

A Cluster Analysis of Ohio Public District Expenditures

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Introduction

Ohio’s public-school districts differ in size, demographics, and student needs, which shape how they allocate funding. Understanding these spending patterns is important for identifying whether district resource allocation aligns with different student outcomes.

Aim

- Identify how Ohio districts vary in spending.
- Develop meaningful clusters that group districts based on expenditure patterns.
- Explore whether clusters relate to district attributes.

Data

- District-level Expenditure Per Pupil (EPP) is calculated using unweighted Average Daily Membership.
- Per Equivalent Pupil (EPEP, weighted ADM) used for comparison.
- District attributes and performance data added for further analysis.
- Data analysis was conducted using excel and R.

Spending Patterns

- Percent-of-total EPP boxplots show wide variation across classroom and non-classroom categories.
- EPP and EPEP produced similar distributions; only per-pupil spending is shown.

Figure 1. % of Total Expenditures Per Pupil (EPP)

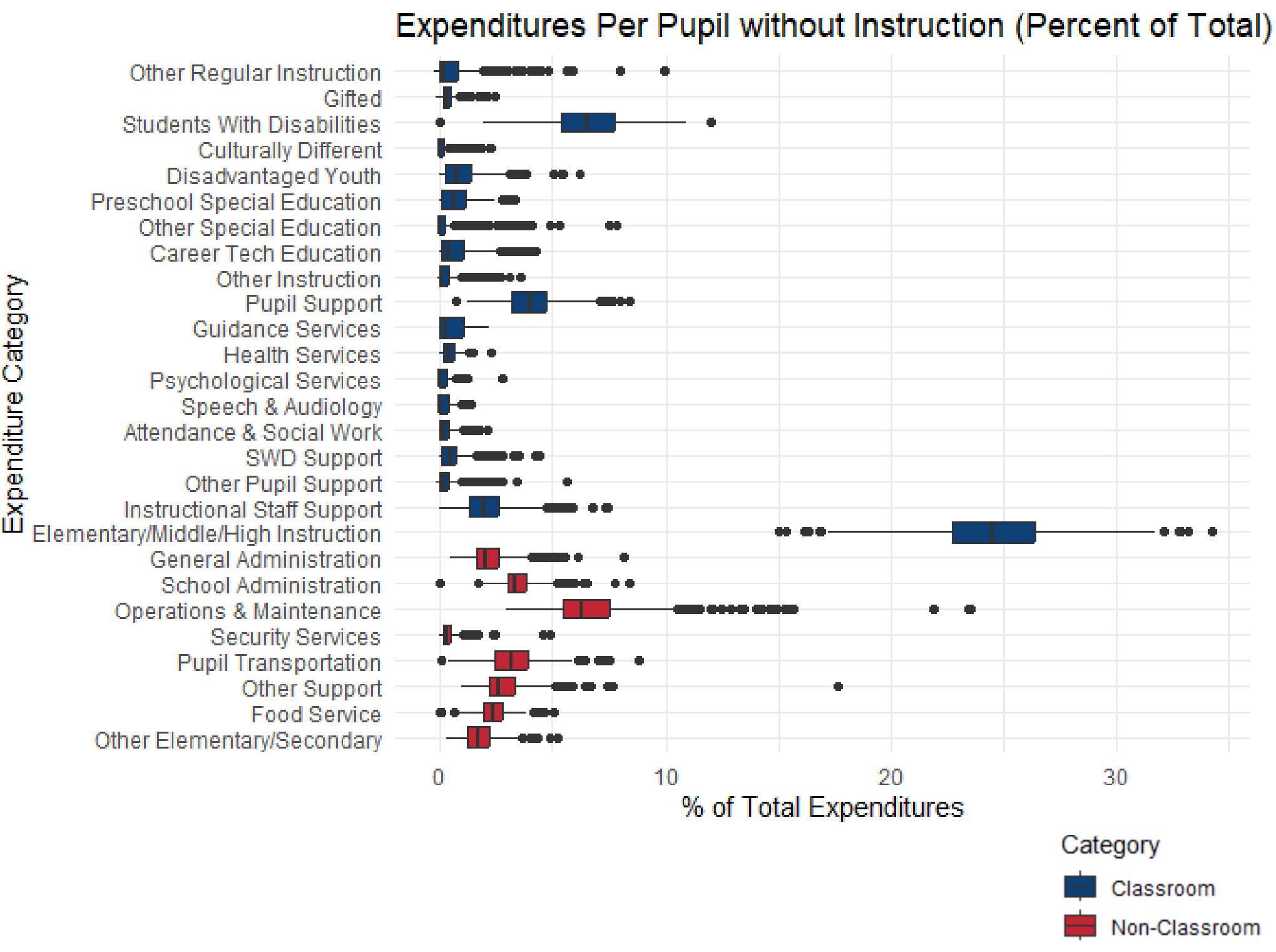


Figure 2. Consolidated Per-Pupil Expenditure (\$) Summary

Expenditure Type	mean	median	stdev	min	q1	q3	max
Regular Instruction PP	7158.9117	6945.1	1514.3084	4483.8	6250.40	7698.65	28496.3
Special Instruction PP	2437.7033	2384.6	756.7892	813.7	1891.80	2904.55	5369.6
Pupil Support PP	1089.1654	1063.7	411.4829	186.9	818.05	1278.45	3236.5
Instr Staff Support PP	556.9817	500.3	317.2101	-0.3	347.35	703.30	2506.4
Admin PP	1541.7715	1439.7	486.5380	726.9	1227.30	1737.55	4859.6

Outlier Analysis

- Z-scores flagged unusually high or low spending.
- Outlier districts are reviewed for alignment with cluster profiles.

Figure 3. Heatmap of Outlier Flags by District

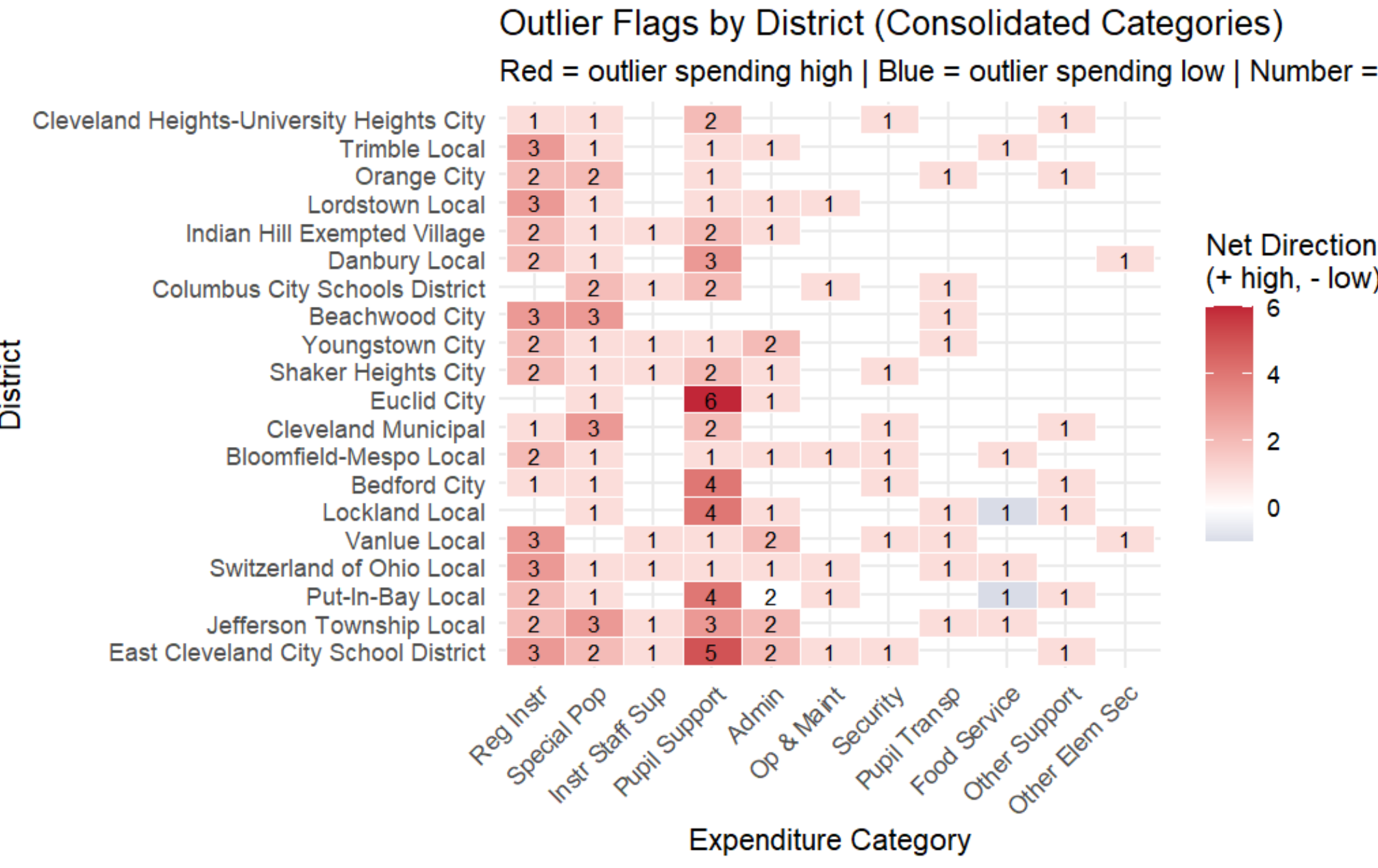
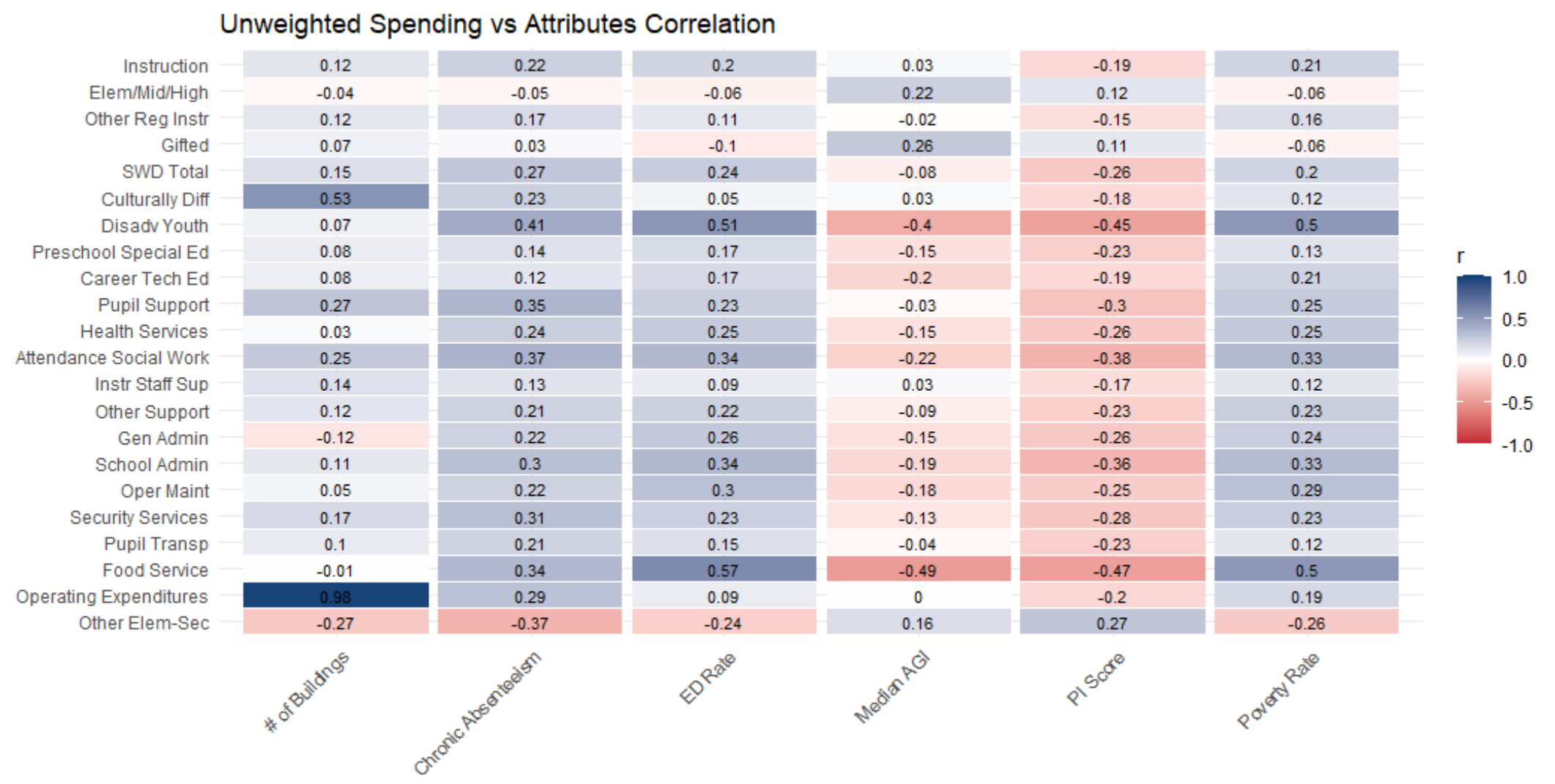


Figure 4. Correlation Heatmap Between Spending Types and District Attributes



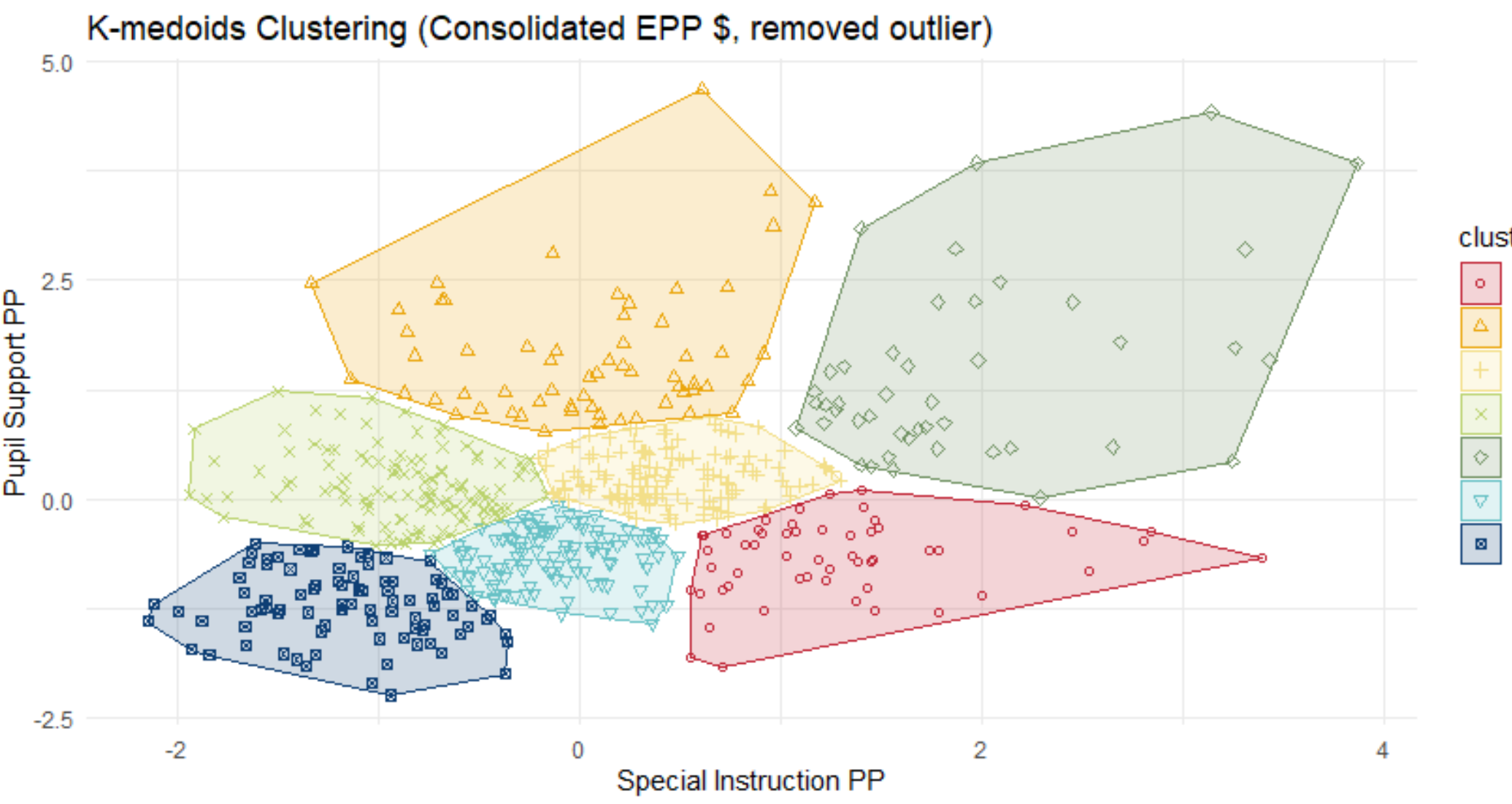
District Characteristics & Outcome Relationships

- Most spending-attribute correlations are modest.
- Operating Expenditures are highly correlated with the number of district buildings ($r = 0.98$).
- No single factor explained spending patterns, supporting the use of clustering.

Clustering Methods

- K-medoids created 7 clusters (one outlier removed).
- K-medoids uses real districts as cluster centers, making it less sensitive to outliers.
- Districts are clustered based on Special Instruction and Pupil Support per-pupil spending.

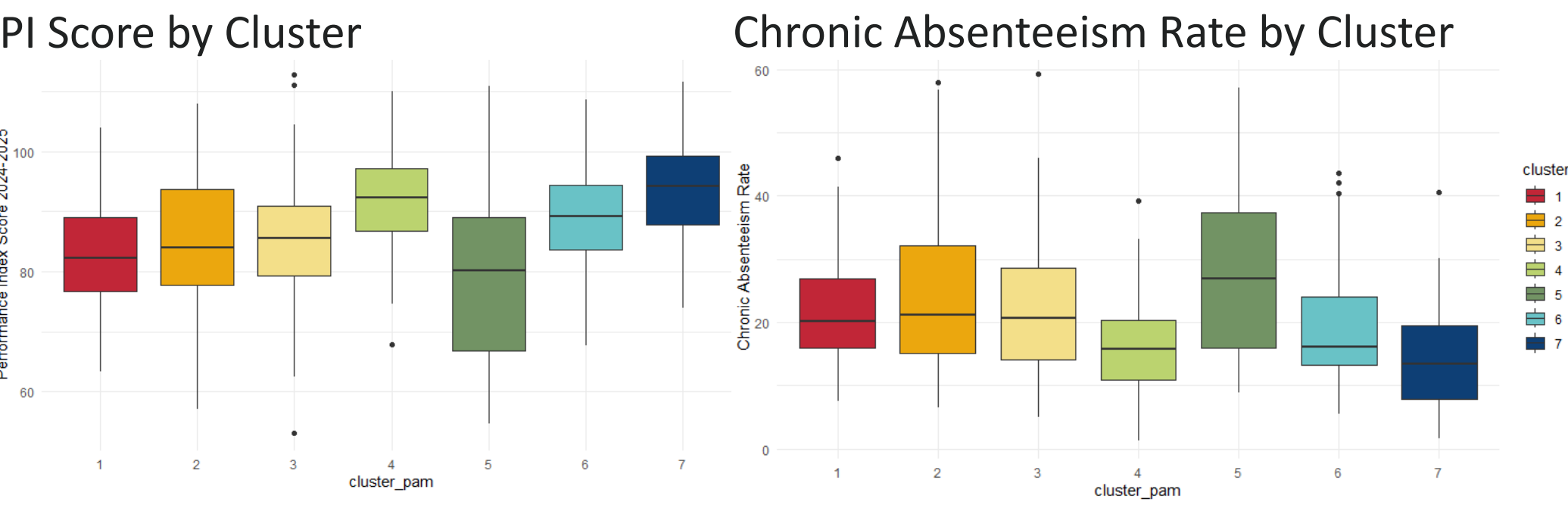
Figure 5. K-Medoids Clustering on Per-Pupil Spending



Clustering Profiles

- Cluster 7: Lower Special Instruction and Pupil Support PP.
- Cluster 5: Highest levels of both.
- Most outliers fall into clusters 5 and 2.
- School attributes show some differences across clusters.
- 2, 3, & 5 had higher absenteeism rates, higher spending.
- Cluster 5 had lower PI scores.
- 4 & 7 show higher PI scores and lower absenteeism and lower student spending.

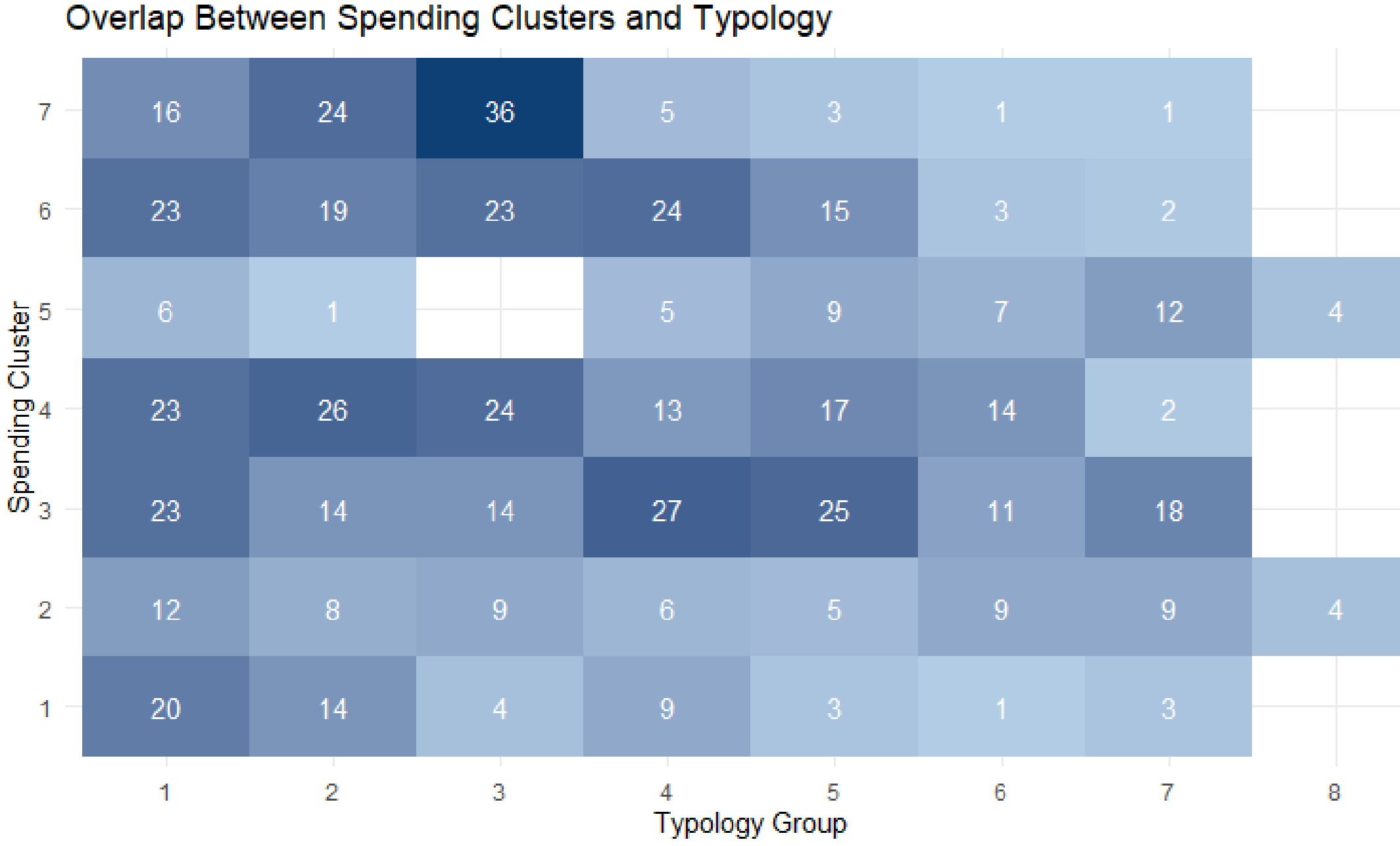
Figure 6. Boxplots of Clusters and Performance Index Score and Chronic Absenteeism Rate



Cluster-Typology Alignment

- Typology categories showed modest overlap with clusters.
- Clusters 7, 6, 4, 1 are largely rural/small-town and show lower spending for SI and PS.
- Outliers are spread across typologies.

Figure 7. Typology Composition within Spending Clusters



Conclusion

- District spending patterns vary, but these differences do not strongly align with socioeconomic or performance measures.
- Clustering on Special Instruction and Pupil Support spending produces clear groups that highlight different student support-related spending levels.
- Typology does not fully capture these spending differences.
- Clustering helps identify districts with similar expenditure priorities and better understand spending behavior.

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