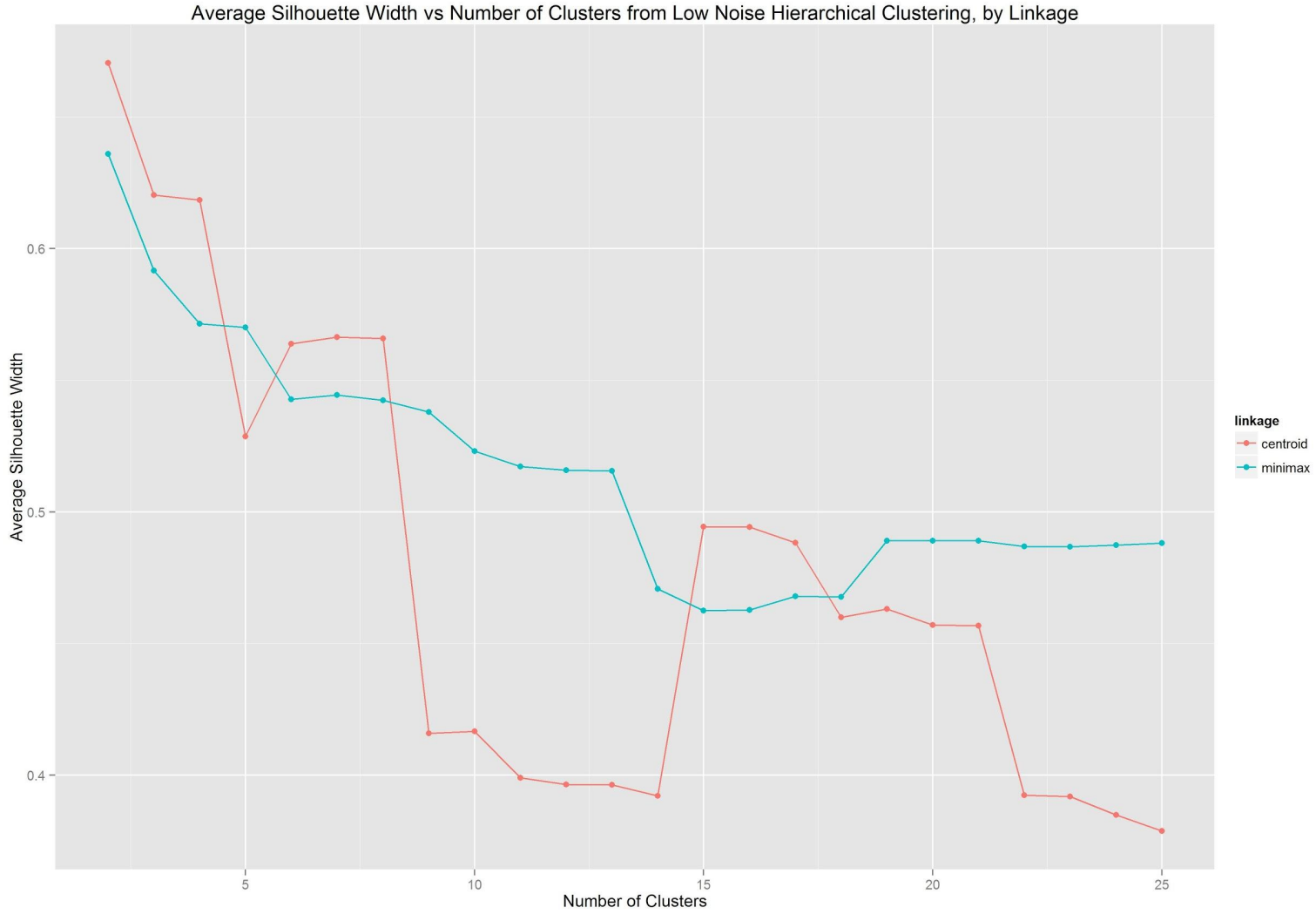
Subset2
Subset3
Subset4
Subset5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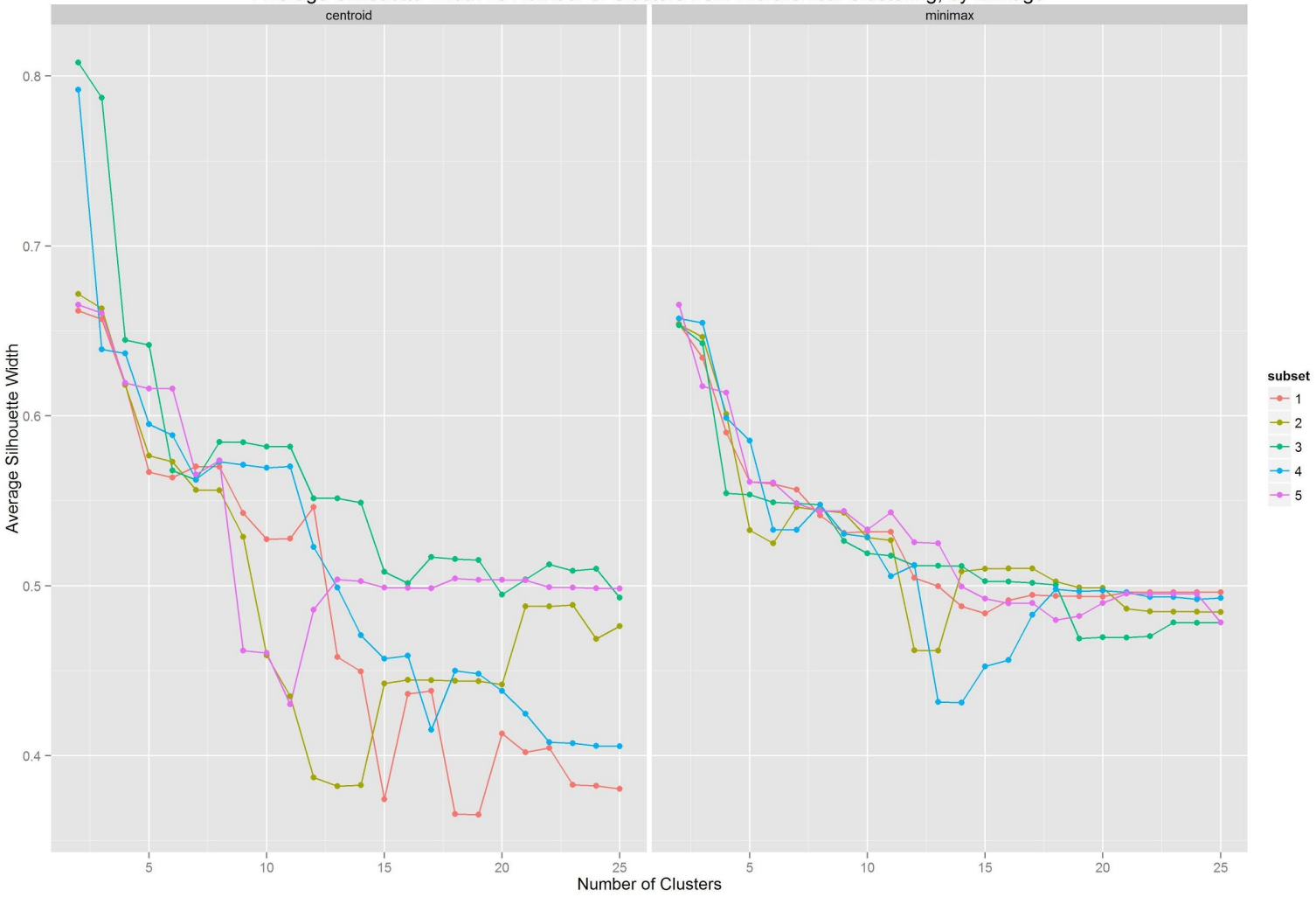
0.5
0.4
5
10
15
20
25
Number of Clusters
linkage
centroid
minimax


Average Silhouette Width vs Number of Clusters from Hierarchical Clustering, by Linkage
centroid
minimax
Average Silhouette Width
0.8
0.7
0.6
0.5
0.4
5
10
15
20
25
Number of Clusters
subset
1
2
3
4
5

OBSTACLES

1) Many observations had at least one missing feature

2) Some variables were constant across all observations

3) Clustering on all observations and features was computationally expensive

4) Visualizing clusters difficult (PCA, dendrograms)

FUTURE QUESTIONS/WORK

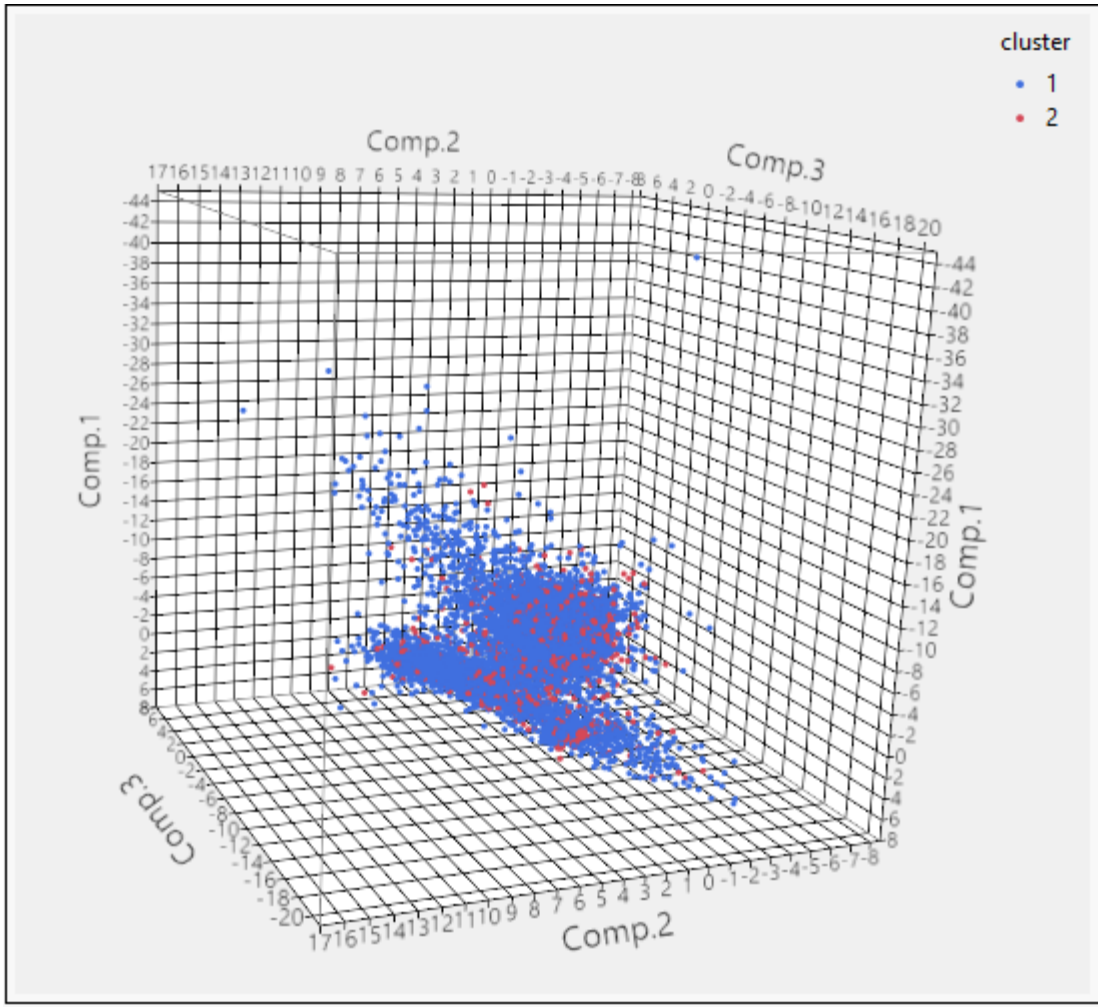
1) Other clustering methods (e.g., model-based)

2) Impute missing values

3) Find better ways to visualize data (e.g., use 3-d plots to display clustering forms)

4) Use COS Computing Cluster

End

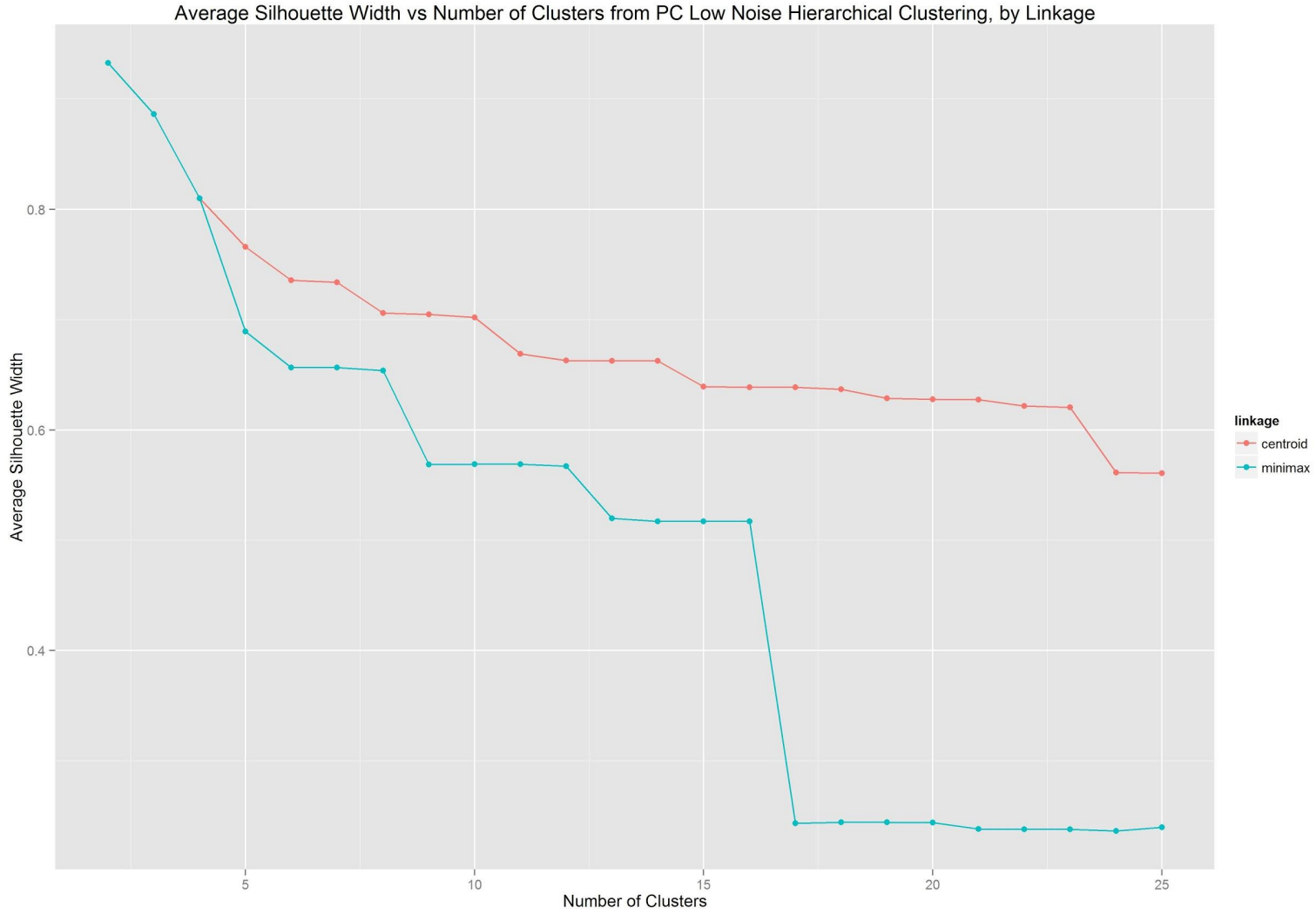


Low Noise data set

First three principal components

k = 2
cluster assignment from hierarchical clustering (28 features), minimax linkage

Cluster	1	2
Count	8759	1108


Average Silhouette Width vs Number of Clusters from PC Low Noise Hierarchical Clustering, by Linkage
Average Silhouette Width
0.8
0.6
0.4
5
10
15
20
25
Number of Clusters
linkage
centroid
minimax