Feature Extraction and Price Prediction for Mobile Phones

This project aims to build a predictive model to estimate mobile phone prices based on key features. By analyzing a detailed dataset, we will identify the most influential attributes affecting pricing in a competitive market. The goal is to enhance the organization's pricing strategy through data-driven insights.

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# Data Exploration and Preprocessing

Data Exploration

We begin by loading the dataset containing mobile phone features features such as model, color, memory, RAM, battery, cameras, cameras, processor, and price. Understanding data types and value and value ranges is essential for effective analysis.

Data Preprocessing

Handling missing values, outliers, and inconsistencies ensures data ensures data quality. Categorical variables like model and color are color are converted into numerical formats using one-hot encoding encoding to prepare for modeling.

DISTRIBUTION OF PRICE

- Most common price range-rs 10,000 to rs 15,000

- It is skewed to the right side (positively skewed)most of phone are priced in the lower range.

- Few phone are above 25,000 and even around 80,000.

Distribution of Mobile Prices
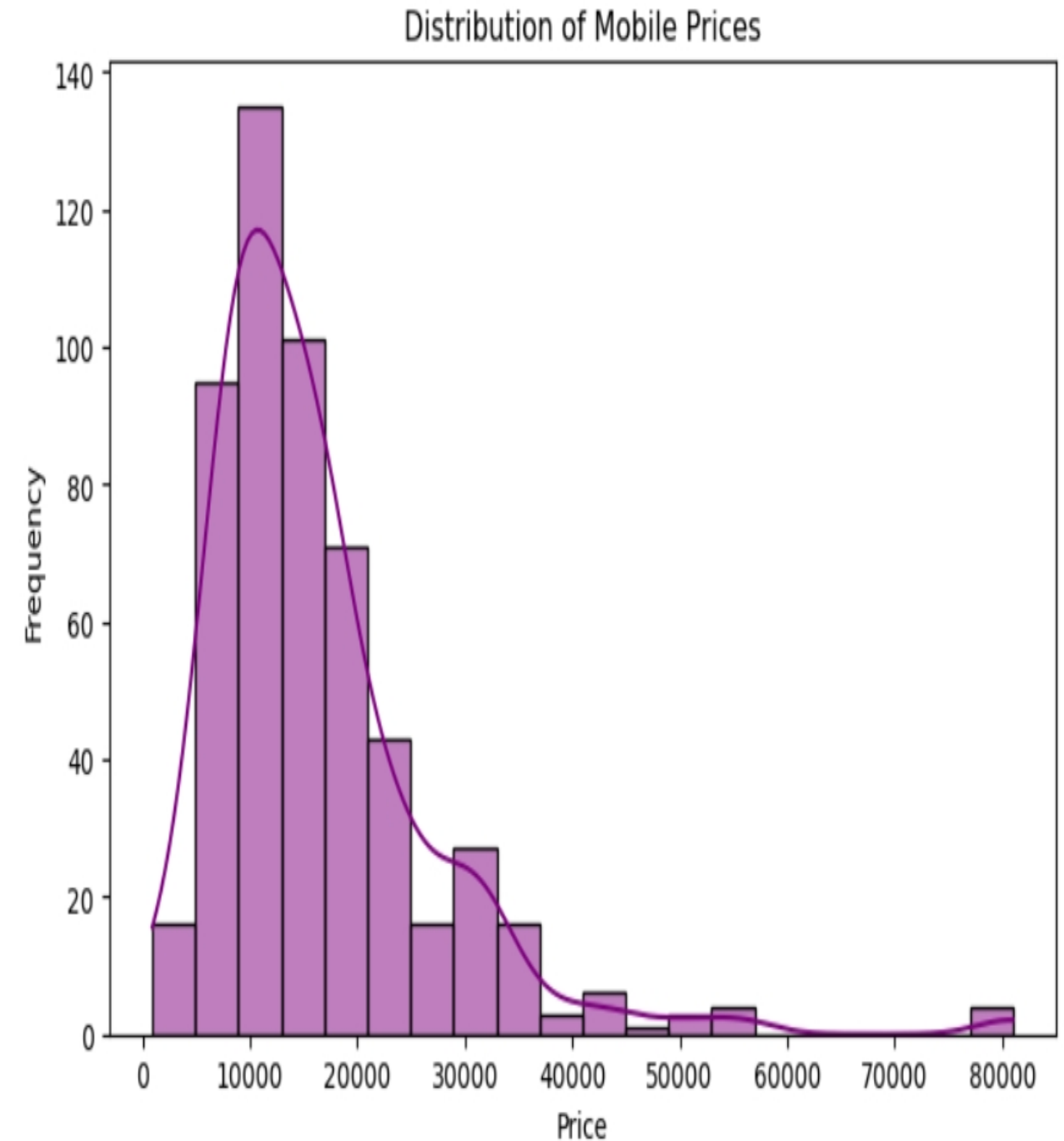
RAM VS Mobile Phone

- 4GB RAM is most frequent likely standard configuration for many budget and mid range phone.

- 8 GB RAM and 6 GB RAM show high frequencies (common in mid range to premium segement phone).

- 2 GB AND 3GB are less frequent (low end phones)

- This is multimodal distribution-multiple peaks(4GB,6GB and 8 GB)

- Could indicate different market segements budget(2-4 GB),Mid range(6GB) AND PREMIUM (8GB+)¶

Distribution of RAM in Mobile Phones
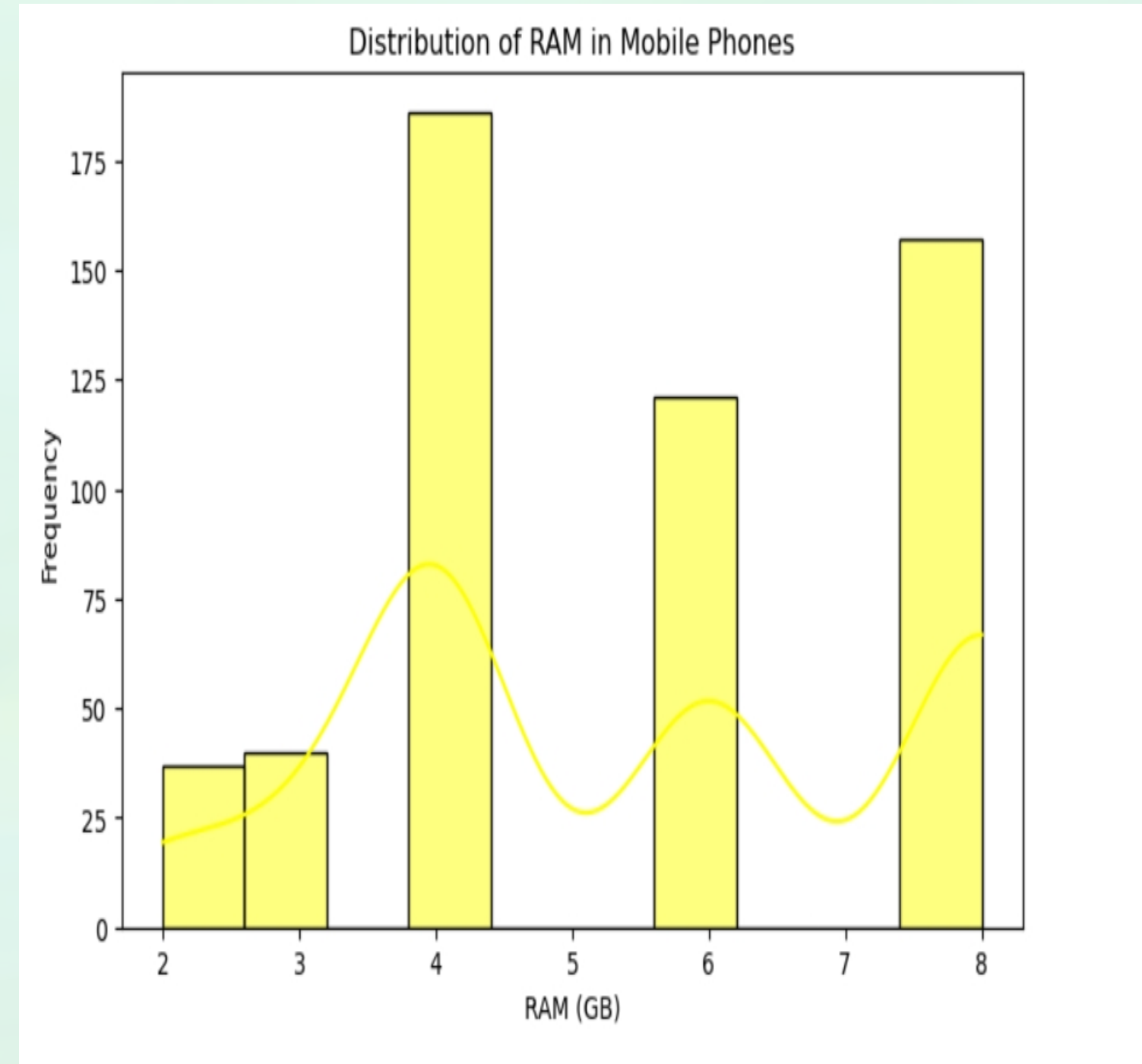
Feature Extraction Techniques

Statistical Methods

Correlation analysis helps identify features strongly related to price.

Feature Selection

Techniques like dimensionality dimensionality reduction narrow down relevant attributes.

Visualizations

Graphs and charts reveal patterns and feature impacts on pricing.

Price vs RAM

- Many 4 GB and 6 GB RAM devices are priced similar to or even higher than 8 GB devices.

- 8 GB RAM category spans from very low prices (~₹2,000–₹5,000) all the way to ₹80,000+.

- This indicates significant diversity in pricing within the 8 GB group—likely due to other features or mislabelled data.

- 2 GB and 3 GB RAM devices also appear at very high prices (~₹80,000), which is unexpected.

- This may suggest:

- *Outliers

- *Data entry errors

- *Niche/luxury products with outdated specs

Price vs RAM
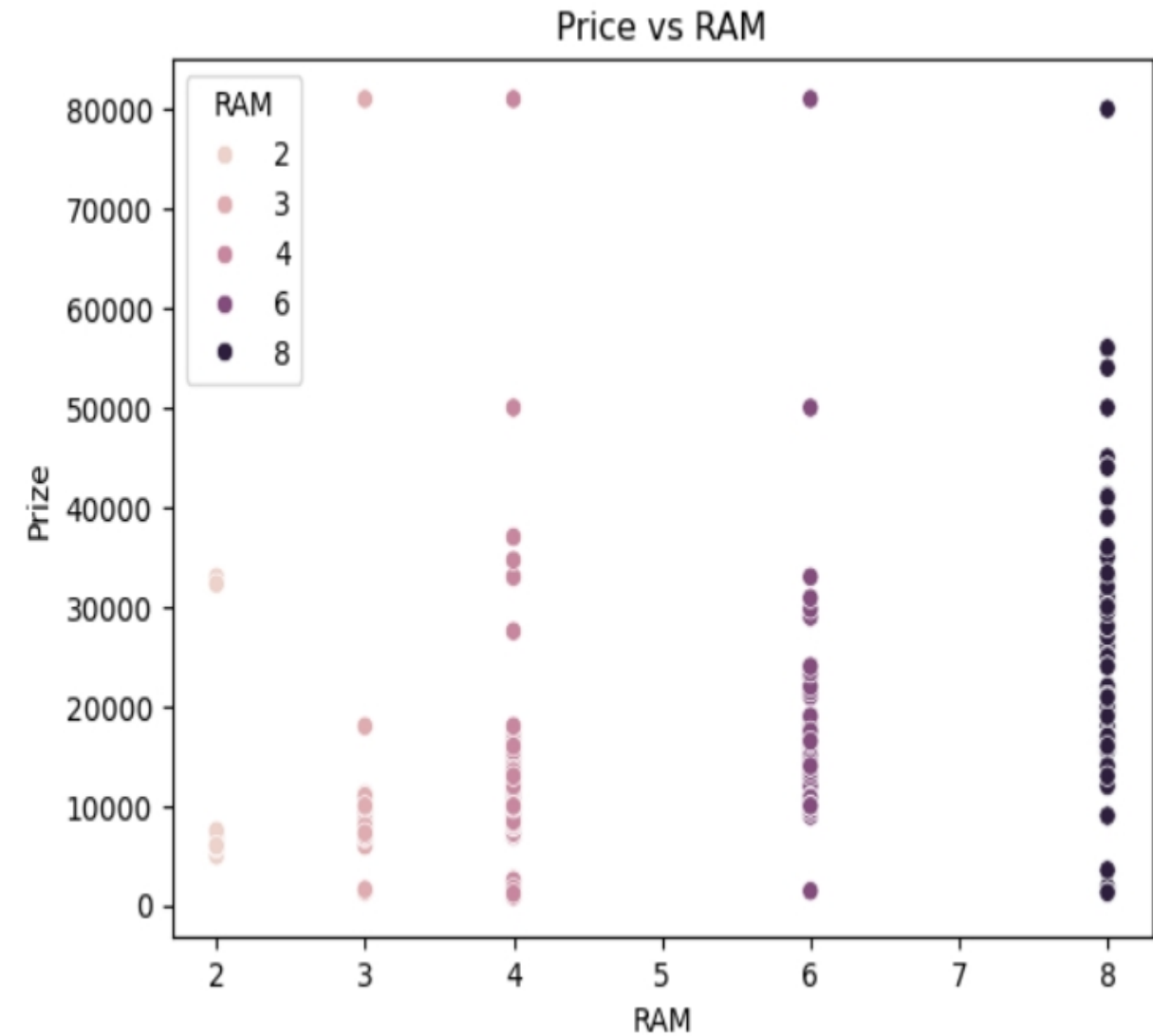
Camera vs. Price of Smartphones
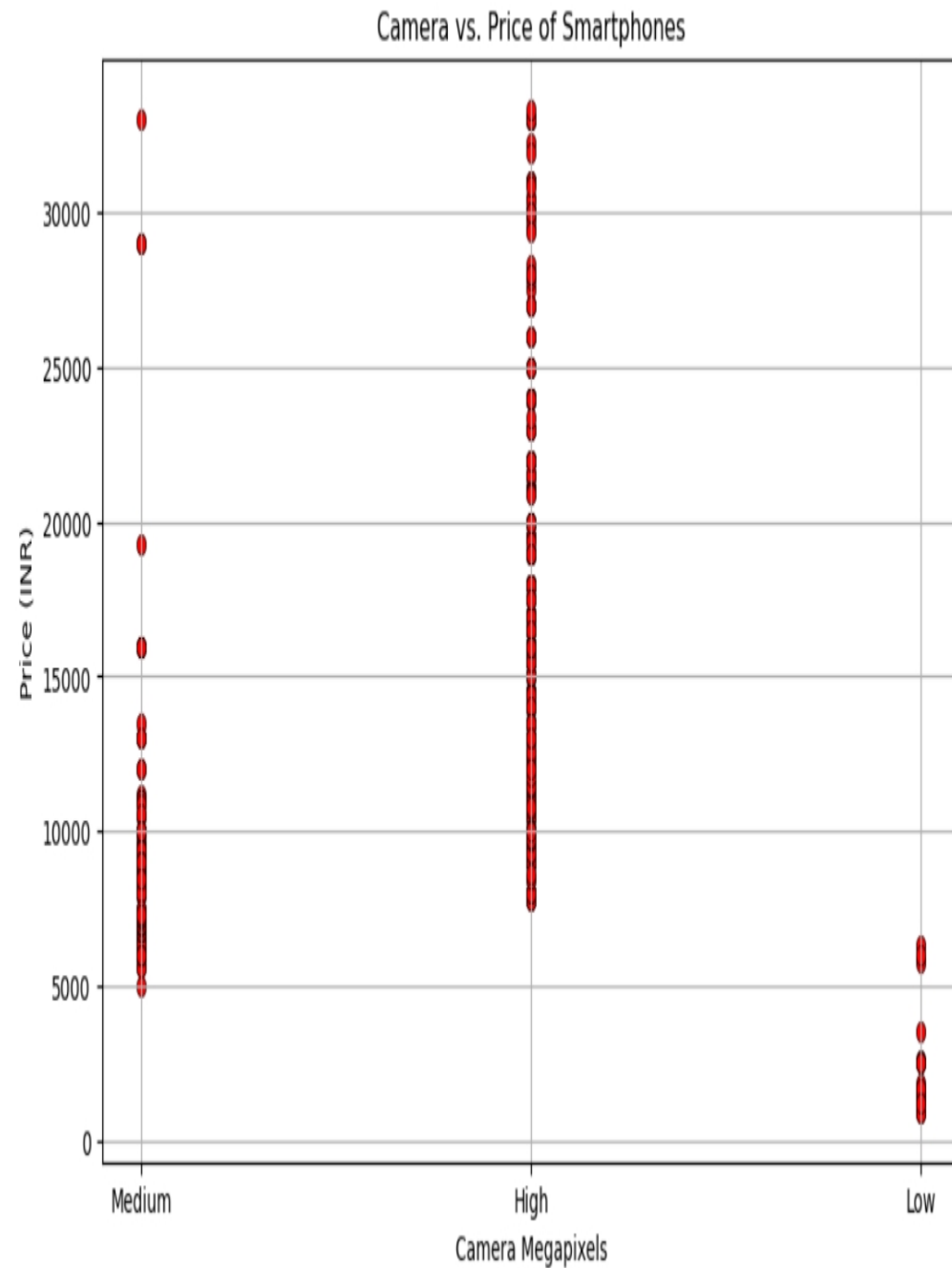
Observations:

High Camera Megapixels:

These smartphones tend to have higher prices.

Prices vary widely but generally range from around ₹8,000 to over ₹30,000.

There is a dense cluster of phones between ₹10,000 and ₹25,000.

Medium Camera Megapixels:

Made with GAMMA

These show a moderate price range.

Most phones are priced between ₹5,000 and ₹15,000, with some going above ₹30,000.
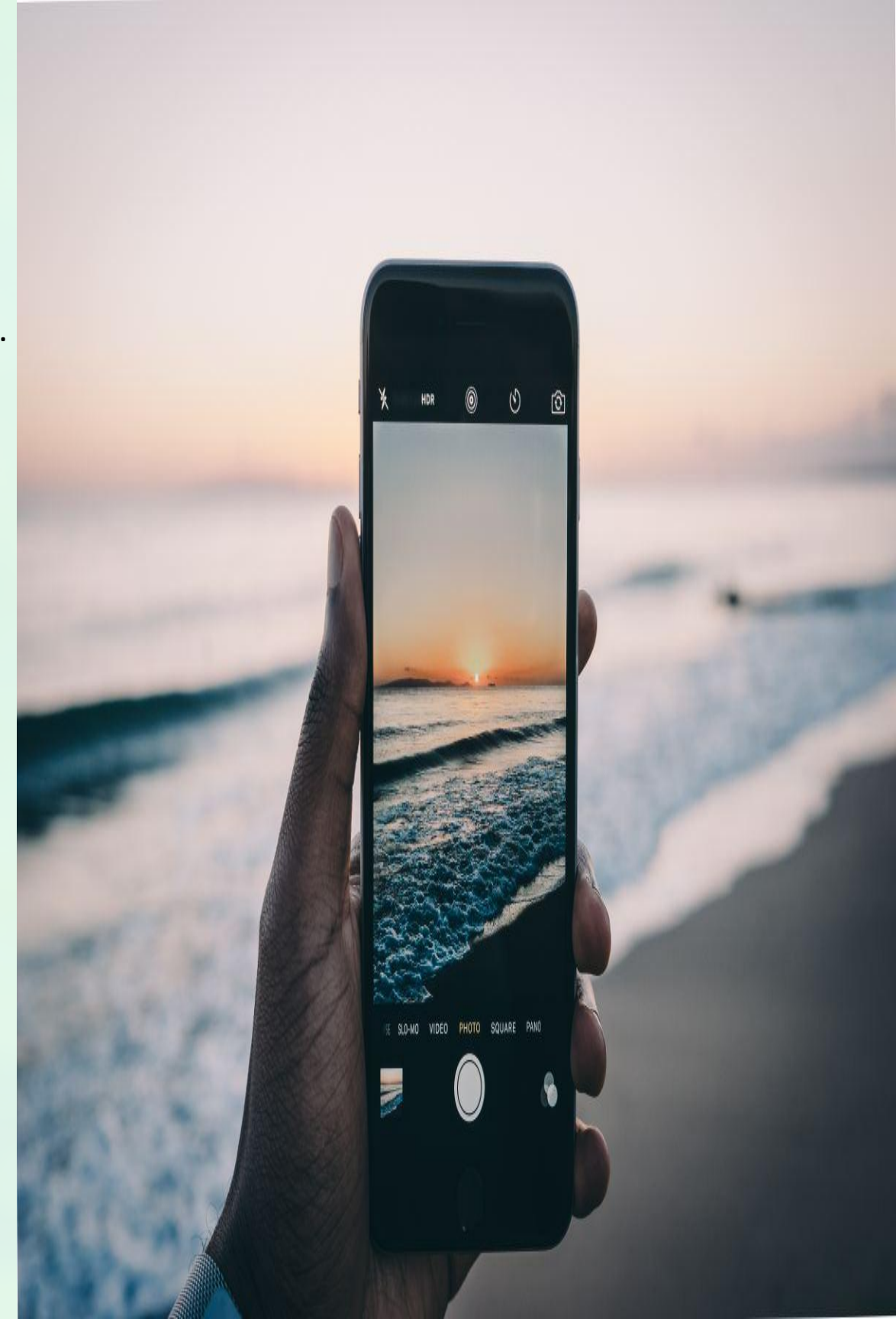
Low Camera Megapixels:

These are consistently lower priced.

Most prices are under ₹7,000.

Conclusion:

There's a visible correlation: higher camera megapixels often correspond to higher smartphone prices, while phones with low camera megapixels are generally more affordable.

Model Building and Training Training

Dataset Splitting

The data is divided into training and testing sets to validate model performance.

Algorithm Selection

Models such as linear regression, regression, decision trees, random random forests, and gradient boosting are considered for price price prediction.

Model Development

Training involves fitting the model to the training data to learn feature-price relationships.

Model Evaluation Metrics

Mean Absolute Error (MAE)

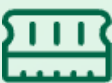Measures average absolute difference between predicted and actual prices.

Root Mean Squared Error (RMSE) (RMSE)

Penalizes larger errors, providing insight insight into prediction accuracy.

Performance Assessment

These metrics help determine how well the well the model predicts mobile phone prices.

Feature Importance Analysis

Memory & RAM

Strongly influence influence price due due to performance performance impact.

Battery Capacity

Higher capacity often correlates with premium pricing.
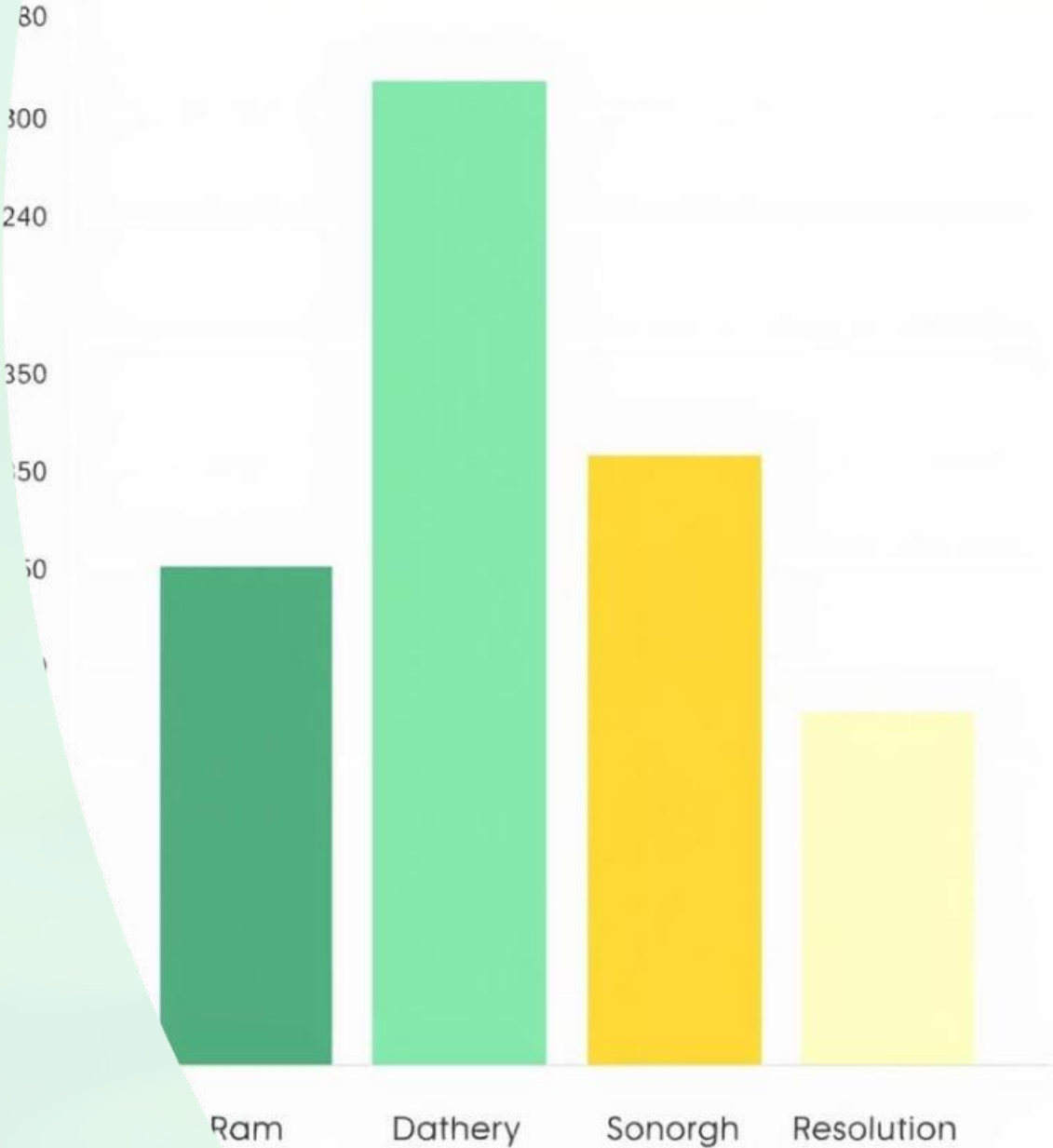
Camera Specifications

Rear and front camera quality affect perceived value.

Processor Type Type

Advanced processors contribute to higher higher prices.

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| Ram | Dathery | Sonorgh | Resolution |

Recommendations for Pricing Strategy

Focus on Key Features

Prioritize memory, RAM, battery, camera, and processor in pricing decisions. decisions.

Leverage Feature Insights

Use feature importance to tailor marketing and product positioning. positioning.

Continuous Model Updates

Regularly update the predictive model with new data for accuracy. accuracy.

Project Summary and Deliverables Deliverables

1 **Data Exploration**

Understanding and preparing the dataset.

2 **Feature Extraction**

Identifying influential features for price prediction.

3 **Model Building & Evaluation**

Developing and assessing predictive models.

4 **Reporting & Recommendations**

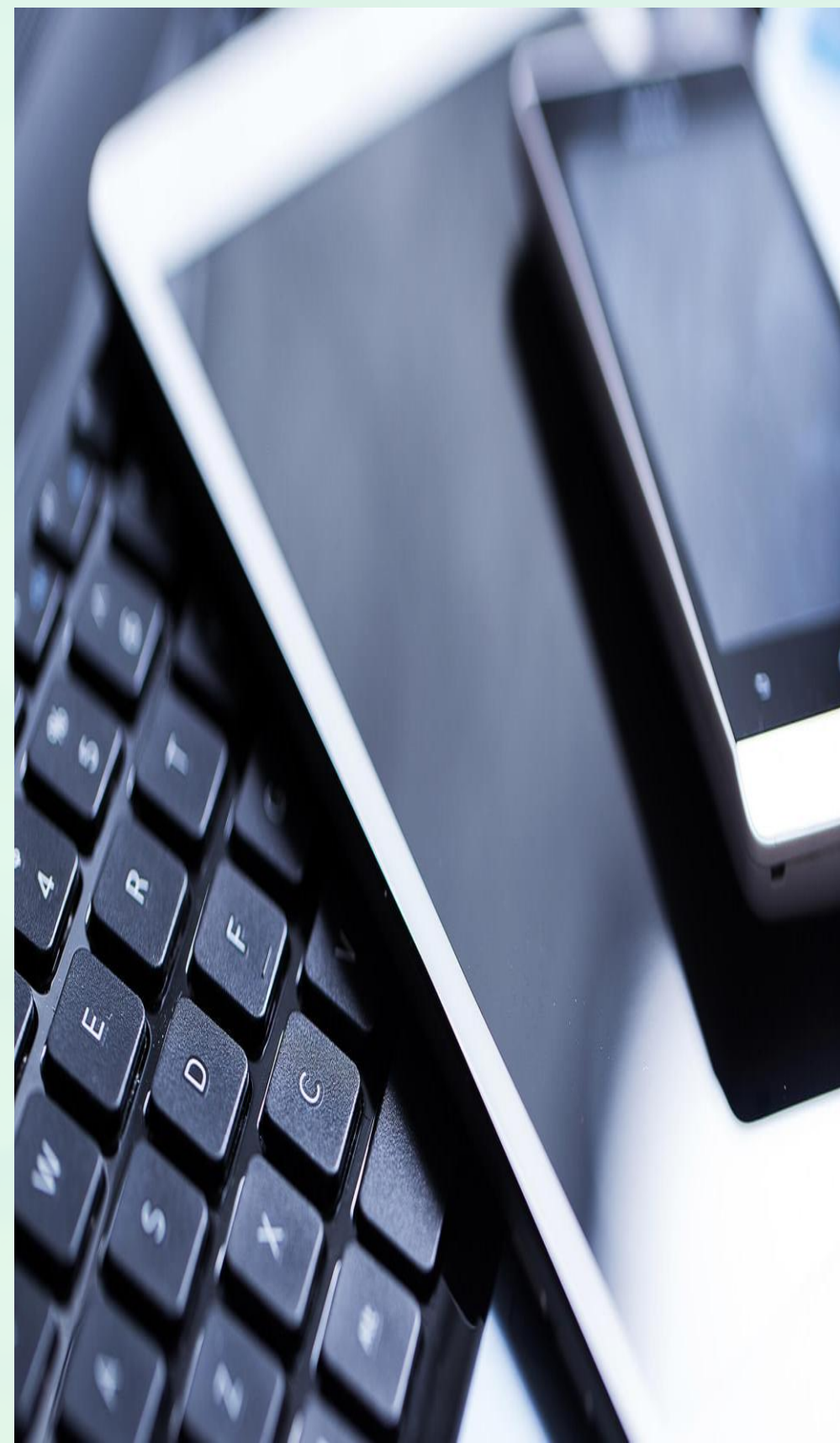Delivering insights and strategic advice to the organization.

- Recommendations according to random forest regressor model

- Based on feature importance, we can provide key insights:

- RAM, Memory, and Mobile Height likely have the highest impact on pricing.

- Camera specifications (Rear and Front) and brand may also be significant but secondary.

- Processor brand, Battery and Base color may have minimal impact and could be excluded from a leaner model.

- Recommendations Based on Feature Importance Analysis

- After evaluating the feature importance from the Random Forest model, we can determine which features play the most

- Significant role in predicting mobile phone prices. These insights can help the organization refine pricing strategies and marketing decisions.

- Key Features Influencing Mobile Phone Prices

- From the feature importance analysis, the most critical factors impacting price are:

- 1)Memory– Models with higher internal storage tend to have higher demand.

- 2)RAM – Higher RAM models tend to be priced significantly higher. Increasing RAM options could cater to performance-focused users.

- 3)Mobile Height – surprisingly mobile height tend to have big impact.

- Marketing & Pricing Strategy

- Segmented Pricing Strategy:

- - Offer premium pricing tiers based on RAM, Camera, Battery, and Processor quality.

- - Introduce budget-friendly versions of popular models by lowering storage and processor specifications.

- Marketing Focus on High-Impact Features:

- Highlight camera quality, RAM size, and processor brand in advertisements.

- Battery life should be emphasized, as it ranks among key decision factors for customers.

- Competitor Benchmarking:

- Compare similar price-tier phones from competing brands.

- Ensure the pricing aligns with customer expectations based on feature offerings.

- Product Bundling Recommendations:

- Phones with higher RAM & storage can be marketed alongside complementary offers (cloud storage, accessories).

- Camera-focused devices could target photography enthusiasts and influencers.