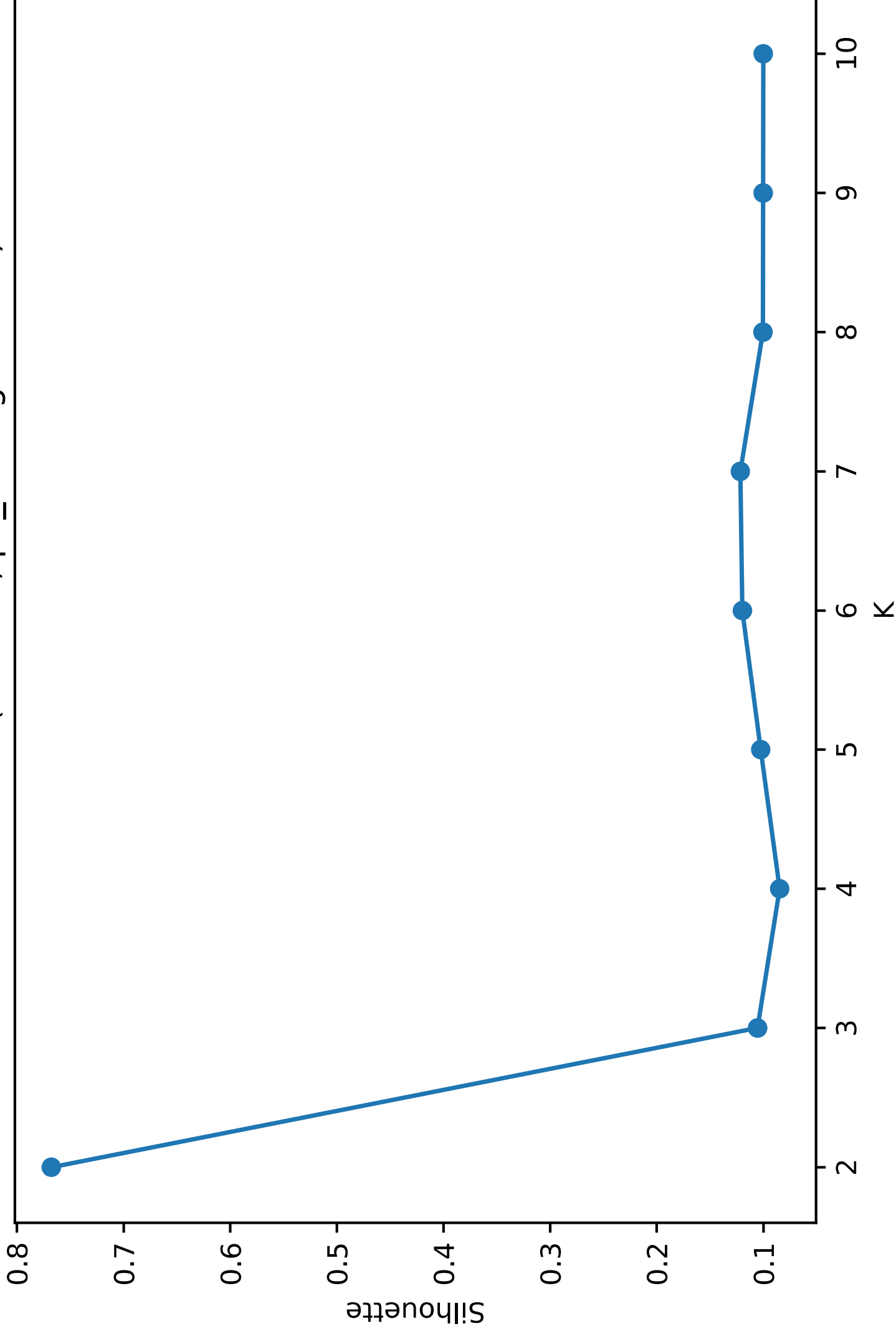
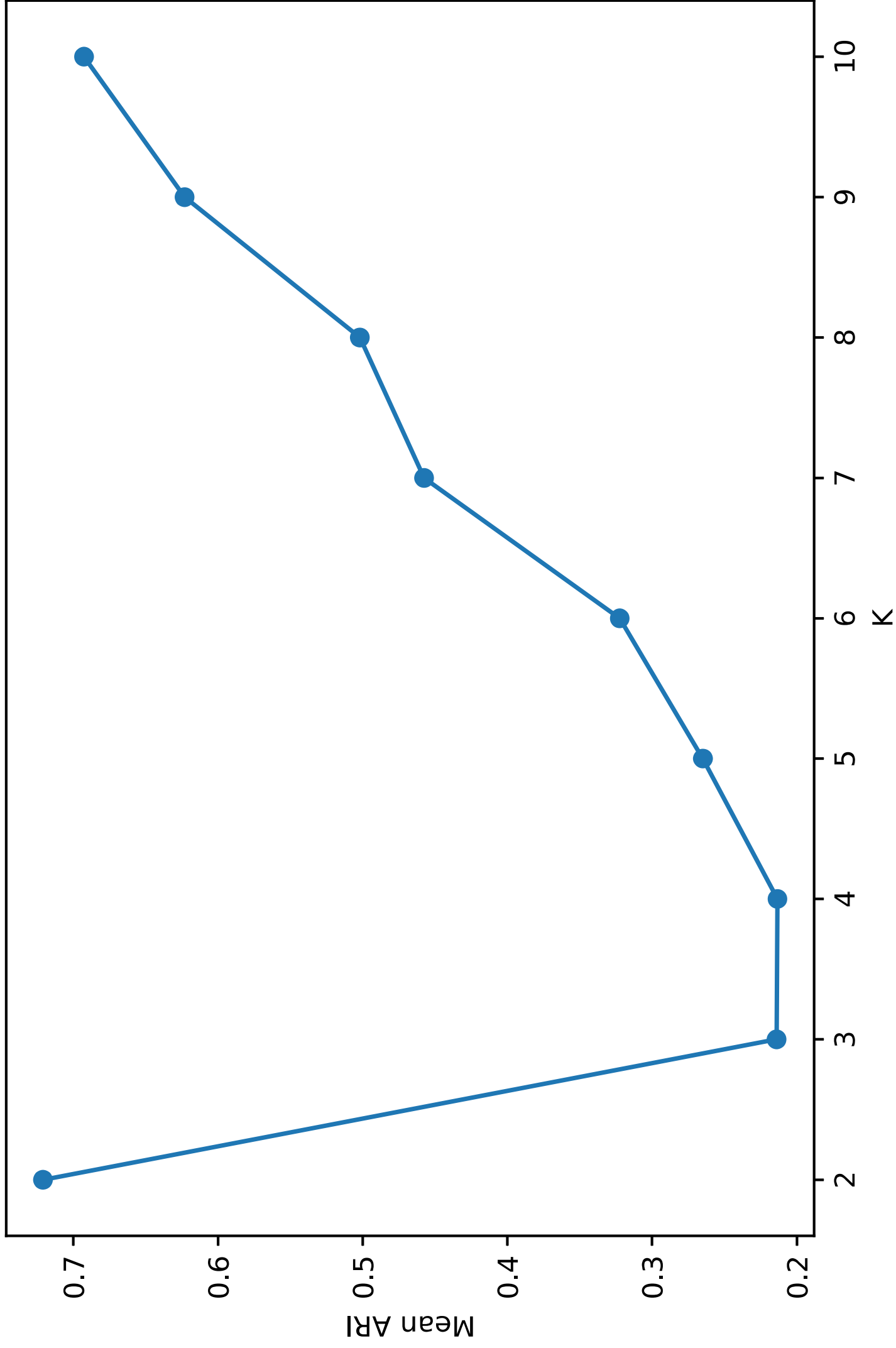


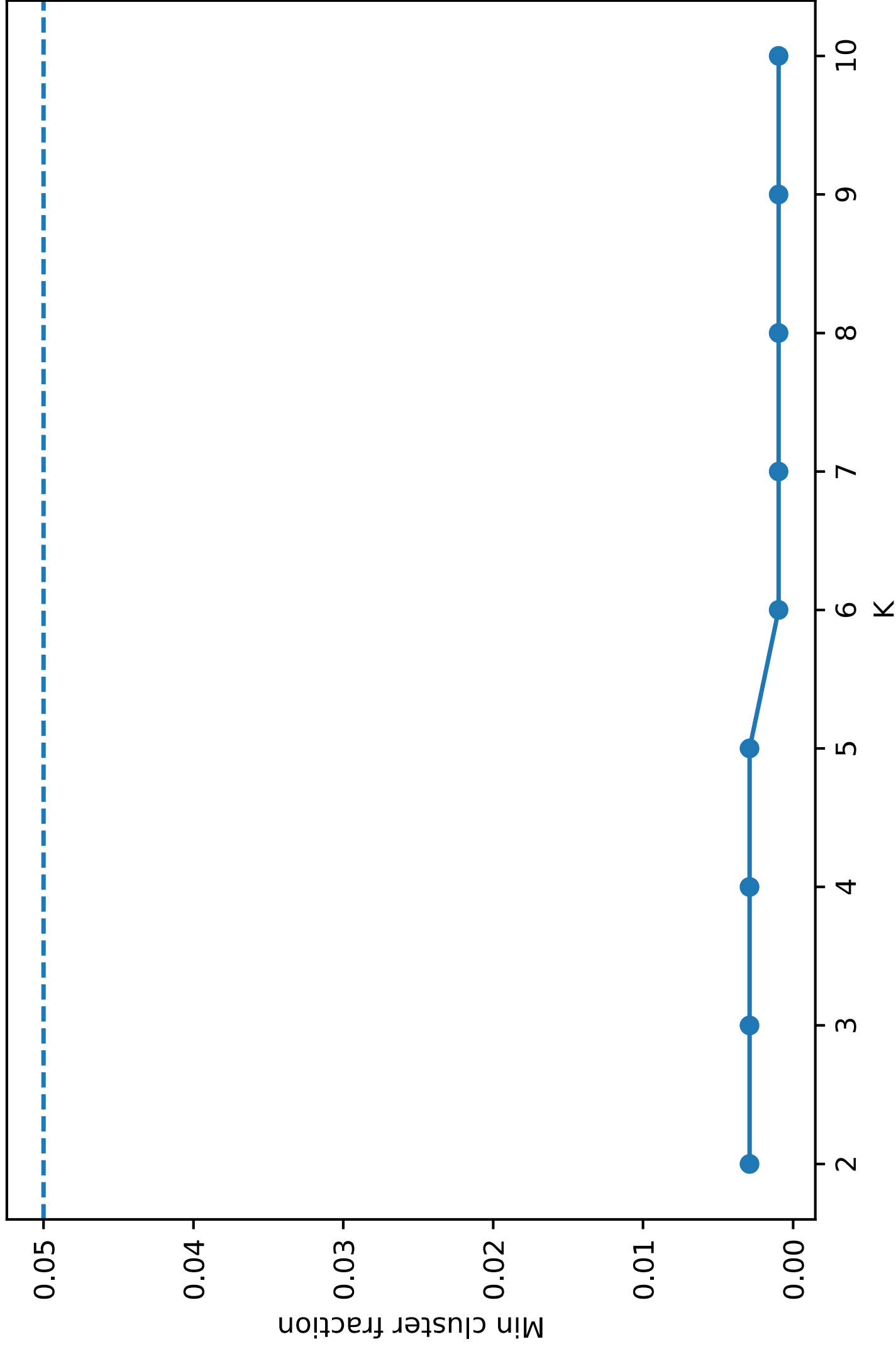
Silhouette vs K (kmeans; pc_scaling=zscore)



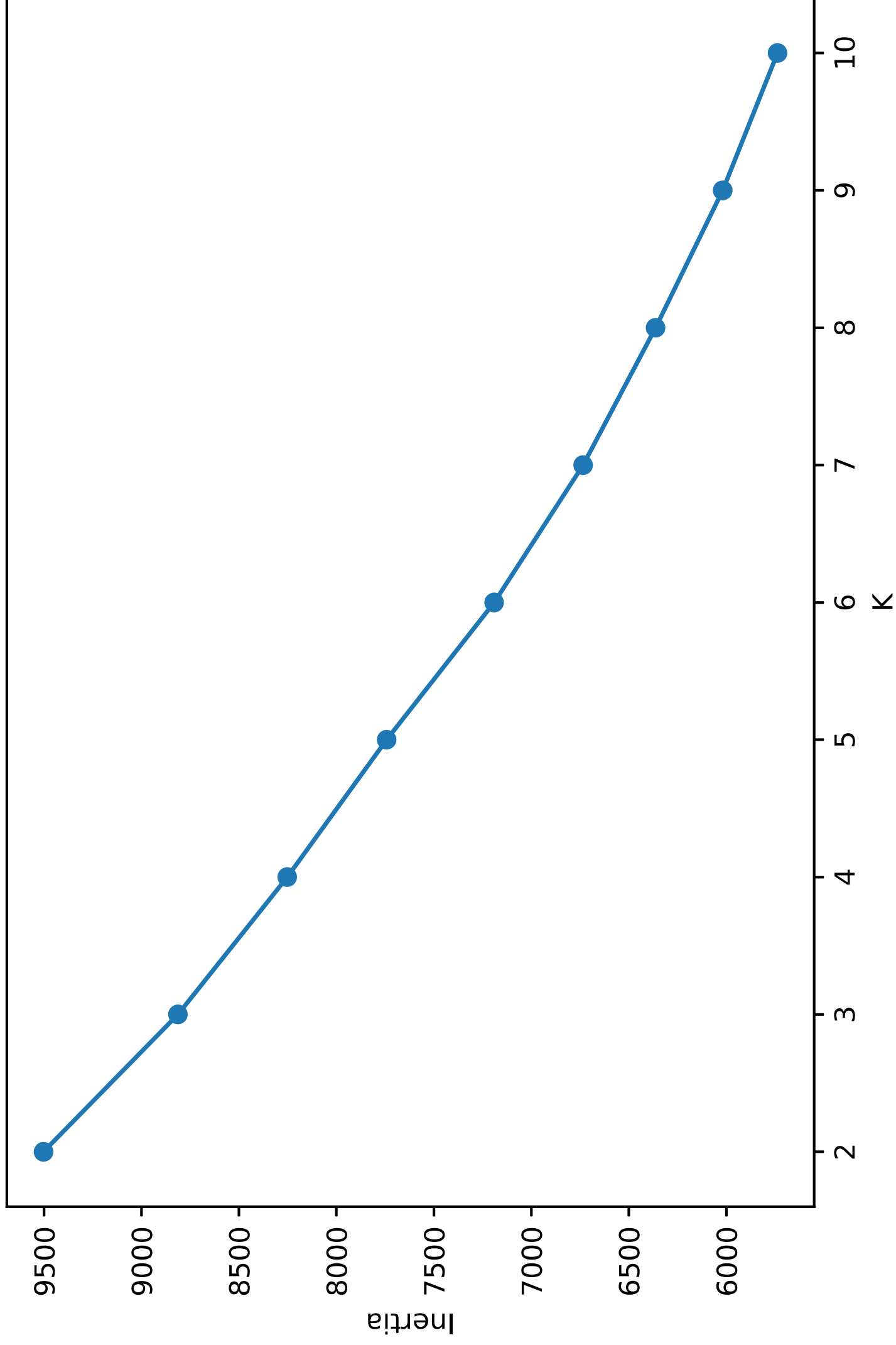
Stability (ARI) vs K (kmeans; pc_scaling=zscore)



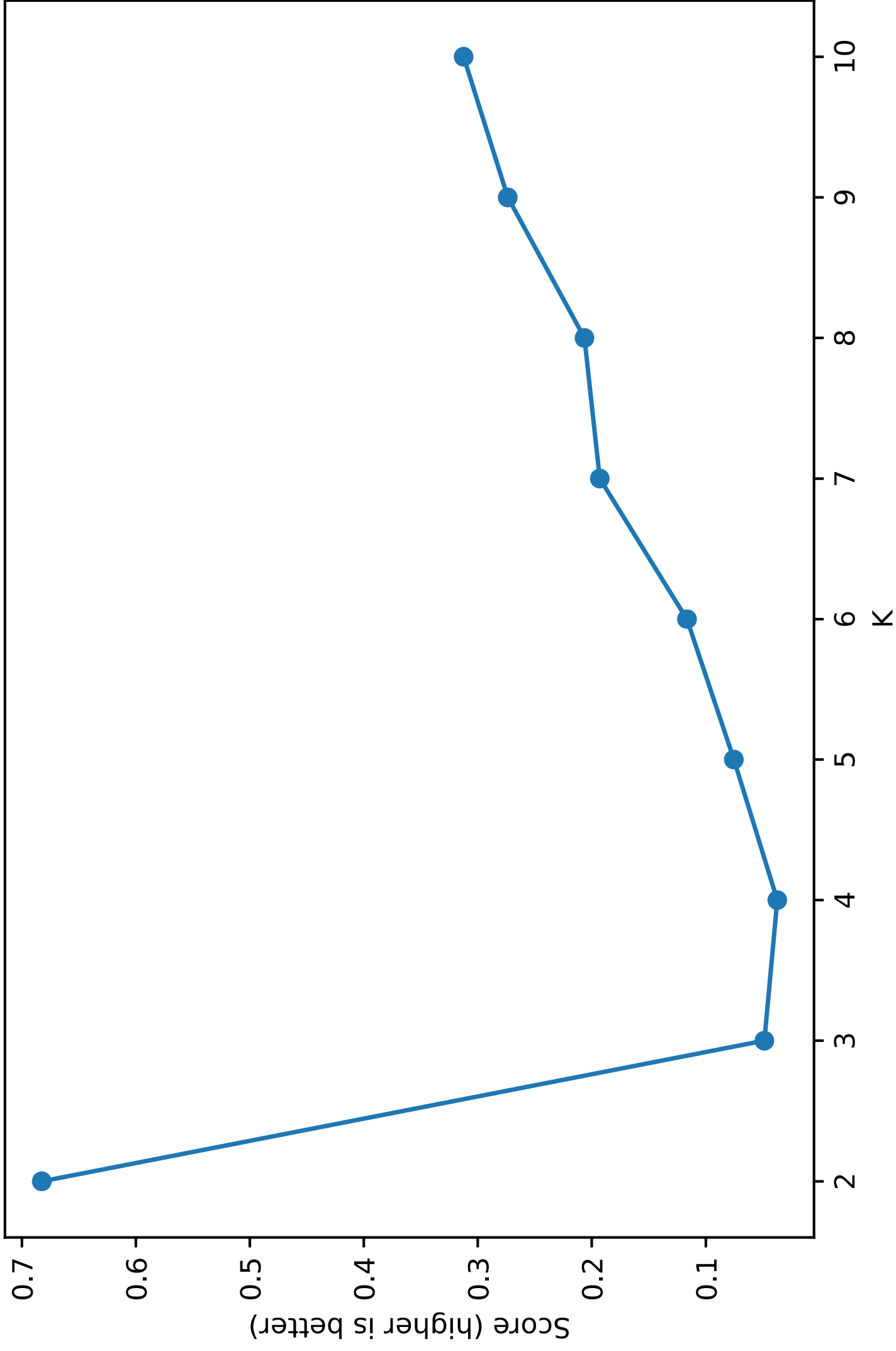
Min cluster fraction vs K (kmeans; pc_scaling=zscore)



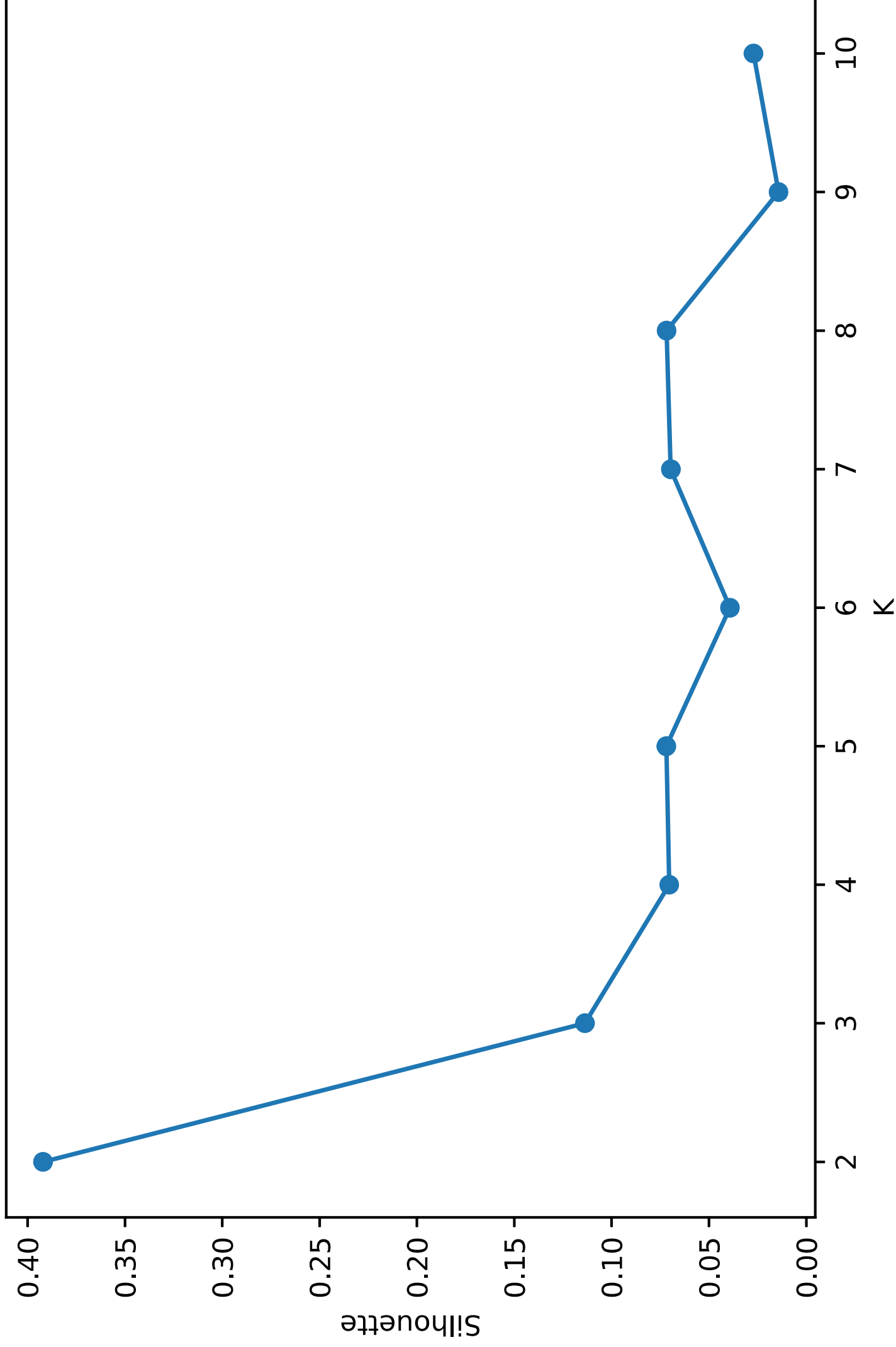
Elbow plot (K-means inertia; pc_scaling=zscore)



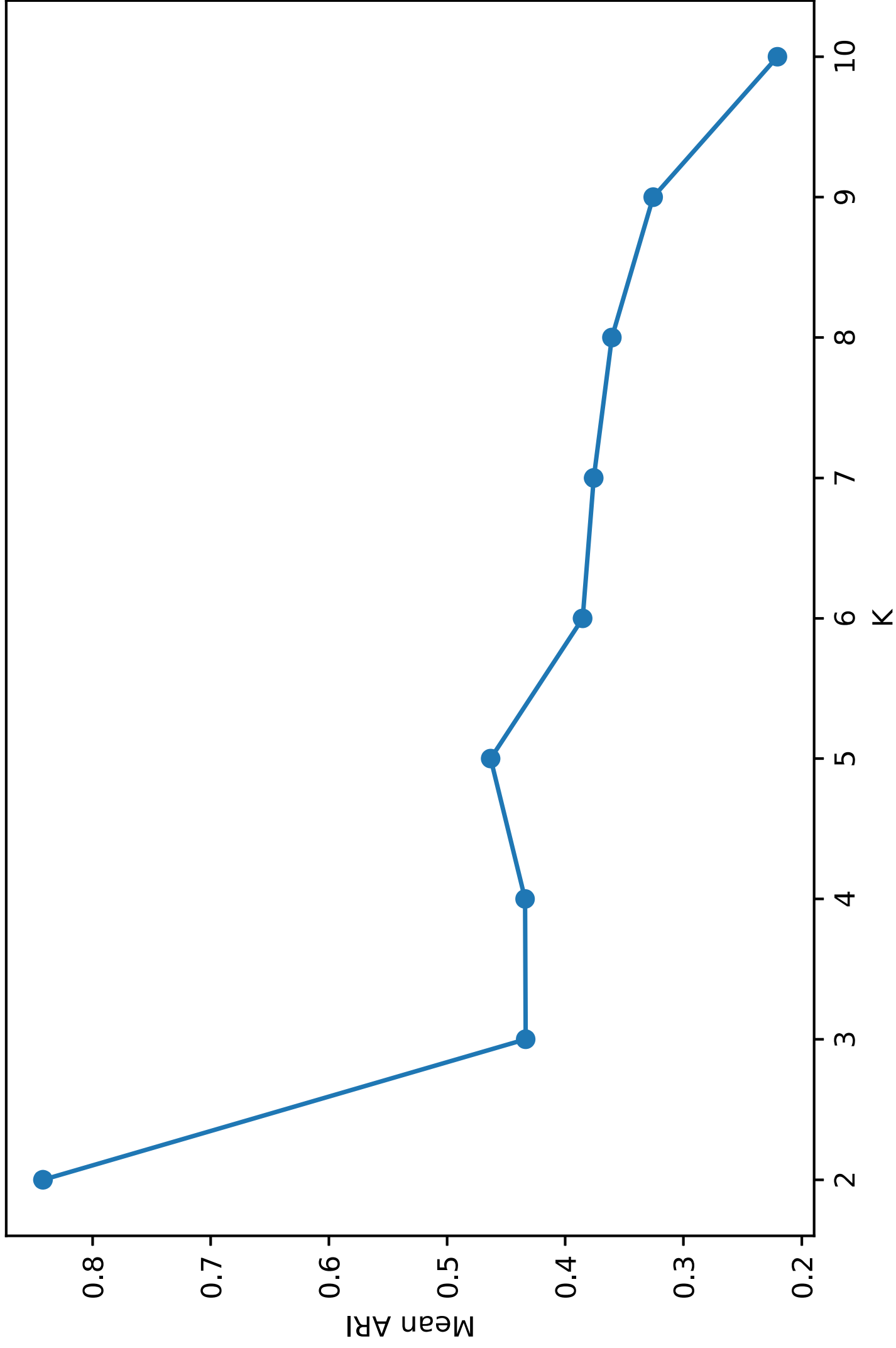
Composite score vs K (kmeans; pc_scaling=zscore)



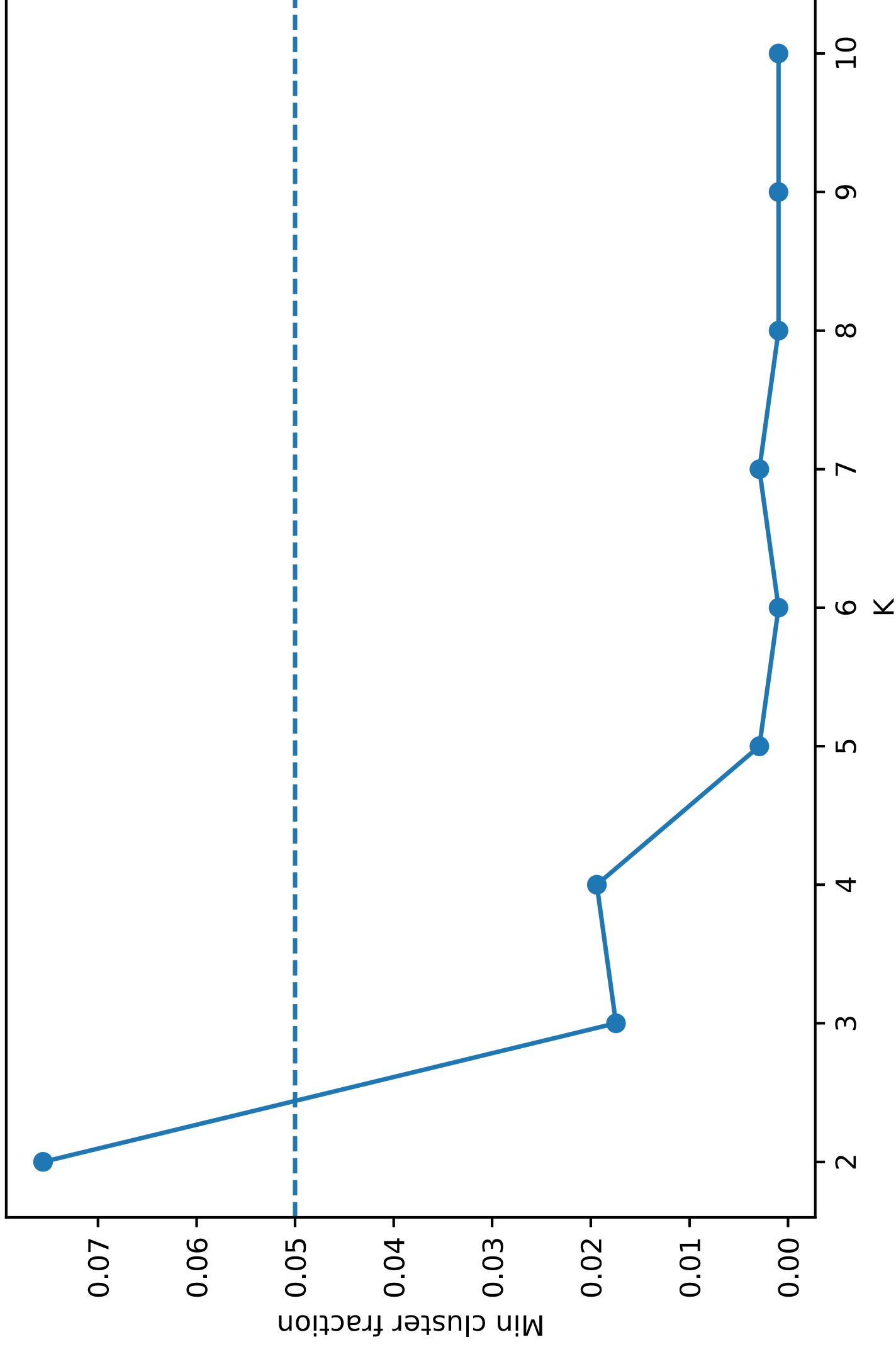
Silhouette vs K (gmm; pc_scaling=zscore)



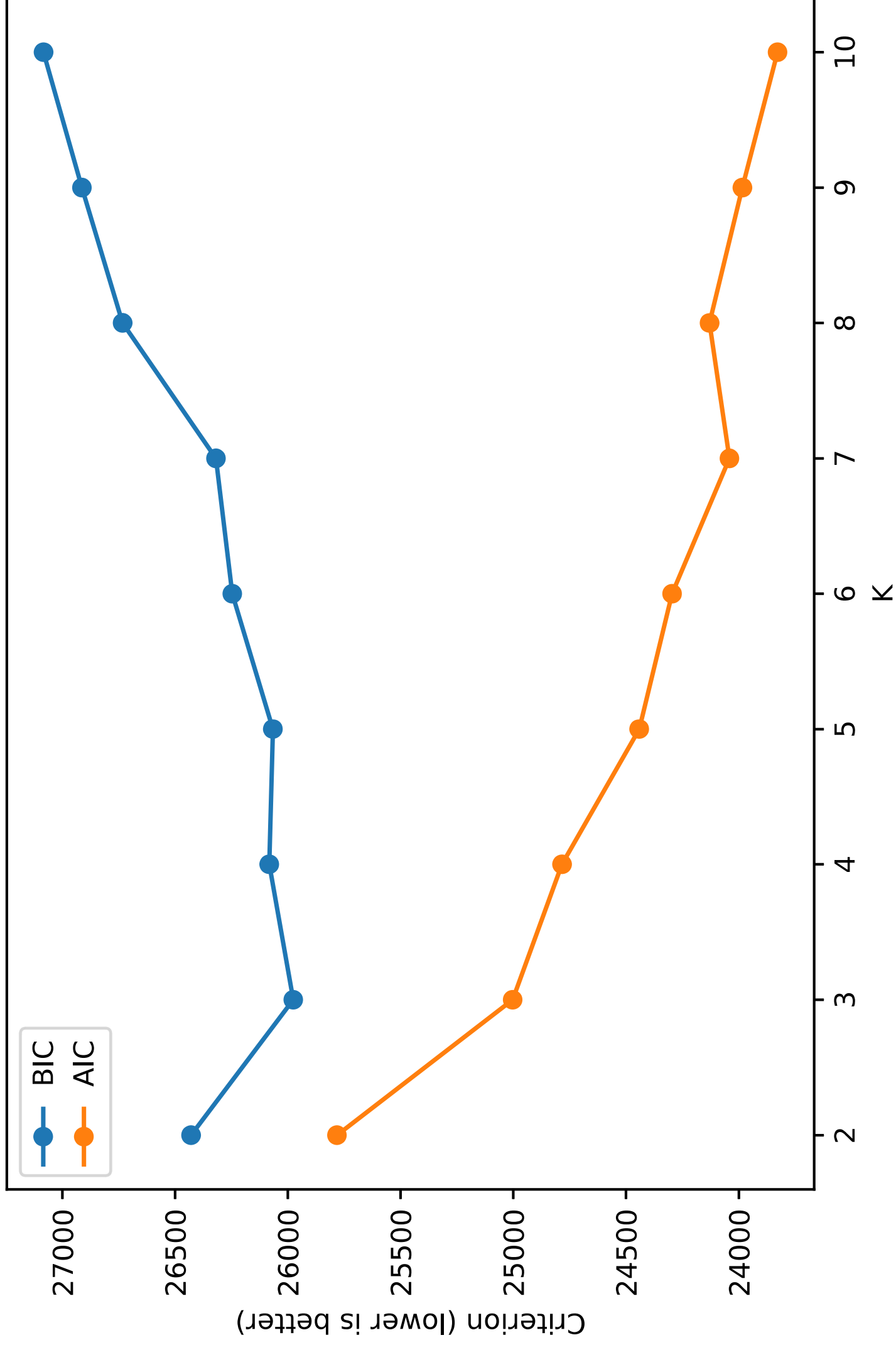
Stability (ARI) vs K (gmm; pc_scaling=zscore)



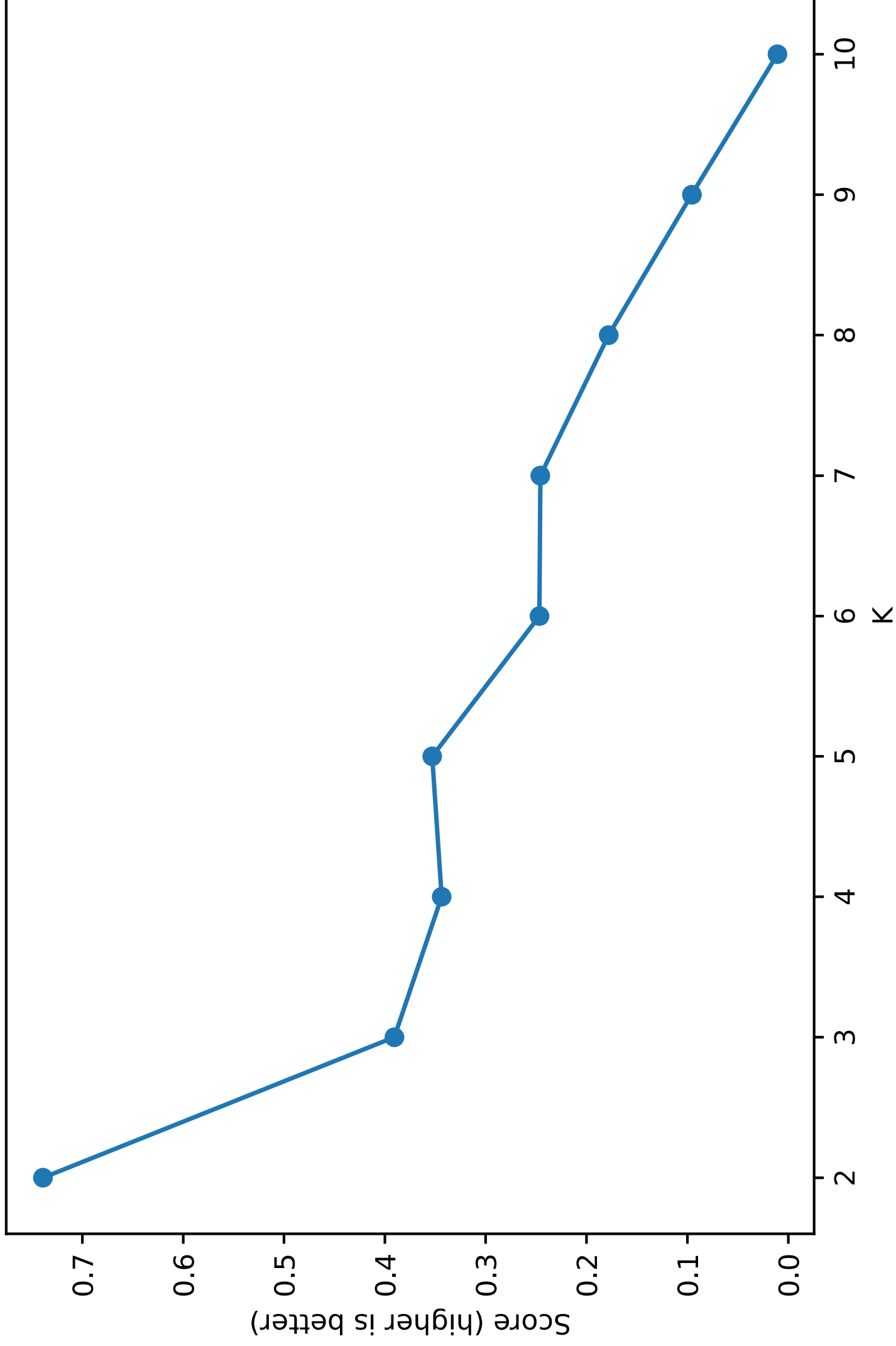
Min cluster fraction vs K (gmm; pc_scaling=zscore)



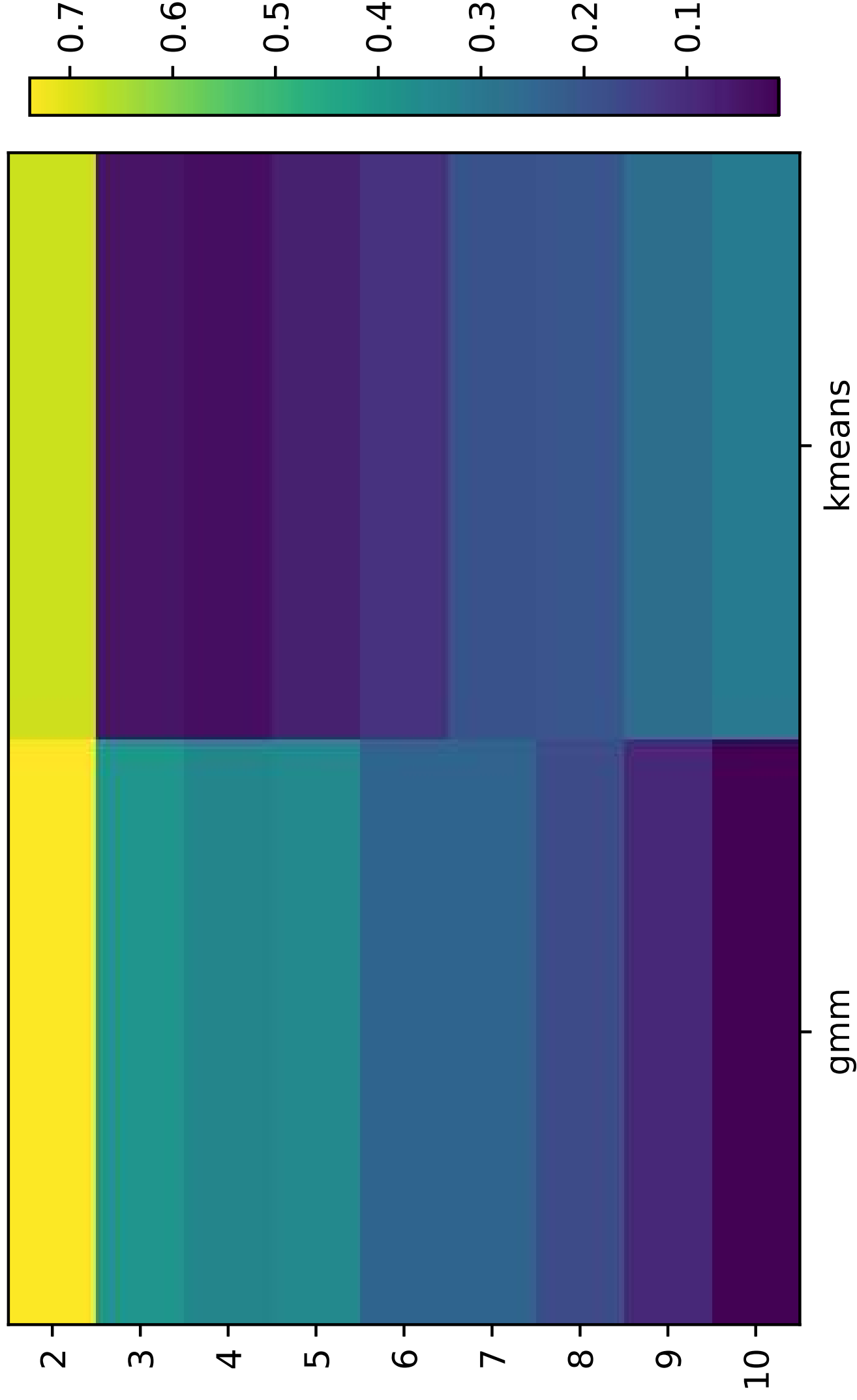
GMM information criteria (pc_scaling=zscore)



Composite score vs K (gmm; pc_scaling=zscore)



Composite score heatmap (pc_scaling=zscore)



Final selection summary

pc_scaling: zscore
model: gmm
K: 2
silhouette: 0.3921
stability_ari: 0.8420
min_cluster_frac: 0.0756 (constraint ≥ 0.050)
BIC: 26429.58 AIC: 25782.53
mean max posterior: 0.9890

Final cluster sizes:

cluster 0: n=954 (92.44%)
cluster 1: n=78 (7.56%)

Notes:

- Stability: subsampling without replacement; ARI vs reference solution.
- UMAP is for visualization only and is not used for clustering.