Advanced clustering in retail industry

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Abstract— *This paper present an efficient and practical method for Oracle Retail Advanced Clustering, part of the Oracle Retail Advanced Science Engine. The objective is to develop the advanced clustering for customer segmentation application using Application Development Framework to help the retailers to monitor the effective-ness of marketing strategies and to allocate marketing budget more effectively by understanding customer needs.*

Customer segmentation is a proposed new capability of Oracle Retail Advanced Clustering, part of the Oracle Retail Advanced Science Engine. It is in support of current and future customer-centric capabilities in many applications, including but not limited to: Category Management, and ORCA. Segmentation of a customer base into groups based on customer attributes and behavior is a necessary step to better describing and predicting of customer behavior, and provides a vehicle to enable customer-targeting of offers, pricing, assortment, and experience.

Keywords— Oracle Retail, Customer segmentation, Cluster

I. INTRODUCTION

Retail is the process of selling consumer goods and services to customers through multiple channels of distribution to earn a profit. Demand is created through diverse target markets and promotional tactics, satisfying consumer's wants and needs through a lean supply chain. Given the amount of transactional data being collected, discovery of homogeneous customer groups who tend to use the store similarly could be used for instance to target individuals with customized assortments and promotions.

Clusters can help retailers to understand who shops in their stores and what their preferences are. Clusters can be created based on consumer profiles, store attributes, product attributes a mixture of attributes, or performance. The resulting clusters can be used to drive assortment, pricing, promotion, forecasting, allocation, and supply chain processes. Advanced Clustering creates store clusters based on common features such as customer demographics in order to manage merchandise assortments and pricing strategies in a targeted way. The Advanced Clustering application optimizes clusters in order to determine the minimum number of clusters that best describes the historical data used in the analysis and that best meets the business objectives, which is defined during the design of clusters [1].

"Customer segmentation is the practice of dividing a customer base into groups of individuals that are similar in specific ways relevant to marketing such as age, gender, interests, spending habits, and so on. Using segmentation allows companies to understand groups effectively, and allocate marketing resources to best effect". Customer segmentation is a proposed new capability of Oracle Retail Advanced Clustering. It helps in better describing and predicting of customer behavior, and provides a vehicle to enable customer targeting of offers, pricing, assortment, and experience.

The solution will provide behavior based customer segmentation to discover hidden customer segments on the basis of the contents of their shopping baskets like product and product attribute bought. Furthermore, it will be used to find out if these customer segments differ in terms of socio-demographic or lifestyle characteristics and whether these characteristics can be used to target different customer segments with more relevant product offers. An enterprise will have the flexibility to define Chain customer segments or customer segments that are specific to Trade Areas, Location and Groups, Category. Chain Customer Segment will be a preferred and A Feasible approach from planning and execution perspective; nonetheless solution will provide flexibility to define customer segments at granular level for an instance Category, Trader Area etc. For an instance if segments are defined separately for Shoes and Dresses for a retailer like Gap, then same customer can exists in 2 different customer segment one defined for Shoes and one defined for Dresses. The new customer segmentation capability must have workflow and visualization to support the management of segmentation, differentiated by relevant locations, merchandise, and purpose.

II. LITERATURE SURVEY

Many researchers have looked into the methods of clustering which can be based on the various attributes. According to previous works done on clustering, methods for clustering can be classified into two types

i. Breakpoint

Breakpoint method clusters, or groups, data points based on user-defined thresholds, or "breakpoints." Breakpoints are properly defined by entering a decreasing sequence of real

numbers that terminate in a value of zero. Breakpoints are entered in the breakpoints administration workbook. Breakpoints are then used to cluster data points based on the index to average of each data point. Grade in a Global Domain Environment 2 Oracle Retail Grade Example While clustering stores, if the user has entered the breakpoints 2.0, 1.5, 1.0, 0.5, and 0.0, the system will generate five grades. Stores that sell more than 2.0 times the average sales (over all stores) will be assigned to the highest grade, and stores that sell less than 0.5 times the average will be assigned to the lowest grade. Index to Average Index to Average is the average sales of the stores in each grade divided by the average sales of all stores. This value provides a relative indication of how well a grade performed compared to the total store average. A value of 1.00 indicates that average sales in the grade were the same as average sales across the chain. For ex-ample, indicates that average sales in the grade were 3.74 times the chain average.

ii. Batch Neural Gas Algorithm (BaNG)

The BaNG algorithm automatically generates optimal clusters based on user-specified number of clusters and clustering criteria. The algorithm provides a means for clustering data based on data distributions. For example, while clustering on weekly store sales data, the BaNG algorithm considers the Euclidean distance of the individual Store/week level data points from a

"cluster center" to determine the clusters. This is different from the Breakpoint method, where clustering is performed based on average sales. The BaNG algorithm iteratively updates cluster centers while considering the distance of each data vector from the cluster centers and its contribution to each cluster center. For every data point, cluster centers are ranked based on their distance from the data point within each iteration. Additionally, the cluster centers are guided, using a control parameter, to gradually spread from the center of the distribution to their optimal locations. The BaNG algorithm is a non-trivial extension of the K-means clustering approach. It is usually faster than the K-means, and is guaranteed to converge [3].

iii. BaNG vs. Breakpoint

The BaNG algorithm generates statistically optimal clusters based on the number of clusters specified by the user. Breakpoint generates clusters based on user input breakpoints, and the number of clusters generated depends on the breakpoints. In order to generate store clusters that vary by dept users need to specify a group by option of Dept. Breakpoint will cluster stores based on average store sales within each Dept, while BaNG can consider an additional dimension for generating the clusters. For example, BaNG can cluster based on weekly sales of each stores within the Dept. Here, weekly sales are the "coordinates" over which the clustering is performed. Grade in a Global Domain Environment When implemented in a

global domain environment, the following workbooks are available to be accessed from the Master domain: ƒ Breakpoint Administration Note: The Breakpoint Administration workbook is accessible from the Master domain to allow for the centralized administration of breakpoints. The remaining Grade workbooks can only be accessed from local domains. These include: ƒ Cluster Review ƒ Delete Cluster Run ƒ Generate Breakpoint Grades ƒ Generate Clusters [3].

III.   PROBLEM DESCRIPTION AND METHOLOGY

The intensified competition that the retail industry faces both in the local and global markets has forced retailers to critically examine and redesign their operations and marketing strategies. In order to help the retailers to monitor the effectiveness of marketing strategies and to allocate marketing budget more effectively by understanding customer needs, there is a need for segmentation of customers based on various attributes which helps better understanding of customer types and their relative importance to business. Customer Segments will be used by different business flavours for an instance for Assortment or Promotion planning. Thus lot of competition results in the necessity for segmenting customers.

The customer segmentation application is mainly developed with the Application Development Framework (ADF). The Oracle Application Development Framework is an end-to-end application framework that builds on Java Platform, Enterprise Edition (Java EE) standards and open-source technologies. Oracle ADF can be used to implement enterprise solutions that search, display, create, modify, and validate data using web, wireless, desktop, or web services interfaces. Because of its declarative nature, Oracle ADF simplifies and accelerates development by allowing users to focus on the logic of application creation rather than coding details. Used in tandem, Oracle JDeveloper and Oracle ADF gives an environment that covers the full development lifecycle from design to deployment, with drag and drop data binding, visual UI design, and team development features built in [3].

IV. SYSTEM MODEL

The entire customer segmentation application is developed using application develop-ment framework, it is necessary to understand the architecture of ADF before looking into de-sign flow of application. ADF is mainly based on MVC design pattern

i. Oracle ADF Architecture

The Oracle Application Development Framework (Oracle ADF) is an end-to-end applica-tion framework that builds on Java Platform, Enterprise Edition (Java EE) standards and open-source technologies. Oracle ADF can be used to

implement enterprise solutions that search, dis-play, create, modify, and validate data using web, wireless, desktop, or web services interfaces. Because of its declarative nature, Oracle ADF simplifies and accelerates development by allow-ing users to focus on the logic of application creation rather than coding details.

Used in tandem, Oracle JDeveloper and Oracle ADF gives an environment that covers the full development lifecycle from design to deployment, with drag and drop data binding, visu-al UI design, and team development features built in. In line with community best practices, ap-plications built using the Fusion web technology stack achieve a clean separation of business logic, page navigation, and user interface by adhering to a model-view-controller architecture as shown in Figure1.The MVC design pattern consists of mainly three layers as follows

- The model layer represents the data values related to the current page.
- The view layer contains the UI pages used to view or modify that data.
- The controller layer processes user input and determines page navigation.
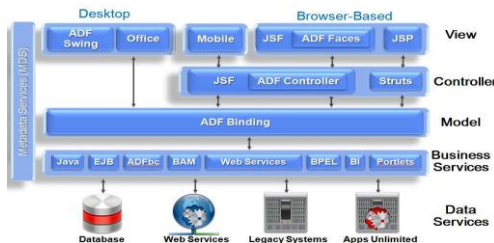- The business service layer handles data access and encapsulates business logic

Figure 1 : ADF Architecture

- ADF Business Components, which simplifies building business services.
- ADF Faces rich client, which offers a rich library of Ajax-enabled UI components for web applications built with Java Server Faces (JSF).
- ADF Controller, which integrates JSF with ADF Model.
- ADF Controller extends the standard JSF controller by providing additional functionality, such as reusable task flows

ii. ADF Business Components

When building service oriented Java EE applications, it is necessary to implement core business logic as one or more business services. These backend services provide clients with a way to query, insert, update, and delete business data as required while enforcing appropriate business rules. ADF Business Components are prebuilt application objects that

accelerate the job of delivering and maintaining high-performance, richly functional, database-centric services

iii. Overview of Building Application with Oracle ADF

Oracle ADF emphasizes the use of the declarative programming paradigm throughout the development process to allow users to focus on the logic of application creation without having to get into implementation details. Using JDeveloper with Oracle ADF as shown in figure 2, benefits from a high-productivity environment that automatically manages application's declarative metadata for data access, validation, page control and navigation, user interface design, and data binding
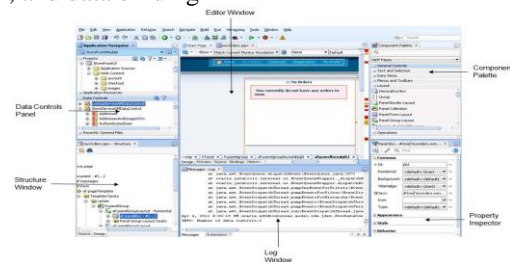

Figure 2 : The JDeveloper Workspace

V. DESIGN FLOW OF THE PROJECT

The entire logic of the application is shown in the figure 3. The customer segmentation application mainly involves three train stops which help to create and manage the clusters for customer segmentation. Segment Criteria, Segment result, Segment insights,

- Segment Criteria: View summary data about existing clusters and define the characteristics of new clusters.
- Explore Data: Examine the supporting data for the cluster defined.
- Segment Results: View the scenario results and compare scenarios.
- Segment Insights: Gain understanding of implications of results through contextual in-formation.
- Manage Store Clusters: Manage existing clusters.

Figure 3 : General Logic of Application

Conclusion

The main idea behind this project is to segment customers into groups based on attributes and behavior which helps to target customers needs thereby increasing pricing, assortment, targeting offers and experience. The UI of the project is developed using oracle application development framework which is supporting framework for java platform. The solution will pro-vide behavior-based customer segmentation to discover hidden customer segments on the basis of the contents of their shopping baskets like product and product attribute bought.

Future Scope

In future versioning concept, can be added to customer segmentation as enhancement. Customer Segmentation currently support global segments and requirement is to support segments at granular level for marketing and promotion planning. This allows retailers to plan promotions or marketing campaigns for Customer Segments that are specific to a Category or Department instead of Global Segments. In order to support such granular level segments, a user interface is required for user to selectively prepare data for segmentation. This data preparation can be done in batch process and it is referred as Version.

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