**Behavioral Clustering (Marketing) Documentation**

This process documents the creation of a dynamic customer segmentation model.

**Phase 1: Data Preparation and Feature Engineering**

1. **Data Simulation:** Generate simulated customer transactional data (e.g., 12 months of utilization).
2. **Feature Engineering:** Manually calculate and engineer three key behavioral features:
   * **Average Utilization**
   * **Utilization Volatility** (Standard deviation of utilization).
   * **Paydown Indicator** (e.g., the difference between max and recent utilization).

**Phase 2: Model Training and Segmentation**

1. **Clustering Method:** Select **K-Means Clustering** as the unsupervised method.
2. **Optimal K Determination (Simplified):** Manually define $K=3$ based on the business objective (Stable, High-Risk, Paydown Phase).
3. **Training:** Fit the K-Means model using the three engineered features.
4. **Cluster Interpretation:** Analyze the mean values of the features within each cluster to assign a **Business Label** (e.g., Cluster 2 = "Paydown Phase").

**Phase 3: Business Action and Streamlit Deployment**

1. **Segmentation Mapping:** Create a lookup table (the cluster\_map) that links the numerical cluster ID to the specific marketing action (e.g., Cluster 2 $\rightarrow$ Balance Transfer Offer).
2. **Visualization:** Plot the clusters in a 2D space (e.g., Avg Utilization vs. Paydown Indicator) to visually validate segmentation.
3. **Actionable Output:** Implement Streamlit logic to display the optimal **Next-Best-Offer** when a simulated customer lands in the target cluster.