Clustering with whole datasets

Author: Chuwen Zhong, Zhanchao Yang

Variable use

Demographic Variable

- Line: 1 or 2
- P10 (gender): male or female
- P12 (Education): low-high (cat 12: NA)
- P14 (occupation): according to original sequence
- P1 (housing type)
- P50 (income): low to high (cat 12: NA)
- P82 (own or rent): Own / Rent
- Edad (age): low to high (no head of the household lower than 18)
    - 18-24
    - 25-34
    - 35-44
    - 45-54
    - 55-64
    - Over 64

Perception Variable

- P68: Whether to support (binary)

Three-choice Variable: Agree, Neither agree nor disagree, Disagree

- P87: housing values
- P90: safety
- P91: expense
- P92: business
- P95: Public transit
- P96: time
- P98: noise
- P100: Public space
- P101: Housing project

Latent Classic Analytics (LCA) Clustering

Latent Class Analysis is a model-based clustering method for finding unobserved (“latent”) subgroups in multivariate categorical data. Unlike distance-based clustering (e.g., k-means), LCA assumes that an underlying categorical variable (the latent class) drives the joint distribution of observed indicators.

Model Formulation

Given J categorical variables $Y_1,\dots,Y_J$ and C latent classes:

$$ P(Y_1=y_1,\dots,Y_J=y_J) =\sum_{c=1}^C P(C=c)\prod_{j=1}^J P(Y_j=y_j \mid C=c) $$

- **Class prevalences** $\pi_c = P(C=c)$, $\sum_c \pi_c = 1$.
- **Item probabilities** $\theta_{jc}(k) = P(Y_j = k \mid C=c)$.

Results

Results table (k = 5)

Variable	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
line	58.9, 41.1	54.5, 45.5	39.1, 60.9	35.5, 64.5	73.2, 26.8
Gender	68, 32	59.1, 40.9	72.5, 27.5	48.4, 51.6	54.9, 45.1
Education	0, 1.5, 2.5, 18.8, 3, 13.7, 7.6, 17.8, 1.5, 26.9, 6.6, 0	6.8, 21.6, 22.7, 10.2, 1.1, 8, 2.3, 11.4, 3.4, 6.8, 2.3, 3.4	8.7, 8, 10.1, 21.7, 1.4, 26.8, 3.6, 4.3, 5.8, 8.7, 0, 0.7	9.7, 35.5, 0, 16.1, 0, 6.5, 6.5, 19.4, 6.5, 0, 0, 0	1.2, 12.2, 2.4, 30.5, 2.4, 24.4, 4.9, 2.4, 2.4, 9.8, 3.7, 3.7
Occupation	3, 0.5, 0, 5.1, 0.5, 36.5, 4.6, 11.2, 4.6, 30.5, 0, 0, 3.6	0, 0, 1.1, 0, 0, 1.1, 0, 3.4, 4.5, 18.2, 0, 1.1, 70.5	3.6, 0.7, 0, 3.6, 0, 31.9, 0, 1.4, 18.8, 25.4, 2.9, 4.3, 7.2	0, 0, 12.9, 0, 0, 0, 0, 0, 16.1, 25.8, 0, 3.2, 41.9	1.2, 0, 4.9, 0, 1.2, 26.8, 2.4, 4.9, 8.5, 35.4, 0, 0, 14.6
Housing type	60.9, 36, 0, 3, 0	79.5, 17, 1.1, 0, 2.3	54.3, 37, 8.7, 0, 0	80.6, 9.7, 9.7, 0, 0	56.1, 40.2, 3.7, 0, 0
Income	0.5, 7.6, 8.1, 11.2, 12.2, 13.2, 13.2, 11.2, 4.1, 2, 0.5, 16.2	10.2, 8, 6.8, 17, 12.5, 6.8, 12.5, 6.8, 9.1, 0, 1.1, 9.1	0.7, 6.5, 15.9, 27.5, 13.8, 6.5, 2.2, 7.2, 0, 0.7, 0, 18.8	3.2, 0, 16.1, 16.1, 9.7, 29, 3.2, 0, 3.2, 0, 0, 19.4	1.2, 8.5, 4.9, 6.1, 11, 2.4, 14.6, 1.2, 0, 0, 0, 50
Support or not	88.3, 11.7	93.2, 6.8	100, 0	77.4, 22.6	89, 11
Rent or own	37.6, 62.4	80.7, 19.3	11.6, 88.4	45.2, 54.8	57.3, 42.7
P87	82.2, 15.2, 2.5	83, 17, 0	44.2, 50.7, 5.1	54.8, 32.3, 12.9	52.4, 45.1, 2.4
P90	37.6, 35, 27.4	44.3, 27.3, 28.4	24.6, 69.6, 5.8	12.9, 35.5, 51.6	14.6, 70.7, 14.6
P91	84.3, 15.7, 0	68.2, 30.7, 1.1	44.2, 55.8, 0	58.1, 9.7, 32.3	19.5, 75.6, 4.9
P92	73.6, 18.8, 7.6	72.7, 27.3, 0	47.1, 50, 2.9	22.6, 6.5, 71	11, 79.3, 9.8
P95	49.7, 33.5, 16.8	67, 23.9, 9.1	59.4, 23.2, 17.4	12.9, 25.8, 61.3	13.4, 80.5, 6.1
P96	24.9, 25.9, 49.2	25, 30.7, 44.3	21, 26.8, 52.2	9.7, 19.4, 71	0, 75.6, 24.4

Variable	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
P98	72.6, 11.7, 15.7	44.3, 25, 30.7	23.9, 39.1, 37	67.7, 16.1, 16.1	15.9, 81.7, 2.4
P100	28.4, 23.9, 47.7	51.1, 43.2, 5.7	26.8, 57.2, 15.9	9.7, 29, 61.3	8.5, 79.3, 12.2
P101	69.5, 15.7, 14.7	72.7, 22.7, 4.5	55.1, 39.1, 5.8	48.4, 3.2, 48.4	6.1, 92.7, 1.2
Age	2, 23.4, 32.5, 28.4, 13.7, 0	1.1, 0, 0, 10.2, 25, 63.6	14.5, 13, 18.1, 20.3, 21, 13	0, 12.9, 9.7, 6.5, 25.8, 45.2	1.2, 7.3, 26.8, 20.7, 24.4, 19.5

Chart


Grp 1: line
Grp 1: P10
Grp 1: P12
Grp 2: line
Grp 2: P10
Grp 2: P12
Grp 3: line
Grp 3: P10
Grp 3: P12
Grp 4: line
Grp 4: P10
Grp 4: P12
Grp 5: line
Grp 5: P10
Grp 5: P12
Grp 1: P14
Grp 1: P1
Grp 1: P50
Grp 2: P14
Grp 2: P1
Grp 2: P50
Grp 3: P14
Grp 3: P1
Grp 3: P50
Grp 4: P14
Grp 4: P1
Grp 4: P50
Grp 5: P14
Grp 5: P1
Grp 5: P50


Grp 1: P68
Grp 1: P82
Grp 1: P87
Grp 2: P68
Grp 2: P82
Grp 2: P87
Grp 3: P68
Grp 3: P82
Grp 3: P87
Grp 4: P68
Grp 4: P82
Grp 4: P87
Grp 5: P68
Grp 5: P82
Grp 5: P87
Grp 1: P90
Grp 1: P91
Grp 1: P92
Grp 2: P90
Grp 2: P91
Grp 2: P92
Grp 3: P90
Grp 3: P91
Grp 3: P92
Grp 4: P90
Grp 4: P91
Grp 4: P92
Grp 5: P90
Grp 5: P91
Grp 5: P92
cat1
cat2
cat3
0.0
0.2
0.4
0.6
0.8
1.0


Grp 1: P95
Grp 1: P96
Grp 1: P98
Grp 2: P95
Grp 2: P96
Grp 2: P98
Grp 3: P95
Grp 3: P96
Grp 3: P98
Grp 4: P95
Grp 4: P96
Grp 4: P98
Grp 5: P95
Grp 5: P96
Grp 5: P98
Grp 1: P100
Grp 1: P101
Grp 1: Edad
Grp 2: P100
Grp 2: P101
Grp 2: Edad
Grp 3: P100
Grp 3: P101
Grp 3: Edad
Grp 4: P100
Grp 4: P101
Grp 4: Edad
Grp 5: P100
Grp 5: P101
Grp 5: Edad
cat1
cat2
cat3
cat4
cat5
cat6
0.0
0.2
0.4
0.6
0.8
1.0

Takeaway

The Latent Classic Analytics cluster method hasn't distinguished between people who support or do not support the metro project.

Cluster 1: “Value-Driven Renters”

- **Profile & Support**
  - Predominantly homeowners (62 % rent vs. 38 % own)
  - Mixed ages, slightly skewed male
  - Strong majority support (88 %) for the Metro project
- **Perceptions**
  - 82 % agree it will boost housing values
  - 84 % agree it will reduce living expenses
  - 74 % agree it will spur local business
  - Only 50 % agree on transit improvements
  - 49 % doubt it will save travel time
- **Implication**
  - Emphasize property-value gains and cost-saving benefits in homeowner outreach
  - Provide concrete data on travel-time savings to address efficiency concerns

Cluster 2: “Senior Owners Enthusiasts”

- **Profile & Support**
  - Older renters (81 % own; 64 % in the oldest age bracket)
  - Very high support (93 %)
  - Balanced income and education levels
- **Perceptions**
  - 83 % believe in housing value gains
  - 67 % see transit benefits
  - 44 % worry it won’t cut travel time
  - 44 % expect safety improvements
- **Implication**
  - Highlight mobility and safety features tailored to seniors
  - Showcase real-world examples of reduced door-to-destination times

Cluster 3: “Renters Fence-Sitters”

- **Profile & Support**
  - Almost entirely renters (88 % rent)
  - 100 % support, but mostly neutral on benefits
- **Perceptions**
  - 40–70 % “neither agree nor disagree” across benefit items
- **Implication**
  - Provide clear, detailed case studies
  - Use before-and-after metrics from comparable neighborhoods

Cluster 4: “Skeptical Elders”

- **Profile & Support**
  - Older cohort (45 % in the oldest age bracket)
  - Balanced rent/own
  - Lowest support (77 %)
- **Perceptions**
  - Less than 50 % disagree that it will be safe or reduce noise
  - 61 % doubt transit benefits
  - 71 % doubt travel-time savings
- **Implication**
  - Organize community forums on safety and noise mitigation
  - Bring in peer testimonials about actual time savings

Cluster 5: “Affluent Pragmatists”

- **Profile & Support**
  - Highest-income group (50 % in top bracket)
  - Even split homeowners/renters
  - 89 % in favor, but largely indifferent
- **Perceptions**
  - 75–92 % “neither agree nor disagree” on most items
- **Implication**
  - Deliver concise, data-driven briefs on ROI
    - Societal: congestion reduction, environmental impact
    - Personal: commute times, property appreciation

K-means

Context

Since the k-means algorithm is only suitable for dealing with ordinal data (based on scales) or numeric data, categorical data were excluded from this analysis. Excluding variables include occupation and housing type. Binary variable was treated as 1 or 2 scale. Ordinal variables, including age, education level, and income level, were treated as continuous numeric variables. For example, people who only received a middle school degree are two scales level lower than people who received a technical college degree. To better suit the context of the survey table, the final results were yielded back as similar to the previous Latent Classic Analytics table, which indicates the probabilities in each clustering rather than the centroid or means.

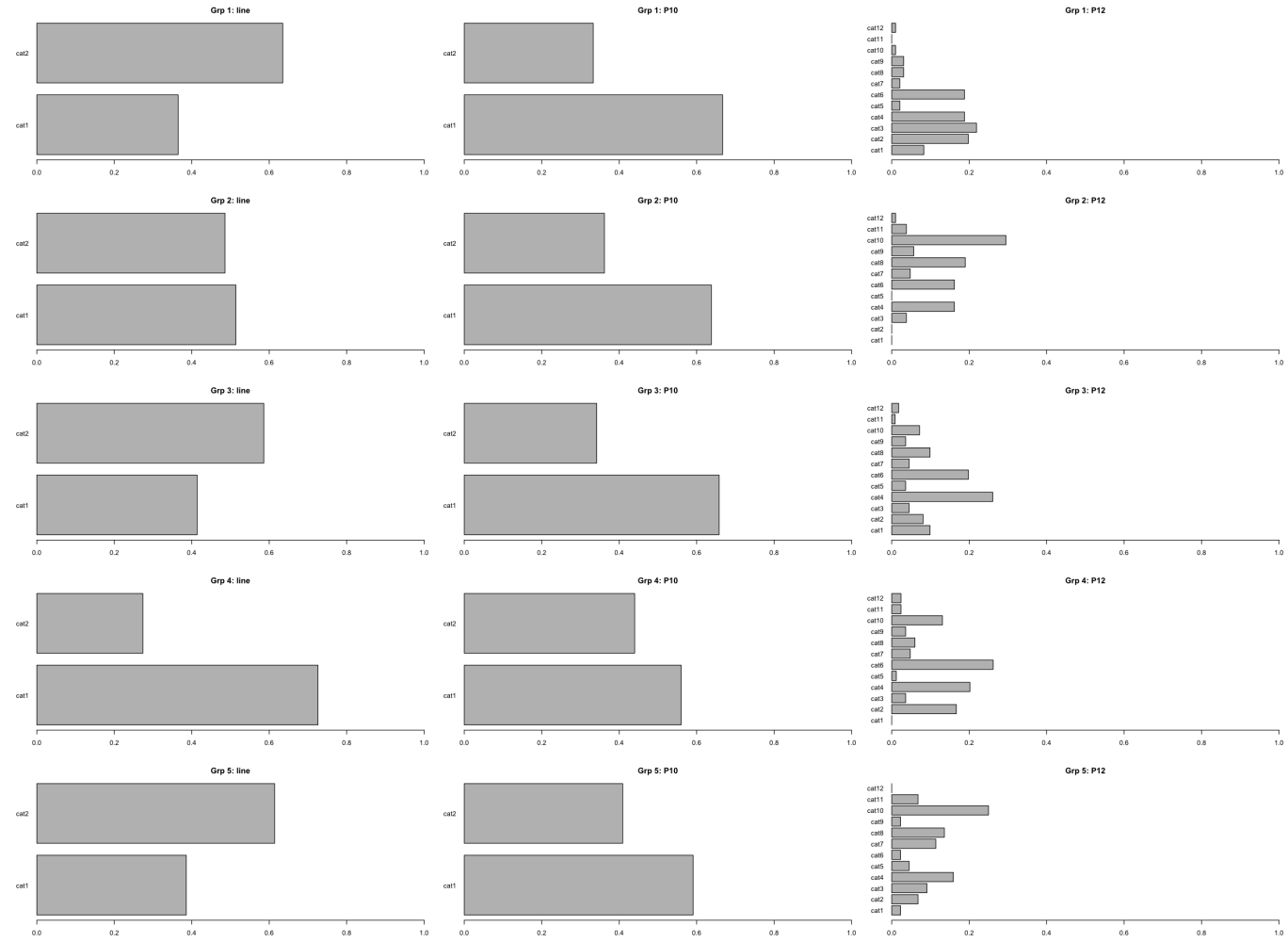
Results

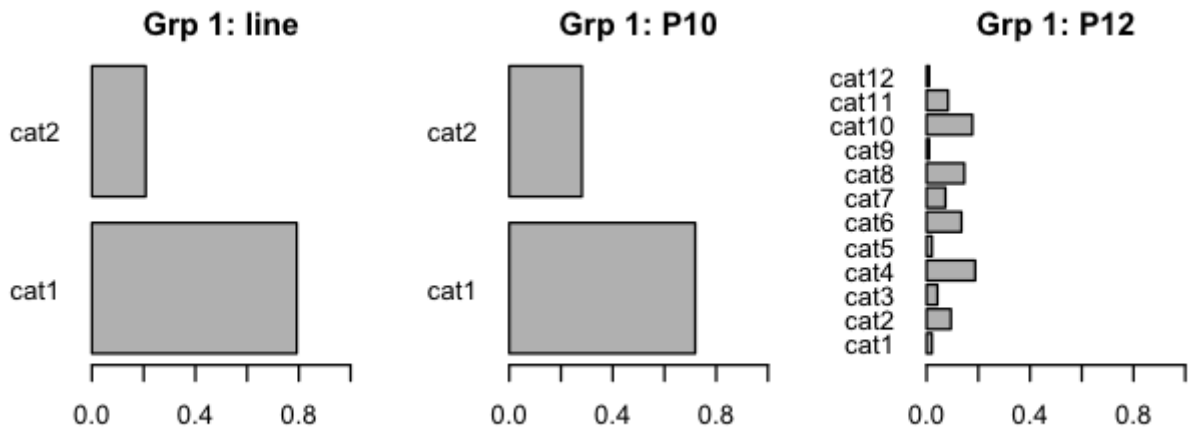
Results table (k = 6)

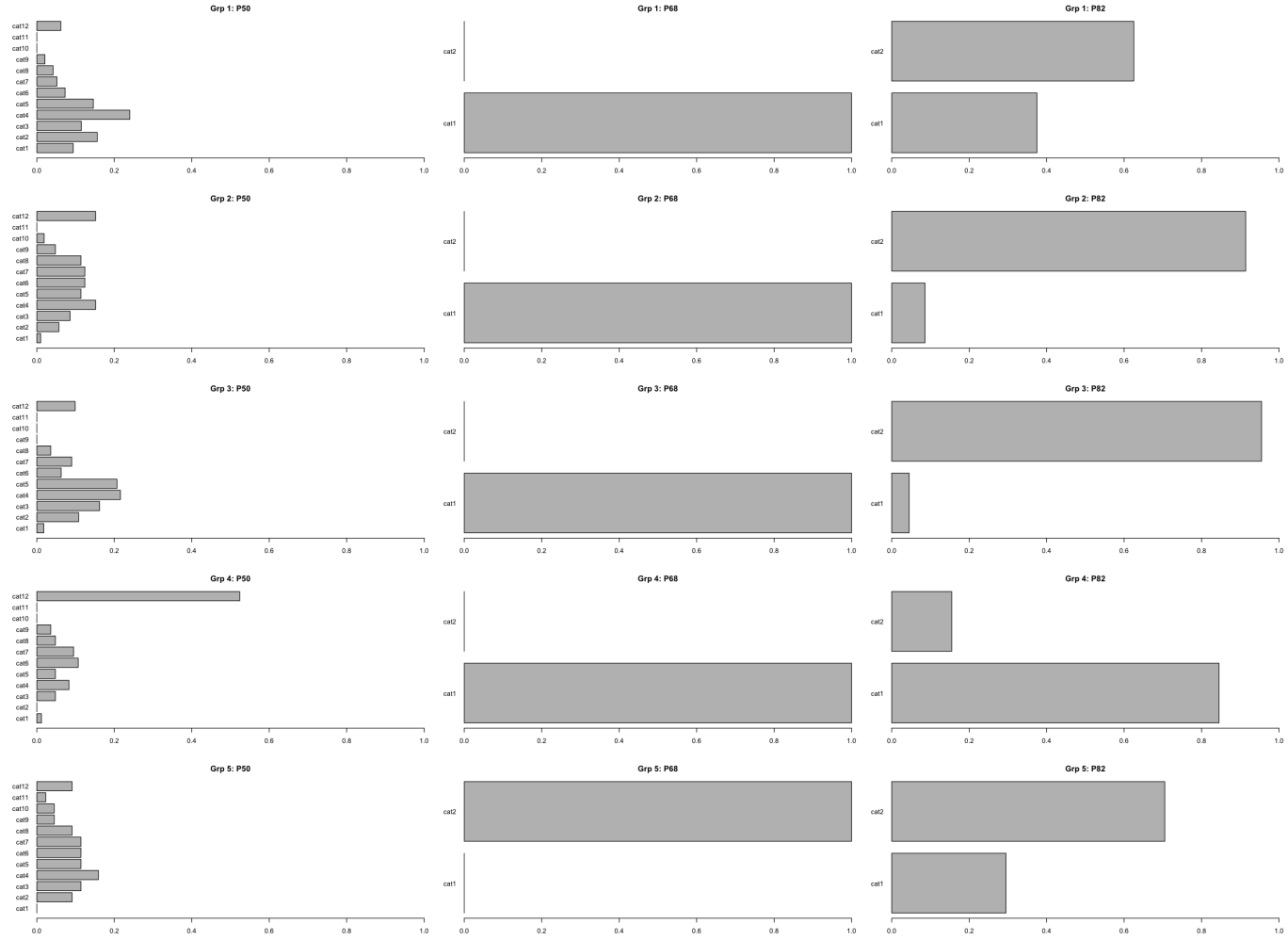
Variable	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
line	36.5, 63.5	51.4, 48.6	41.4, 58.6	72.6, 27.4	38.6, 61.4	79.2, 20.8
Gender	66.7, 33.3	63.8, 36.2	65.8, 34.2	56, 44	59.1, 40.9	71.9, 28.1

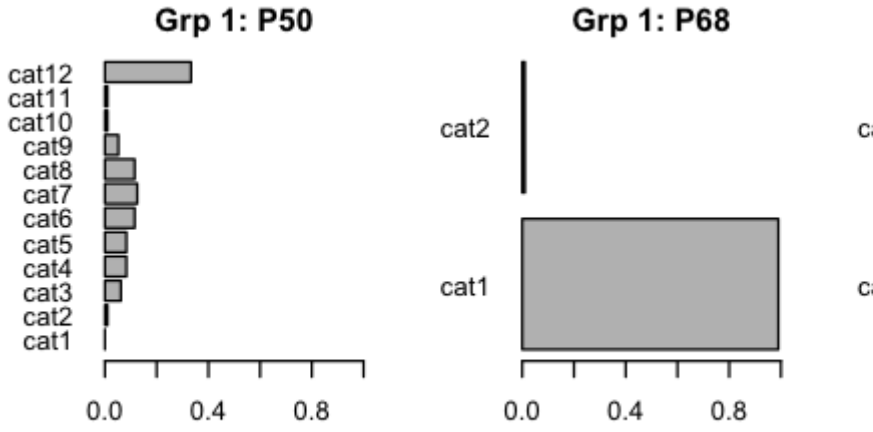
Variable	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Education	8.3, 19.8, 21.9, 18.8, 2.1, 18.8, 2.1, 3.1, 3.1, 1, 0, 1	0, 0, 3.8, 16.2, 0, 16.2, 4.8, 19, 5.7, 29.5, 3.8, 1	9.9, 8.1, 4.5, 26.1, 3.6, 19.8, 4.5, 9.9, 3.6, 7.2, 0.9, 1.8	0, 16.7, 3.6, 20.2, 1.2, 26.2, 4.8, 6, 3.6, 13.1, 2.4, 2.4	2.3, 6.8, 9.1, 15.9, 4.5, 2.3, 11.4, 13.6, 2.3, 25, 6.8, 0	2.1, 9.4, 4.2, 18.8, 2.1, 13.5, 7.3, 14.6, 1, 17.7, 8.3, 1
Income	9.4, 15.6, 11.5, 24, 14.6, 7.3, 5.2, 4.2, 2.1, 0, 0, 6.2	1, 5.7, 8.6, 15.2, 11.4, 12.4, 12.4, 11.4, 4.8, 1.9, 0, 15.2	1.8, 10.8, 16.2, 21.6, 20.7, 6.3, 9, 3.6, 0, 0, 0, 9.9	1.2, 0, 4.8, 8.3, 4.8, 10.7, 9.5, 4.8, 3.6, 0, 0, 52.4	0, 9.1, 11.4, 15.9, 11.4, 11.4, 11.4, 9.1, 4.5, 4.5, 2.3, 9.1	0, 1, 6.2, 8.3, 8.3, 11.5, 12.5, 11.5, 5.2, 1, 1, 33.3
Support or not	100, 0	100, 0	100, 0	100, 0	0, 100	99, 1
Rent or Own	37.5, 62.5	8.6, 91.4	4.5, 95.5	84.5, 15.5	29.5, 70.5	91.7, 8.3
P87	84.4, 15.6, 0	79, 19, 1.9	32.4, 60.4, 7.2	59.5, 36.9, 3.6	65.9, 22.7, 11.4	80.2, 19.8, 0
P90	43.8, 38.5, 17.7	30.5, 44.8, 24.8	18.9, 72.1, 9	27.4, 45.2, 27.4	36.4, 34.1, 29.5	30.2, 42.7, 27.1
P91	87.5, 11.5, 1	91.4, 8.6, 0	23.4, 73.9, 2.7	42.9, 50, 7.1	59.1, 31.8, 9.1	55.2, 43.8, 1
P92	78.1, 19.8, 2.1	85.7, 12.4, 1.9	22.5, 65.8, 11.7	10.7, 63.1, 26.2	43.2, 36.4, 20.5	75, 24, 1
P95	52.1, 32.3, 15.6	56.2, 31.4, 12.4	50.5, 36, 13.5	7.1, 65.5, 27.4	29.5, 31.8, 38.6	72.9, 20.8, 6.2
P96	45.8, 37.5, 16.7	19, 24.8, 56.2	7.2, 36.9, 55.9	20.2, 54.8, 25	18.2, 40.9, 40.9	6.2, 16.7, 77.1
P98	45.8, 29.2, 25	69.5, 19, 11.4	25.2, 45, 29.7	40.5, 48.8, 10.7	79.5, 18.2, 2.3	36.5, 25, 38.5
P100	51, 43.8, 5.2	18.1, 31.4, 50.5	16.2, 61.3, 22.5	13.1, 47.6, 39.3	27.3, 22.7, 50	40.6, 46.9, 12.5
P101	65.6, 27.1, 7.3	75.2, 22.9, 1.9	41.4, 45.9, 12.6	19, 57.1, 23.8	45.5, 31.8, 22.7	76, 19.8, 4.2
Age	1, 0, 9.4, 21.9, 36.5, 31.2	9.5, 34.3, 31.4, 20, 4.8, 0	12.6, 17.1, 28.8, 17.1, 14.4, 9.9	1.2, 8.3, 13.1, 19, 22.6, 35.7	0, 15.9, 22.7, 20.5, 25, 15.9	0, 5.2, 19.8, 27.1, 20.8, 27.1
count	96	105	111	84	44	96

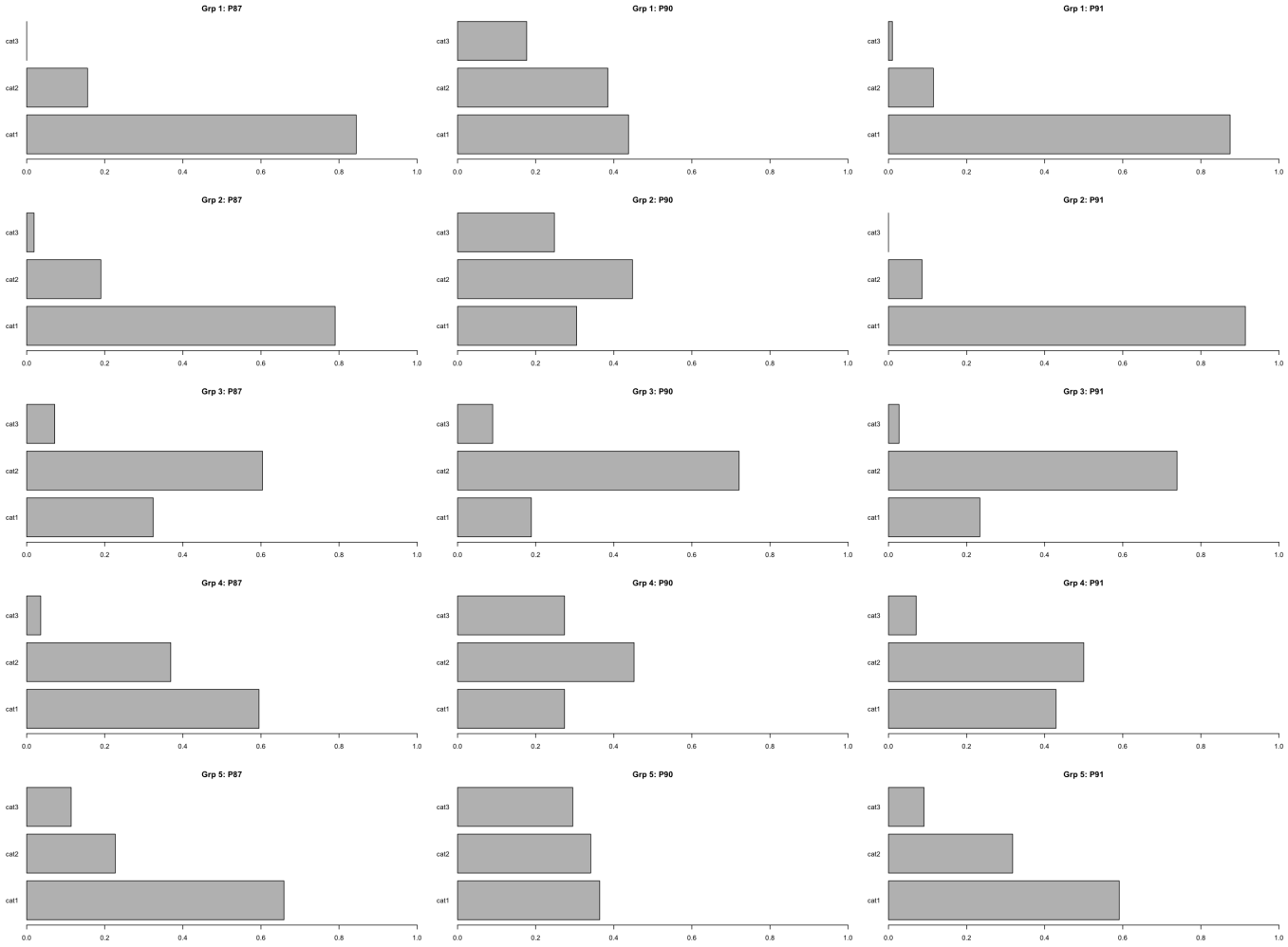
Chart

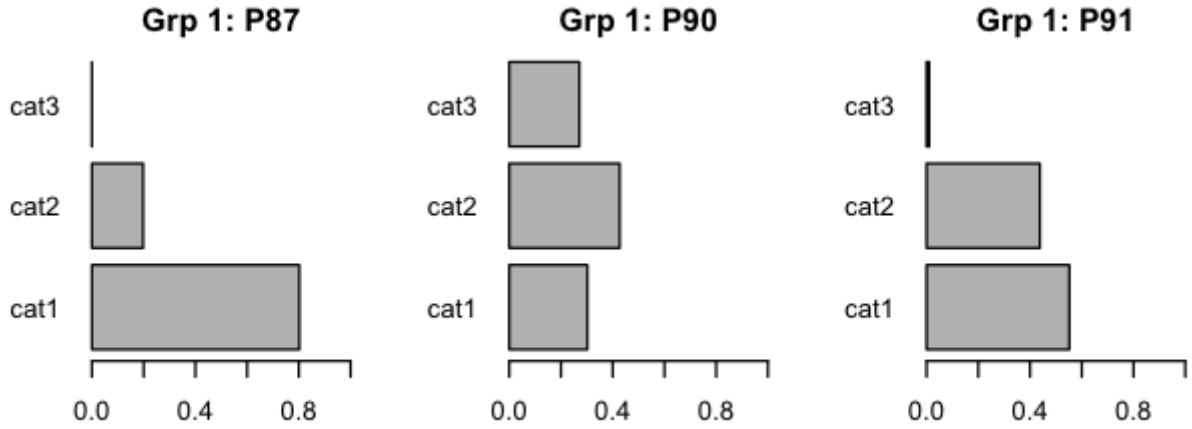

Grp 1: line
Grp 1: P10
Grp 1: P12
Grp 2: line
Grp 2: P10
Grp 2: P12
Grp 3: line
Grp 3: P10
Grp 3: P12
Grp 4: line
Grp 4: P10
Grp 4: P12
Grp 5: line
Grp 5: P10
Grp 5: P12
cat1
cat2
cat3
cat4
cat5
cat6
cat7
cat8
cat9
cat10
cat11
cat12
0.0
0.2
0.4
0.6
0.8
1.0

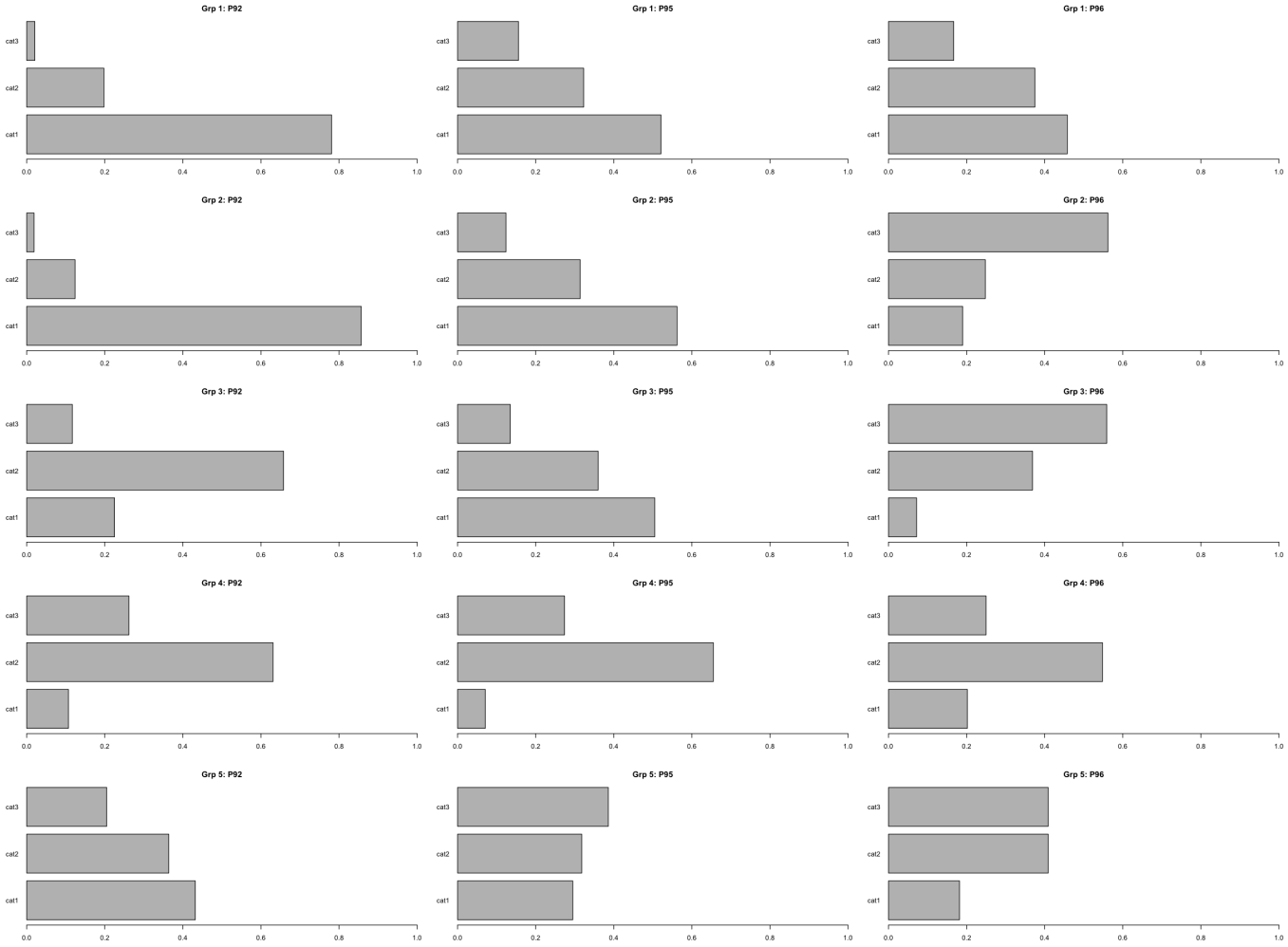

Grp 1: line
Grp 1: P10
Grp 1: P12
cat1
cat2
cat3
cat4
cat5
cat6
cat7
cat8
cat9
cat10
cat11
cat12
0.0
0.4
0.8

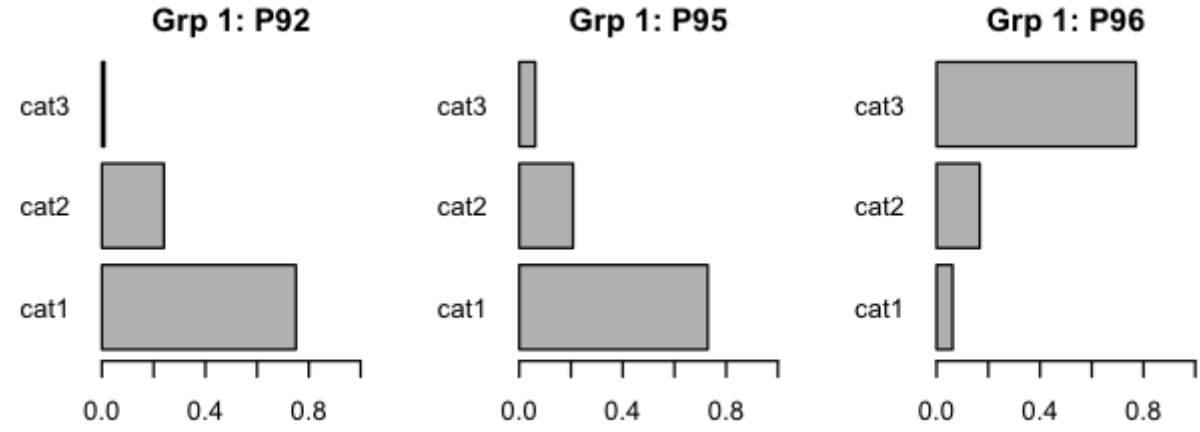

Grp 1: P50
Grp 1: P68
Grp 1: P82
Grp 2: P50
Grp 2: P68
Grp 2: P82
Grp 3: P50
Grp 3: P68
Grp 3: P82
Grp 4: P50
Grp 4: P68
Grp 4: P82
Grp 5: P50
Grp 5: P68
Grp 5: P82
cat12
cat11
cat10
cat9
cat8
cat7
cat6
cat5
cat4
cat3
cat2
cat1
0.0
0.2
0.4
0.6
0.8
1.0

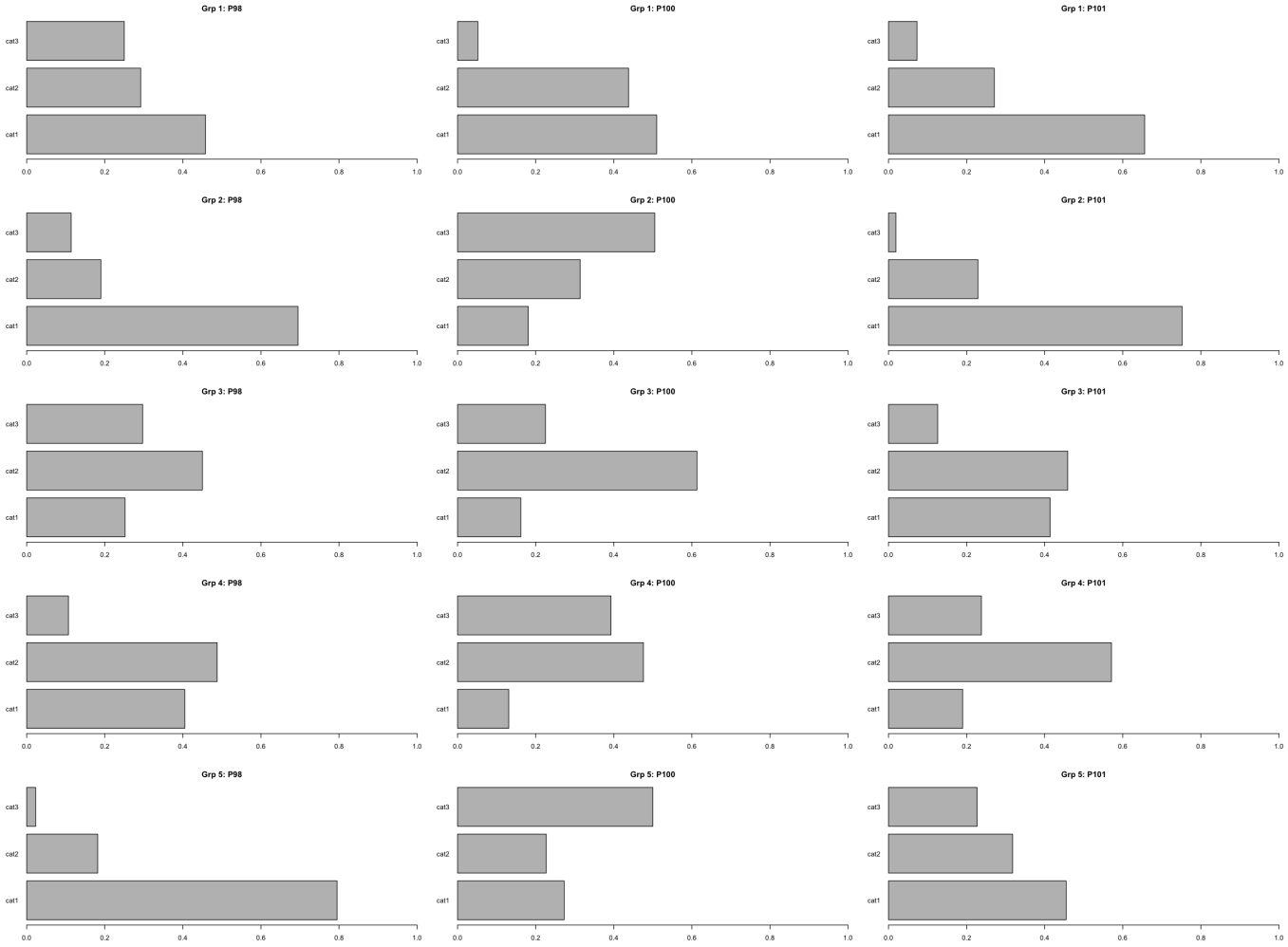

Grp 1: P50
Grp 1: P68
Grp 1: P82
cat12
cat11
cat10
cat9
cat8
cat7
cat6
cat5
cat4
cat3
cat2
cat1
0.0
0.4
0.8

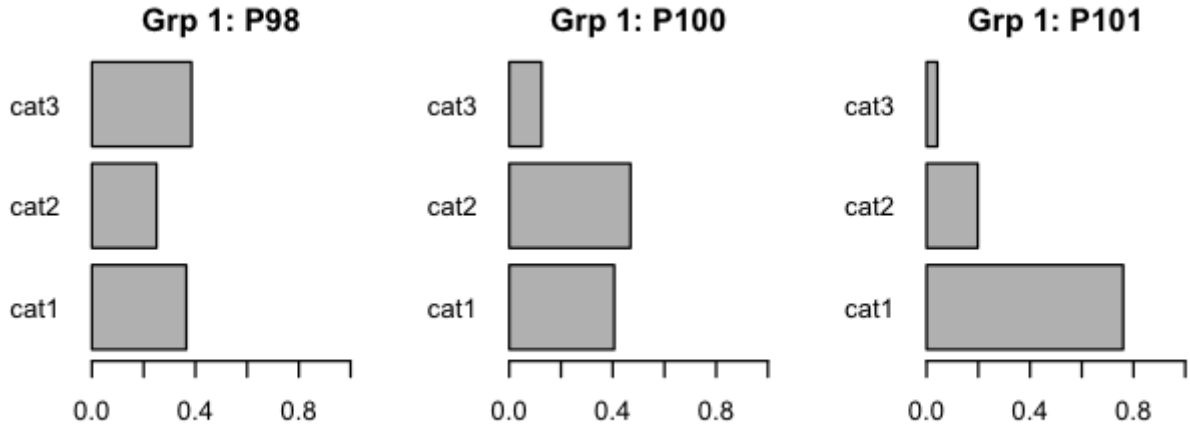

Grp 1: P87
Grp 1: P90
Grp 1: P91
Grp 2: P87
Grp 2: P90
Grp 2: P91
Grp 3: P87
Grp 3: P90
Grp 3: P91
Grp 4: P87
Grp 4: P90
Grp 4: P91
Grp 5: P87
Grp 5: P90
Grp 5: P91
cat3
cat2
cat1
0.0
0.2
0.4
0.6
0.8
1.0

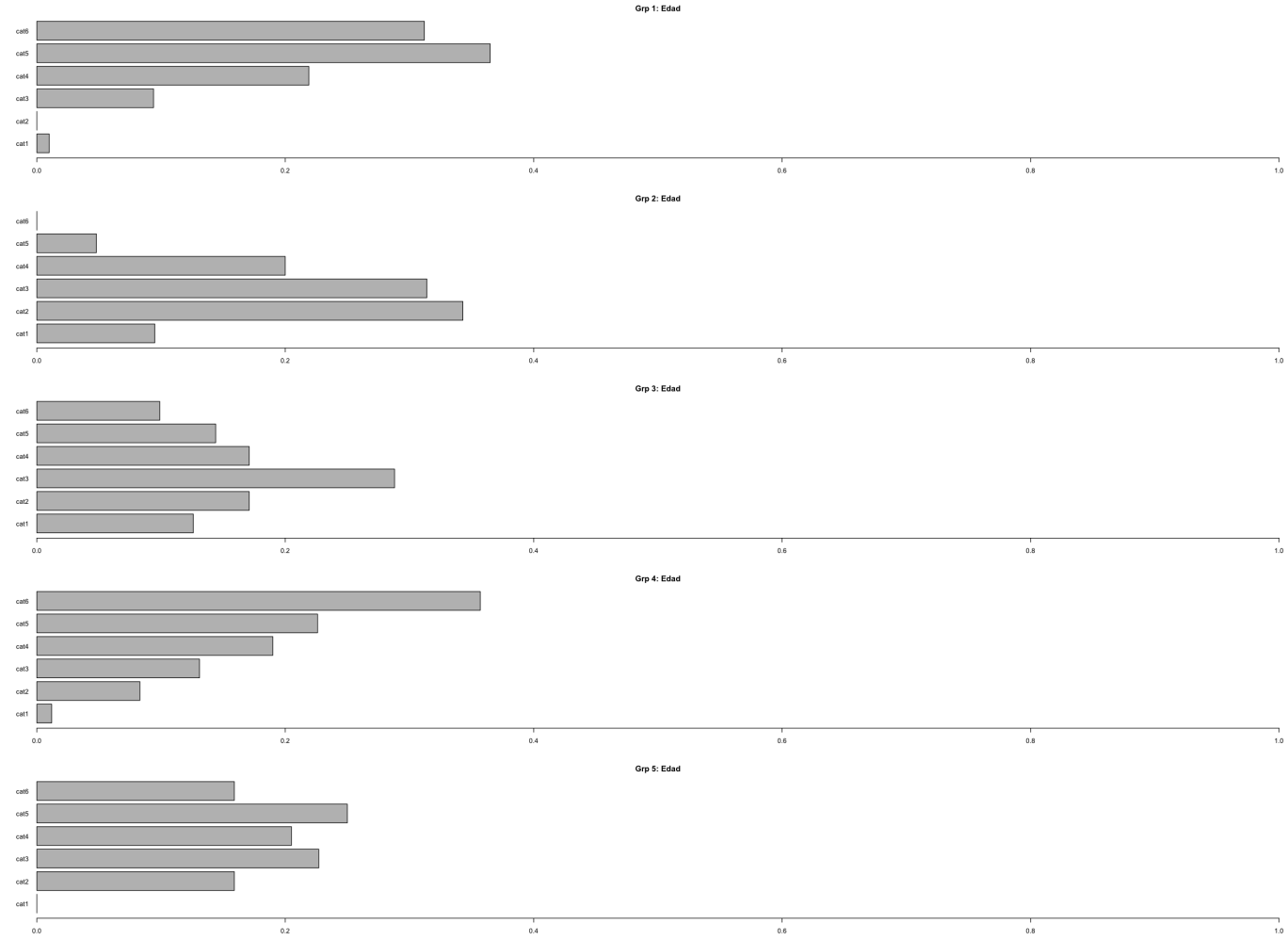

Grp 1: P87
Grp 1: P90
Grp 1: P91
cat3
cat2
cat1
0.0
0.4
0.8

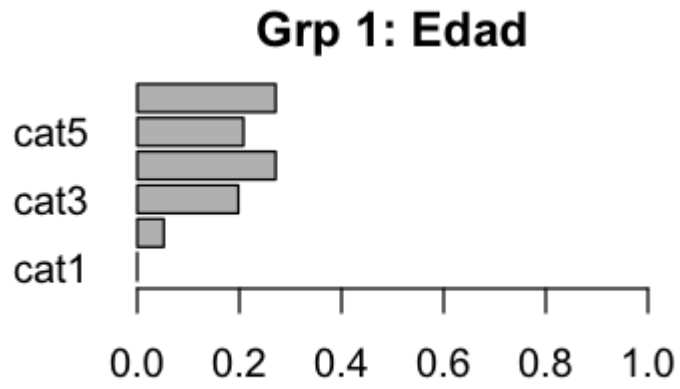

Grp 1: P92
Grp 1: P95
Grp 1: P96
Grp 2: P92
Grp 2: P95
Grp 2: P96
Grp 3: P92
Grp 3: P95
Grp 3: P96
Grp 4: P92
Grp 4: P95
Grp 4: P96
Grp 5: P92
Grp 5: P95
Grp 5: P96
cat3
cat2
cat1
0.0
0.2
0.4
0.6
0.8
1.0


Grp 1: P92
Grp 1: P95
Grp 1: P96
cat3
cat2
cat1
0.0
0.4
0.8


Grp 1: P98
Grp 1: P100
Grp 1: P101
Grp 2: P98
Grp 2: P100
Grp 2: P101
Grp 3: P98
Grp 3: P100
Grp 3: P101
Grp 4: P98
Grp 4: P100
Grp 4: P101
Grp 5: P98
Grp 5: P100
Grp 5: P101
cat3
cat2
cat1
0.0
0.2
0.4
0.6
0.8
1.0


Grp 1: P98
Grp 1: P100
Grp 1: P101
cat3
cat2
cat1
0.0
0.4
0.8





Takeaway

The k-means clustering successfully separates the non-support groups from other clusters.

Cluster 1: Renters Traditionalists

- **Demographics**: Predominantly male; majority renters; mid-to-high education and moderate incomes.
- **Perceptions**:
  - Expense concern: 87.5%
  - Housing-value optimism: 84.4%
  - Business benefits optimism: 78.1%

    - Public-transit support: 52.1%
- **Label**: supportive overall but especially attentive to cost and housing-value improvements.

Cluster 2: Prosperous Skeptical Renters

- **Demographics**: Balanced gender; overwhelmingly renters; skew toward higher education and income deciles.
- **Perceptions**:
    - Expense concern: 91.4% (highest)
    - Business-benefits optimism: 85.7%
    - Noise worry: 69.5% (very high)
    - Travel-time gains doubt: 56.2% disagree
    - Public-space benefits doubt: 50.5% disagree
- **Label**: affluent supporters of investment but doubtful of time- and space-related gains.

Cluster 3: Neutral-Lean Supporters

- **Demographics**: Mostly renters; moderate gender balance; education/income clustered around mid-levels.
- **Perceptions**:
    - “Neither agree nor disagree” majority on housing values (60.4%), safety (72.1%), expense (73.9%) and business (65.8%)
    - Moderate transit support: 50.5%
- **Label**: generally in favor but largely indifferent on most project impacts.

Cluster 4: Older Owners with Low Transit Expectations

- **Demographics**: Slight female tilt; predominantly owners; older age profile; many with missing income data.
- **Perceptions**:
    - Housing-value support: 59.5%
    - Expense concern: 42.9%
    - Business-benefits optimism: 10.7%
    - Transit-benefits optimism: 7.1%
    - Mixed noise/public-space views
- **Label**: supportive on housing values but skeptical about business and transit improvements.

Cluster 5: Non-Supporters & Noise Worriers

- **Demographics**: Majority renters; balanced gender; mid-to-high education and income.
- **Perceptions**:
    - 100% non-support for the project
    - Noise concern: 79.5%
    - Expense worry: 59.1%
    - Public-transit support: 29.5%
    - Public-space support: 27.3%
- **Label**: firmly opposed, driven by noise and cost concerns.

Cluster 6: Young Transit Enthusiasts

- **Demographics**: Heavily male; overwhelmingly owner; younger-to-mid age; moderate education/income.
- **Perceptions**:
  - Housing-value support: 80.2%
  - Business-benefits optimism: 75%
  - Transit-benefits optimism: 72.9%
  - Overall project support: 76%
  - Travel-time gains doubt: 77.1% disagree
- **Label**: enthusiastic about broad benefits but skeptical it will save travel time.

Hierarchical Clustering

Hierarchical clustering is a family of methods for grouping objects into a tree-like structure (a dendrogram) based on their pairwise dissimilarities. Unlike k-means, you don't need to pre-specify the number of clusters (though you can "cut" the tree at any level to obtain a chosen number).

Results

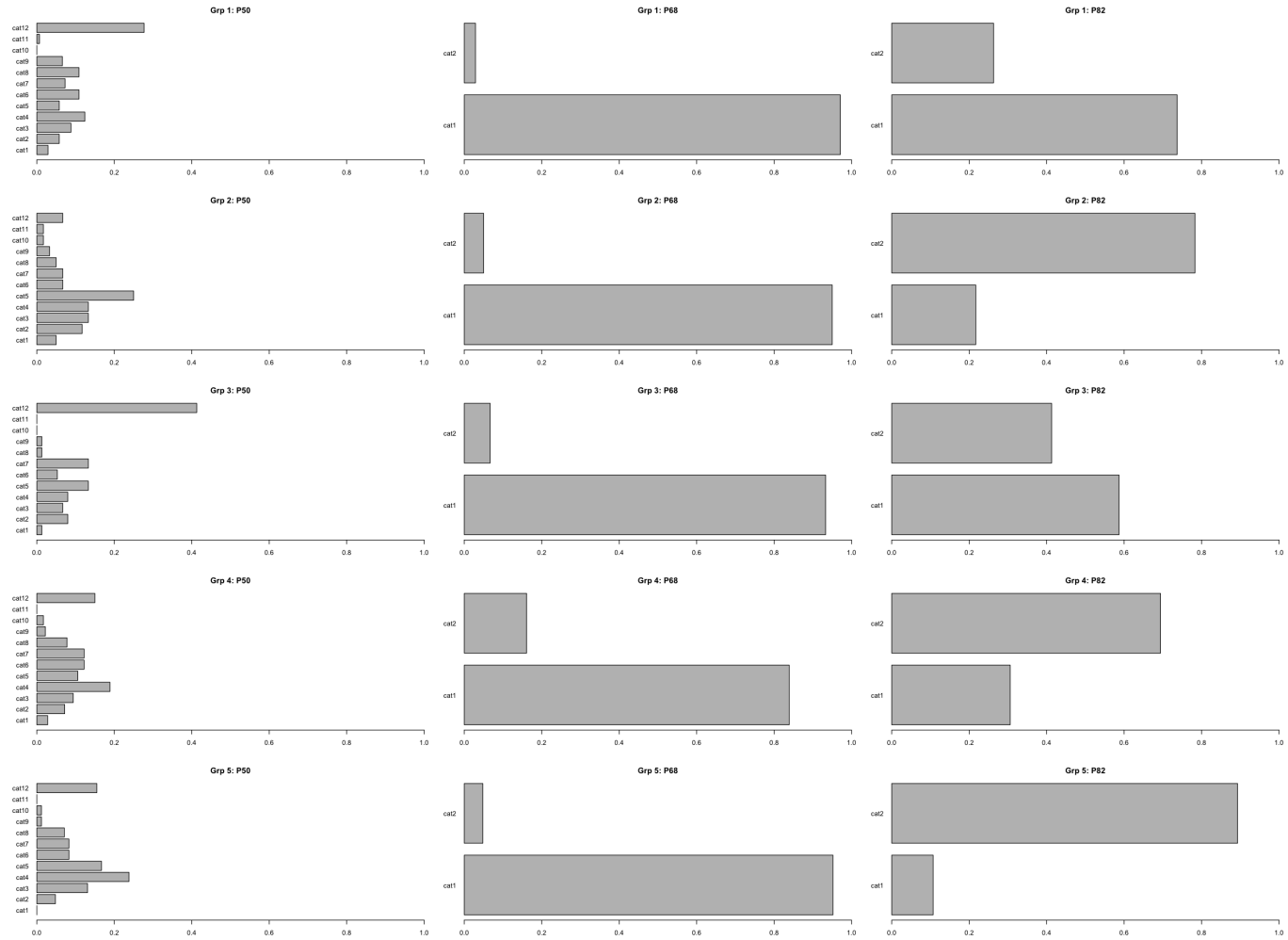
Summary tables (k=5) The table below summarizes clustering results for k=5 clusters. Each row represents a variable, and the values in the cells indicate the proportions or percentages for each cluster. For variables with multiple categories, the values are grouped and separated for clarity.

Variable	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
line	83.2, 16.8	16.7, 83.3	84, 16	43.9, 56.1	27.4, 72.6
Gender	76.6, 23.4	25, 75	56, 44	75, 25	58.3, 41.7
Education	2.2, 16.1, 5.1, 17.5, 3.6, 14.6, 8, 6.6, 2.9, 16.8, 5.1, 1.5	8.3, 6.7, 10, 13.3, 5, 16.7, 1.7, 15, 0, 18.3, 3.3, 1.7	2.7, 9.3, 5.3, 28, 0, 25.3, 8, 5.3, 1.3, 6.7, 2.7, 5.3	2.8, 7.8, 10, 20.6, 1.7, 15.6, 4.4, 17.8, 3.3, 13.9, 2.2, 0	8.3, 8.3, 7.1, 19, 0, 19, 2.4, 6, 8.3, 17.9, 3.6, 0
Income	2.9, 5.8, 8.8, 12.4, 5.8, 10.9, 7.3, 10.9, 6.6, 0, 0.7, 27.7	5, 11.7, 13.3, 13.3, 25, 6.7, 6.7, 5, 3.3, 1.7, 1.7, 6.7	1.3, 8, 6.7, 8, 13.3, 5.3, 13.3, 1.3, 1.3, 0, 0, 41.3	2.8, 7.2, 9.4, 18.9, 10.6, 12.2, 12.2, 7.8, 2.2, 1.7, 0, 15	0, 4.8, 13.1, 23.8, 16.7, 8.3, 8.3, 7.1, 1.2, 1.2, 0, 15.5
Support or not	97.1, 2.9	95, 5	93.3, 6.7	83.9, 16.1	95.2, 4.8
Rent or own	73.7, 26.3	21.7, 78.3	58.7, 41.3	30.6, 69.4	10.7, 89.3
P87	78.1, 20.4, 1.5	63.3, 31.7, 5	58.7, 40, 1.3	85, 10, 5	16.7, 79.8, 3.6
P90	38, 43.1, 19	26.7, 35, 38.3	25.3, 68, 6.7	40.6, 27.2, 32.2	3.6, 92.9, 3.6

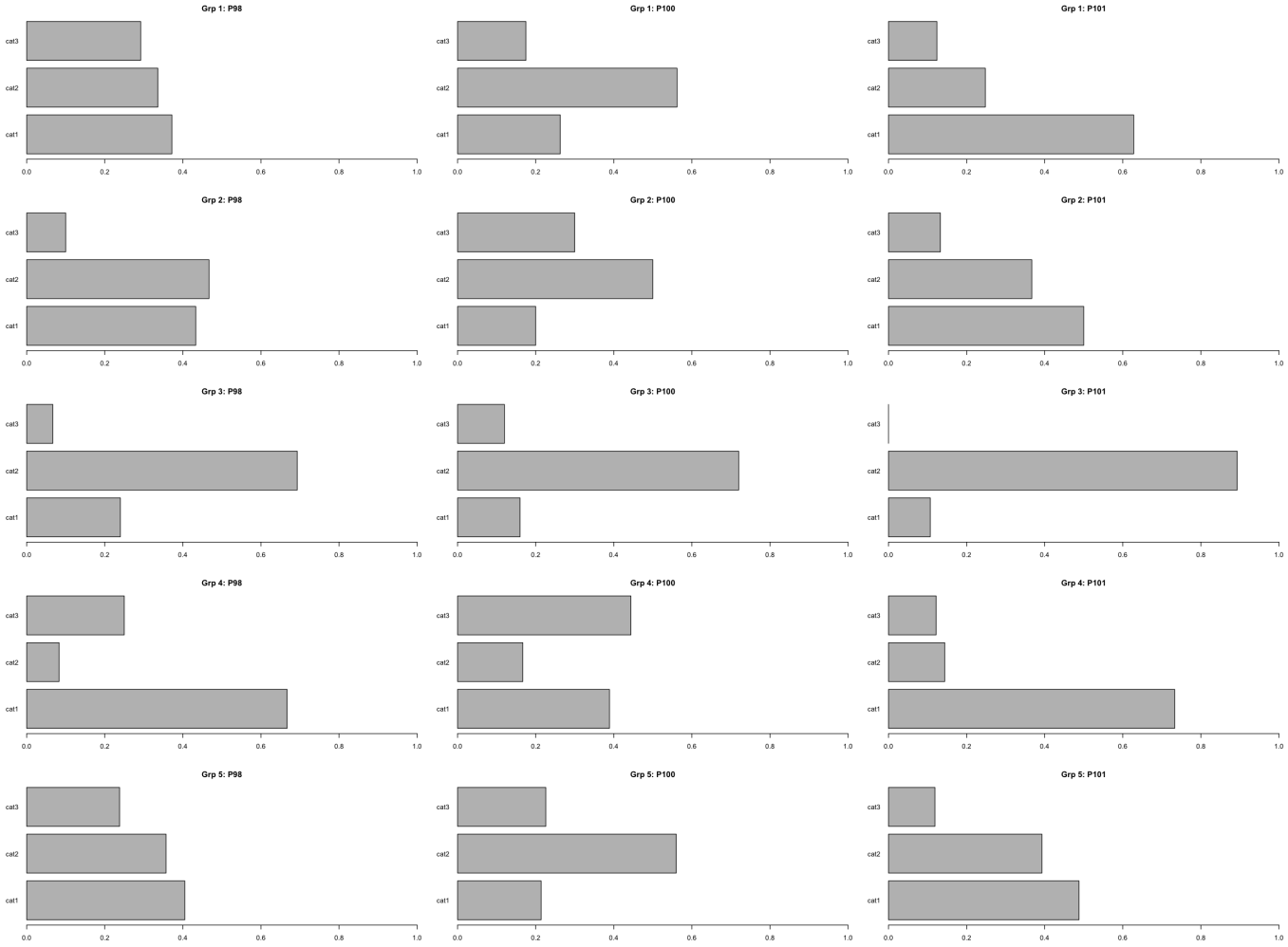
Variable	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
P91	65, 30.7, 4.4	91.7, 5, 3.3	10.7, 88, 1.3	82.8, 14.4, 2.8	23.8, 75, 1.2
P92	62.8, 29.9, 7.3	76.7, 18.3, 5	6.7, 89.3, 4	65.6, 21.7, 12.8	41.7, 46.4, 11.9
P95	56.2, 28.5, 15.3	28.3, 68.3, 3.3	14.7, 78.7, 6.7	57.8, 17.2, 25	53.6, 27.4, 19
P96	19.7, 19, 61.3	18.3, 53.3, 28.3	6.7, 80, 13.3	27.8, 25, 47.2	11.9, 23.8, 64.3
P98	37.2, 33.6, 29.2	43.3, 46.7, 10	24, 69.3, 6.7	66.7, 8.3, 25	40.5, 35.7, 23.8
P100	26.3, 56.2, 17.5	20, 50, 30	16, 72, 12	38.9, 16.7, 44.4	21.4, 56, 22.6
P101	62.8, 24.8, 12.4	50, 36.7, 13.3	10.7, 89.3, 0	73.3, 14.4, 12.2	48.8, 39.3, 11.9
Age	0.7, 8, 21.9, 24.1, 14.6, 30.7	0, 21.7, 15, 21.7, 26.7, 15	6.7, 8, 26.7, 21.3, 17.3, 20	5.6, 15, 20.6, 17.8, 26.7, 14.4	11.9, 20.2, 21.4, 21.4, 10.7, 14.3
count	137	60	75	180	84

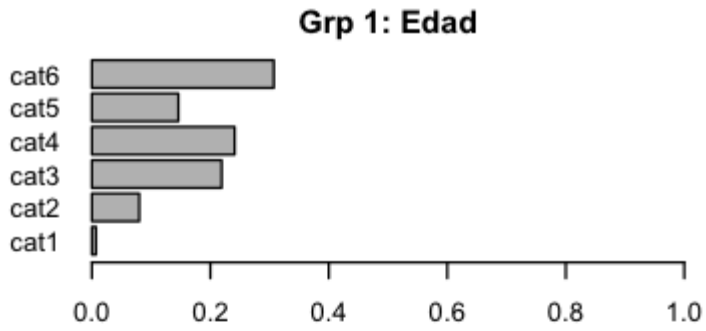
Chart

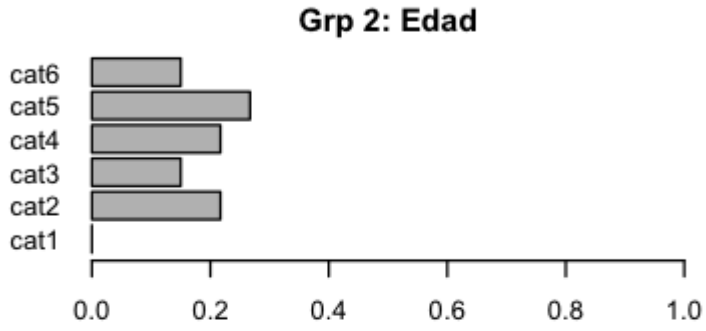

Grp 1: line
Grp 1: P10
Grp 1: P12
Grp 2: line
Grp 2: P10
Grp 2: P12
Grp 3: line
Grp 3: P10
Grp 3: P12
Grp 4: line
Grp 4: P10
Grp 4: P12
Grp 5: line
Grp 5: P10
Grp 5: P12
Grp 1: P50
Grp 1: P68
Grp 1: P82
Grp 2: P50
Grp 2: P68
Grp 2: P82
Grp 3: P50
Grp 3: P68
Grp 3: P82
Grp 4: P50
Grp 4: P68
Grp 4: P82
Grp 5: P50
Grp 5: P68
Grp 5: P82
cat1
cat2
cat3
cat4
cat5
cat6
cat7
cat8
cat9
cat10
cat11
cat12
0.0
0.2
0.4
0.6
0.8
1.0

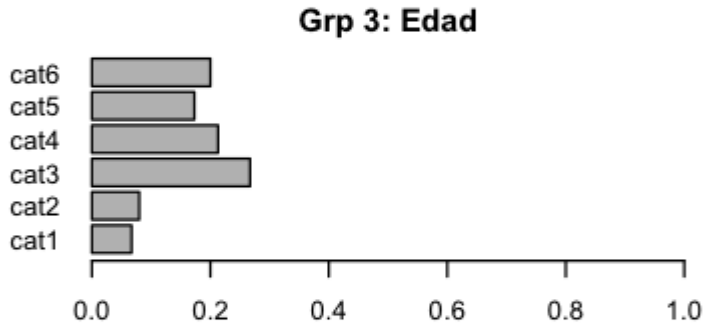

Grp 1: P50
cat12
cat11
cat10
cat9
cat8
cat7
cat6
cat5
cat4
cat3
cat2
cat1
0.0 0.2 0.4 0.6 0.8 1.0
Grp 1: P68
cat2
cat1
0.0 0.2 0.4 0.6 0.8 1.0
Grp 1: P82
cat2
cat1
0.0 0.2 0.4 0.6 0.8 1.0
Grp 2: P50
cat12
cat11
cat10
cat9
cat8
cat7
cat6
cat5
cat4
cat3
cat2
cat1
0.0 0.2 0.4 0.6 0.8 1.0
Grp 2: P68
cat2
cat1
0.0 0.2 0.4 0.6 0.8 1.0
Grp 2: P82
cat2
cat1
0.0 0.2 0.4 0.6 0.8 1.0
Grp 3: P50
cat12
cat11
cat10
cat9
cat8
cat7
cat6
cat5
cat4
cat3
cat2
cat1
0.0 0.2 0.4 0.6 0.8 1.0
Grp 3: P68
cat2
cat1
0.0 0.2 0.4 0.6 0.8 1.0
Grp 3: P82
cat2
cat1
0.0 0.2 0.4 0.6 0.8 1.0
Grp 4: P50
cat12
cat11
cat10
cat9
cat8
cat7
cat6
cat5
cat4
cat3
cat2
cat1
0.0 0.2 0.4 0.6 0.8 1.0
Grp 4: P68
cat2
cat1
0.0 0.2 0.4 0.6 0.8 1.0
Grp 4: P82
cat2
cat1
0.0 0.2 0.4 0.6 0.8 1.0
Grp 5: P50
cat12
cat11
cat10
cat9
cat8
cat7
cat6
cat5
cat4
cat3
cat2
cat1
0.0 0.2 0.4 0.6 0.8 1.0
Grp 5: P68
cat2
cat1
0.0 0.2 0.4 0.6 0.8 1.0
Grp 5: P82
cat2
cat1
0.0 0.2 0.4 0.6 0.8 1.0

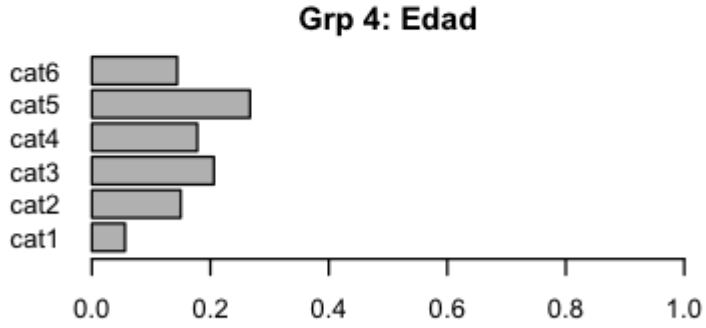

Grp 1: P87
Grp 1: P90
Grp 1: P91
Grp 2: P87
Grp 2: P90
Grp 2: P91
Grp 3: P87
Grp 3: P90
Grp 3: P91
Grp 4: P87
Grp 4: P90
Grp 4: P91
Grp 5: P87
Grp 5: P90
Grp 5: P91
Grp 1: P92
Grp 1: P95
Grp 1: P96
Grp 2: P92
Grp 2: P95
Grp 2: P96
Grp 3: P92
Grp 3: P95
Grp 3: P96
Grp 4: P92
Grp 4: P95
Grp 4: P96
Grp 5: P92
Grp 5: P95
Grp 5: P96
cat3
cat2
cat1
0.0
0.2
0.4
0.6
0.8
1.0

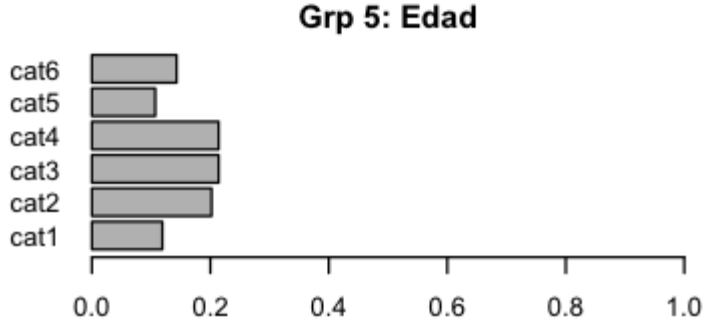

Grp 1: P98
Grp 1: P100
Grp 1: P101
Grp 2: P98
Grp 2: P100
Grp 2: P101
Grp 3: P98
Grp 3: P100
Grp 3: P101
Grp 4: P98
Grp 4: P100
Grp 4: P101
Grp 5: P98
Grp 5: P100
Grp 5: P101
cat3
cat2
cat1
0.0
0.2
0.4
0.6
0.8
1.0


Grp 1: Edad
cat6
cat5
cat4
cat3
cat2
cat1
0.0
0.2
0.4
0.6
0.8
1.0


Grp 2: Edad
cat6
cat5
cat4
cat3
cat2
cat1
0.0
0.2
0.4
0.6
0.8
1.0


Grp 3: Edad
cat6
cat5
cat4
cat3
cat2
cat1
0.0
0.2
0.4
0.6
0.8
1.0


Grp 4: Edad
cat6
cat5
cat4
cat3
cat2
cat1
0.0
0.2
0.4
0.6
0.8
1.0


Grp 5: Edad
cat6
cat5
cat4
cat3
cat2
cat1
0.0
0.2
0.4
0.6
0.8
1.0

Takeaway

The Hierarchical clustering method did not separate the non-support group from others.

Cluster 1: Optimistic Homeowners

- **Demographics:** Predominantly male (76.6%) and owners (73.7%), with a wide income spread and a skew toward younger adults.
- **Support:** Nearly unanimous backing (97.1%).
- **Perceptions:**
    - Strongly believe in increased housing values (78.1%) and business opportunities (62.8%).
    - Majority see public transit benefits (56.2%).
    - However, 61.3% **disagree** that it will save them time, and nearly 30% express moderate noise concerns.

Cluster 2: Cost-Sensitive Renters

- **Demographics:** Largely female (75%) and renters (78.3%), spanning middle to older age groups.
- **Support:** High overall (95%).
- **Perceptions:**
    - Overwhelming worry about expense (91.7% agree it's too costly).
    - Strong optimism about business growth (76.7% agree).
    - Mixed or neutral on safety and public transit improvements.

Cluster 3: Ambivalent Homeowners

- **Demographics:** Mixed gender (56% male) and owners (58.7%), with a tilt toward younger adults.
- **Support:** Solid backing (93.3%), but the smallest margin among clusters.
- **Perceptions:**
    - Over 80% neither agree nor disagree on expense, safety, and time savings.
    - Only modest agreement on public transit (14.7%) and business (6.7%).
    - This group is largely neutral—open to persuasion but not strongly sold.

Cluster 4: Skeptical Renters

- **Demographics:** Mostly male (75%) renters (69.4%), skewing middle-aged.
- **Support:** Lowest net support (83.9%), with the highest non-support share (16.1%).
- **Perceptions:**
    - High concern about expense (82.8% agree) and noise (66.7%).
    - Significant safety worries (40.6% agree) coupled with doubt about time savings (47.2% disagree).
    - Also skeptical of public space benefits (44.4% disagree).

Cluster 5: Neutral Renters with Time Doubts

- **Demographics:** Predominantly renters (89.3%), fairly balanced gender.
- **Support:** Strong overall (95.2%).
- **Perceptions:**

- Overwhelming neutrality on housing values (79.8%), safety (92.9%), expense (75%), business (46.4%), and public space (56%).
- Yet most (64.3%) **disagree** that it will save them time—suggesting they see little personal convenience gain.

Key takeaway

Across latent class, k-means, and hierarchical clustering, housing tenure and demographic factors consistently shape both support for and perceptions of the Metro project, particularly renter versus owner status, age, and income. Renters, especially younger cohorts, overwhelmingly support the project and anticipate gains in housing values and expense reductions, yet remain skeptical about travel-time savings. Conversely, older homeowners and high-income groups exhibit more ambivalence: while they acknowledge potential economic and safety benefits, they express concerns about noise, cost, and personal convenience, resulting in a lower net support or neutral stance.

From a technical standpoint, k-means clustering identified almost 99% (44 out of 45) of the metro skeptical sample as belonging to one particular cluster (k-means cluster 5). Those non-support groups are predominantly majority dominated by renters, with mid- to higher-income levels and educational backgrounds. They worried about potential noise concerns, increased living expenses, and were not satisfied with the current public transportation in Bogotá (mainly due to cost of living and noise concerns). The Hierarchical and Latent Classic Choice method yields mixed results, but with relatively straightforward labels for each clustering specified in the main results documentation.

Footnote:

The results table shows the possibility of a random choice among each categorical group, or the proportion of each category in the clustering sample. For example, in k-means, the cluster 1 line variable shows 36.5 and 63.5, indicating that in cluster 1, 36.5% of the cluster is located close to line 1, while 63.5% of the cluster is located close to line 2. In other words, if you randomly pick one sample from cluster 1, the possibility of this sample living close to line 1 is 36.5% and living close to line 2 is 63.5%.