**📊 1. Data Analysis Report**

**Objective:** Discover statistical relationships between features and churn.

**✅ Statistical Tests Performed:**

* **T-tests** for numerical features vs. churn (e.g., Purchase\_Amount, Age, Return\_Rate)
* **Chi-squared tests** for categorical features (e.g., Brand\_Loyalty, Shipping\_Preference)
* **Correlation Analysis**:
  + Features like Brand\_Loyalty, Discount\_Used, and Customer\_Satisfaction showed moderate correlation with churn.

**✅ Key Insights:**

* **Higher return rates** and **lower product ratings** were significantly associated with churners.
* **Frequent use of discounts** was more common among churned users.
* **Loyalty program membership** reduced churn odds.
* **Age** had a weak correlation with churn — suggesting it's not a strong driver.

**📈 2. Enhanced Visualizations**

Since the dataset is large (2,377 columns), we narrowed visuals to the top 20 most correlated features.

**✅ Delivered Visuals:**

* **Correlation Heatmap** (top features)
* **Churn vs. Brand Loyalty** boxplots
* **Customer Satisfaction distributions**
* **Bar plots** of churn rates by shipping preference, purchase intent

📌 These visuals help identify which user behaviors and preferences align with churn likelihood.

✅ All visuals are reproducible via Matplotlib/Seaborn. If needed, I can help convert these to interactive dashboards using Plotly or Streamlit.

**🛠️ 3. Feature Engineering Summary**

**✅ Features Created:**

| **Feature** | **Description** | **Reasoning / Impact** |
| --- | --- | --- |
| tenure\_days | Days since signup | Customers with short tenures churn more |
| avg\_session\_duration | Time spent per session | Signals engagement level |
| interaction\_frequency | Sessions per day | High = more engaged |
| used\_discount\_ratio | Ratio of purchases with discounts | Discount reliance linked to churn |
| is\_loyalty\_member | Binary encoding of loyalty program membership | Loyalty reduces churn |

**✅ Transformations:**

* **Log-scaling**: Applied to Purchase\_Amount, Return\_Rate
* **Normalization**: Applied to engagement metrics
* **Encoding**: One-hot encoded Shipping\_Preference, Purchase\_Intent