Product Performance Analysis

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Problem 1:

I'll use two dimensions:

- **Popularity (Total Sales)** – high vs. low
- **Profitability (Profit Amount)** – high vs. low

  Median → If Sales > median → High, else Low (same for Profit).

That gives me 4 categories:

1. **Stars (High Sales, High Profit)** → Prioritize, grow aggressively
2. **Cash Cows (Low Sales, High Profit)** → Niche but profitable, maintain
3. **Volume Traps (High Sales, Low Profit)** → Popular but low profitability, optimize costs/pricing
4. **Underperformers (Low Sales, Low Profit)** → Consider deprioritizing

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Overall Product-Level Analysis (All Regions Combined)

From the top summary row: (Among Gadgets: Headphones, Smartwatches, Speakers)

- **Headphones**
  - Sales: ₹95,624,865,55 (Highest)
  - Profit: ₹2,12,05,08,321 (Lowest)
  - Popular but not as profitable → **Volume Trap**
- **Smartwatches**
  - Sales: ₹9,05,01,43,773 (Lowest)
  - Profit: ₹2,55,99,34,563 (2nd)
  - Profitable but least popular → **Cash Cow**
- **Speakers**
  - Sales: ₹9,41,32,93,415 (2nd, close to Headphones)
  - Profit: ₹2,69,71,13,042 (Highest)
  - Strong profitability, decent sales → **Star**

Row Labels	Sum of Profit_Amt	Sum of Total_sale	Sum of Total_manufacturing_cost
Headphones	2,12,05,08,321	9,56,24,86,555	7,44,19,78,234
Smartwatches	2,55,99,34,563	9,05,01,43,773	6,49,02,09,210
Speakers	2,69,71,13,042	9,41,32,93,415	6,71,61,80,373
Grand Total	**7,37,75,55,926**	**28,02,59,23,743**	**20,64,83,67,817**

Regional Breakdown

North (Sales ~₹686.65 Cr, Profit ~₹216.99 Cr)

- **Smartwatches & Speakers** dominate profitability.
- **Headphones** sell big (₹218.34 Cr) but contribute less profit.
  - Prioritize **Smartwatches & Speakers** in North.

South (Sales ~₹698.49 Cr, Profit ~₹193.22 Cr)

- **Headphones** lead sales but relatively moderate profit.
- **Speakers** give strong profit relative to sales.
  - Focus more on **Speakers**, optimize **Headphone margins**.

East (Sales ~₹707.13 Cr, Profit ~₹165.57 Cr)

- Overall profit margin is weaker despite highest sales.
- **Smartwatches** are relatively strong, but **Headphones** lag in profitability.
  - Improve cost/pricing in **East Headphones & Smartwatches**.

West (Sales ~₹710.39 Cr, Profit ~₹161.97 Cr)

- Highest sales, but lowest profit per unit (weak profitability).
- **Smartwatches** contribute most profit, **Headphones** also good.
  - Focus on **Smartwatches**; improve margins on **Speakers**.

Row Labels	Sum of Profit_Amt	Sum of Total_sale	Sum of Total_manufacturing_cost
North	**2,16,98,94,497**	**6,86,65,22,947**	**4,69,66,28,450**
Headphones	60,13,47,074	2,18,34,85,639	1,58,21,38,565
Smartwatches	88,31,66,493	2,58,41,92,100	1,70,10,25,607
Speakers	68,53,80,930	2,09,88,45,208	1,41,34,64,278
South	**1,93,22,40,989**	**6,98,40,89,499**	**5,05,18,48,510**
Headphones	67,84,29,958	2,63,62,23,856	1,95,77,93,898
Smartwatches	44,86,13,165	1,82,11,41,947	1,37,25,28,782
Speakers	80,51,97,866	2,52,67,23,696	1,72,15,25,830
East	**1,65,56,77,401**	**7,07,13,92,775**	**5,41,57,15,374**
Headphones	35,74,64,316	2,15,07,89,671	1,79,33,25,355
Smartwatches	55,75,35,908	2,24,92,72,041	1,69,17,36,133
Speakers	74,06,77,177	2,67,13,31,063	1,93,06,53,886
West	**1,61,97,43,039**	**7,10,39,18,522**	**5,48,41,75,483**
Headphones	48,32,66,973	2,59,19,87,389	2,10,87,20,416
Smartwatches	67,06,18,997	2,39,55,37,685	1,72,49,18,688
Speakers	46,58,57,069	2,11,63,93,448	1,65,05,36,379
Grand Total	**7377555926**	**28025923743**	**20648367817**

Final Categorization

Stars (High Sales + High Profit):

- Overall, 390 Product units are starts among all 3 gadgets.
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Row Labels	East	North	South	West	Grand Total
Headphones	25	34	30	33	122
Smartwatches	31	42	24	33	130
Speakers	39	31	37	31	138
Grand Total	**95**	**107**	**91**	**97**	**390**

Cash Cows (Low Sales + High Profit):

- Overall, 110 Product units are starts among all 3 gadgets.
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Row Labels	East	North	South	West	Grand Total
Headphones	14	5	11	7	37
Smartwatches	13	4	10	11	38
Speakers	17	6	7	5	35
Grand Total	**44**	**15**	**28**	**23**	**110**

Volume Traps (High Sales + Low Profit):

- Overall, 110 Product units are starts among all 3 gadgets.
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Row Labels	East	North	South	West	Grand Total
Headphones	10	5	15	11	41
Smartwatches	8	10	11	11	40
Speakers	10	4	7	8	29
Grand Total	**28**	**19**	**33**	**30**	**110**

Underperformers (Low Sales + Low Profit):

- Overall, 390 Product units are starts among all 3 gadgets.
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Row Labels	East	North	South	West	Grand Total
Headphones	37	30	31	36	134
Smartwatches	37	30	27	36	130
Speakers	32	30	31	33	126
Grand Total	**106**	**90**	**89**	**105**	**390**

Recommendation:

- **Prioritize Speakers** (best combination of sales & profit).
- **Push Smartwatches** in South & West (great margins).

- **Revisit Headphones strategy** (popular but margins leak – maybe discount less or cut manufacturing cost).
- **Fix West region operations** (sales high but profitability lowest).

Problem 2:

1. What are SKUs?

- **SKU = Stock Keeping Unit**
- It's a unique identifier assigned to each **specific product variant**.
- Example:
  - Product Category = *Headphones*
  - Product Name = *XYZ Noise Cancelling*
  - Variants = Black, White, Wireless, Wired
  - Each variant = **1 SKU**

    So SKUs are the *granular units* we're tracking in our dataset, not just broad categories.

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2. Why Stock-outs & Excess Inventory Happen

- **Stock-outs** → Demand > Supply (forecasting or replenishment failure, slow lead time).
- **Excess Inventory** → Supply > Demand (overproduction, wrong demand forecast, poor sales).
  Both tie up capital and reduce profitability.

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3. Inventory Optimization Metrics

➢ Demand & Supply Alignment

1. **Sell-through Rate (%)**

$$\text{Sell-through Rate} = \frac{\text{Units Sold}}{\text{Units Sold} + \text{Inventory Level}} \times 100$$

   - High = strong demand (risk of stockouts).
   - Low = excess inventory (slow movers).
2. **Stockout Frequency**
   - Used Stockout_Days column.
   - Average stockout days per quarter = shows where demand forecasting failed.

➢ Efficiency & Cost

3. **Inventory Turnover Ratio**

$$\text{Inventory Turnover} = \frac{\text{Units Sold}}{\text{Average Inventory Level}}$$

   High = inventory moves fast → risk of stockouts.

- Low = inventory moves slowly → capital locked.

4. **Days of Inventory (DOI)**

$$DOI = \frac{\text{Inventory Level}}{\text{Units Sold per Day}}$$

(Units sold per day = Units Sold ÷ Days in Quarter)

- Shows how long current stock will last.

5. **Service Level (%)**

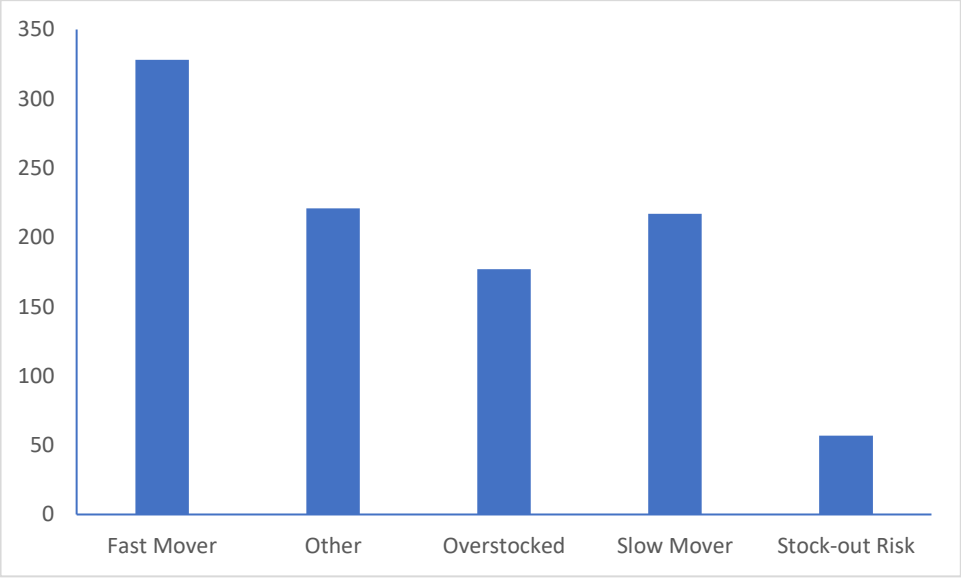
$$Service\ Level = 1 - \frac{\text{Stockout Days}}{\text{Total Days in Quarter}}$$

Higher = better ability to meet demand.

Categorize Products

Segment products based on these metrics:

- **High Sell-through + High Turnover + Low DOI** → *Fast movers* → Keep sufficient stock.
- **Low Sell-through + Low Turnover + High DOI** → *Slow movers / Excess inventory* → Reduce purchase, promote discounts.
- **High Service Level but Low Sell-through** → Overstocked items → Free up capital.
- **Low Service Level but High Sell-through** → Stock-out risk → Increase safety stock.



Problem 3:

1. Performance Differences Across Regions

- **Headphones**: Best performance in **West (241k units)**, slightly ahead of South & East. Profits are highest in East and South.
- **Smartwatches**: East leads in sales (231k units), West lags (221k).
- **Speakers**: East is strongest (244k), North weakest (186k).

This suggests **regional preferences exist**. East generally performs better across categories, while North underperforms.

2. Correlation Drivers

- **Pricing vs Sales (0.028)** → Very weak **positive** → Price isn't driving sales much. Customers don't react strongly to small price differences.
- **Marketing vs Sales (-0.027)** → Very weak **negative** → Surprisingly, more marketing spend does **not** increase sales in your data. Could mean inefficient spending or diminishing returns.
- **Marketing vs Rating (0.021)** → Very weak **positive** → Slight link that marketing may improve customer perception, but not strongly.
- **Discount % vs Sales (-0.063)** → Slight negative → higher discounts are *not* boosting sales; could even signal poor product perception.
- **Competitor Price vs Sales (-0.020)** → Negligible → competitor pricing doesn't explain sales variation.
- **Customer Rating vs Sales (-0.042)** → Slight negative → higher ratings are not translating into sales (maybe other factors dominate, like brand presence or distribution).
- **Stockouts vs Sales (0.008)** → Almost **zero** → Stockouts don't seem to explain sales differences (maybe inventory management is consistent across regions).
- **Return Rate % vs Sales (0.029)** → Very weak positive — oddly, products with higher returns sell slightly more (popular products get returned more).
- **Warranty Claims % vs Sales (0.067)** → Weak positive — higher claims linked with higher sales (again, higher volume → more issues).

All correlations are very close to zero (weak). This means **no single factor is strongly driving sales**.
→ Customers in different regions are likely influenced by **other unmeasured factors** such as:

  - Regional consumer preferences (taste, culture, habits)
  - Distribution reach / availability in stores
  - Brand awareness differences
  - Seasonal or local events

1. **Discounts backfired**
   - The negative correlation (-0.063) suggests **heavier discounts aren't improving sales**.
   - This often happens when discounts signal *lower quality* or when competitors also discount at the same time.

2. **Customer Ratings not linked to sales**
    - Sometimes products are well-rated but still don't sell (niche appeal, limited reach, lack of awareness).
    - This suggests ratings alone are not driving consumer purchase decisions.
3. **Warranty & Returns look "positive"** not because they improve sales, but because **high-selling products naturally generate more returns/claims**.
   → It's a **volume effect**, not a causal effect

Row Labels	Sum of Units_Sold	Sum of Profit_Amt	Sum of Total_sale	Average of Customer_Rating	Sum of Stockout_Days
Headphones	**892798**	**2026323059**	**9562486555**	**3.0**	**3439**
East	218816	333083387	2150789671	3.1	872
North	201885	579744338	2183485639	3.2	778
South	230835	653337058	2636223856	2.8	903
West	241262	460158276	2591987389	3.1	886
Smartwatches	**843791**	**2469485402**	**9050143773**	**3.0**	**3321**
East	231890	533585956	2249272041	3.2	925
North	230171	859828245	2584192100	2.9	803
South	160020	430572535	1821141947	2.9	644
West	221710	645498666	2395537685	3.2	949
Speakers	**841661**	**2604222482**	**9413293415**	**3.0**	**3156**
East	244937	711788381	2671331063	3.1	945
North	186390	666182962	2098845208	2.9	753
South	218077	782061490	2526723696	2.8	708
West	192257	444189649	2116393448	3.1	750
Grand Total	**2578250**	**7100030943**	**28025923743**	**3.0**	**9916**

Problem 4:

Step 1: Calculate Key Metrics

Added new calculated columns:

1. **Revenue** = Units_Sold * Selling_Price_per_Unit
2. **Total Cost** = (Units_Sold * Manufacturing_Cost_per_Unit) + Marketing_Spend
3. **Profit** = Revenue - Total Cost
4. **ROI (Return on Investment)** → measures profitability vs marketing
   = (Profit / Marketing_Spend)
   (Format as %)
5. **Marketing Efficiency Ratio (MER)** → how much revenue each $1 marketing brings
   = Revenue / Marketing_Spend

ROI values are **extreme** (e.g., +58,100% or -22,349%). This usually happens because **Marketing Spend is very low** for some SKUs, so even a small profit gives a huge ROI%, or a small loss gives a huge negative ROI%.

Step 2: Segment Products

Used PERCENTILE.INC to calculate ROI percentiles:
=IF(OR(W2<AB2,W2<0),"Loss making",IF(W2<AB3,"Low ROI",IF(W2<AB4,"Moderate"," High ROI")))

- **This gives a clear classification:**
- **High ROI → Marketing spend is working well.**
- **Moderate ROI → Acceptable efficiency.**
- **Low ROI → Spending more than return.**
- **Loss Making → Negative ROI.**

Key Insights

1. Marketing Efficiency is Uneven

- **Loss-making spend dominates**:
  - ₹9.97 Cr is in loss-making buckets.
  - South (₹2.49 Cr) and West (₹2.93 Cr) have the highest wasteful spends.
- **High ROI spend is much lower**: Only ₹5.46 Cr.
  - East and South show relatively better utilization.
  - North achieves the highest absolute high-ROI spend (₹1.57 Cr).

2. Product-wise Marketing Impact

- **Headphones**:
  - Largest spend (₹9.4 Cr), but **₹3.8 Cr is loss-making**.

    - High ROI spend is only ₹1.7 Cr → inefficient compared to total spend.
- **Smartwatches**:
    - Spend is slightly more balanced (₹9 Cr total).
    - Loss-making (₹3.1 Cr) and moderate ROI (₹2.5 Cr).
- **Speakers**:
    - ₹9.2 Cr spend, but again, ₹3 Cr is loss-making.
    - Moderate ROI dominate.

Sum of Marketing_Spend	Column Labels			
Row Labels	Headphones	Smartwatches	Speakers	Grand Total
Loss making	3,79,07,929	3,10,85,898	3,07,59,502	9,97,53,329
Moderate	2,53,26,346	2,52,73,306	2,79,21,229	7,85,20,881
High ROI	1,71,55,584	1,88,63,525	1,85,80,486	5,45,99,595
Low ROI	1,37,95,403	1,52,26,432	1,56,29,343	4,46,51,178
Grand Total	**9,41,85,262**	**9,04,49,161**	**9,28,90,560**	**27,75,24,983**

Across all products, **marketing spend is not strongly converting to profitable growth**.

3. Regional Variability

- **East**: Highest overall spend (₹7.7 Cr) but also **highest loss-making (₹2.45 Cr)** → over-investing without proportional returns.
- **North**: More efficient — less spend (₹6.4 Cr), yet **high ROI spend (₹1.57 Cr)** is significant.
- **South**: Similar to North — ₹6.6 Cr spend with better balance (₹1.41 Cr High ROI).
- **West**: Weakest efficiency — ₹6.9 Cr spend with high loss-making (₹2.93 Cr) and lowest high ROI (₹1.44 Cr).

North & South use spend more effectively, East & West show heavy wastage.

Sum of Marketing_Spend	Column Labels				
Row Labels	East	North	South	West	Grand Total
Loss making	2,44,83,975	2,10,11,507	2,49,48,883	2,93,08,964	9,97,53,329
Moderate	2,37,19,265	1,94,55,112	1,86,17,461	1,67,29,043	7,85,20,881
High ROI	1,29,78,138	1,57,26,052	1,14,73,036	1,44,22,369	5,45,99,595
Low ROI	1,60,38,299	79,46,281	1,12,30,526	94,36,072	4,46,51,178
Grand Total	**7,72,19,677**	**6,41,38,952**	**6,62,69,906**	**6,98,96,448**	**27,75,24,983**

Recommendations

1. **Reallocate Marketing Budgets**
    - Cut back on **loss-making campaigns in East & West**. Shift ~10–15% of that spend into North & South where ROI is proven higher.

- Within products, reduce headphone marketing spend — it absorbs the largest budget but delivers weaker ROI.

2. **Optimize Product Marketing**
   - **Headphones**: Test smaller, targeted campaigns instead of blanket spends. The product has high volume but marketing ROI is weak.
   - **Smartwatches**: Moderate ROI suggests campaigns work but need optimization (better targeting, digital focus).
   - **Speakers**: Low ROI bucket is large — focus on performance marketing instead of generic brand awareness.
3. **Reduce Discount-Based Marketing**
   - Correlation showed **discount % vs sales = -0.063** (negative).
   - Instead of discount-heavy campaigns, emphasize **value-add messaging** (durability, features, regional needs).
4. **Prioritize High-ROI Channels**
   - Double down on **digital & targeted online sales campaigns** in regions where online adoption is high.
   - Reduce offline mass-marketing that doesn't scale with ROI.

Sum of Marketing_Spend	Column Labels			
Row Labels	Headphones	Smartwatches	Speakers	Grand Total
Loss making	**3,79,07,929**	**3,10,85,898**	**3,07,59,502**	**9,97,53,329**
East	93,96,958	78,68,169	72,18,848	2,44,83,975
North	71,44,523	74,47,061	64,19,923	2,10,11,507
South	1,04,75,144	67,29,543	77,44,196	2,49,48,883
West	1,08,91,304	90,41,125	93,76,535	2,93,08,964
Moderate	**2,53,26,346**	**2,52,73,306**	**2,79,21,229**	**7,85,20,881**
East	62,49,004	78,28,422	96,41,839	2,37,19,265
North	74,16,010	61,72,835	58,66,267	1,94,55,112
South	59,89,176	52,23,740	74,04,545	1,86,17,461
West	56,72,156	60,48,309	50,08,578	1,67,29,043
High ROI	**1,71,55,584**	**1,88,63,525**	**1,85,80,486**	**5,45,99,595**
East	33,44,152	37,56,597	58,77,389	1,29,78,138
North	45,76,641	65,78,973	45,70,438	1,57,26,052
South	40,89,484	29,09,034	44,74,518	1,14,73,036
West	51,45,307	56,18,921	36,58,141	1,44,22,369
Low ROI	**1,37,95,403**	**1,52,26,432**	**1,56,29,343**	**4,46,51,178**
East	53,90,815	44,96,764	61,50,720	1,60,38,299
North	24,65,562	31,39,379	23,41,340	79,46,281
South	45,39,096	31,78,313	35,13,117	1,12,30,526
West	13,99,930	44,11,976	36,24,166	94,36,072
Grand Total	**9,41,85,262**	**9,04,49,161**	**9,28,90,560**	**27,75,24,983**

Problem 5:

Price Band Overlaps

- Used Selling_Price_per_Unit to cluster products into **price bands (low, mid, premium)**.
- If multiple SKUs fall in the **same band** and share the same region, they are at risk of cannibalization.
- Look for **shifts in sales between products with overlapping prices**.

Headphones

Product Typ	Count of Product_ID	Sum of Revenue	Sum of Profit
Low	84	84,98,83,388	-1,32,67,22,531
Mid	83	1,58,92,52,628	6,49,04,061
Premium	167	7,12,33,50,539	3,28,81,41,529
Grand Total	**334**	**9,56,24,86,555**	**2,02,63,23,059**

Smartwatches

Product Typ	Count of Product_ID	Sum of Revenue	Sum of Profit
Low	85	83,59,34,694	-80,46,58,931
Mid	84	1,80,47,37,333	18,30,37,817
Premium	169	6,40,94,71,746	3,09,11,06,516
Grand Total	**338**	**9,05,01,43,773**	**2,46,94,85,402**

Speakers

Product Typ	Count of Product_ID	Sum of Revenue	Sum of Profit
Low	82	79,48,60,066	-88,14,26,830
Mid	82	1,76,10,51,141	9,01,62,865
Premium	164	6,85,73,82,208	3,39,54,86,447
Grand Total	**328**	**9,41,32,93,415**	**2,60,42,22,482**

What the Profit View Tells Me

1. Low-End Products = Heavy Losses

- **Headphones (Low)**: Revenue ₹84.9 Cr but **Profit = –₹132 Cr**.
- **Smartwatches (Low)**: Revenue ₹83.5 Cr but **Profit = –₹80 Cr**.
- **Speakers (Low)**: Revenue ₹79.5 Cr but **Profit = –₹88.1 Cr**.

All low-tier products are loss-making. With **80+ SKUs per gadget category**, this strongly suggests **overcrowding + cannibalization**.

These SKUs aren't bringing new customers — they're splitting sales, requiring discounts, and eroding margins.

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2. Mid-Tier Products = Thin Profits

- Profit margins are **tiny** in mid-tier.
    - Headphones: ₹6.5 Cr profit on ₹159 Cr revenue.
    - Smartwatches: ₹18.3 Cr on ₹180 Cr revenue.
    - Speakers: ₹9 Cr on ₹176 Cr revenue.

Mid-tier SKUs may also be cannibalizing each other — sales aren't translating to healthy profit.

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3. Premium Products = True Profit Drivers

- Premium SKUs dominate profits:
    - Headphones: ₹329 Cr profit.
    - Smartwatches: ₹309 Cr profit.
    - Speakers: ₹339 Cr profit.

Premium SKUs are carrying the categories. But having **too many low/mid SKUs drags total profitability down**.

What This Means for Cannibalization

1. **Many low/mid SKUs, but almost no profit (even losses)** → they are likely eating into each other instead of growing category sales.
2. **Premium SKUs are profitable, but their gains are offset by low/mid underperformance.**
3. **Total market share may look stable**, but internal competition reduces **net profit** → the textbook definition of cannibalization.

Insights

- The company has **SKU proliferation**: ~80+ products in low/mid tiers per category but contributing almost nothing to profit.
- Low-tier models generate **negative profits**, suggesting **deep discounting and cannibalization** of mid-tier sales.
- **Premium products drive nearly all the profit**, but this is diluted by losses elsewhere.
- Streamlining the portfolio (fewer low/mid SKUs, focus on premium + a small number of well-positioned mid-tier models) would improve profitability without hurting revenue.

Recommendations

- **Rationalize Portfolio** → Reduce low-performing SKUs in Low & Mid tiers.
- **Focus on Premium & Select Mid-Tier** → Concentrate marketing & innovation where profitability is proven.

- **Shift Marketing ROI** → Cut loss-making campaigns, tailor promotions to **grow total category**, not shuffle demand.