Smarter SKU Stratification
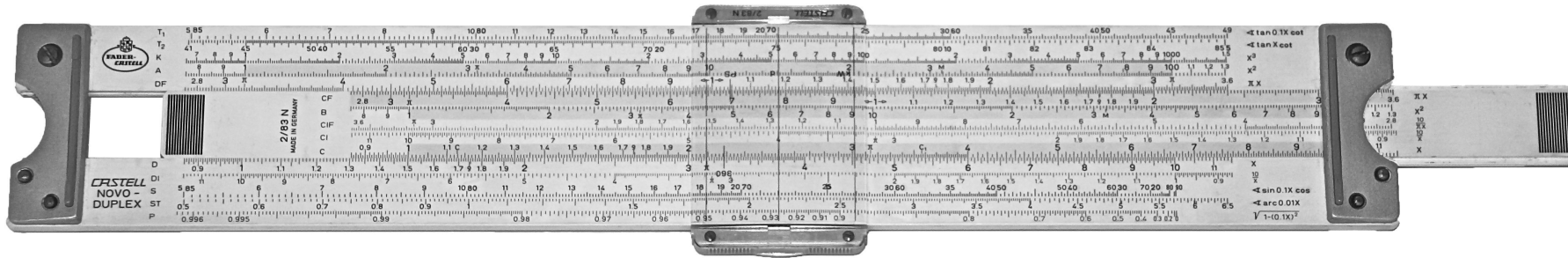
Jiaxin Jiang & Andrew Steverson

Outline

- Motivation
- Objectives
- Methodology & Results
- Recommendation
- Application
- Potential Next Steps

"There has to be a better way"

- Historically, SKU Stratification was based on sales volume

- Sponsor company asked for more comprehensive analysis methods

- Tool to be applied to variety of relationships between manufacturer/distributor and retail customers

Objectives

To identify a better SKU stratification method for Consumer Packaged Goods companies to better serve their retailers.

To provide a ready-to-use stratification modelling package for our sponsor company.

Relevant Factors

▶ **Sales Volume** – still a key consideration

▶ **Volatility** – critical in forecasting and replenishment

▶ **Profit Margin** – impact to the bottom line

Data

Sales volume data by SKU by DC for the past two years

Current price & cost by SKU for retailer

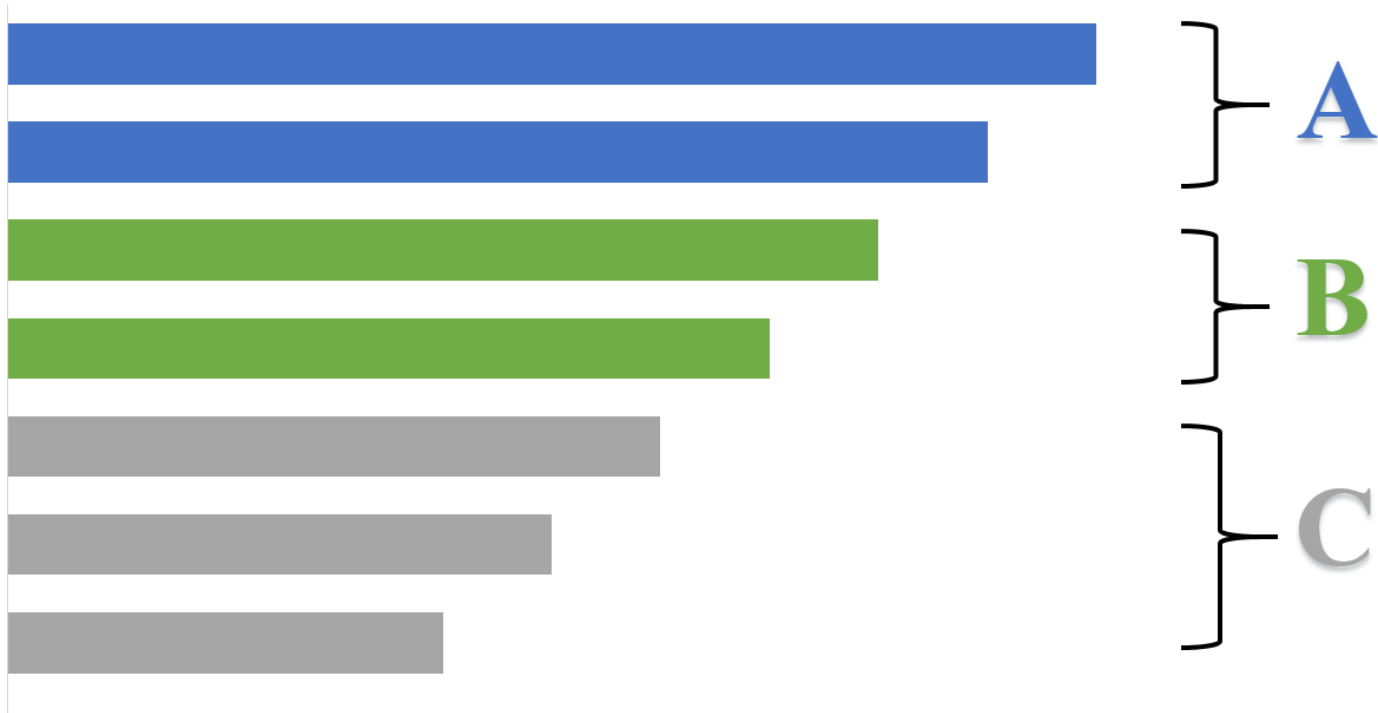# Methods Under Consideration

Single Factor

Dual Matrix

Analytical Hierarchy Process (AHP)

Clustering

Single Factor

- Rank SKUs based on one criterion – current method

Dual Matrix

- Two sets of single factor classifications

- Cross-tabulation to determine new classification

Analytical Hierarchy Process

▶ Pairwise comparison of importance of factors => weightage

|	Sales Volume	Profit Margin	Volatility
Sales Volume	1	1	3
Profit Margin	1	1	3
Volatility	1/3	1/3	1

Eigen Vector Calculator

Factor	Weight
Sales Volume	0.43
Profit Margin	0.43
Volatility	0.14

▶ Values are normalized to allow for direct comparison

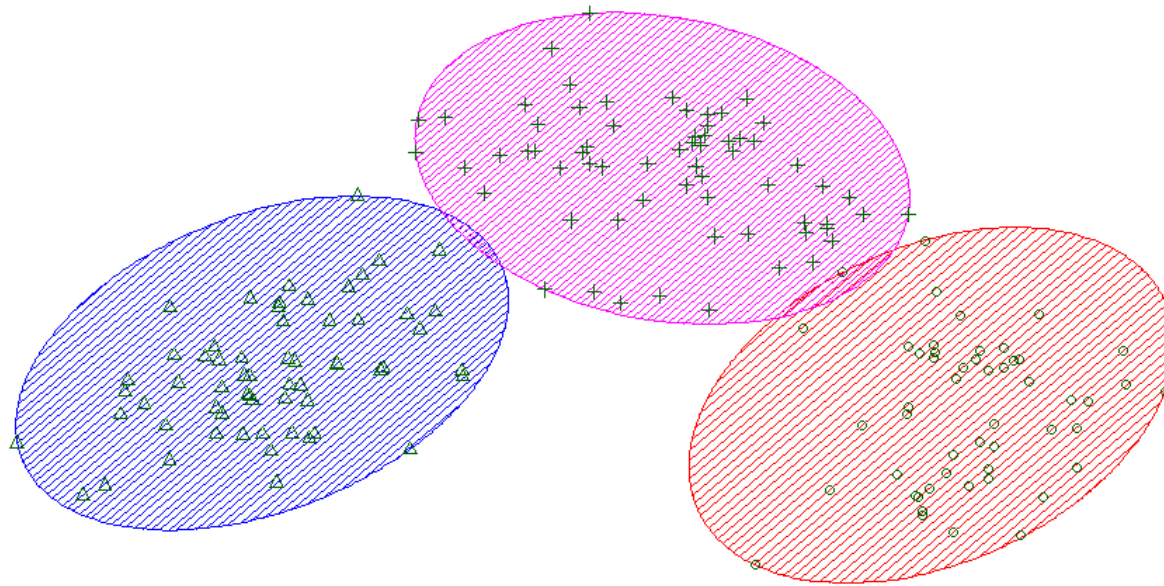▶ Weighted sum calculated and ranked

▶ Ranked sum => stratification

Analytical Hierarchy Process

AHP vs Single Factor Stratification Comparison
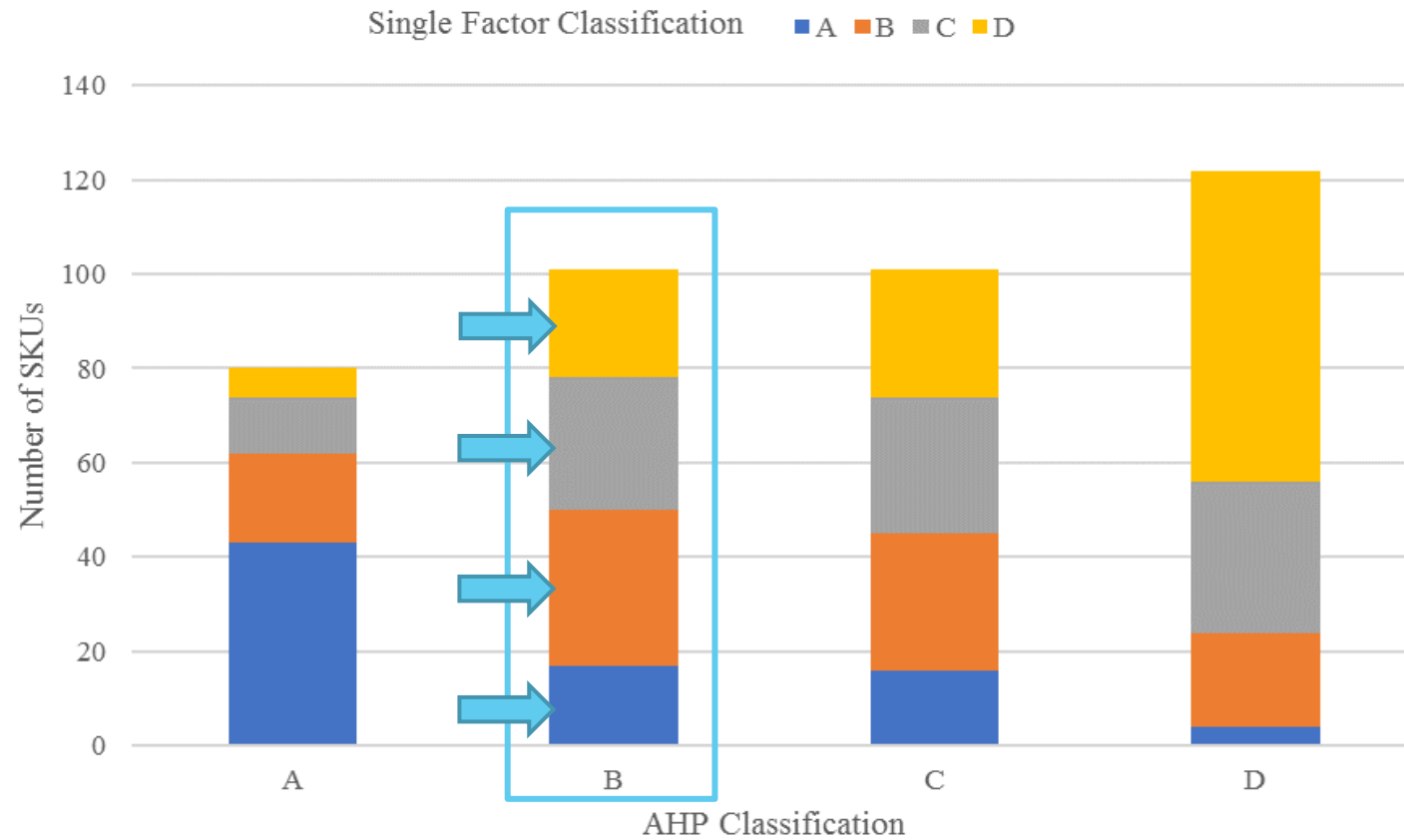
Clustering

- Algorithms group data points based on mathematical proximity
- K-means clustering for SKU stratification
- Data supplied to specialized software - JMP Pro 12

Clustering

- Size of each cluster is variable & cannot be controlled
- Impractical to apply to inventory management

Cluster #	Number of SKUs		
	3 Clusters	4 Clusters	5 Clusters
1	11	11	11
2	275	277	100
3	118	3	283
4		113	3
5			7

Methods Comparison

Method	Factors Considered	Comprehensive Level	Ease of Implementation	Ability to Customize Class Size	Software Required
Single Factor	1	Low	High	High	-
Dual Matrix	2	Medium	Medium	Medium	-
AHP	3 or more	High	Low	High	Eigen Vector Calculator
Clustering	3 or more	High	Medium	Low	JMP

Recommendation

- We recommend the AHP method for SKU stratification
  - Comprehensive
  - Flexible
  - User determination of importance of different factors

Before and After

Product	Sales Volume
SKU 1	D
SKU 2	A

Significant change in classification from Single Factor to AHP

Applications

A better way to focus on and invest in the important products

Forecasting

- More complex models for 'A' SKU

Service Level

▶ Calculated per SKU, then aggregated for the classifications

$$Q^* = \sqrt{\frac{2c_t D}{c_e}}$$

$$P[StockOut] = P[x \geq k] = \frac{Qc_e}{Dc_s}$$

Service Level = 1 – P[StockOut]

c_t: Ordering Costs (\$/order)

c_e: Excess holding Costs (\$/unit/time);

c_s: Shortage costs (\$/unit)

D: Demand (units/time)

	Service Level		
	Min	Max	Avg
A	69%	100%	95%
B	70%	97%	91%
C	28%	95%	84%
D	12%	90%	72%

Potential Drawbacks

- User input via pairwise comparison
- Misunderstanding of relationship of inputs to results

Potential Next Steps

- Exception handling
  - New products
  - Promotions
- Set inventory management strategies for stratification
  - How do customers measure company service?

Thank you

Q & A