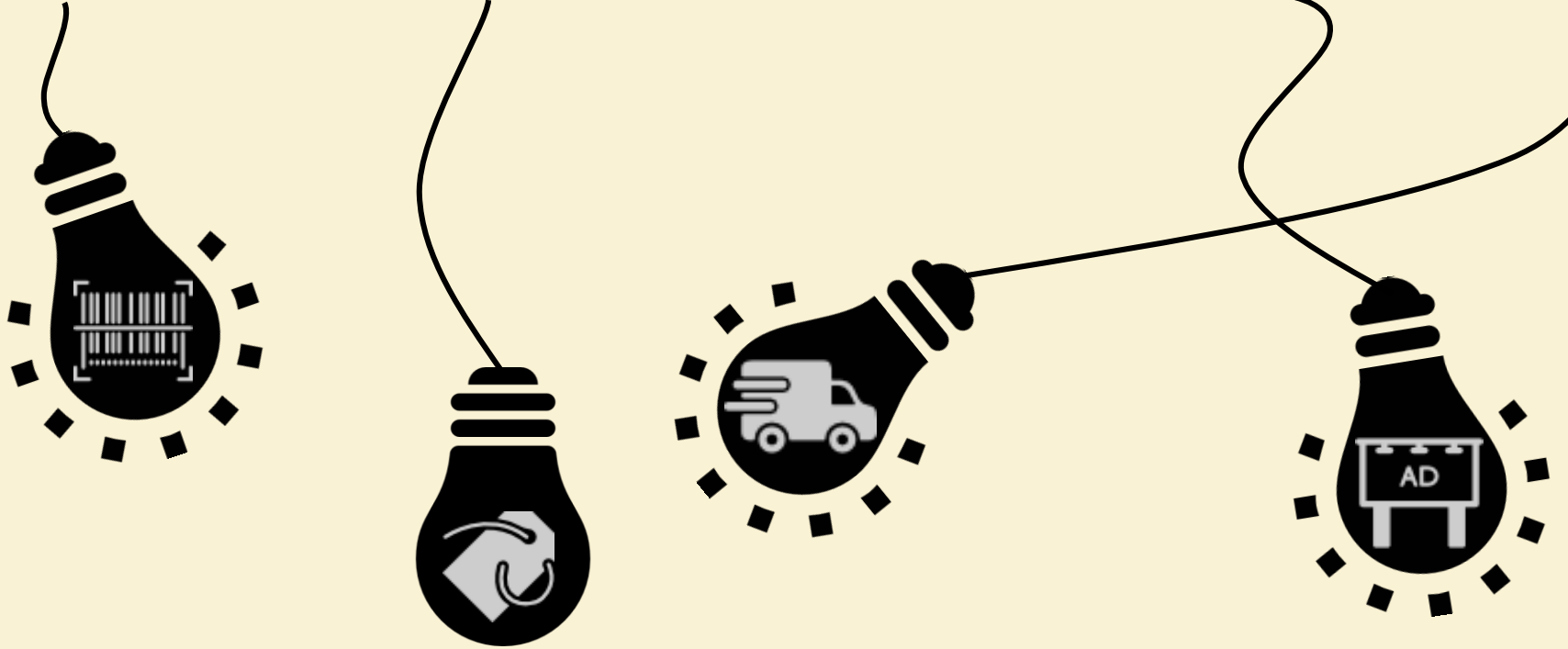


# GEOSPATIAL OPERATIONAL INSIGHTS FOR NATIONAL LIBRARY BOARD

## APPLYING THE HUFF'S MODEL AND RFM ANALYSIS IN SHINY R

TEAM QUI VIVRA VERRA

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# PROJECT STAKEHOLDERS

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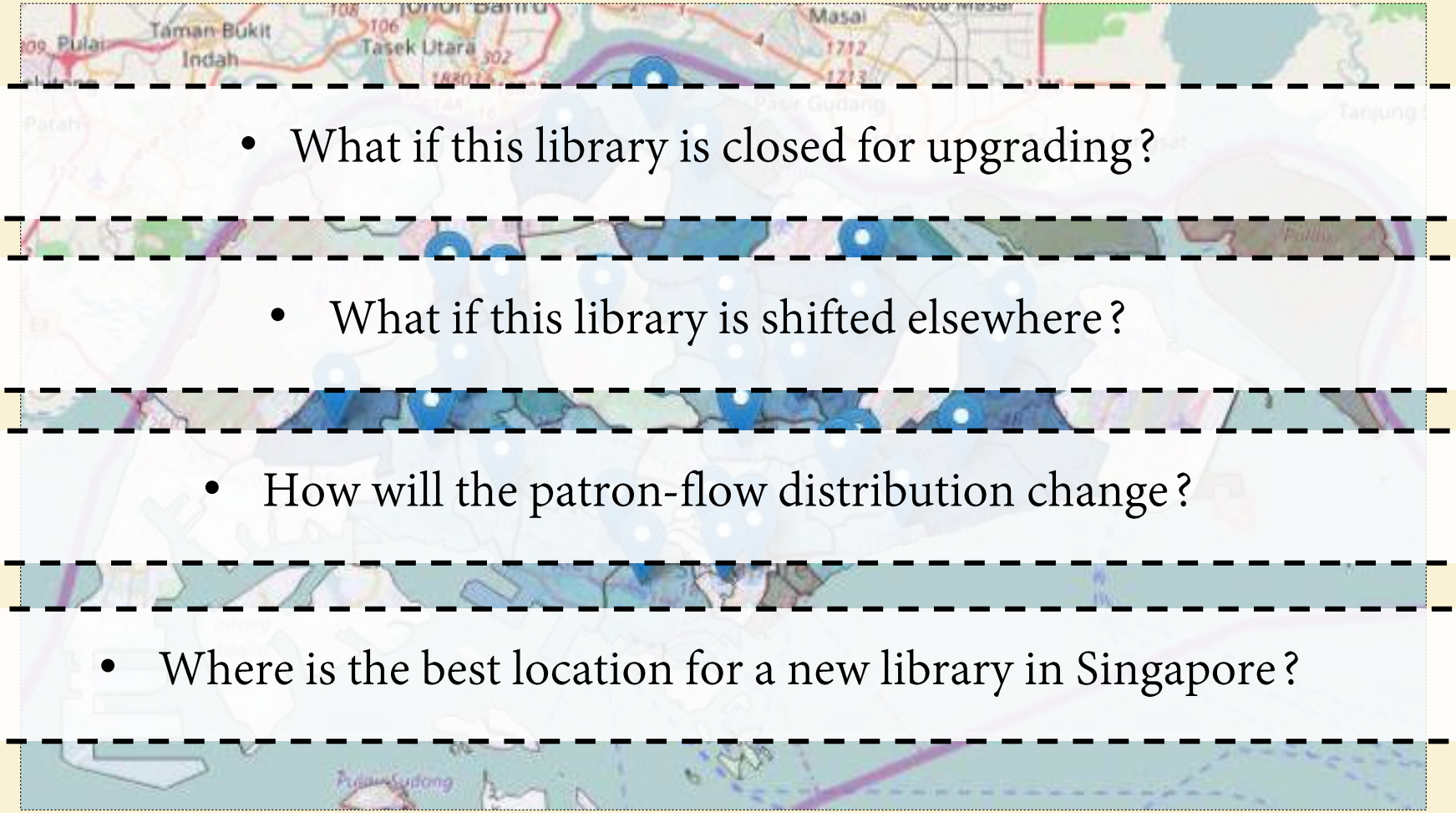
*School of Information Systems*

# OVERVIEW

| | |
|---|---|
|  WHAT | • Patron-flow distribution to libraries<br>• Different patrons' profiles |
|  WHY | • To implement future campaigns |
|  HOW | • Retail trade area analysis<br>• Customer segmentation |

# INTRODUCTION

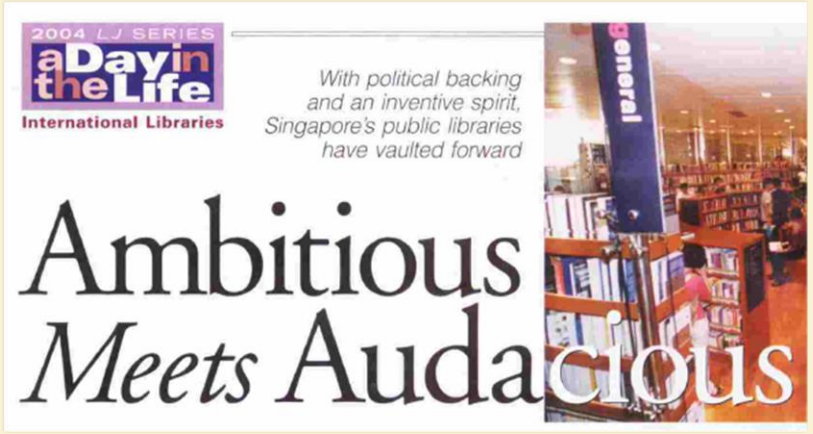



- What if this library is closed for upgrading?
- What if this library is shifted elsewhere?
- How will the patron-flow distribution change?
- Where is the best location for a new library in Singapore?

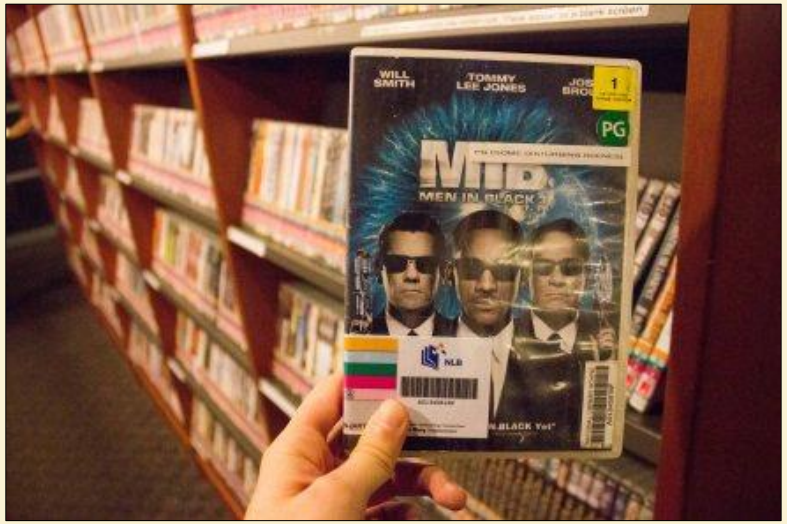
# MOTIVATION

- Campaigns and policies are to be supported by scientific methods


*Opening of library@orchard in 2014.*

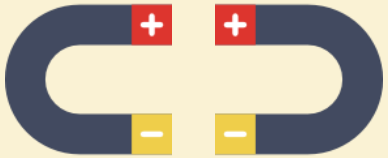



*NLB has experimented with many different library prototypes.*




*You can borrow popular movie titles from library@esplanade*

# LITERATURE REVIEW - HUFF'S MODEL



Push Factor

Distance Decay

Gravity Model

Pull Factor

Destination Attractiveness

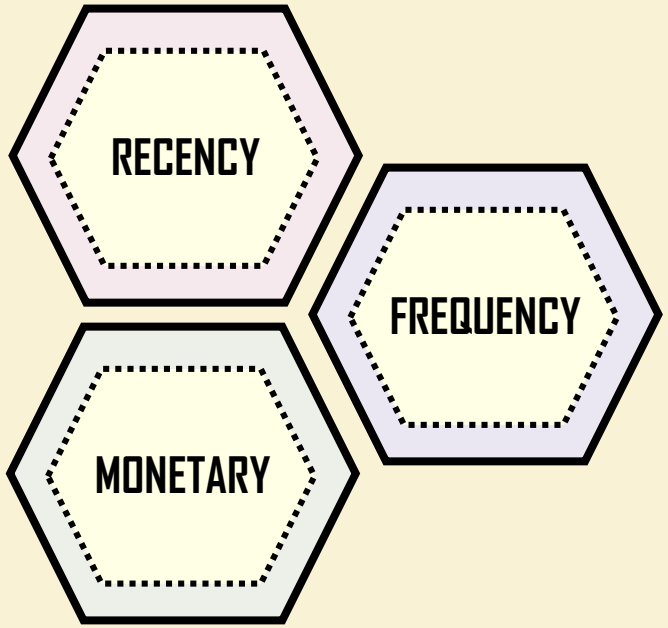
# LITERATURE REVIEW - RFM ANALYSIS

COMPANY

SUPPORTED BY

CONSUMER BASE

SORTED BASED ON



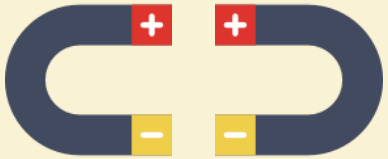

SCORING 1-5 ON EACH METRIC

**5-5-5**

BEST CUSTOMERS

**ADJUST MARKETING PLANS ACCORDINGLY**

# METHODOLOGY - HUFF'S MODEL



Push Factor

Pull Factor

Distance Decay

- Distance from subzone centroid to library

Destination Attractiveness

- Collection size
- No. of MRT stations in 1km
- No. of tuition centres in 1km
- No. of shopping malls in 1km

OLS REGRESSION

CONTRIBUTION OF EACH FACTOR

# METHODOLOGY - HUFF'S MODEL

Let the general form of the Huff's Model be:

$$P_{ij} = \frac{(\sum_{h=1}^{H} A_{hj}^{\alpha_h}) D_{ij}^{\beta}}{\sum_{j=1}^{n} (\sum_{h=1}^{H} A_{hj}^{\alpha_h}) D_{ij}^{\beta}}$$

$P_{ij}$ = probability of a patron residing at planning area $i$ visiting library $j$.

$A_{hj}^{\alpha_h}$ = a measure of the $h$-th characteristic that reflects the attractiveness of library $j$.

$D_{ij}^{\beta}$ = distance from centroid of subzone $i$ to library $j$.

$\alpha$ = a parameter for the sensitivity of $P_{ij}$ associated with an attractiveness variable $h$.

$\beta$ = a parameter for the sensitivity of $P_{ij}$ associated with the distance

$n$ = total number of libraries

# METHODOLOGY - HUFF'S MODEL

We start by taking the logarithm of the general form:

$$\log P_{ij} = \sum_{h=1}^{H} \alpha_h \log A_{hj} + \beta \log D_{ij} - \log \sum_{j=1}^{n} (\sum_{h=1}^{H} A_{hj}^{\alpha_h}) D_{ij}^{\beta}$$

Summing both sides over *j (= 1, 2, …, n)*, and dividing both sides by *n*, we have:

$$\frac{1}{n}\sum_{j=1}^{n} \log P_{ij} = \sum_{h=1}^{H} \alpha_h (\frac{1}{n}\sum_{j=1}^{n} \log A_{hj}) + \frac{\beta}{n}\sum_{j=1}^{n} \log D_{ij} - \log \sum_{j=1}^{n} (\sum_{h=1}^{H} A_{hj}^{\alpha_h}) D_{ij}^{\beta}$$

Let $\widetilde{P_{ij}}$, $\widetilde{A_{hj}}$, and $\widetilde{D_{ij}}$ be the respective geometric means for $P_{ij}$, $A_{hj}$, and $D_{ij}$. We can write the equation as:

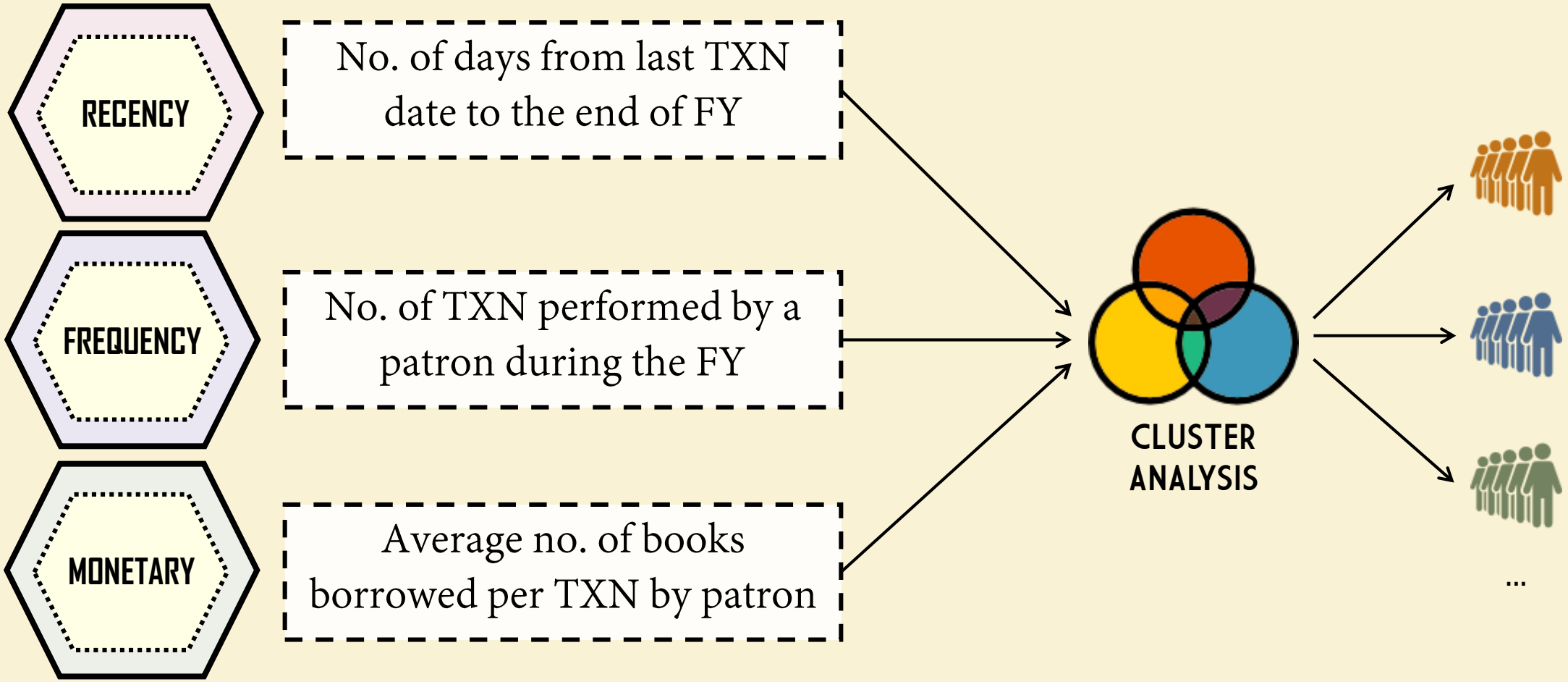
$$\log (\frac{P_{ij}}{\widetilde{P_{ij}}}) = \sum_{h=1}^{H} \alpha_h \log (\frac{A_{hj}}{\widetilde{A_{hj}}}) + \beta \log (\frac{D_{ij}}{\widetilde{D_{ij}}})$$

# METHODOLOGY - HUFF'S MODEL

Therefore, we can estimate the probability of a patron residing at subzone *i* visiting library *j* using the equation, with the estimated parameters:

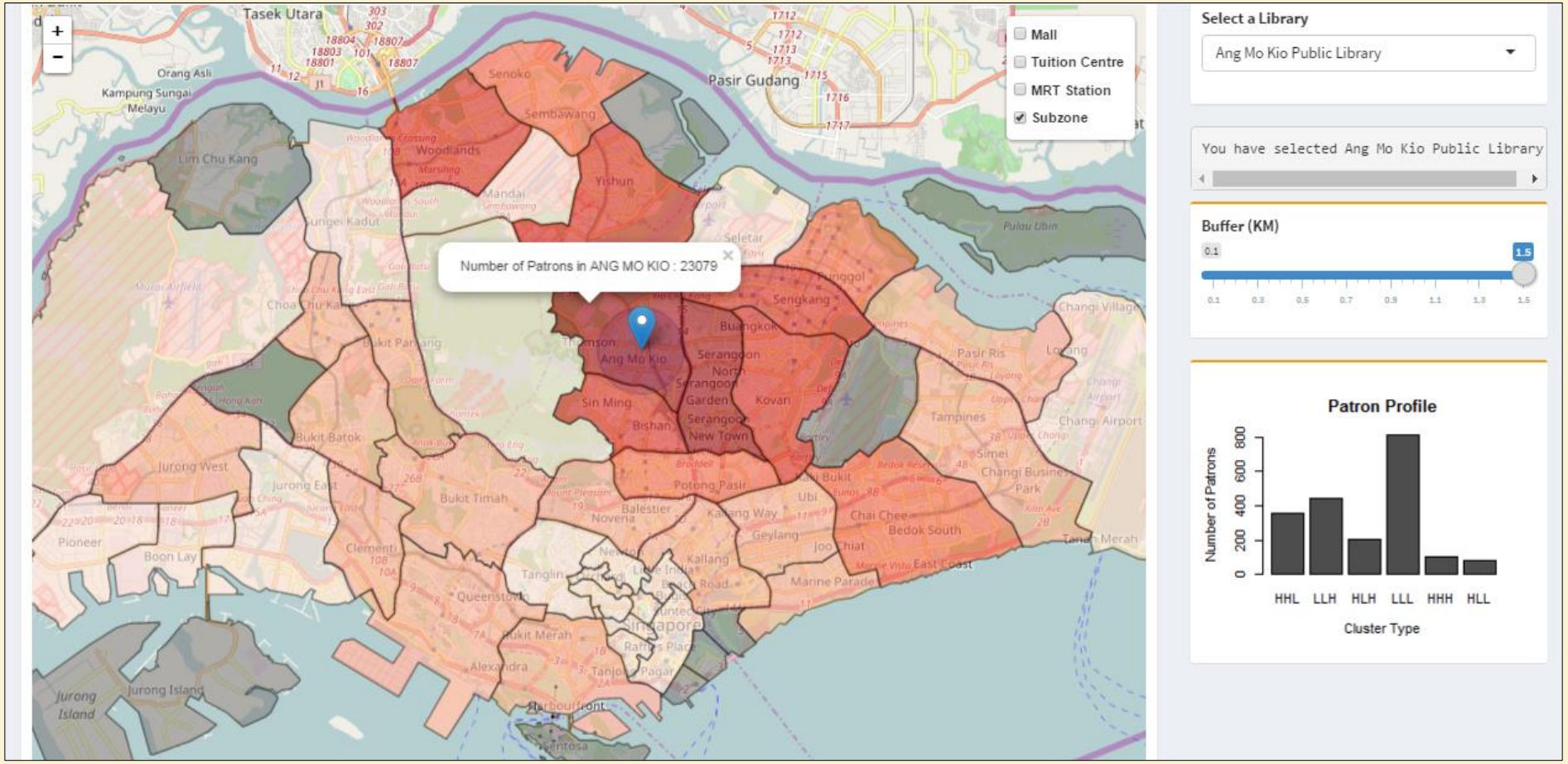
$$\widehat{P_{ij}} = \frac{(\sum_{h=1}^{H} A_{hj}^{\hat{\alpha}_h}) D_{ij}^{\hat{\beta}}}{\sum_{j=1}^{n} (\sum_{h=1}^{H} A_{hj}^{\hat{\alpha}_h}) D_{ij}^{\hat{\beta}}}$$

# METHODOLOGY – RFM ANALYSIS

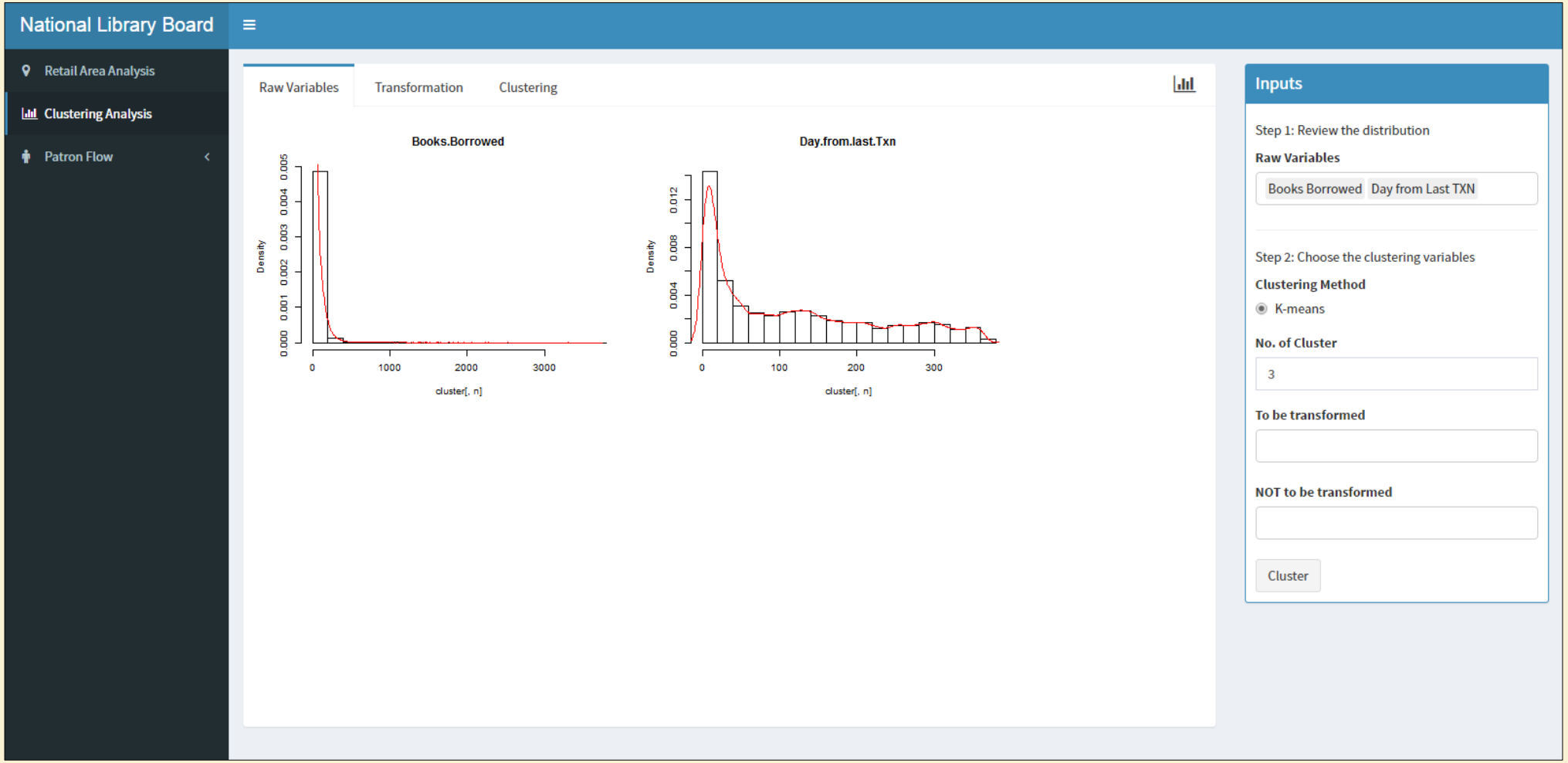


# ADJUSTABLE BUFFER FOR AMENITIES

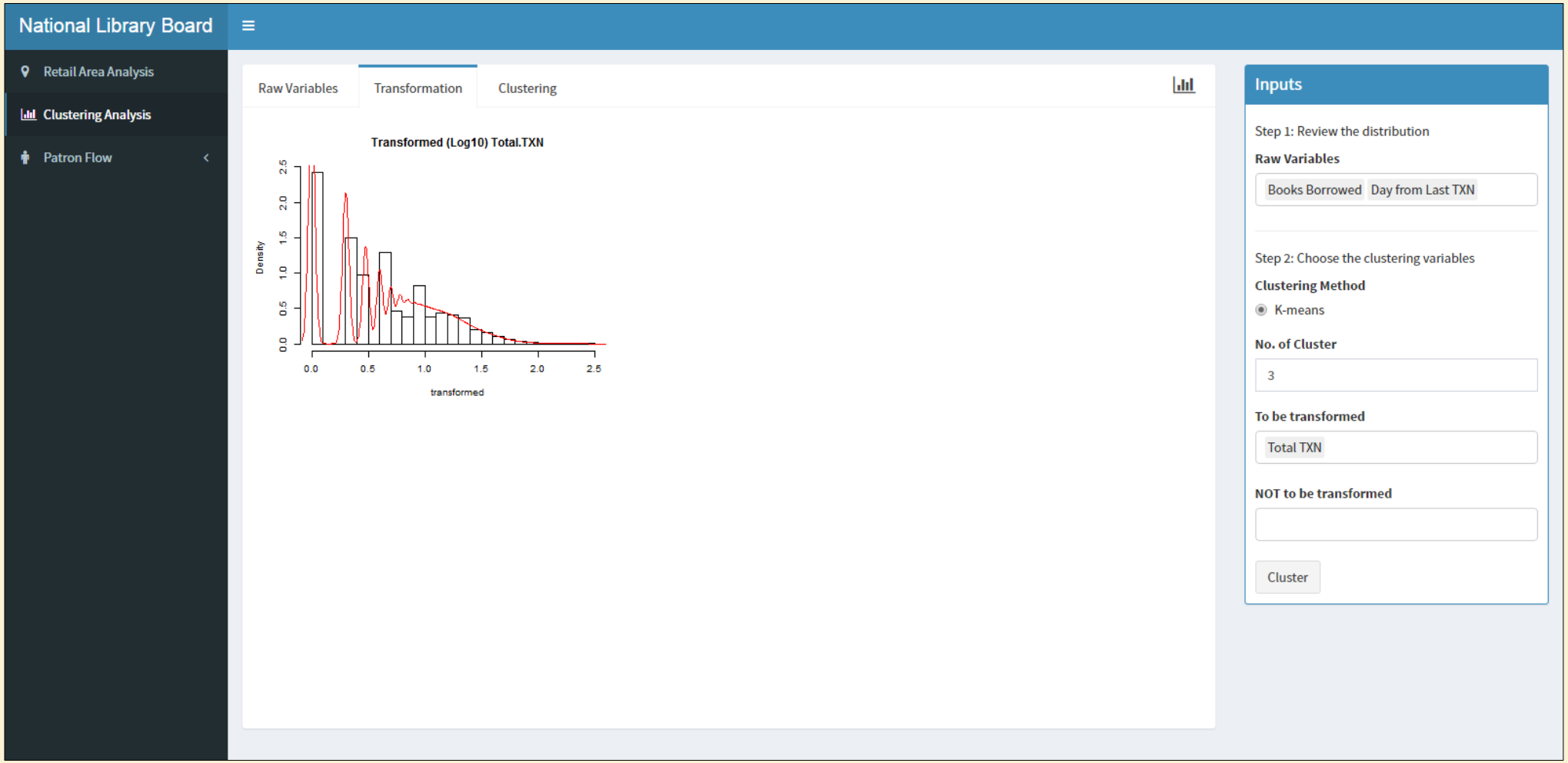
# PATRON FLOW CHOROPLETH MAP



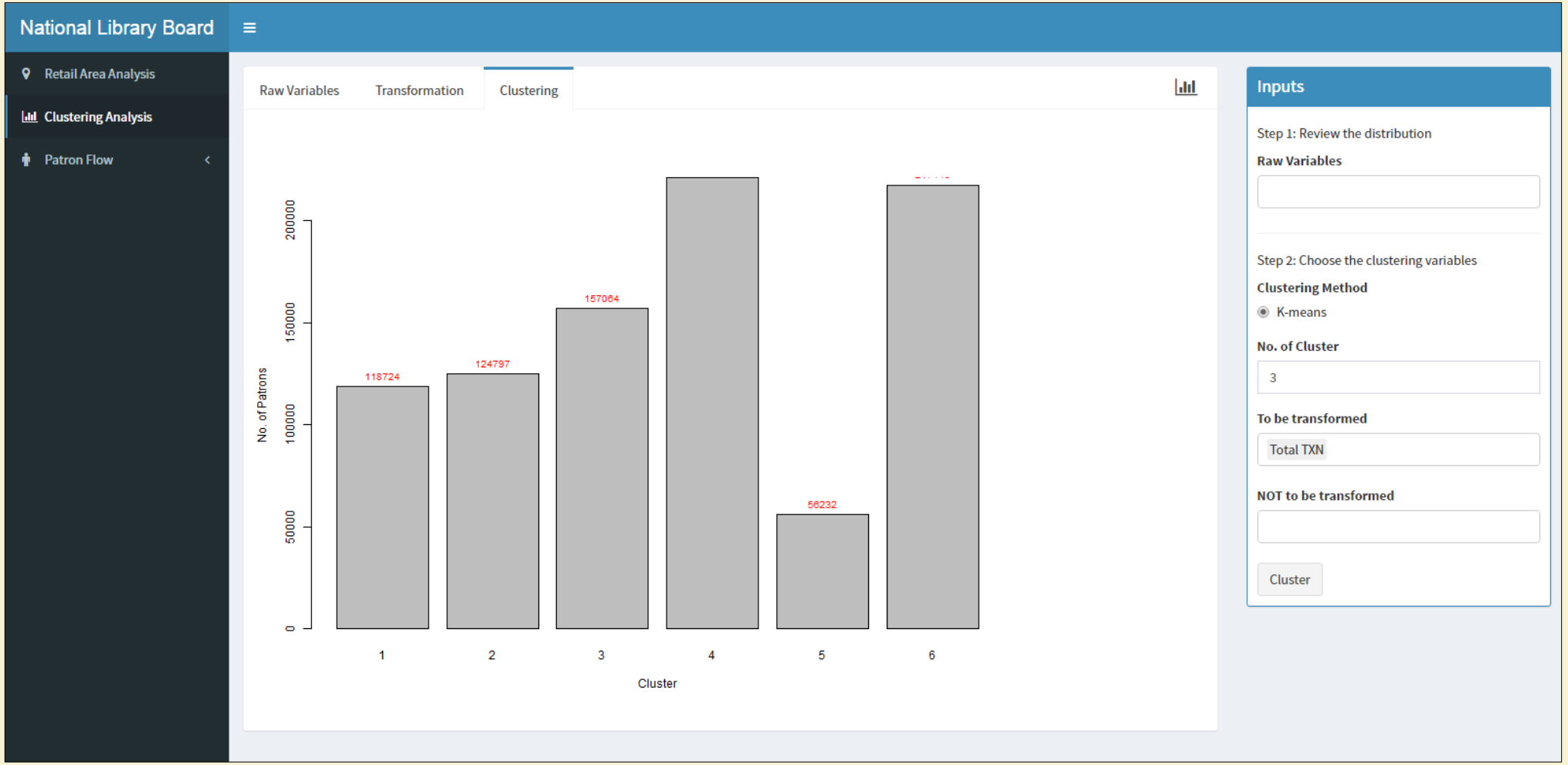
# RFM – REVIEW DISTRIBUTION



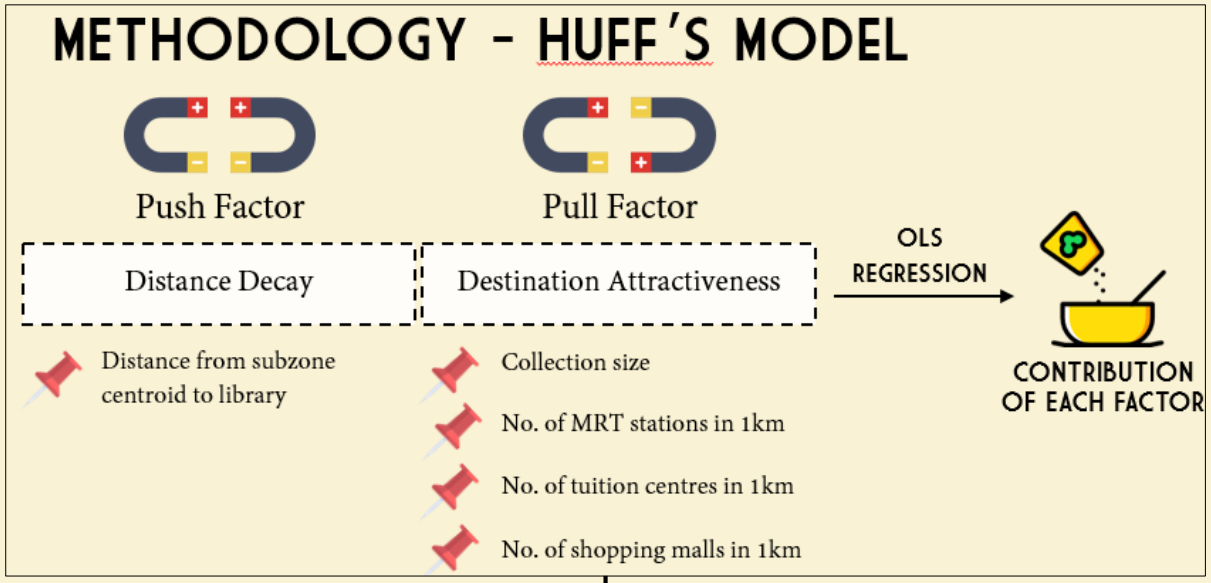
# RFM – TRANSFORM VARIABLE

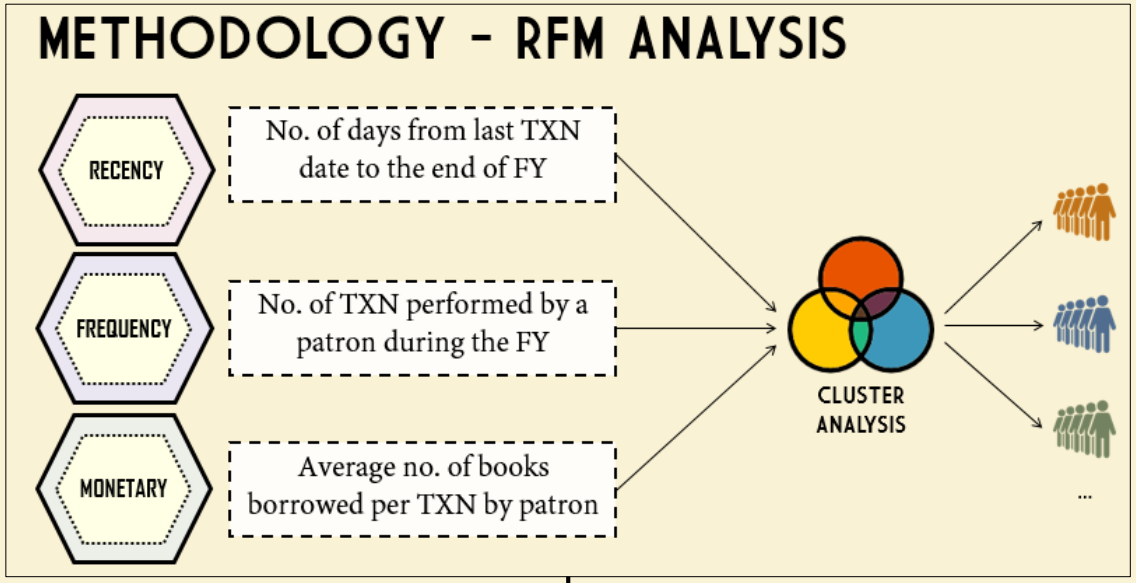


# RFM – PATRON SEGMENTATION



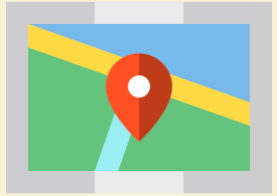
# IMPLICATIONS




Forward-planning in resource allocation for future campaigns and policies

# QUESTIONS



# ANSWERS