BitPin Data Analysis Task

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Data loading and cleaning

Initial loading and data conversion

The Maven Toys dataset is split across 6 files. We load all files except the calendar and dictionary and do outer joins on Product_ID, Store_ID. We convert the IDs to numerical types and Store_City, Store_Location, Product_Name, Product_Category to categorical types. Also we converted the prices to numerical as well.

Handling missing values

The dataset has missing values for 3 Sales, and 6232 inventory values. Upon further inspection it was revealed that these missing values were for sales that had 0 stock.
We dropped the 3 rows with 3 missing sales because of the low amount of missing values there.
For the inventory values we simply set the Stock On Hand value to 0 and provided the Product_Name and other inventory values using the Product_ID.

Feature engineering

Temporal features

We created the following features for investigating the seasonal and temporal effect on sales. These values were extracted using the Date value:

- Sale_Year
- Sale_Month
- Sale_Is_Weekend: boolean feature indicating if the sale happen on a weekend
- Sale_Quarter: The quarter of the year in which the sale happened, (i.e. 2023Q1, …)
- Store_Age: The store opening date subtracted from the analysis date.

Sales features

The following features were created to investigate the interaction between sale variables:

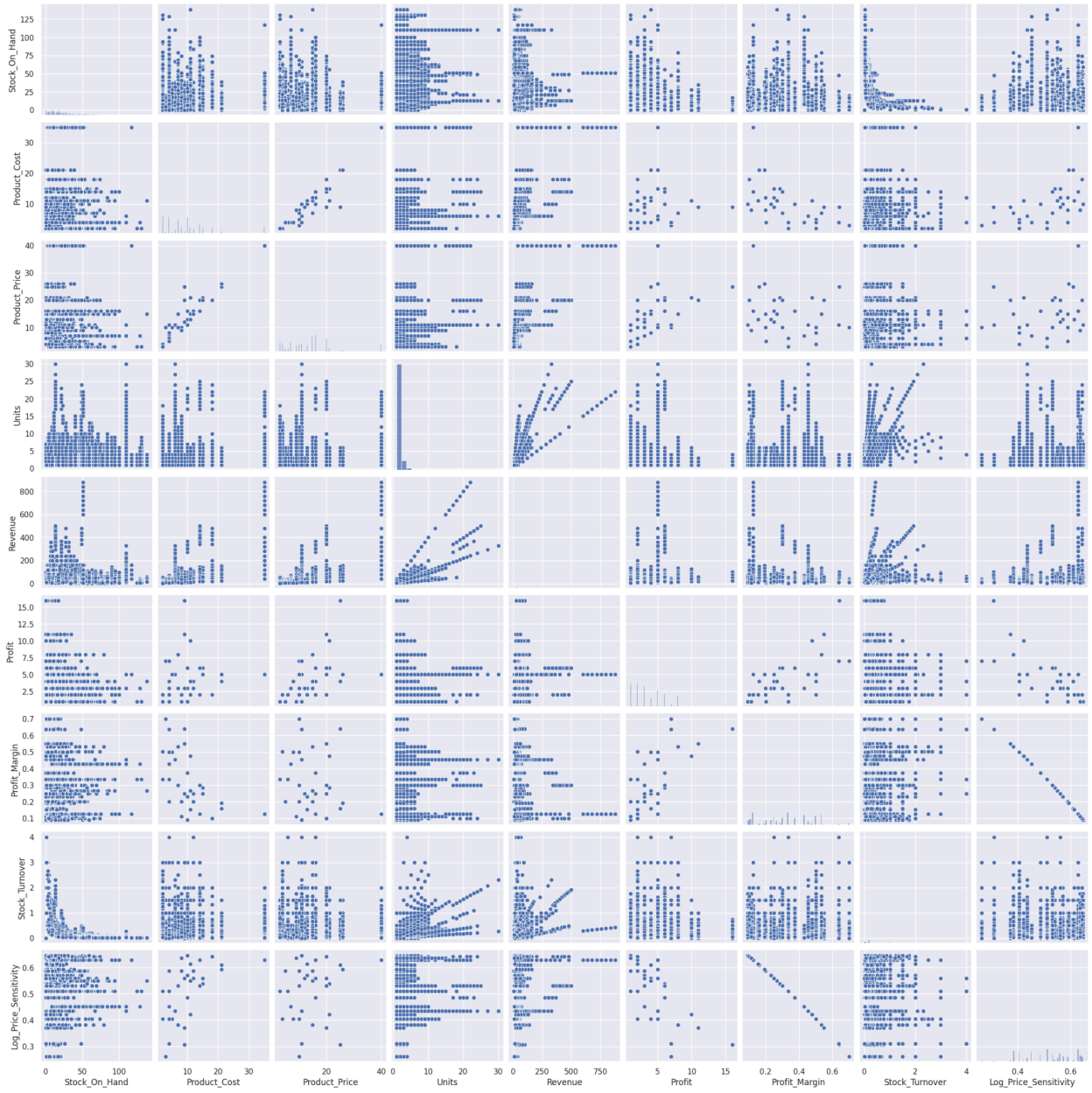
- Revenue: Units sold in the sale times the Product Cost
- Profit: Product Price minus Product Cost
- Profit Margin: Profit divided by Product Price
- Price Sensitivity: logarithm of Product Cost divided by Product Price.

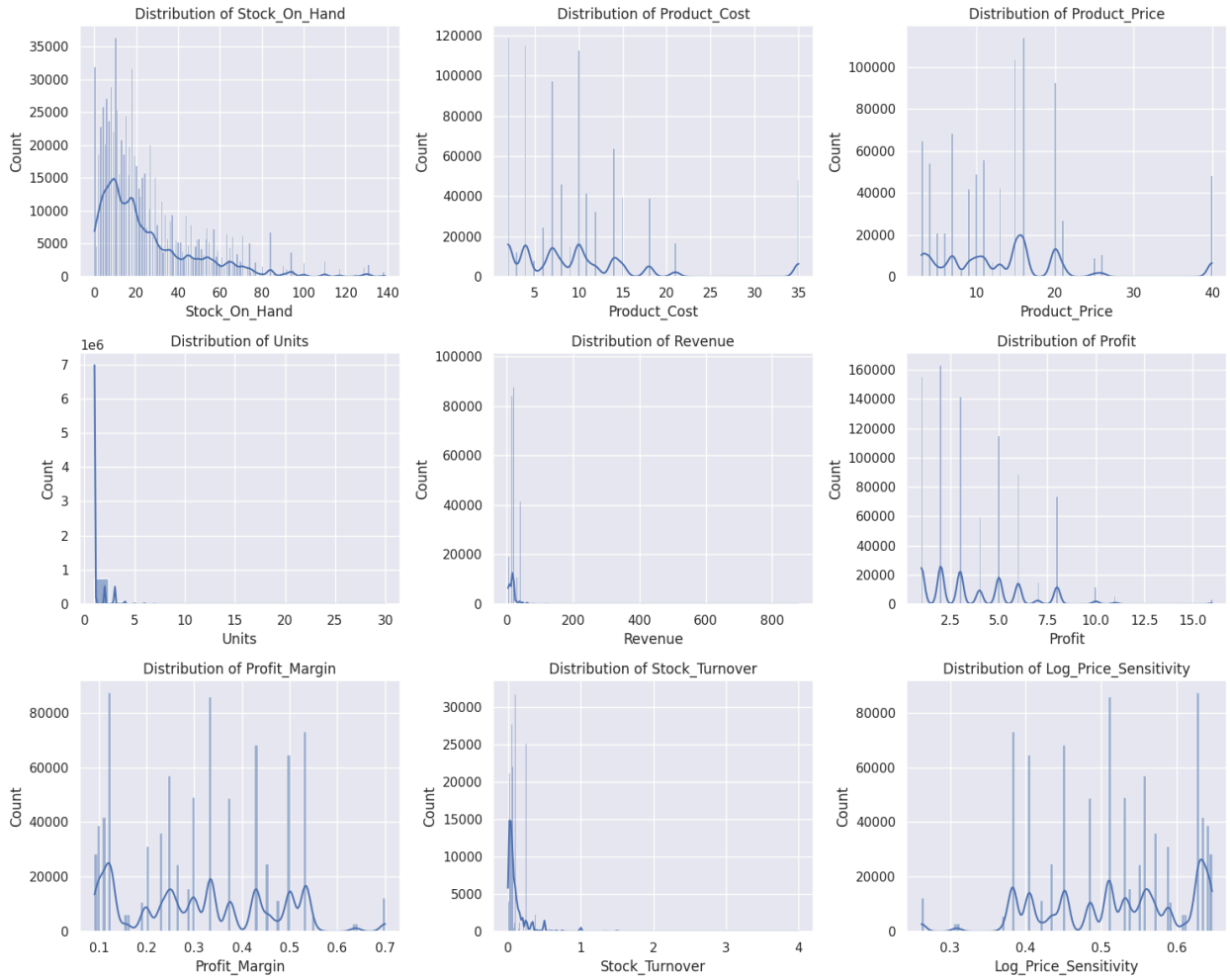
Inventory features

- Stock Turnover: Units sold divided by Stock On Hand, this feature indicates how fast the goods are sold.
- Stock Available: If the Stock On Hand is bigger than a threshold (here we set it to 10), this feature is true otherwise false.
- Inventory Value: Stock On Hand times the Product Price

Outlier handling

We begin the analysis of the dataset by plotting pair plots and histogram of specific features to look for outliers.





In the following plots we can notice some outliers in Units sold, Revenue, and Stock Turnover. We remove the outliers by using the IQR method. The Interquartile Range method is a statistical technique used to identify and remove outliers from a dataset. We divide the data into four equal parts, or quartiles. Each quartile represents 25% of the data.

- Q1 (First Quartile): The median of the lower half of the data (25th percentile)
- Q2 (Second Quartile): The median of the entire dataset (50th percentile)
- Q3 (Third Quartile): The median of the upper half of the data (75th percentile)

The IQR is the difference between Q3 and Q1. It represents the range of the middle 50% of the data.
To identify outliers, we set two bounds:

- Lower Bound: Q1 - 1.5 * IQR (any value below this is considered an outlier)
- Upper Bound: Q3 + 1.5 * IQR (any value above this is considered an outlier)

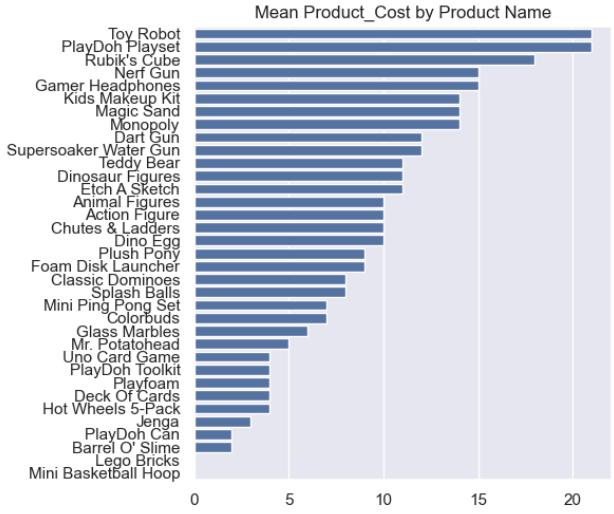
Analysis

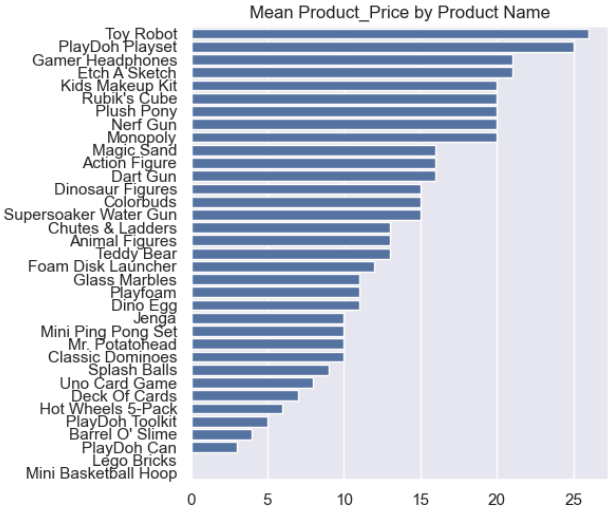
Initial analysis

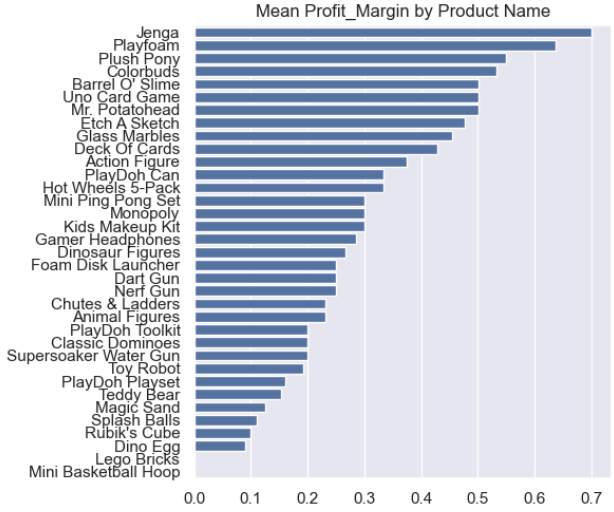
We begin by checking some characteristics about the data.

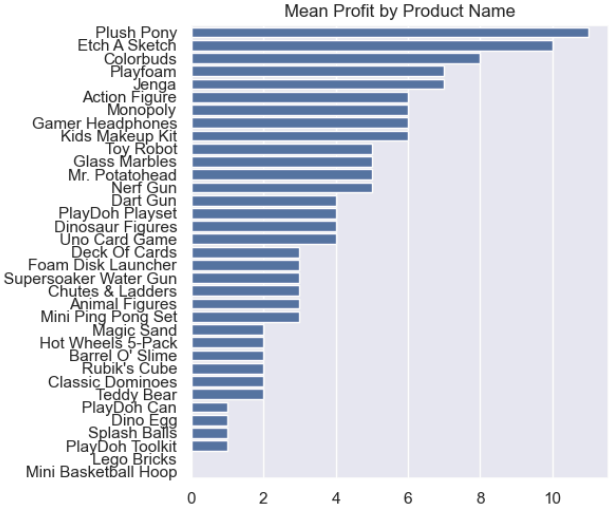
- In how many cities do the stores operate? 29 cities.
- How many types of locations are there? 4 locations ('Residential', 'Commercial', 'Downtown', 'Airport')
- What are the oldest and newest stores? Maven Toys Guadalajara 1 in the city of Guadalajara of type Residential is the oldest and opened on 1992-09-18. Maven Toys Guanajuato 3 in the city of Guanajuato of type Residential opened on 2016-05-18.
- How many products are there and what categories? There are 33 products, with categories Toys, Arts & Craft, Games, Sports & Outdoors and Electronics. The most being Toys and the least being Electronics.

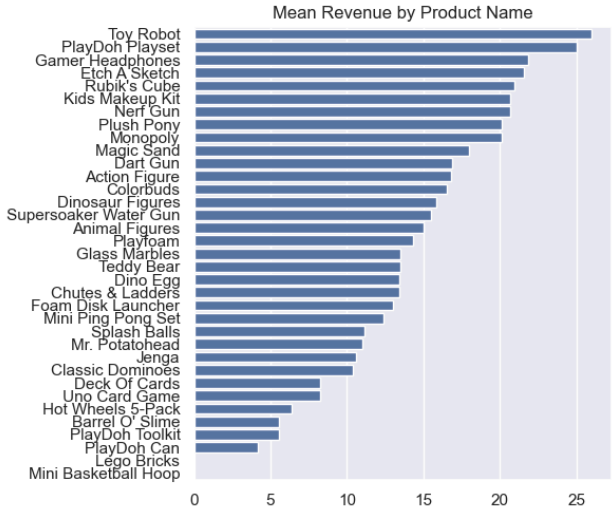
Sales metrics across products

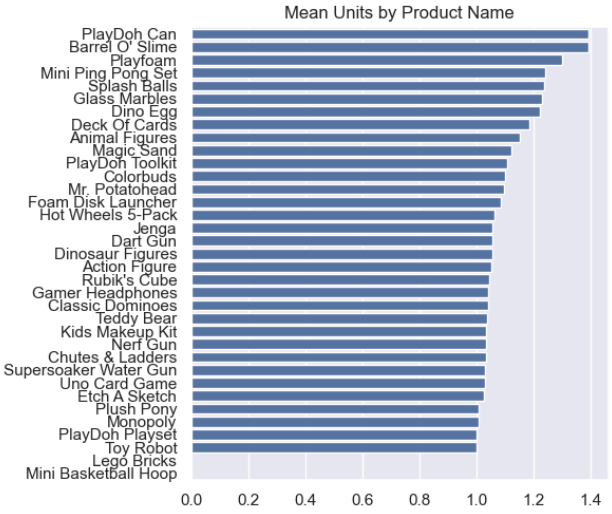












1. Product Cost and Price:

- **Toy Robot**, **PlayDoh Playset**, and **Rubik's Cube** are among the most expensive products, with mean costs close to $20. These products also have high mean prices, indicating they are positioned as premium offerings.
- **Lower-cost products** like **PlayDoh Can** and **Barrel O' Slime** have much lower mean costs (under $5), but they contribute heavily to units sold, suggesting they are high volume products.

2. Profit Margins:

- **Jenga**, **Playfoam**, and **Plush Pony** have the highest profit margins, exceeding 0.5. These products show a good cost-to-profit ratio, and they generate significant profit per unit sold.
- Despite lower sales volumes, these high-margin products can drive profitability, especially when marketed as value-based or exclusive items.

3. Profit:

- **Plush Pony**, **Etch A Sketch**, and **Colorbuds** generate the highest profits, between $8-$10 per unit.
- **Mini Basketball Hoop** and **Dino Egg** have lower profit margins and profits, making them less profitable despite their unit sales.

4. Revenue Contribution:

- **Toy Robot** and **PlayDoh Playset** lead in revenue generation, contributing between $20 and $25 on average per unit. These products likely account for a significant portion of total revenue due to their high profit and units sold.
- **Gamer Headphones**, **Etch A Sketch, Rubik's Cube** are also high in the revenue metric, further indicating their popularity and importance to the overall picture.

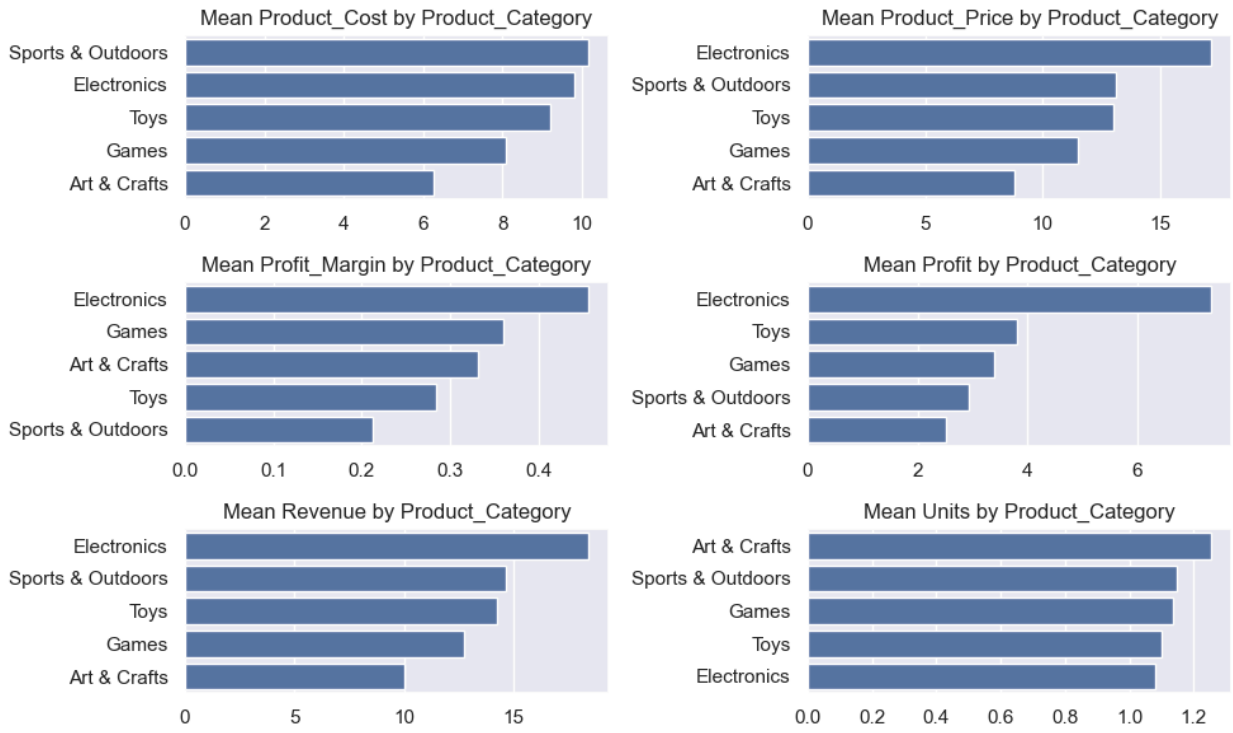
5. Units Sold:

- Products like **PlayDoh Can**, **Barrel O' Slime**, and **Playfoam** are in top of the list in terms of units sold, though these products have lower profit margins and individual revenue contributions. They show the importance of maintaining high unit sales to compensate for lower per-unit profitability.
- Higher-cost products like **Toy Robot** and **PlayDoh Playset** still manage considerable unit sales, showing strong demand for premium products from customers.

Conclusions and Recommendations:

- **Revenue Focus**: Emphasize products like **Toy Robot** and **PlayDoh Playset**, which combine high prices, significant unit sales, and strong revenue generation. These should be the cornerstone of marketing efforts.
- **Profit Optimization**: Focus on products like **Jenga** and **Plush Pony**, which have high profit margins. Increasing sales could increase profit.
- **Volume Sales Strategy**: Low-cost, high-volume products like **PlayDoh Can** and **Barrel O' Slime** are ideal for promotions or bundle offers to drive overall sales volume.

Sales metrics across categories



Key Findings:

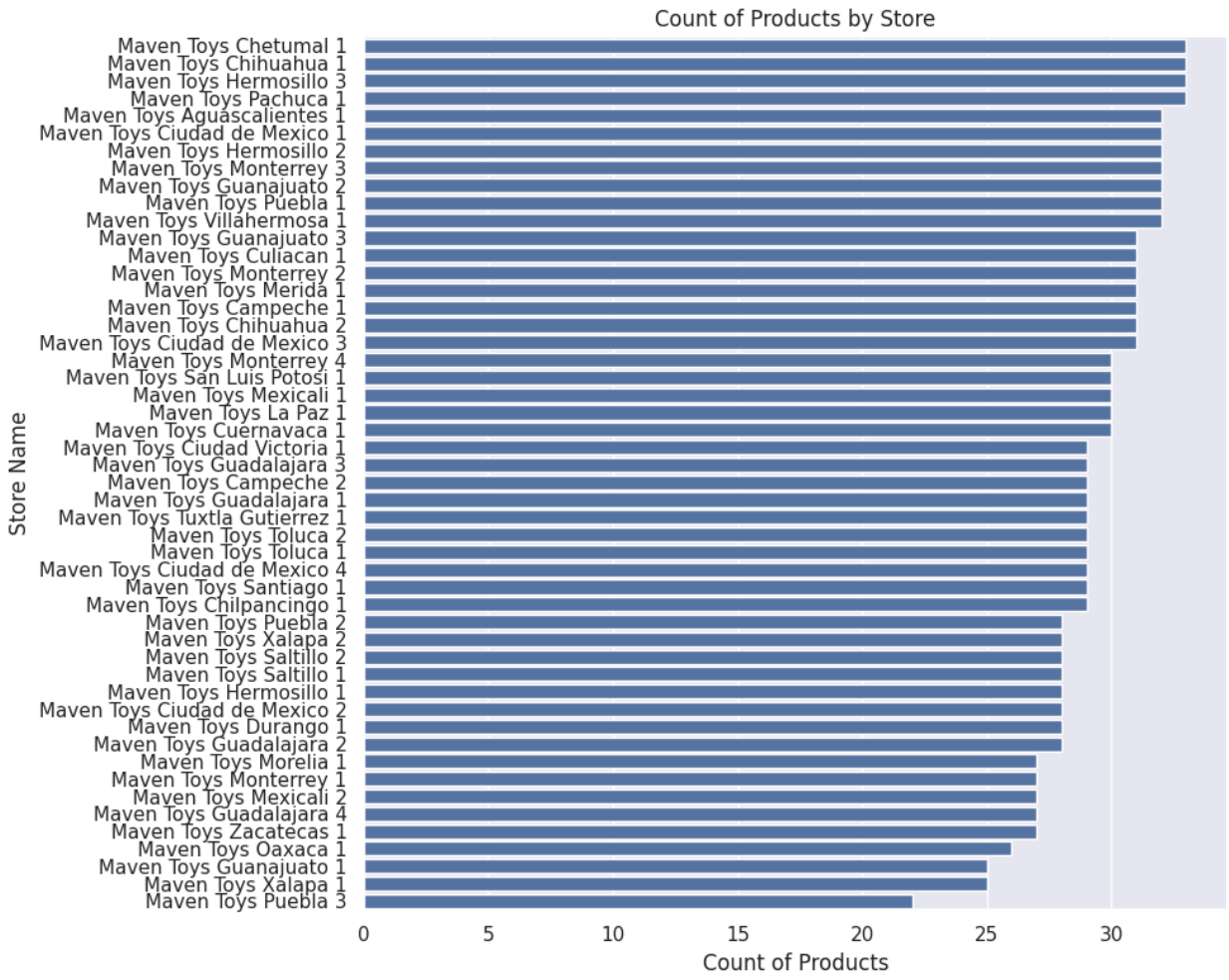
1. **Product Cost & Price**:
    - **Electronics** have the highest cost and highest priced category, indicating it is the most premium segment. **Art & Crafts** have the lowest average cost and price, likely due to the lower production or material costs of these items.
    - **Sports & Outdoors** is also high in terms of cost and price, being it between **Electronics** and other categories like **Toys** and **Games**.
2. **Profit Margin**:
    - **Electronics** leads with the highest average profit margin, despite its high cost, it generates significant returns per sale.
    - **Sports & Outdoors** has the lowest profit margin, which may signal potential inefficiencies or lower price elasticity in this category.
3. **Profit**:
    - **Electronics** is the most profitable category, followed by **Toys**. **Games** and **Sports & Outdoors** fall behind, although the latter has high sales volumes.
    - **Art & Crafts** has a relatively low profit, likely due to its lower price point and smaller margins.
4. **Revenue**:

    - **Electronics** has the highest revenue, followed by **Sports & Outdoors** and **Toys**. **Art & Crafts**, although high in units sold, contributes less to revenue, due to its lower pricing.
5. **Units Sold**:
    - **Art & Crafts** has the highest units sold, it could be because of strong demand despite its lower contribution to profit and revenue. **Electronics**, though very profitable, has the lowest unit sales, indicating it relies on higher pricing to drive profitability.

Decisions for the Future:

1. **Optimize Pricing in Low-Margin Categories**: Given the low profit margin in **Sports & Outdoors**, it might be helpful to evaluate pricing in this category. A slight price increase or cost reduction could boost profitability.
2. **Leverage High-Volume Categories**: **Art & Crafts** has high sales volumes but low profit. Strategies to either lower production costs or slightly increase pricing could turn this into a more profitable category.
3. **Sustain Investment in Electronics**: Continued investment in this segment, such as introducing new high-end products, could further improve its performance.
4. **Evaluate Profit Potential in Lower Categories**: For **Toys** and **Games**, optimizing stock turnover and analyzing demand patterns may help extract more profit without significant price increases. Future strategies could involve cross-selling items.

Count of products by store



Key Findings:

1. **Variation in Product Count**: There is a noticeable disparity in product counts across different stores. Stores like **Maven Toys Chetumal 1** and **Maven Toys Chihuahua 1** have over 30 products, while stores such as **Maven Toys Puebla 3** and **Maven Toys Oaxaca** have around 20 products. This variation could indicate differences in store size, market demand, or strategic importance of each location.
2. **Geographical Implications**: The variation in product count could also suggest geographical differences. Locations with higher product counts may be situated in more populous or commercial regions, while stores with fewer products may be in rural or less trafficked areas.

Decisions for the Future:

1. **Evaluate Product Allocation**: Given the wide variation in product counts, it might be worth evaluating if certain stores with fewer products could use an expanded inventory. For example, if **Maven Toys Oaxaca** or **Maven Toys Puebla 3** are in growing markets, expanding product offerings might increase revenue.
2. **Specialization vs. Diversification**: Stores with fewer products might be highly specialized, which could be a deliberate strategy.
3. **Inventory Management**: Stores with higher product counts, such as **Maven Toys Pachuca**, should be analyzed to ensure that the wide range of products is leading to profitable sales. Overstocking could lead to higher holding costs, so balancing inventory with demand is essential.

Inventory and sales metrics by store

Key Findings:

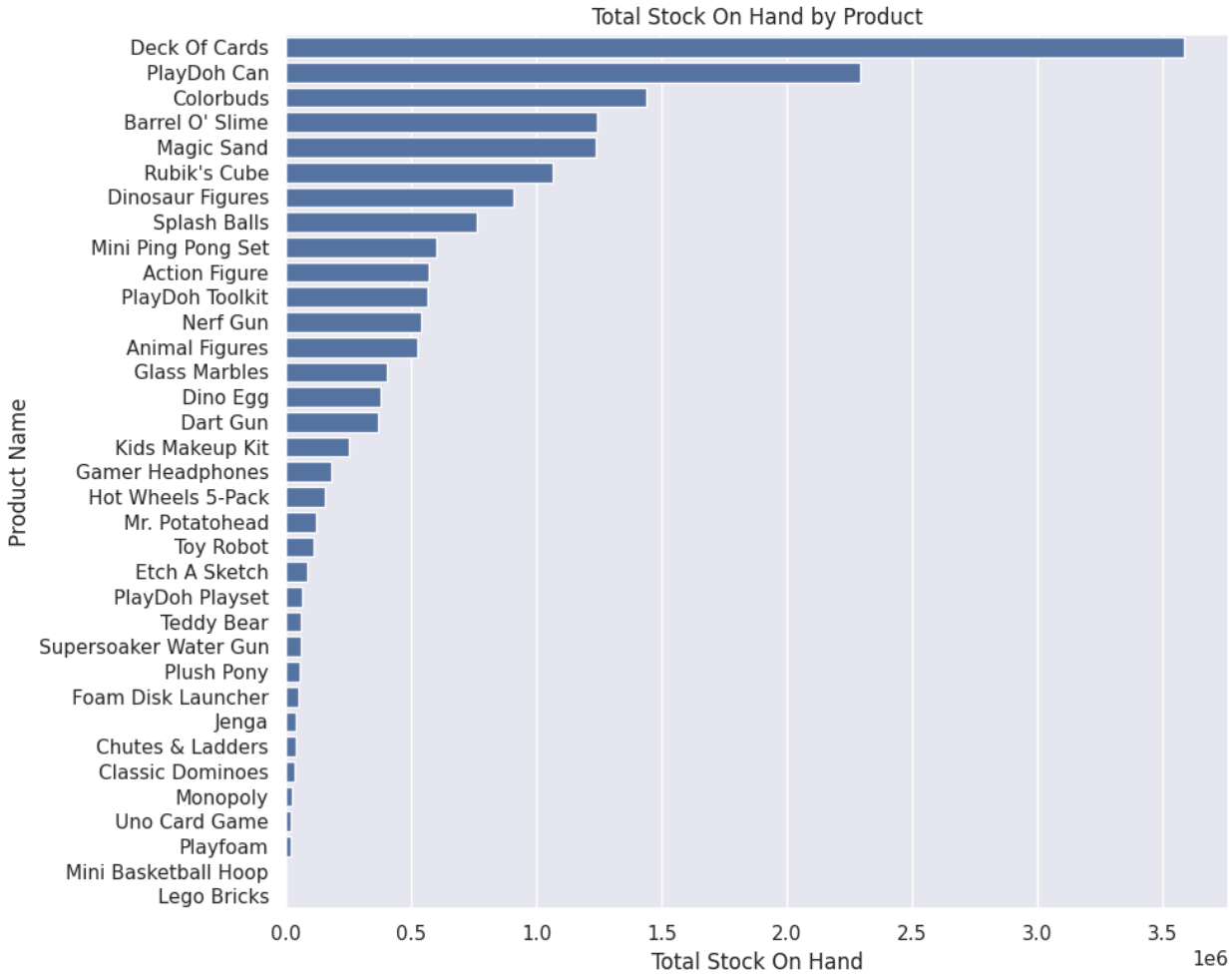
1. **Revenue and Units Sold Correlation**:
    - Stores like **Maven Toys Guadalajara 3**, **Maven Toys Ciudad de Mexico 2**, and **Maven Toys Hermosillo 3** rank the highest in both **Mean Revenue** and **Mean Units Sold**, which is to be expected, these stores might have efficient sales processes and high customer demand.
    - **Maven Toys Puebla 3** and **Maven Toys Oaxaca 1** show lower revenue and units sold. These locations might be in lower-demand areas, or the offerings may not align with demands.
2. **Stock Turnover vs. Inventory Value**:
    - **Maven Toys Ciudad Victoria 1** and **Maven Toys Monterrey 2** have high **Stock Turnover** rates but relatively modest **Inventory Values**, suggesting efficient inventory management. These stores are likely selling their products quickly, avoiding overstocking issues.
    - **Maven Toys Ciudad de Mexico 2** and **Maven Toys Chihuahua 2** have both high **Inventory Values** and decent **Stock Turnover**, indicating that these stores likely serve large markets and efficiently manage larger inventories.
    - Stores with lower **Stock Turnover**, such as **Maven Toys Puebla 3**, could be facing challenges with slower-moving inventory, leading to higher holding costs and inefficiencies.
3. **Revenue vs. Inventory Value**:
    - **Maven Toys Ciudad de Mexico 2** and **Maven Toys Guadalajara 3** both have high **Revenue** and **Inventory Values**, indicating large markets with high demand, explaining the larger stock holdings.
    - **Maven Toys Puebla 3** and **Maven Toys Hermosillo 2** have both low revenue and low inventory values, which could signal to a smaller target market or inefficiencies in inventory management to demand.
4. **Stock Turnover and Revenue Mismatch**:
    - Interestingly, stores like **Maven Toys Ciudad Victoria 1** have high **Stock Turnover** but comparatively lower **Revenue**. This might indicate that they are efficiently managing small inventories, but their sales volume or products may need optimization to increase revenue.

Potential Decisions:

1. **Inventory Optimization**:
    - Stores with low **Stock Turnover** and high **Inventory Value** (e.g., **Maven Toys Puebla 3**) should consider reducing their inventory levels or reevaluating their offerings to align with demand.
2. **Expand High-Performing Stores**:
    - High-revenue stores like **Maven Toys Guadalajara 3** and **Maven Toys Ciudad de Mexico 2** are candidates for expansion, either by increasing product count or adding additional locations in similar markets. Their strong performance across multiple metrics suggests they are well-positioned.

3. **Review Low-Performing Stores**:
    - Stores with consistently low performance across all metrics, such as **Maven Toys Puebla 3**, might need a review.

Stock on Hand by Product



Key Findings:

1. **High Stock Levels**:
    - The **Deck of Cards** product has a lead in stock quantity. This is significantly higher than the second-most stocked product, **PlayDoh Can**. Other products like **Colorbuds** and **Barrel O' Slime** also have high stock levels, though much lower than the top two products.
    - The high stock levels of these products could indicate a few possible hypotheses: either these are high-demand products that require large inventory levels, or these items may not be moving as quickly as expected, leading to stockpiling.
2. **Low Stock Levels**:
    - Products like **Mini Basketball Hoop**, **Lego Bricks**, and **Playfoam** have relatively low stock quantities, which may suggest that either they are niche products with lower demand or they are fast-selling products with limited stock on hand.
    - If these products are in high demand, there might be a risk of being out of stock in the future, it would be wise to monitor turnover rates and restocking closely.

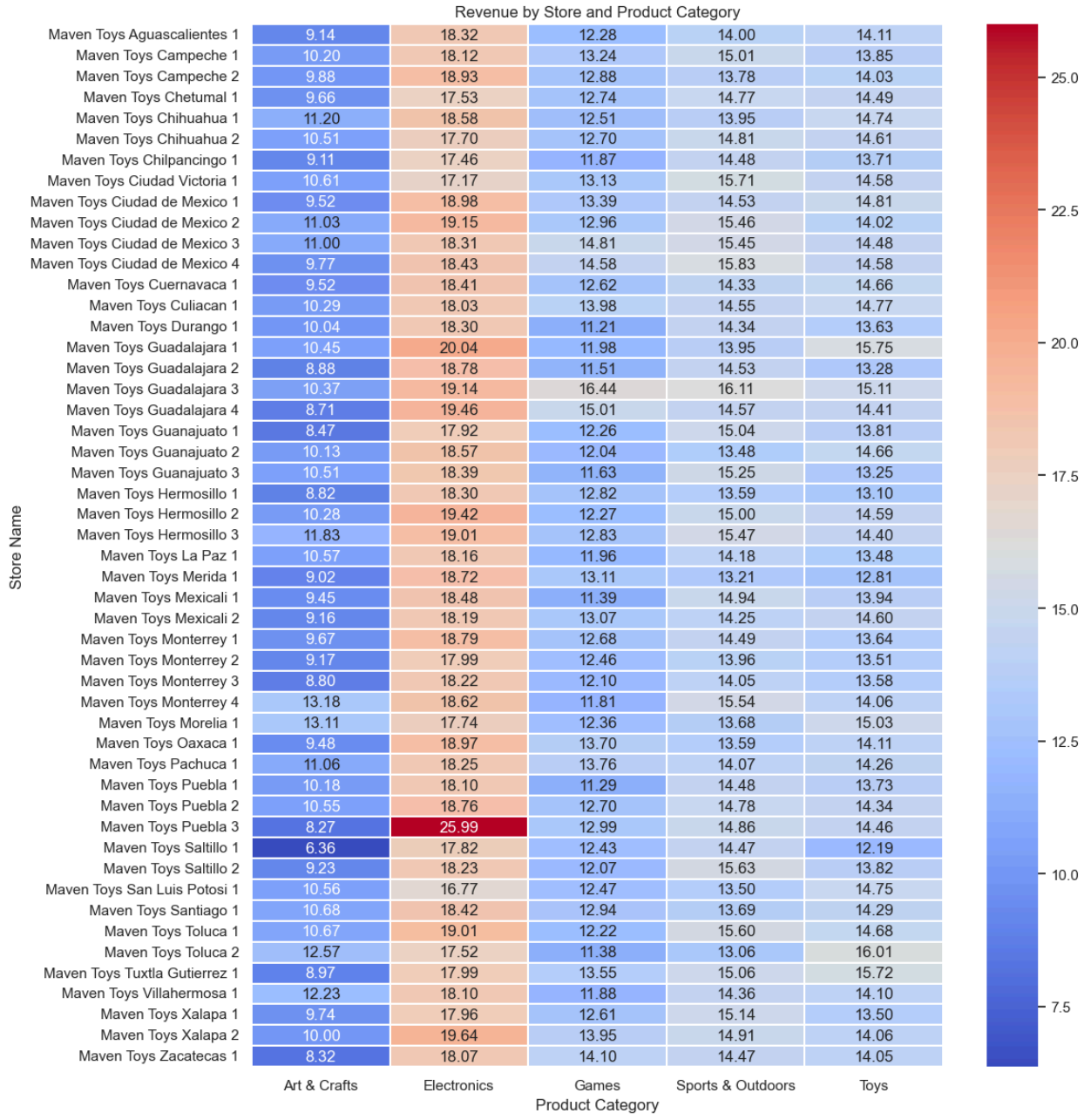
3. **Imbalance in Stock Allocation**:
    - The plot shows a stark imbalance in stock levels between the top few products and the rest.
    - There may be a disconnect between supply and demand forecasting. Certain products may have been over-ordered, leading to excess inventory. On the other hand, low-stock products may need restocking to meet future demand.
4. **High Stock Levels for High-Volume, Low-Cost Products**:
    - **Deck of Cards**, **PlayDoh Can**, and **Barrel O' Slime** have substantial stock levels (millions of units), which aligns with their high unit sales but low profit margins. These products are clearly high-volume sellers despite lower per-unit profits. Maintaining a large stock of these items ensures that customer demand is consistently met, particularly as these products form the bulk of unit sales. However, the high inventory levels may signal the need for periodic promotions or bundle deals to clear excess stock, especially for **Deck of Cards**.
5. **Moderate Stock for Premium, High-Profit Products**:
    - **Rubik's Cube**, **Magic Sand**, and **Plush Pony** have a balance between stock levels and sales potential. While these products don't sell as many units, they offer significant profit margins. Their high profitability justifies focusing marketing efforts here, ensuring stock levels are adequate for demand.
6. **Potential Over-Stocking for Certain Items**:
    - **Colorbuds** and **Barrel O' Slime** have high stock levels, yet their sales volumes and profitability aren't exceptional. Excessive stockpiling here could lead to issues like aging inventory or increased holding costs. There is an opportunity to run promotions to free up warehouse space for more profitable or fast-moving items.
7. **Low Stock for High-Value Products**:
    - **Plush Pony**, **Etch A Sketch**, and **Playfoam** have lower stock levels but show high profitability and good sales potential. Increasing stock levels for these products, especially around peak demand periods, can help capitalize on their profitability and customer demand.

Strategic Considerations:

1. **Inventory Optimization**:
    - Given the high stock levels of products like **Deck of Cards** and **PlayDoh Can**, it would be beneficial to conduct a detailed demand analysis to determine if the current stock levels can be explained by historical sales performance.
    - For products with lower stock, such as **Lego Bricks** and **Playfoam**, careful monitoring is needed to ensure these products do not go out of stock, especially in case of sudden popularity.
2. **Review of Stocking Policies**:
    - The wide disparity in stock levels between products may indicate the need to revise stocking policies. More accurate demand forecasting would help avoid overstocking certain items while ensuring that popular products remain available.
3. **Potential Product Reallocation**:

    - If certain stores have higher demand for products that are overstocked, reallocating inventory from slower-moving stores to faster-moving stores can optimize sales. This would prevent overstock in certain areas while ensuring popular items remain available in high-demand locations.
4. **Supply Chain Flexibility**:
    - Given the different stocking needs for high-margin and high-volume products, implementing a more dynamic supply chain system that can quickly adjust stock levels based on real-time sales data will ensure products are neither overstocked nor understocked.
5. **Cross-Sell & Bundle Opportunities**:
    - There are opportunities to bundle low-margin, high-volume products (e.g., **PlayDoh Can**) with high-margin items (e.g., **Plush Pony**) to encourage customers to purchase more while increasing overall profitability.

Revenue by store and product category



Store Name	Art & Crafts	Electronics	Games	Sports & Outdoors	Toys
Maven Toys Aguascalientes 1	9.14	18.32	12.28	14.00	14.11
Maven Toys Campeche 1	10.20	18.12	13.24	15.01	13.85
Maven Toys Campeche 2	9.88	18.93	12.88	13.78	14.03
Maven Toys Chetumal 1	9.66	17.53	12.74	14.77	14.49
Maven Toys Chihuahua 1	11.20	18.58	12.51	13.95	14.74
Maven Toys Chihuahua 2	10.51	17.70	12.70	14.81	14.61
Maven Toys Chilpancingo 1	9.11	17.46	11.87	14.48	13.71
Maven Toys Ciudad Victoria 1	10.61	17.17	13.13	15.71	14.58
Maven Toys Ciudad de Mexico 1	9.52	18.98	13.39	14.53	14.81
Maven Toys Ciudad de Mexico 2	11.03	19.15	12.96	15.46	14.02
Maven Toys Ciudad de Mexico 3	11.00	18.31	14.81	15.45	14.48
Maven Toys Ciudad de Mexico 4	9.77	18.43	14.58	15.83	14.58
Maven Toys Cuernavaca 1	9.52	18.41	12.62	14.33	14.66
Maven Toys Culiacan 1	10.29	18.03	13.98	14.55	14.77
Maven Toys Durango 1	10.04	18.30	11.21	14.34	13.63
Maven Toys Guadalajara 1	10.45	20.04	11.98	13.95	15.75
Maven Toys Guadalajara 2	8.88	18.78	11.51	14.53	13.28
Maven Toys Guadalajara 3	10.37	19.14	16.44	16.11	15.11
Maven Toys Guadalajara 4	8.71	19.46	15.01	14.57	14.41
Maven Toys Guanajuato 1	8.47	17.92	12.26	15.04	13.81
Maven Toys Guanajuato 2	10.13	18.57	12.04	13.48	14.66
Maven Toys Guanajuato 3	10.51	18.39	11.63	15.25	13.25
Maven Toys Hermosillo 1	8.82	18.30	12.82	13.59	13.10
Maven Toys Hermosillo 2	10.28	19.42	12.27	15.00	14.59
Maven Toys Hermosillo 3	11.83	19.01	12.83	15.47	14.40
Maven Toys La Paz 1	10.57	18.16	11.96	14.18	13.48
Maven Toys Merida 1	9.02	18.72	13.11	13.21	12.81
Maven Toys Mexicali 1	9.45	18.48	11.39	14.94	13.94
Maven Toys Mexicali 2	9.16	18.19	13.07	14.25	14.60
Maven Toys Monterrey 1	9.67	18.79	12.68	14.49	13.64
Maven Toys Monterrey 2	9.17	17.99	12.46	13.96	13.51
Maven Toys Monterrey 3	8.80	18.22	12.10	14.05	13.58
Maven Toys Monterrey 4	13.18	18.62	11.81	15.54	14.06
Maven Toys Morelia 1	13.11	17.74	12.36	13.68	15.03
Maven Toys Oaxaca 1	9.48	18.97	13.70	13.59	14.11
Maven Toys Pachuca 1	11.06	18.25	13.76	14.07	14.26
Maven Toys Puebla 1	10.18	18.10	11.29	14.48	13.73
Maven Toys Puebla 2	10.55	18.76	12.70	14.78	14.34
Maven Toys Puebla 3	8.27	25.99	12.99	14.86	14.46
Maven Toys Saltillo 1	6.36	17.82	12.43	14.47	12.19
Maven Toys Saltillo 2	9.23	18.23	12.07	15.63	13.82
Maven Toys San Luis Potosi 1	10.56	16.77	12.47	13.50	14.75
Maven Toys Santiago 1	10.68	18.42	12.94	13.69	14.29
Maven Toys Toluca 1	10.67	19.01	12.22	15.60	14.68
Maven Toys Toluca 2	12.57	17.52	11.38	13.06	16.01
Maven Toys Tuxtla Gutierrez 1	8.97	17.99	13.55	15.06	15.72
Maven Toys Villahermosa 1	12.23	18.10	11.88	14.36	14.10
Maven Toys Xalapa 1	9.74	17.96	12.61	15.14	13.50
Maven Toys Xalapa 2	10.00	19.64	13.95	14.91	14.06
Maven Toys Zacatecas 1	8.32	18.07	14.10	14.47	14.05

Key Findings:

1. **Electronics Category Dominance in Some Stores**:
    - **Maven Toys Puebla 3** leads with significantly higher revenue in **Electronics** ($25.99), whereas some stores show much lower numbers, around $16. These variations suggest that some stores are capturing more value from high-ticket electronics, perhaps due to demographic factors, local demand, or marketing.

    - This inconsistency could also imply that some stores may not be stocking enough electronics or not targeting the demand effectively. Also, the revenue disparity suggests that not all stores are reaching their full potential in this high-margin category.
2. **Art & Crafts Underperformance**:
    - Across the board, **Art & Crafts** consistently generates the lowest revenue. Notably, **Maven Toys Saltillo 1** ($6.36) and **Maven Toys Puebla 3** ($8.27) underperform significantly compared to other categories in these stores. This might indicate low consumer interest in this category, poor product advertisement and other factors.
    - Interestingly, stor^es that generate high revenue from **Electronics**, such as **Puebla 3**, tend to show a significant drop in **Art & Crafts** sales. This inverse relationship suggests that stores with a focus on high-tech goods may not cater as much to craft or artistic products, possibly due to differences in target demographics.
3. **Toys and Games Revenue Consistency**:
    - **Toys** and **Games** categories display consistent but modest revenue across stores. While no single store dominates these categories, stores like **Maven Toys Guadalajara 3** and **Maven Toys Mexicali 3** show balanced revenue in both **Toys** ($13.73) and **Games** ($15.01). Stores with high **Electronics** revenue also seem to maintain reasonable performance in these categories, indicating that they complement one another in these stores.
    - However, stores with lower revenues in **Art & Crafts** do not show a direct inverse increase in **Toys** or **Games**, meaning there isn't a clear trade-off between these categories. This suggests that poor **Art & Crafts** sales are more likely due to lack of interest in the category rather than competition with other product lines.

Interactions Across Categories:

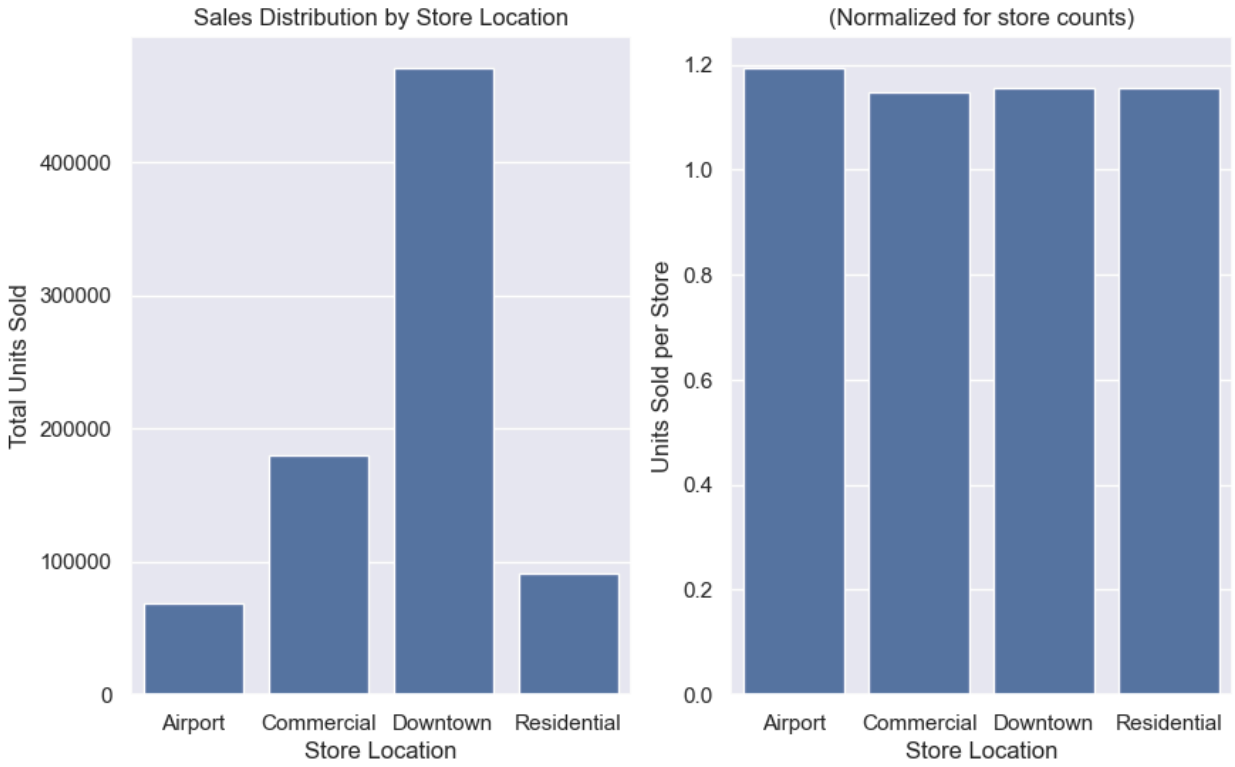
1. **Inverse Relationship Between Electronics and Art & Crafts**:
    - High-performing stores in **Electronics**, like **Puebla 3** and **Oaxaca 1**, show weaker performance in **Art & Crafts**. This could suggest that stores focusing on premium or high-tech products may not have as much demand for lower-cost, creative products. These stores might be targeting different customer segments, prioritizing electronics consumers over families interested in crafts.
2. **Balanced Revenue in Toys and Games**:
    - Stores like **Guadalajara 3** and **Mexicali 3** show a more balanced distribution of revenue between **Toys** and **Games**, without either category dominating.
    - The relationship between **Toys** and **Games** doesn’t seem to strongly interact with other categories.

Decisions and Future Considerations:

1. **Targeted Marketing for Electronics**:

    - Given the high revenue potential of **Electronics**, stores with lower sales in this category, such as **Saltillo 1** and **La Paz 1**, should be examined for growth.
2. **Reassessing the Art & Crafts Category**:
    - Reducing the **Art & Crafts** inventory in stores like **Puebla 3** and **Saltillo 1** and reallocating resources toward more profitable categories such as **Electronics** could maximize overall store revenue.
3. **Store-Specific Strategies**:
    - Stores like **Puebla 3** and **Oaxaca 1** clearly outperform others in **Electronics** and should continue focusing on this category.
    - Stores with more balanced revenues across categories (e.g., **Guadalajara 3**) might benefit from a diversified strategy, promoting multiple categories to avoid reliance on single products.
4. **Regional Product Preferences**:
    - The variations in **Sports & Outdoors** performance suggest that regional differences play a role in category success. Localized marketing efforts or adapting inventory to match regional preferences could increase revenue.

Sales Distribution by Store Location



Key Findings:

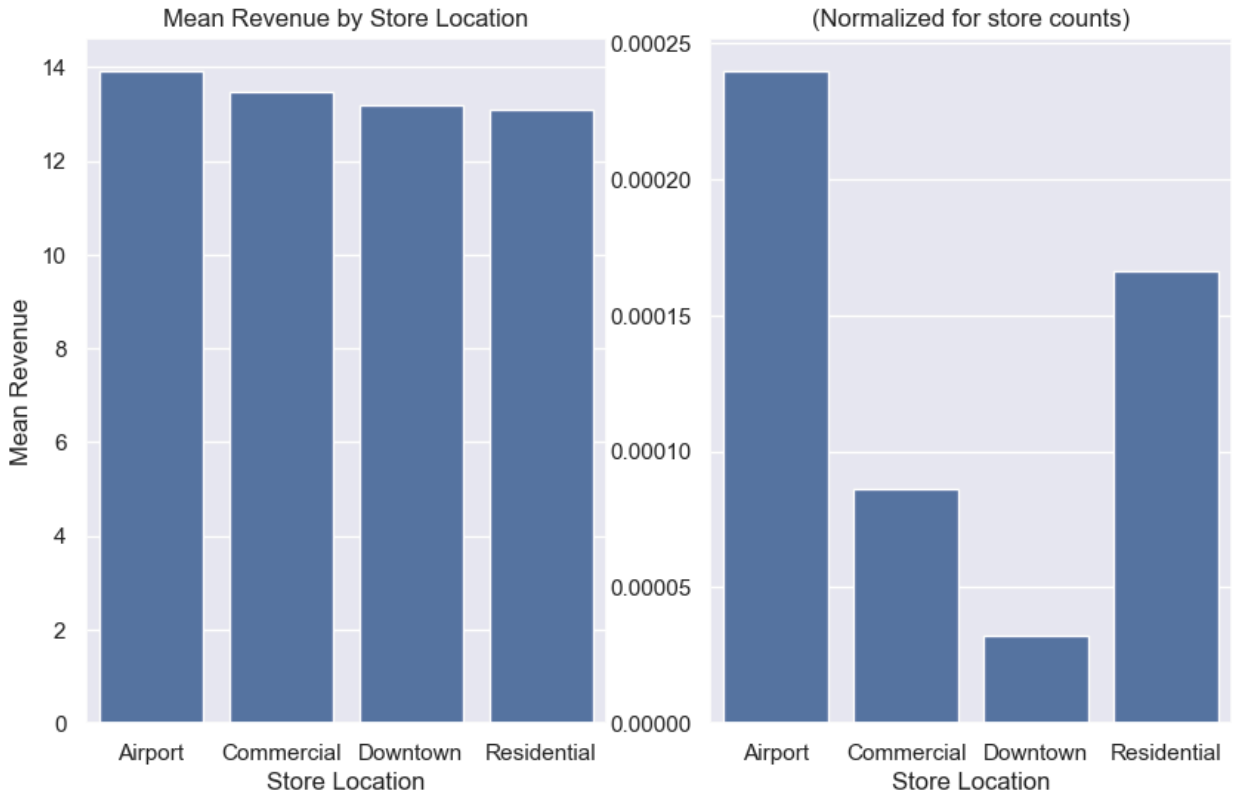
1. **Downtown Stores Lead in Total Units Sold:**
    - Downtown stores sold the highest number of units, exceeding 450,000, which is significantly higher than the other locations.
    - Commercial stores are second, followed by Residential, with Airport stores selling the least number of total units.
    - This indicates that downtown stores serve a larger customer base or benefit from higher traffic, which increases total sales.
2. **Normalization for Store Counts Reveals Equal Performance:**
    - When normalized for the number of stores in each location, we see that **Airport**, **Commercial**, **Downtown**, and **Residential** stores perform similarly in terms of units sold per store.
    - This suggests that while downtown stores sell the most units overall, the **difference is largely due to the higher number of downtown stores**, rather than superior individual store performance.
3. **Residential and Airport Stores Lag in Total Sales:**
    - Despite having similar per-store sales, **Residential** and **Airport** locations contribute the least in total unit sales due to the smaller number of stores in those categories.

- This might imply that opening more stores in these locations could balance the sales distribution if demand is sufficient.

Decisions and Recommendations:

1. **Downtown Focus:**
   - Since downtown stores are leading in total units sold, it might be beneficial to focus marketing and promotional activities in downtown areas to capitalize on the larger customer base.
2. **Evaluate Store Expansion in Other Areas:**
   - Given that **Airport** and **Residential** stores perform well on a per-store basis, expanding the number of stores in these locations would increase total unit sales.
3. **Inventory Management:**
   - Since **Downtown** stores sell the most units overall, inventory replenishment for these locations should be prioritized to avoid stockouts.
   - However, **Airport and Residential** stores, though fewer in number, sell just as many units per store. Inventory strategies should be tailored accordingly to prevent overstocking or understocking in these locations.

Mean Revenue by Store Location



Key Findings:

1. **Mean Revenue Across Locations:**
    - **Airport** stores have the highest mean revenue when comparing store types, followed by **Commercial** and **Downtown** stores.
    - **Residential** stores generate slightly less mean revenue but are still comparable to **Commercial** and **Downtown** stores.
    - The relatively consistent mean revenue across these locations implies that the overall customer demand and spending behavior is quite similar across different store types, despite different store environments.
2. **Normalized Revenue per Store (Right Chart):**
    - When normalizing for the number of stores in each category, **Airport** stores generate the highest revenue per store, significantly higher than the other store locations.
    - **Residential** stores follow next, showing better revenue performance per store than **Commercial** or **Downtown** stores.
    - **Downtown** stores, despite having the highest total sales and overall store count, have the **lowest revenue per store** after normalization. This implies that individual stores in downtown areas are underperforming compared to their counterparts in other regions when adjusted for the number of stores.

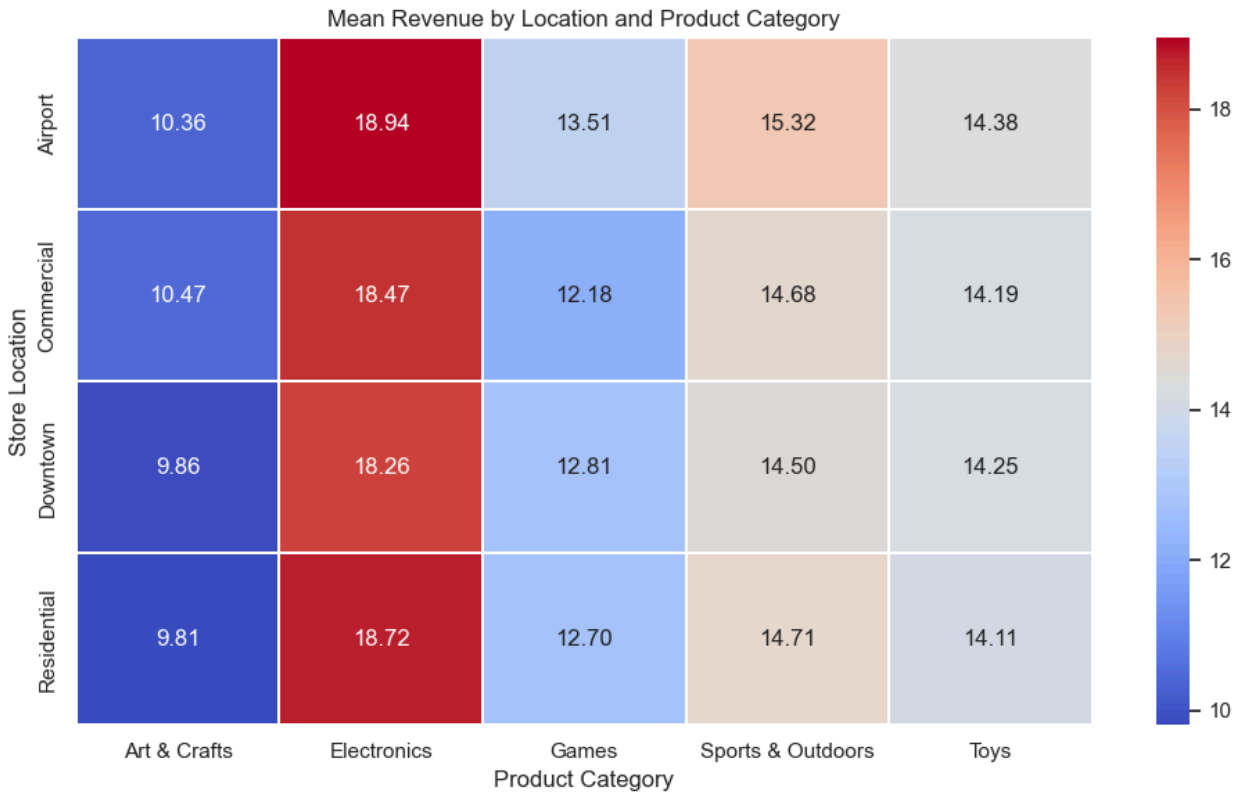
Decisions and Recommendations:

1. **Optimize Downtown Stores:**
    - Since **Downtown** stores show the lowest revenue per store, there may be room for improvement. Downtown locations may be oversaturated, or individual stores might not be optimized for local demand.
2. **Leverage Airport Stores:**
    - **Airport** stores outperform others in terms of revenue per store. Given their unique environment (high traffic, travelers), it would be beneficial to:
        - Expand the number of airport stores
        - Offer products that cater to the traveler's needs (e.g., toys for children, electronics for travelers).
        - Implement higher-margin products.
3. **Boost Residential Store Potential:**
    - **Residential** stores have strong normalized revenue, suggesting unused potential.
    - Expanding store presence in residential areas could increase overall revenue, provided there is local demand to support this.
    - Experiment with **promotions, local events, or community-focused products** to further drive engagement and revenue in these stores.
4. **Rethink Commercial Store Strategy:**
    - **Commercial** stores underperform compared to **Airport** and **Residential** stores in normalized revenue. Considering their central business location, these stores might need different strategies or marketing campaigns to capture customers better.

Comparison with Older Findings:

- Previous findings indicated that **Downtown** stores lead in **total units sold**, but this plot shows they do not lead in per-store revenue, showing the need for efficiency improvements.
- **Residential and Airport stores** consistently show promise, suggesting potential store expansion in these areas.
- Leveraging high-selling products like **Toy Robot** and **PlayDoh** in **Airport and Residential** locations could further boost performance.

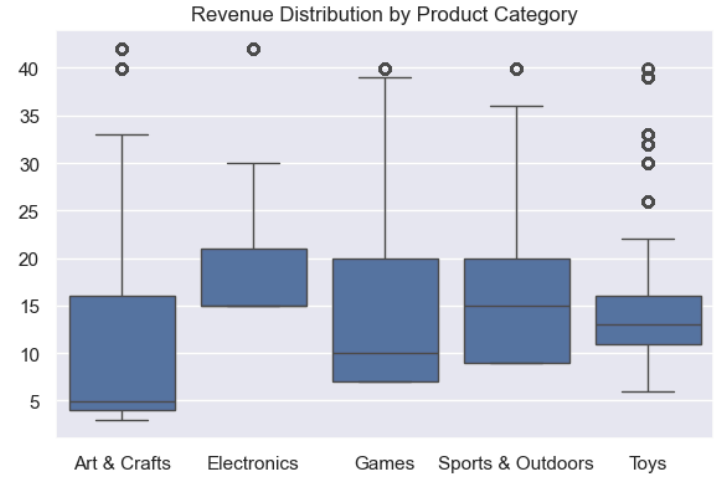
Revenue by location and product category

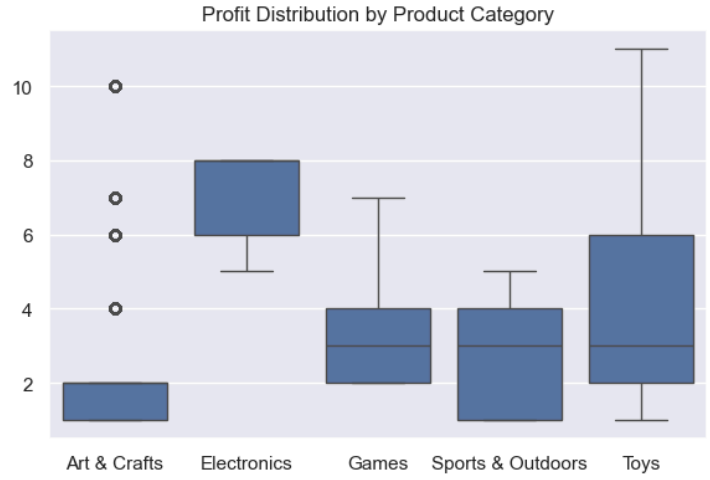


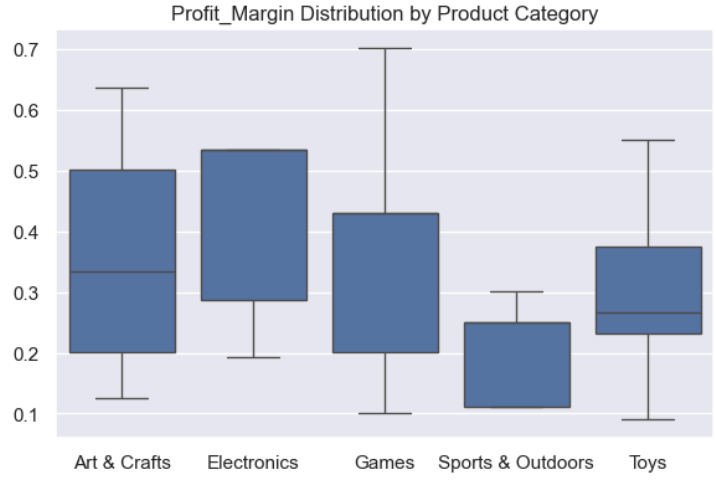
Key Findings:

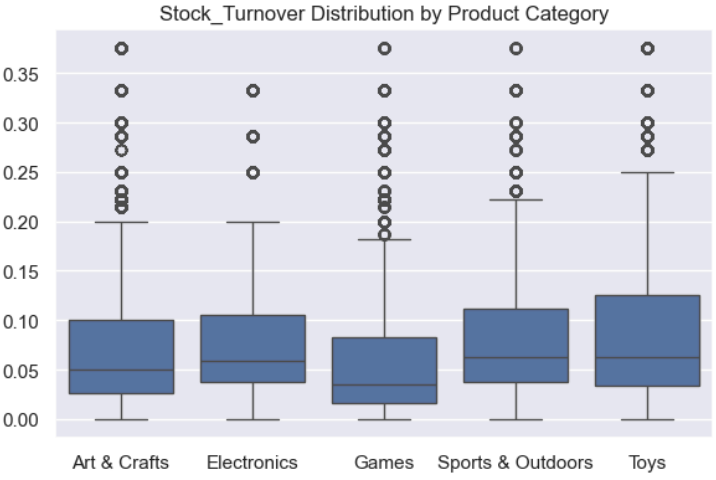
1. **High Revenue from Electronics**:
    - Airport locations have the highest average revenue from Electronics at 18.94, followed closely by Residential stores at 18.72.
    - This suggests that electronics are a key product category for all store types, particularly in high-traffic locations like Airports.
2. **Lower Revenue from Art & Crafts**:
    - The revenue variation for Art & Crafts is minimal across store types, indicating that this category underperforms compared to others, regardless of store location.
3. **Games and Toys Revenue**:
    - Games seem to have the lowest revenue in Commercial locations (12.18), while Sports & Outdoors perform well in the Airport and Residential locations.
    - Toys have consistent performance across all stores, which might indicate balanced demand for these products.
4. **Sports & Outdoors**:
    - The Sports & Outdoors category performs well, especially in Residential and Airport stores.

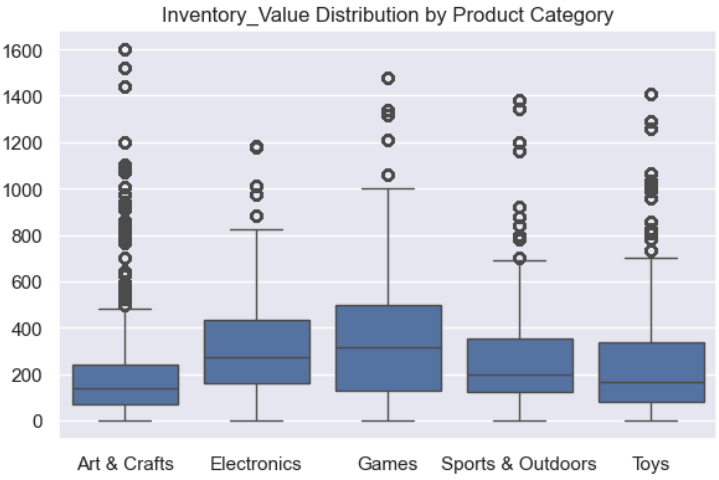
Sales and inventory distribution per category

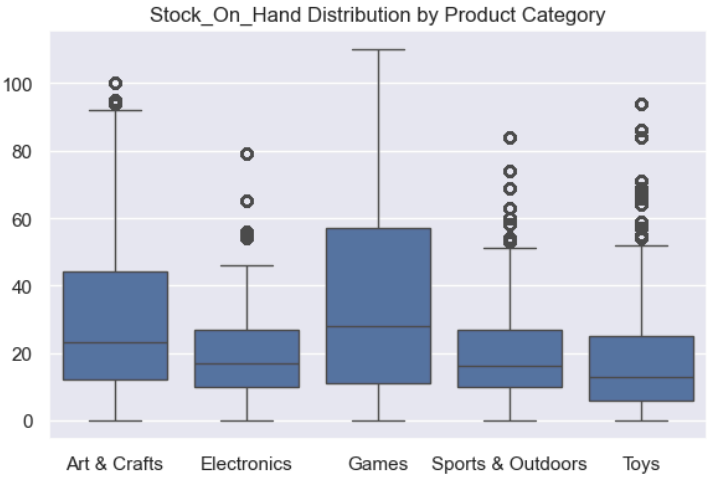












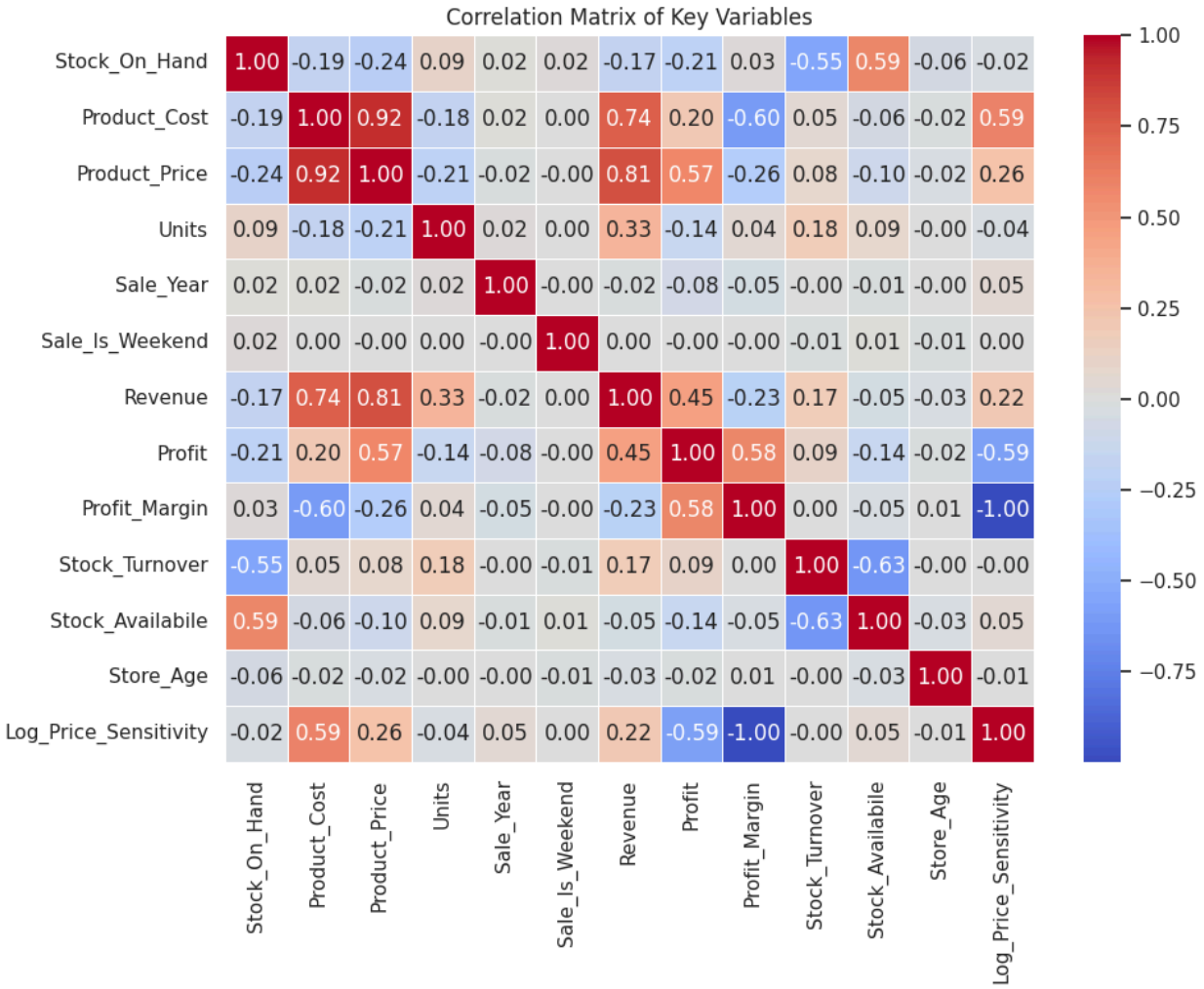
Key Findings:

1. **Revenue Distribution**:
    - **Art & Crafts** and **Sports & Outdoors** have lower median revenue, suggesting they might contribute less to overall sales, but they also show some outliers indicating occasional high-revenue sales.
2. **Profit Distribution**:
    - Despite Electronics' high profit, **Art & Crafts** occasionally have high-profit outliers, potentially indicating certain high-margin, low-volume items in that category.
3. **Profit Margin Distribution**:
    - **Art & Crafts** show a higher median profit margin but have high variability. This suggests that while the overall revenue from this category is lower, there may be niche products with significant margins.
    - **Sports & Outdoors** have the lowest median profit margin, which might indicate a need for reassessment or adjustments to improve profitability in this category.
4. **Stock Turnover Distribution**:
    - **Games** and **Toys** show higher stock turnover with significant variability, indicating fast-moving products in these categories. However, outliers with very high turnover in all categories suggest the presence of certain highly demanded items.
    - **Electronics** and **Sports & Outdoors** have more stable but lower stock turnover, potentially pointing to slower-moving products in those categories, likely due to higher prices or specialized demand.
5. **Stock on Hand Distribution**:
    - **Games** and **Toys** have the highest stock-on-hand, indicating that stores maintain larger inventories for these categories. This makes sense considering their higher stock turnover rates.
6. **Profitability vs. Stock Turnover**:
    - While **Games** and **Toys** show high stock turnover, their profit margins are relatively low. This suggests that these categories rely on volume sales rather than per-unit profitability.
    - On the other hand, **Electronics** have high profits but relatively lower stock turnover, indicating that these products are likely to have longer shelf lives but contribute heavily to overall profit.

Recommendations:

1. **Electronics Focus**: Continue emphasizing **Electronics**, as they generate the highest profits and revenue. Ensuring steady stock levels while optimizing the turnover rate could improve overall profitability.
2. **Optimize Stock Turnover in Toys & Games**: The high stock turnover in **Toys** and **Games** indicates strong demand. Ensuring efficient stock management to prevent overstocking or shortages will be essential to maintaining profitability.
3. **Reevaluate Sports & Outdoors**: The low profit margins and relatively lower revenue of **Sports & Outdoors** suggest that this category may need reassessment.

Correlation matrix of key variables



Key Findings:

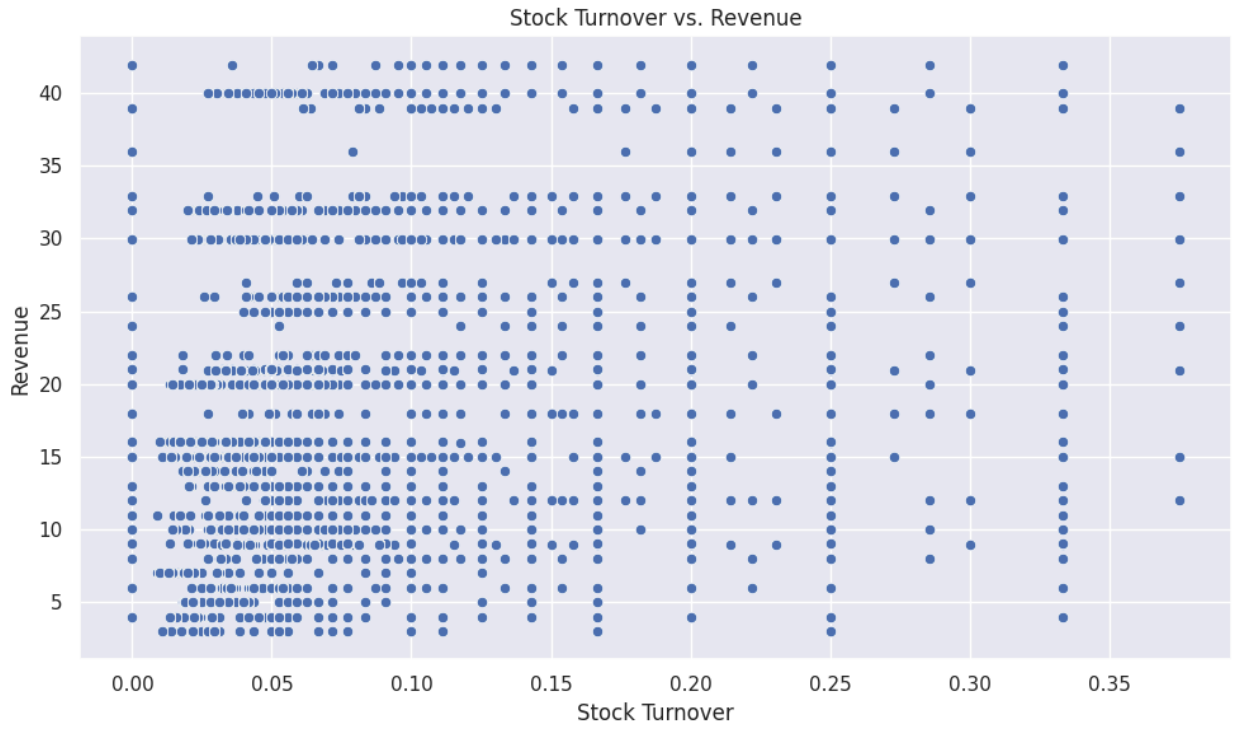
1. **Stock_on_Hand**:
    - It is **negatively correlated with Stock_Turnover** (-0.55), meaning that higher stock levels tend to result in slower stock movement. This suggests that stores holding larger inventories may struggle with product turnover.
    - Its relationship with Revenue (-0.17) and Profit (-0.21) is slightly negative, suggesting that maintaining higher stock levels doesn't necessarily lead to higher revenue or profit, which might indicate overstocking.
2. **Product Cost and Price**:
    - **Strong correlation between Product Cost and Product Price** (0.92). This high correlation is expected and indicates that more expensive products are priced higher, as typical in most retail environments.
    - **Product Cost and Revenue** show a significant correlation (0.74), indicating that higher-cost products are likely contributing more to total revenue. However, the

Profit correlation is much lower (0.45), meaning higher-cost items don't always contribute proportionately to profitability.
    - There's a **negative correlation between Profit Margin and Product Cost** (-0.60), indicating that as product cost rises, profit margins tend to shrink. High-cost products may be bringing in revenue but eroding profit margins.
3. **Profit and Revenue**:
    - There is a **moderate positive correlation between Revenue and Profit** (0.45), suggesting that higher revenue is often, but not always, accompanied by higher profits. However, the strength of this correlation isn't perfect, indicating that some high-revenue products may still be underperforming in terms of profit.
    - **Profit and Profit Margin** are correlated (0.58), which suggests that while margin helps drive profit, other factors like volume and pricing strategy may play a significant role too.
4. **Stock Turnover**:
    - Stock Turnover has a low positive correlation with Revenue (0.17) and Profit (0.09), suggesting that quick-moving items don't necessarily result in higher revenues or profits. These products may be lower-cost or less profitable despite moving fast.
5. **Log_Price_Sensitivity**:
    - **Log_Price_Sensitivity shows a positive correlation with Product Cost** (0.59) and Product Price (0.26). This indicates that more expensive products tend to have higher price sensitivity, meaning customers are more responsive to price changes in higher-priced items.
    - **Negative correlation with Profit** (-0.59) suggests that products with high price sensitivity might be less profitable, potentially due to price reductions or promotions affecting their profit margins.
6. **Profit Margin**:
    - Interestingly, it has no strong correlation with other variables such as Revenue (-0.23), suggesting that high-margin products might not necessarily be the highest revenue-generators.

Recommendations:

1. **Optimize Stock Levels**:
    - The negative correlation between Stock_on_Hand and Stock_Turnover highlights inefficiencies in inventory management.
2. **Price Sensitivity Considerations**:
    - Products with higher Log_Price_Sensitivity tend to generate lower profit, implying that price reductions could have diminishing returns.
3. **Revenue vs. Profit Strategy**:
    - Since Revenue and Profit have only a moderate correlation (0.45), identifying which products drive profitability beyond just revenue will be necessary

Stock Turnover vs. Revenue



Key Findings:

1. **No Strong Correlation**:
    - The scatter plot shows no strong or clear correlation between stock turnover and revenue. This indicates that products with higher or lower stock turnover do not consistently lead to higher or lower revenue. Revenue appears to be distributed across various stock turnover rates.
2. **Concentration of Data at Low Stock Turnover**:
    - This could indicate potential inefficiencies in inventory management—certain slow-moving products are generating substantial revenue, while others are not.
3. **Sparse Data for Higher Stock Turnover**:
    - Stock turnover values above 0.15 are less frequent, and the associated revenue values do not form any discernible pattern. While some high stock turnover items contribute to decent revenue, there isn't a substantial number of products in this category.
4. **Wide Revenue Spread for Low Stock Turnover**:
    - Products with low stock turnover still show considerable variation in revenue contributions, meaning some slow-moving items are generating significant revenue, while others contribute little.

Considerations for the Future:

1. **Inventory Management**:
    - Given the lack of correlation between stock turnover and revenue, it may be beneficial to review how inventory is managed. Slow-moving, high-revenue products should be treated differently from slow-moving, low-revenue items.
2. **Review Pricing Strategy**:
    - Since no clear relationship exists between stock turnover and revenue, adjusting pricing strategies to encourage quicker turnover could be a consideration.

Stock on hand vs. Revenue

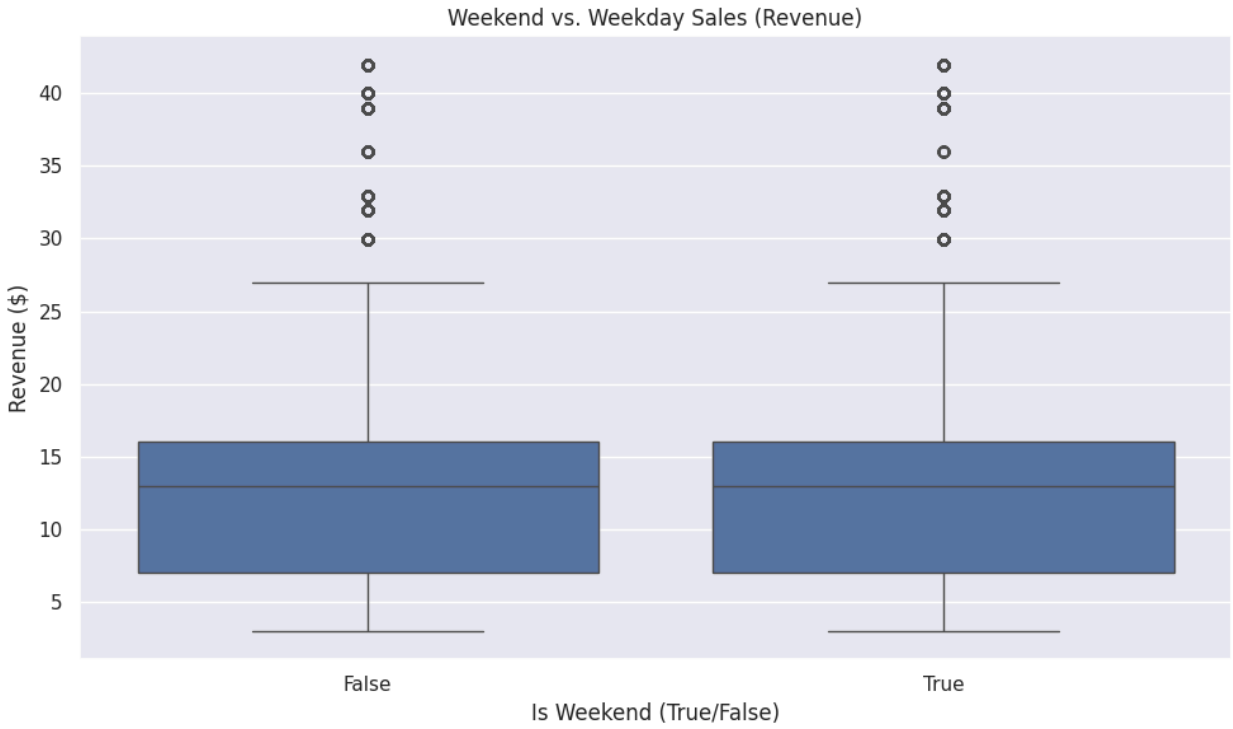
Key Findings:

1. **No Clear Linear Correlation**:
    - Similar to the stock turnover vs. revenue plot, there is no evident linear or strong correlation between stock on hand and revenue. The data points are widely scattered across various stock on hand values, indicating that higher stock levels do not necessarily lead to higher revenue.
2. **Sparse Data for High Stock Levels**:
    - For products with stock on hand exceeding 60 units, there are relatively fewer data points, and these products tend to contribute to a wide range of revenue outcomes. Some high-stock items generate high revenue, while others remain low in revenue contribution, suggesting inefficiencies in inventory management for some products.
3. **Wide Spread in Revenue for Moderate Stock Levels**:
    - For stock levels between 20 and 40, there is a large spread in revenue values, ranging from as low as $5 to as high as $40. This suggests that different products with similar stock levels can have vastly different performance in terms of revenue generation. It may reflect differences in product demand, pricing, or marketing strategies.

Considerations for the Future:

1. **Optimize Stock Levels Based on Product Demand**:
    - The absence of a clear correlation between stock on hand and revenue suggests that simply increasing stock does not guarantee higher sales. Inventory levels should be optimized based on product-specific demand, with frequent reviews of sales trends to avoid overstocking low-demand items while ensuring high-demand items are sufficiently stocked.
2. **Evaluate Underperforming High-Stock Items**:
    - Products with high stock on hand but low revenue contributions should be analyzed closely. These items may represent overstocking issues or products that are not aligned with current customer demand.
3. **Dynamic Pricing Strategies**:
    - Implementing dynamic pricing strategies for high stock, low revenue items could help stimulate demand and clear excess inventory.

Weekend vs. Weekday Revenue



Key Findings:

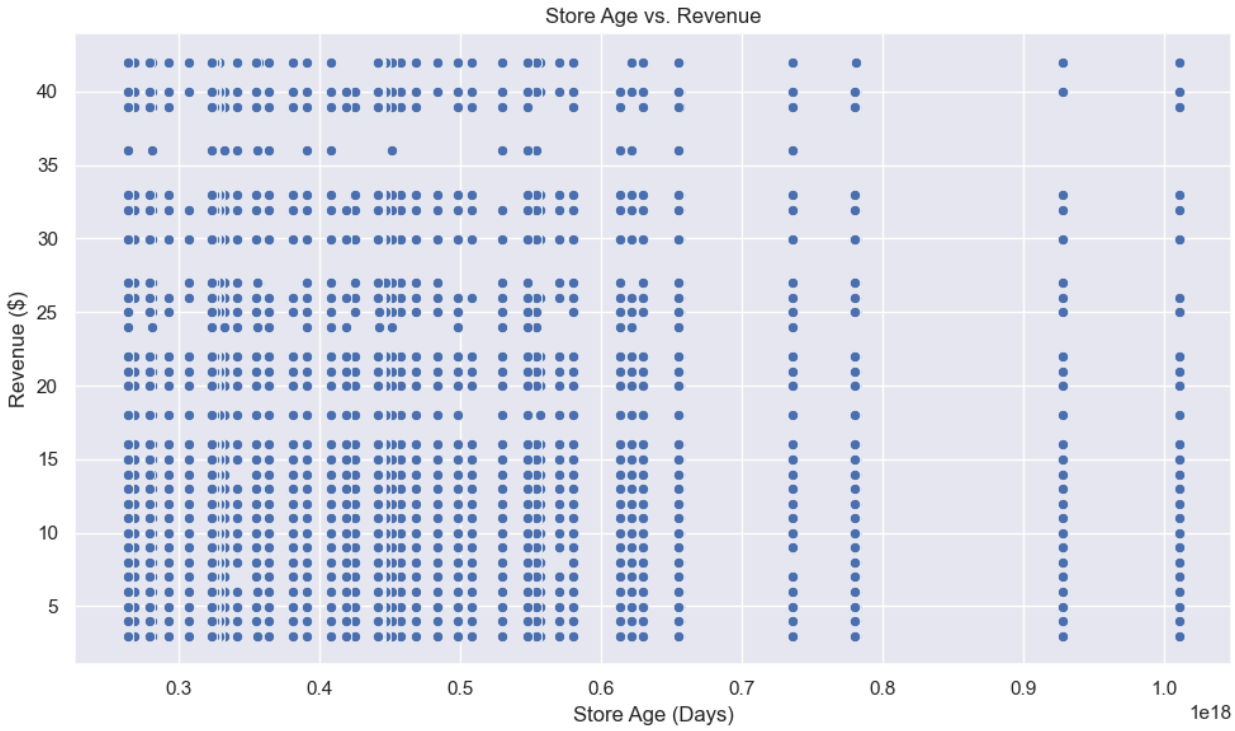
1. **Similar Revenue Distribution**:
    - The boxplot reveals that the distribution of revenue on both weekends and weekdays is quite similar. The majority of sales are centered around the same median value, with the interquartile range (IQR) also being similar for both types of days. This suggests that the sales performance of products does not drastically change between weekends and weekdays.
2. **Slightly Higher Median on Weekends**:
    - While both distributions are nearly identical, the median revenue on weekends is slightly higher than that on weekdays, but the increase is not substantial enough to suggest a significantly different sales pattern. The higher median could suggest that some products see a slight boost in demand during weekends, but the overall sales performance remains consistent across both periods.
3. **Outliers in Both Distributions**:
    - Both weekend and weekday distributions contain outliers, with a few sales reaching upwards of $40. These outliers represent occasional higher-value transactions, possibly due to premium or higher-priced products. The presence of these outliers is consistent across both weekend and weekday sales, indicating that larger purchases can happen at any time, without being influenced by the day of the week.
4. **Consistent Sales Performance**:

- Given the similarities in the overall revenue distribution for weekends and weekdays, the sales performance of products remains stable throughout the week. This suggests that customers are purchasing products at a relatively consistent rate regardless of whether it is a weekday or weekend.

Considerations for the Future:

1. **No Need for Major Adjustments Based on Day of the Week**:
    - Since there is no drastic difference between weekend and weekday sales, there is no immediate need to alter sales or marketing strategies based on the day of the week.

Store Age vs. Revenue



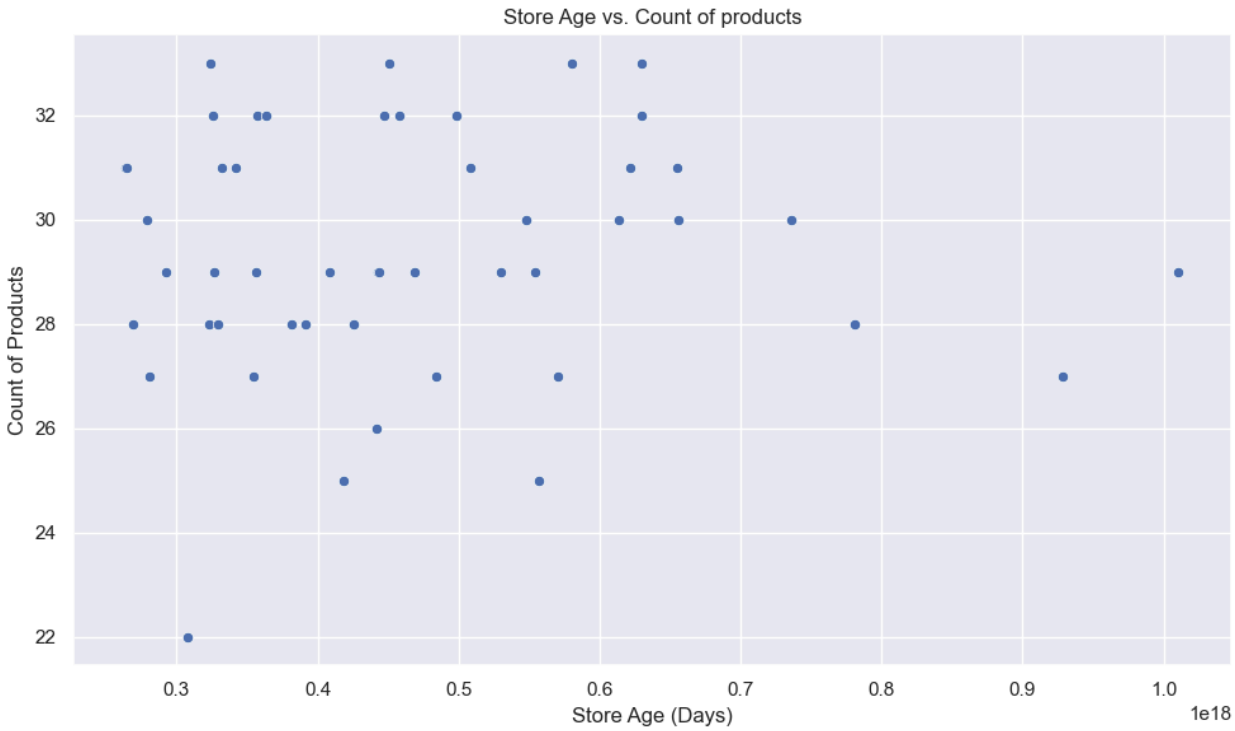
Key Findings:

1. **No Clear Correlation**:
    - The scatter plot of store age versus revenue shows no obvious linear or strong correlation between these two variables. Stores of varying ages appear to generate similar levels of revenue, ranging from around $0 to $40. This suggests that the age of a store does not directly influence its profitability.
2. **Consistent Profit Distribution**:
    - Regardless of how long a store has been operating (as represented by store age), the profits tend to cluster around the same range. Revenues are distributed across stores of all ages, with no store age dominating in terms of revenue generation.

Decisions and Considerations:

1. **Monitor Underperforming Older Stores**:
    - Although most stores generate consistent revenues, some older stores appear to be outliers, generating low revenue. It may be useful to investigate these cases individually to identify possible causes, such as outdated marketing tactics, reduced customer footfall, or inventory management issues.

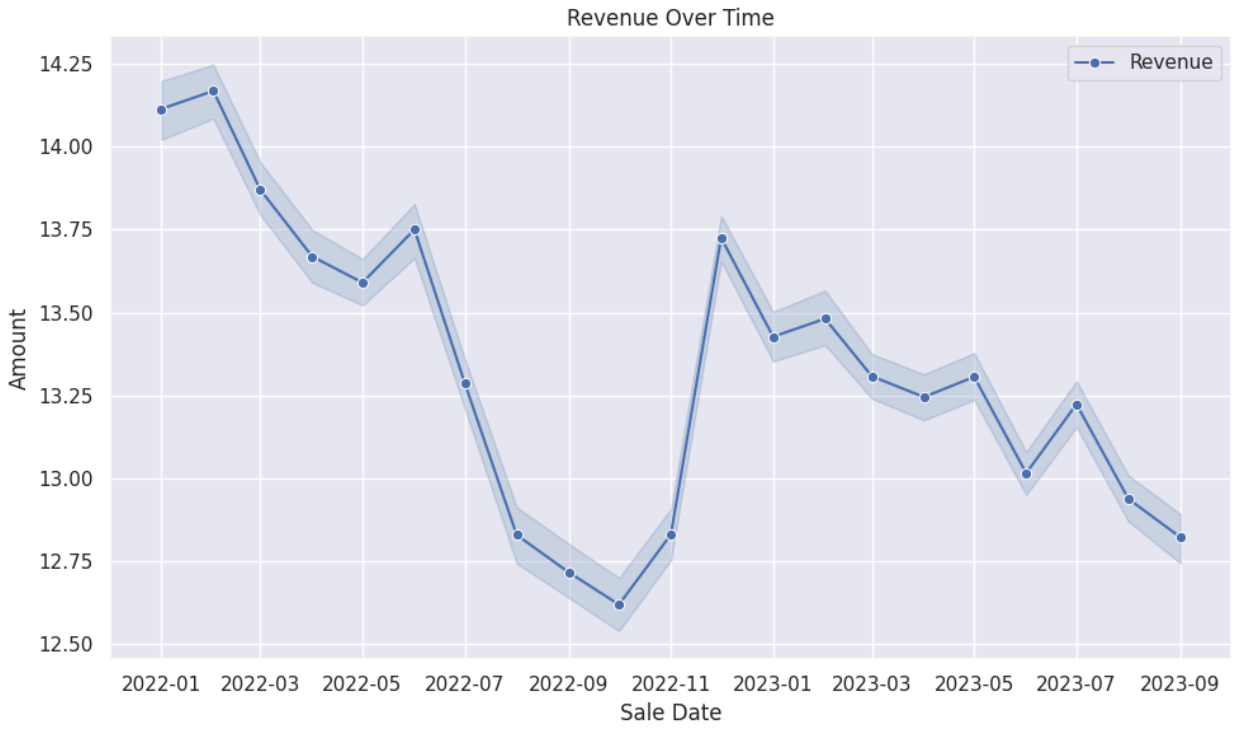
Store Age vs. Count of Products



Key Findings:

1. **No Strong Correlation**:
    - The scatter plot shows no clear or strong relationship between store age (x-axis) and the count of products available (y-axis). Regardless of whether a store is older or newer, the number of products available remains fairly consistent, clustering between 26 to 32 products.
2. **Variation in Product Counts**:
    - Although the majority of stores, both older and newer, tend to have product counts within a narrow range, there are outliers on both ends. A few stores have significantly fewer products (as low as 22), while others have as many as 32 products.
3. **Age Does Not Impact Product Variety**:
    - This lack of variation in product count across stores of different ages suggests that the age of a store is not a significant factor in determining the range of products it offers. This finding aligns with previous data showing no correlation between store age and other performance metrics like profit or revenue.

Revenue over time



Key Findings:

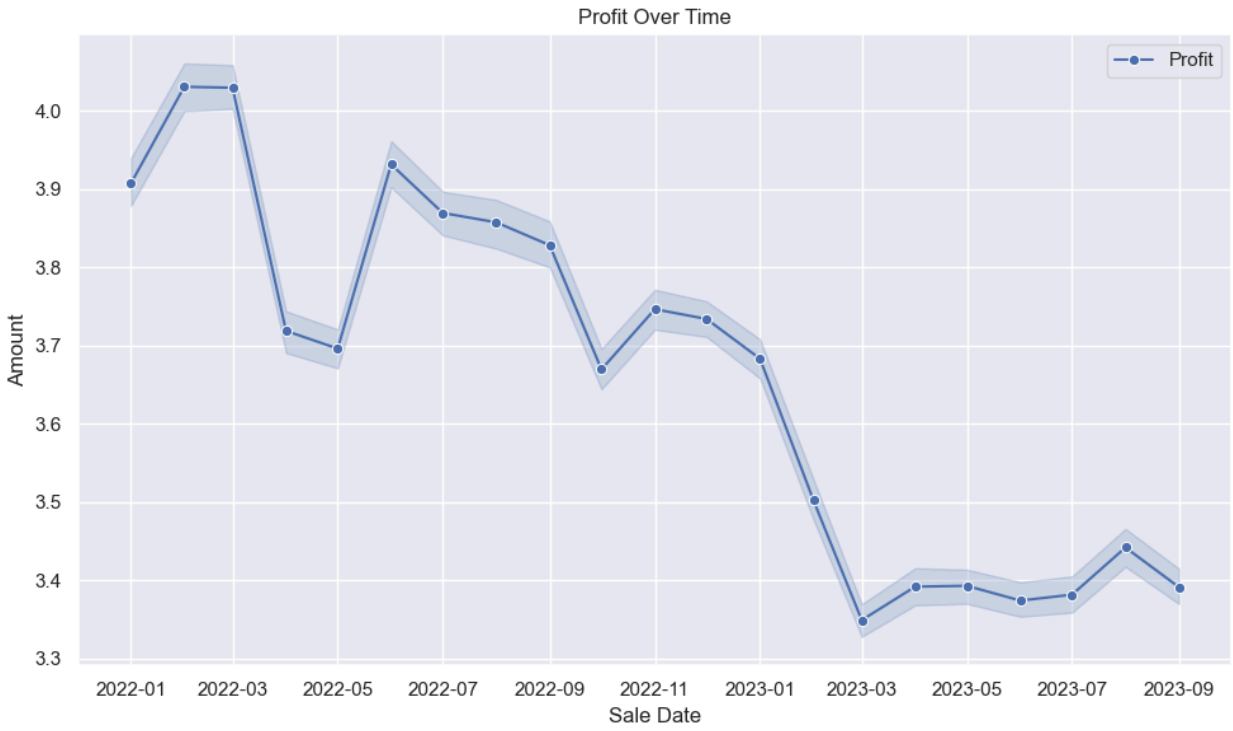
1. **Overall Declining Trend**:
    - The plot shows a clear downward trend in revenue from January 2022 to mid-2023. Starting at a high of approximately $14.25 in early 2022, the revenue gradually declines, reaching below $12.75 by mid-2023. This overall trend suggests that the company is experiencing decreasing revenue over time, which may be due to several factors such as market saturation, competitive pricing pressures, or changing consumer demand.
2. **Seasonal Peaks and Troughs**:
    - While the overall trend is downward, there are noticeable fluctuations in revenue, suggesting possible seasonality in sales. For example, there is a sharp dip in revenue around mid-2022, followed by a noticeable spike in late 2022 (around the holiday season). Similar smaller peaks can be seen in early 2023, likely linked to seasonal events or promotions.
3. **Steady Decline Post Early 2023**:
    - After the spike in revenue in late 2022, there is a steady and consistent decline through 2023, with minor upward fluctuations. This could be due to macroeconomic factors, reduced consumer spending, or less effective marketing efforts.
4. **Revenue Stabilization**:

- Although the revenue shows a decline, there are periods of relative stabilization, especially in the early months of 2023. However, the continuous decline suggests that efforts to stabilize revenue have not been sufficient to reverse the downward trend.

Decisions and Considerations for the Future:

1. **Seasonal Promotions**:
   - The revenue spikes observed during late 2022 and early 2023 likely correspond to high sales periods. It would be beneficial to maximize the use of these periods with marketing campaigns, discounts, and bundled offers.
2. **Investigate Revenue Decline Causes**:
   - The overall decline in revenue warrants further investigation into internal and external factors.
3. **Adjust Inventory and Stock Turnover**:
   - With the revenue decreasing steadily, it would be prudent to align inventory levels with sales trends. High stock levels during periods of low revenue could lead to increased holding costs and reduced profitability. Consider adjusting inventory turnover strategies to better reflect seasonal demands.

Profit over time



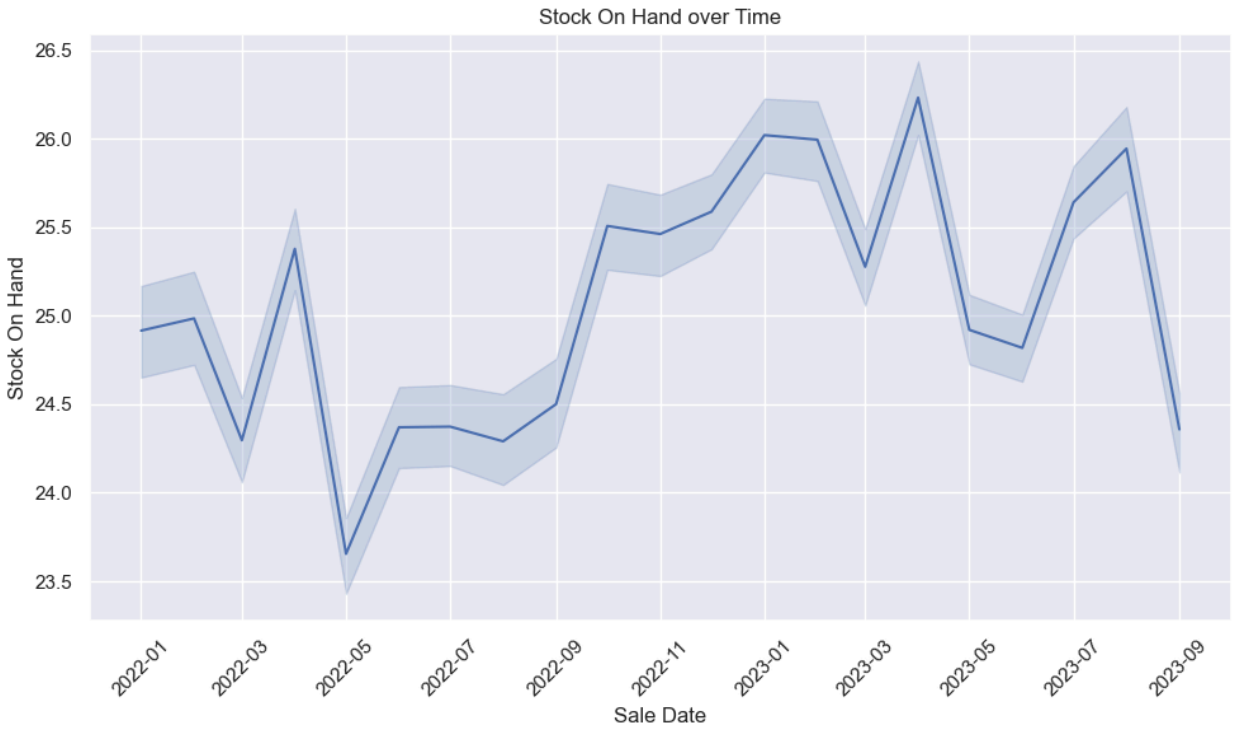
Key Findings:

1. **Overall Decline in Profit**:
    - The plot shows a consistent decline in profit from early 2022 to mid-2023. In January 2022. This mirrors the downward trend observed in the revenue plot, indicating a broader issue affecting both revenue and profitability.
2. **Seasonal Fluctuations**:
    - Despite the overall decline, there are noticeable peaks and troughs throughout the time period. There is a significant dip in profit around mid-2022, followed by a brief recovery towards the end of 2022. This could be tied to seasonal factors, such as high-demand periods during the holiday season, which provide temporary boosts to profit.
3. **Notable Drop in Early 2023**:
    - A sharp decline in profit occurs from January 2023, falling below $3.5. This decline is sustained through early 2023, with a very slight recovery in the second half of the year.
4. **Stabilization Around Mid-2023**:
    - Following the significant decline in early 2023, the profit stabilizes slightly around the $3.4 to $3.5 mark. This stabilization suggests that the downward momentum may have slowed, although it is still far from the levels observed in 2022.

Decisions and Considerations for the Future:

1. **Cost Control Measures**:
    - Given the decline in profits, it would be prudent to focus on identifying and controlling any rising costs. A deeper analysis into product cost structures, supplier contracts, and overhead expenses could help mitigate profit losses. Optimizing pricing strategies without losing customers due to price sensitivity could also help.
2. **Seasonal Marketing Strategies**:
    - The seasonal fluctuations in profit suggest that certain periods of the year (likely tied to holidays or special events) contribute to short-term profit boosts.

Stock on hand over time



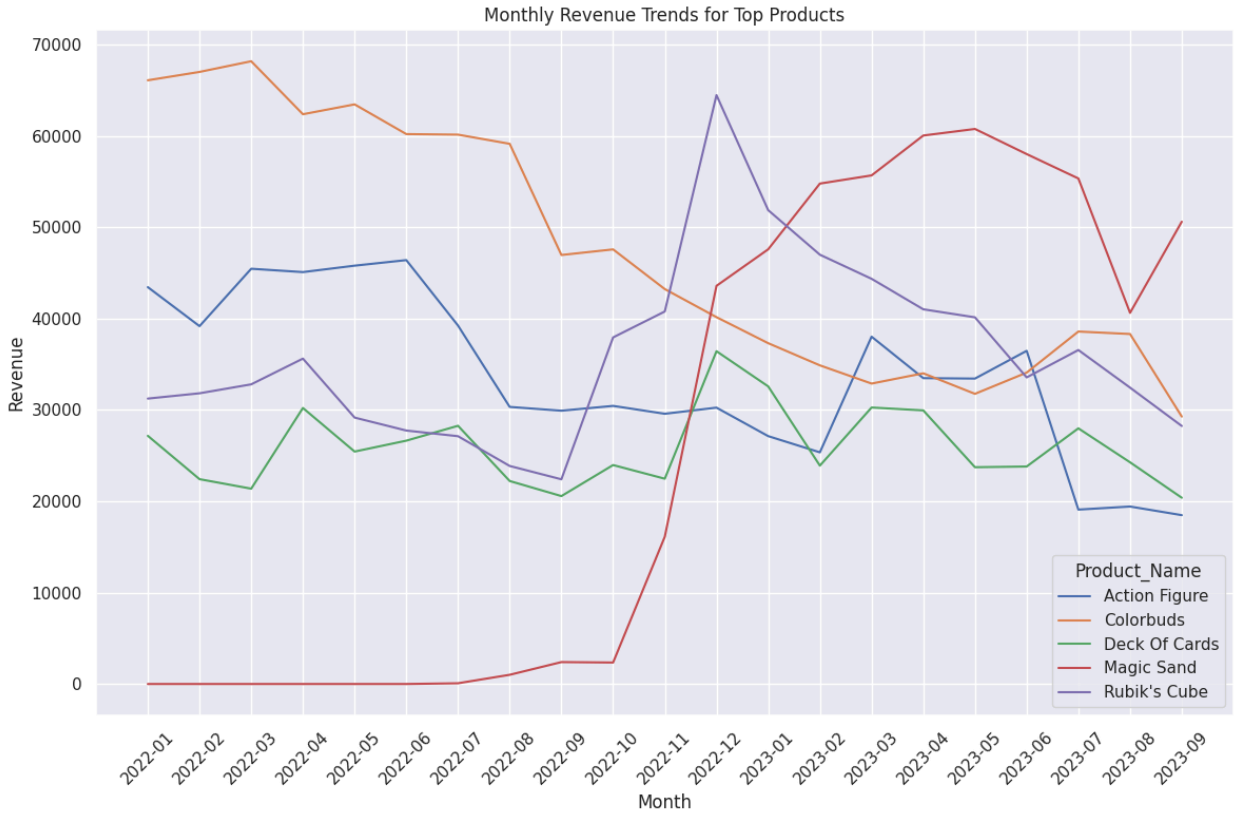
Key Findings:

1. **Seasonal Fluctuations in Stock Levels:**
    - The plot reveals **cyclical patterns** in stock levels, with **noticeable peaks** occurring around **March, May, and July** in both **2022 and 2023**. These periodic increases could reflect **seasonal restocking practices** or responses to **sudden increase in demand** during specific times of the year.
    - The fluctuations suggest that stock levels rise in preparation for periods of higher sales or marketing events, followed by a drawdown as sales decrease the stock.
2. **Stable Average Stock Levels:**
    - Despite the observed peaks and troughs, the **overall average stock level** remains relatively **consistent** across the observed period, hovering around **25 units**. This indicates that, although restocking occurs periodically, the business maintains a generally stable inventory size.
3. **Decreased Stock Towards September 2023:**
    - There is a noticeable **decline in stock levels** starting in **August 2023**, with a steep drop-off occurring by **September 2023**. This could indicate a **sales rush**, a **restocking delay**, or potential issues in the supply chain during this period.
    - If the drop continues into later months, it might require an investigation to determine whether **supply constraints** or **unexpected demand** are causing the decline.

Potential Decisions:

1. **Optimize Restocking Cycles:**
    - Given the **periodic restocking patterns**, further analysis should be conducted to understand the exact factors driving these peaks. This information can be used to optimize the **inventory management cycle** and ensure that stock levels align more precisely with periods of **higher demand**.
    - Additionally, ensuring that **restocking coincides** with promotional events or seasonal sales periods could help maximize revenue during high-demand times.
2. **Monitor Declining Stock Levels:**
    - The **drop in stock levels** in **late 2023** should be closely monitored. If this trend continues, it could indicate **supply chain disruptions** or increasing demand. In such cases, it may be necessary to **increase stock** or investigate the underlying cause of the shortage to avoid stockouts.
    - Should this decline in stock reflect a **supply chain issue**, developing contingency plans such as **alternative suppliers** or **improved logistics** may help prevent further disruptions.
3. **Prepare for Seasonal Peaks:**
    - The **cyclical nature of stock on hand** implies that businesses should plan for **increased demand** in specific months. Coordinating marketing efforts and promotions during periods like **March, May, and July** could capitalize on these stock increases, further driving sales.
    - Ensuring **adequate inventory** during these peaks can help **reduce the risk of stockouts** and capture maximum revenue during high-demand periods.

Monthly Revenue Trends for Top Products



Key Findings:

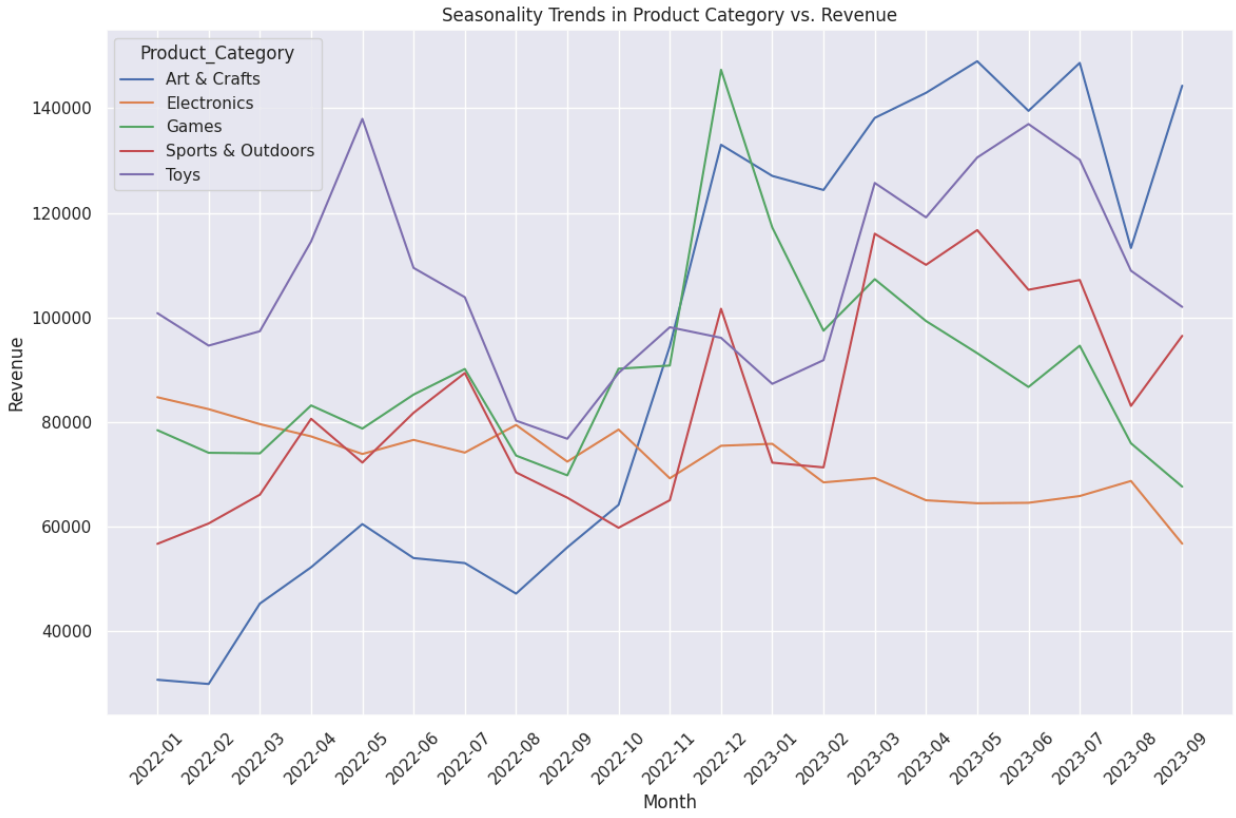
1. **Deck of Cards and Action Figures as Steady Revenue Generators**:
    - Throughout most of the observed period, **Deck of Cards** and **Action Figures** consistently appear to generate high revenue. Despite minor fluctuations, both products maintain a steady performance.
    - **Action Figures** show some minor decreases but still contribute significantly to the overall revenue, indicating that they remain popular and demand is relatively stable.
2. **Strong Surge in Magic Sand**:
    - One of the most notable trends is the sharp increase in revenue for **Magic Sand** starting in October 2022. This suggests that Magic Sand may have been newly introduced or benefited from an effective marketing campaign.
    - After this peak, Magic Sand's revenue stabilizes but remains strong, with another minor increase observed around late mid-2023. This indicates continued demand, though at a lower rate than during its initial surge.
3. **Decline in Colorbuds Revenue**:
    - **Colorbuds** show a steady decline in revenue from the start of 2022 until mid-2023. This suggests a possible decrease in customer interest or potential market saturation for this product.

    - The continuous downward trend suggests that renewed marketing efforts or a potential phase-out may be needed if profitability continues to decline.
4. **Rubik's Cube Faces Sharp Increase**:
    - While relatively stable throughout most of the observed period, **Rubik's Cube** experienced a sudden surge in revenue around late 2022. Unlike Magic Sand, this increase is likely not due to the product being new, but rather other factors such as seasonal demand, promotions, or discounts.
    - This unexpected increase warrants further investigation into the drivers behind this surge, such as potential marketing efforts or discounts that were offered during that period.

Decisions and Considerations for the Future:

1. **Focus on Seasonal Peaks for Certain Products**:
    - The sharp increase in revenue for **Rubik's Cube** and **Magic Sand** suggests that there are specific periods where these products experience higher demand. Seasonal promotions, holiday campaigns, or strategic discounting may help capitalize on these trends in the future.
2. **Maintain Steady Marketing for High Performers**:
    - **Deck of Cards** and **Action Figures** have shown steady performance, and continued marketing efforts can help maintain their momentum. Consider introducing variations or bundles of these products to keep customer interest high.
3. **Reevaluate the Colorbuds Strategy**:
    - With a continuous decline in revenue, **Colorbuds** may need reevaluation. A refreshed marketing strategy, promotional offers, or product redesign may help revive interest. If no improvement is seen, a potential phase-out of this product might be necessary to allocate resources to more profitable items.
4. **Investigate Rubik's Cube Revenue Surge**:
    - The sharp increase in **Rubik's Cube** revenue should be further investigated. Understanding whether this was driven by a seasonal trend, a one-time promotion, or another external factor will help replicate this success in future campaigns.

Seasonality Trends in Product Category vs. Revenue



Key Findings:

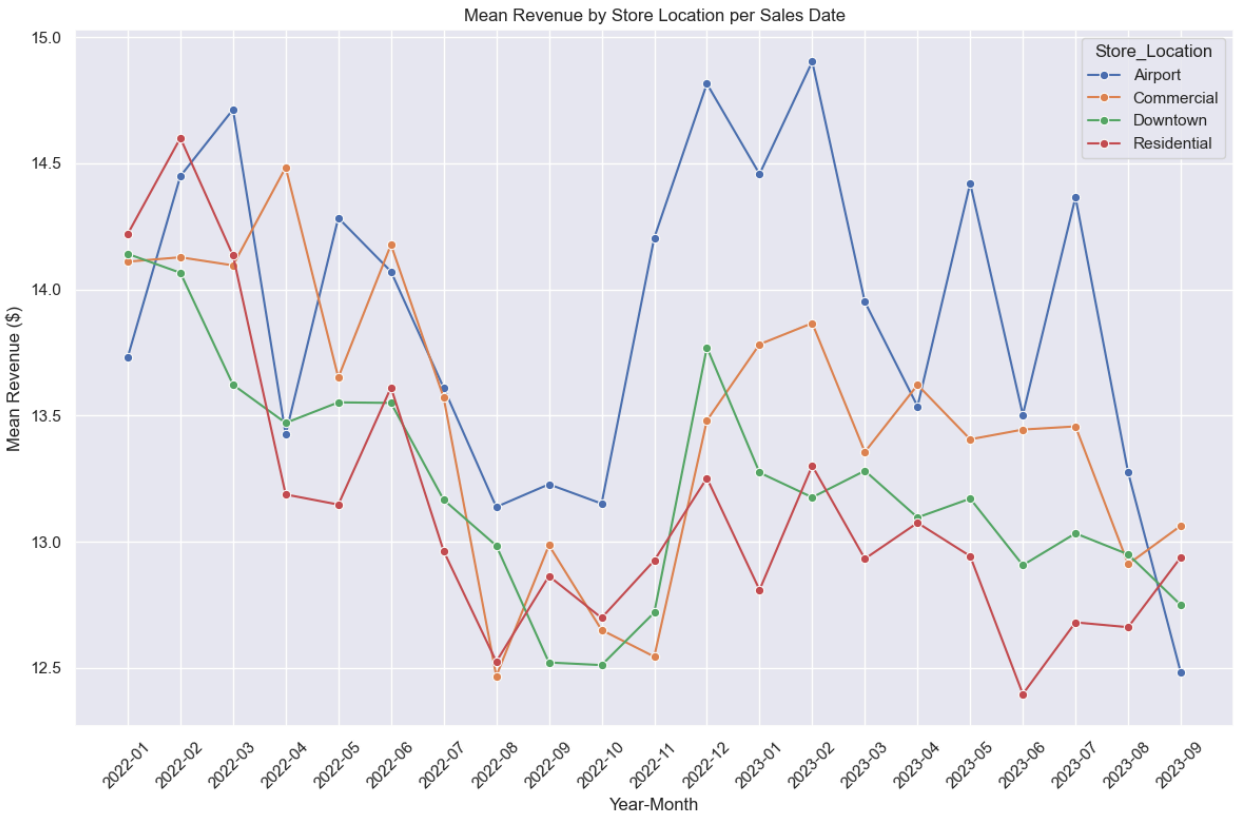
1. **Electronics – Steady Performance:**
    - The **Electronics** category maintained a **steady** performance throughout the observed period, with minimal fluctuations. It shows consistent revenue over time, indicating stable demand.
2. **Sports & Outdoors – Seasonal and Post-2023 Growth:**
    - The **Sports & Outdoors** category experienced a **seasonal peak** around **mid-2022**, likely influenced by outdoor activities and sports-related demand during warmer months.
    - Notably, after **February 2023**, revenue for this category shows a significant **upward trend**, which could be attributed to the introduction of new products or heightened consumer interest post-holiday season.
3. **Toys – Multiple Seasonal Peaks:**
    - **Toys** had two prominent **seasonal peaks**, one around **April 2022** and another around **December 2022**. These peaks likely correspond to gift-giving periods such as holidays and special occasions (e.g., Easter and year-end holidays).
    - After these peaks, the revenue slightly dips, but **Toys** still contribute strongly overall, reflecting consistent demand during peak periods.

4. **Games – Strong Holiday Season Spike:**
    - The **Games** category saw a **sharp increase in revenue** from **October 2022** to **January 2023**, with the highest spike during the holiday season. This pattern suggests that games are popular holiday purchases, likely for gifting or family activities during winter.
    - After **January 2023**, revenue declines and stabilizes, indicating reduced interest after the holiday season.
5. **Art & Crafts – Steady Growth:**
    - Interestingly, **Art & Crafts** started at a **low revenue point** but showed a **steady and continuous climb**, eventually becoming one of the top revenue-generating categories.
    - This consistent growth suggests better marketing and resource allocation to this potential.

Decisions and Recommendations:

1. **Boost Promotions for Games and Sports During Holiday Seasons:**
    - Since **Games** and **Sports & Outdoors** see clear spikes in revenue during the holiday season, focused marketing campaigns, bundled deals, and promotions during **October to January** could further drive sales in these categories.
2. **Leverage Steady Performance of Electronics:**
    - Given the **steady performance** of the **Electronics** category, consider positioning it as a reliable revenue source.
3. **Target Toy Sales for Key Periods:**
    - With **Toys** showing seasonal peaks around **April and December**, promotions and inventory increases should be timed around these periods to maximize revenue. Identifying similar spikes for other holidays can also enhance sales.
4. **Capitalize on the Growth of Arts & Crafts:**
    - The growth of **Arts & Crafts** from a low starting point to a top revenue generator suggests rising demand. The marketing and strategies used in this growth should be more investigated and improved upon.
5. **Strategic Inventory Management:**
    - Based on these trends, **inventory allocation** should prioritize **Games, Toys, and Sports & Outdoors** ahead of key holiday seasons, while maintaining stable stock levels for **Electronics** and **Art & Crafts** throughout the year to meet steady demand.

Mean Revenue by Store Location per Sales Date



Key Findings:

1. **Sharp Decline in Airport Revenue (Starting in July 2023):**
    - A significant and sharp **decrease in airport store revenue** begins around **July 2023**. Prior to this, airports had shown strong fluctuations with a series of peaks and troughs, but the **steep decline** suggests a potential issue with travel volume, demand, or store performance during this period. This sharp drop could be due to reduced travel seasonality, changes in flight patterns, or shifts in customer spending behaviors within airports.
2. **Increase in Downtown and Commercial Revenue (November 2022):**
    - Both **downtown and commercial store revenues** experience an upward trend in **November 2022**, with the increase in downtown being particularly noticeable. This period of growth coincides with **seasonal events** such as holiday shopping, Black Friday sales, and end-of-year promotions, which could explain the rise in traffic and spending in these store locations. The simultaneous increase in **commercial locations** further supports the hypothesis that holiday promotions and discounts likely played a significant role in the revenue uptick.
3. **Volatility in Airport and Commercial Stores:**

    - **Airport stores** continued to demonstrate **significant volatility**, particularly in the period from **late 2022 to mid-2023**. A large surge occurs from **September 2022** to **April 2023**, possibly due to post-pandemic recovery in travel or travel-related shopping behaviors. However, after peaking in **April 2023**, airports experienced a **sharp decline starting in July 2023**. This volatility is something that must be analyzed further, as it could point to inconsistent passenger numbers or shifting consumer preferences in airports.
4. **Stable Performance in Downtown and Residential Stores:**
    - Compared to airports and commercial locations, **downtown** and **residential stores** showed relatively stable performance, although both experienced **minor increases** around key sales periods like **November 2022**. These locations were less volatile, but they followed the general downward trend seen across all store types after early 2023.

Key Trends:

- **Seasonality and Promotional Influence:**
    - The spikes observed in **November 2022** for both downtown and commercial locations likely correlate with **holiday shopping** and **seasonal promotions**. This period is historically a peak shopping season, which benefits stores in **high-traffic areas** like downtown and commercial districts.
    - Similarly, the **airport store surge** from **September 2022 to April 2023** suggests a possible correlation with the **holiday travel period** and **peak travel times**, which aligns with increased consumer spending in airport environments.
- **Post-July 2023 Airport Decline:**
    - The **post-July 2023 decline** in airport store performance is striking and may indicate broader challenges, such as **reduced travel** during summer or operational challenges at airport stores. Alternatively, it could signal a **shift in consumer behavior**, with fewer travelers opting to make purchases within airports.

Recommendations:

1. **Investigate the Airport Revenue Decline (July 2023 Onward):**
    - Conduct a more detailed investigation into the **sharp revenue decline** in airport locations starting in **July 2023**. Possible causes could include **reduced travel volume**, **operational issues**, or changes in consumer preferences at airport stores. Strategies like **improved in-store promotions**, targeted **travel-based marketing**, and **inventory adjustments** could help mitigate further losses.
2. **Focus on Seasonal Promotions for Downtown and Commercial Stores:**
    - The **November 2022 spike** in **downtown and commercial** revenues suggests these locations benefit significantly from **seasonal shopping periods**. To capitalize on this trend, businesses should plan **promotions, discounts**, and **events** around the holiday season, **Black Friday**, and other key periods.
3. **Monitor Volatility in Airport Stores:**

- Given the extreme volatility in **airport store revenue**, it's essential to regularly **monitor travel patterns** and **consumer behaviors** to anticipate potential surges or declines. **Seasonal inventory planning** and **timely promotions** could help capitalize on peak travel times, while mitigating revenue drops in slower travel months.

Important decisions for future

1. Enhance Marketing Efforts for High-Revenue Products

Decision:
Focus marketing and promotional activities on high-revenue products such as **Toy Robot**, **PlayDoh Playset**, **Rubik's Cube**, **Gamer Headphones**, and **Etch A Sketch**.

Reasons:

- These products combine high prices with significant unit sales, contributing substantially to overall revenue.
- Positioning them as premium offerings can attract more customers willing to pay higher prices, increasing profitability.

Further Investigation Needed:

- Identify the most effective marketing channels and strategies for these products.
- Analyze customer demographics and preferences to tailor marketing messages.

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2. Optimize Inventory Levels to Prevent Over- and Under-Stocking

Decision:
Implement dynamic inventory management systems to align stock levels with real-time demand, particularly for high-volume products like **PlayDoh Can** and **Barrel O' Slime**.

Reasons:

- High stock levels of certain products indicate potential overstocking, leading to increased holding costs.
- Low stock levels on high-demand items risk stockouts, potentially losing sales and customer trust.

Further Investigation Needed:

- Conduct a detailed demand forecasting analysis for each product.
- Evaluate the current supply chain efficiency and identify bottlenecks.

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3. Expand Store Presence in High-Performing Locations

Decision:
Increase the number of stores in **Airport** and **Residential** areas, where normalized revenue per store is high.

Reasons:

- Airport stores generate the highest revenue per store, benefiting from high traffic and diverse customer profiles.
- Residential stores also show strong revenue performance, indicating untapped potential for growth.

Further Investigation Needed:

- Assess the feasibility and potential return on investment for opening new stores in these locations.
- Study local market conditions and customer behavior to ensure successful expansion.

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4. Investigate and Address the Decline in Airport Store Revenues

Decision:
Conduct a thorough investigation into the sharp revenue decline in Airport stores starting July 2023 and implement corrective measures.

Reasons:

- Airport stores have shown a significant revenue drop, which could be due to reduced travel, operational issues, or changing consumer behaviors.
- Addressing this decline is crucial as Airport stores are high-revenue generators.

Further Investigation Needed:

- Analyze travel and passenger data to understand external factors affecting sales.
- Review operational processes and customer feedback specific to Airport stores.

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5. Reevaluate the Art & Crafts Product Category

Decision:
Reduce inventory and marketing efforts for the **Art & Crafts** category in underperforming stores like **Puebla 3** and **Saltillo 1**, reallocating resources to more profitable categories.

Reasons:

- Art & Crafts consistently generate low revenue and profit across multiple store locations.
- Resources can be better utilized in higher-performing categories like Electronics and Toys.

Further Investigation Needed:

- Determine if the low performance is due to lack of interest, poor product quality, or inadequate marketing.
- Explore potential for niche marketing or product diversification within this category.

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6. Implement Seasonal Promotions Aligned with Revenue Peaks

Decision:
Plan and execute targeted promotions and marketing campaigns during key seasonal periods (e.g., holiday seasons, Easter) to maximize sales in high-demand categories like **Games**, **Toys**, and **Sports & Outdoors**.

Reasons:

- Historical data shows significant revenue spikes during specific seasons, indicating high consumer demand.
- Leveraging these periods can drive substantial short-term revenue increases.

Further Investigation Needed:

- Identify the most effective types of promotions (discounts, bundles, exclusive offers) for each seasonal peak.
- Analyze past promotion performance to refine future strategies.

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7. Focus on High-Margin Products to Boost Profitability

Decision:
Prioritize the sales and marketing of high-margin products such as **Jenga**, **Plush Pony**, and **Etch A Sketch** to enhance overall profitability.

Reasons:

- These products have the highest profit margins, contributing significantly to per-unit profitability.
- Promoting high-margin items can offset lower margins from high-volume products.

Further Investigation Needed:

- Explore opportunities for bundling high-margin products with other items to increase sales.
- Assess pricing strategies to ensure competitive yet profitable pricing.

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8. Investigate the Causes of Overall Revenue and Profit Declines

Decision:
Conduct a comprehensive analysis to identify the underlying factors contributing to the overall decline in revenue and profits from early 2022 to mid-2023.

Reasons:

- Understanding the root causes is essential to reversing the downward trend and implementing effective corrective actions.
- Factors could include market saturation, increased competition, changing consumer preferences, or ineffective marketing strategies.

Further Investigation Needed:

- Perform a company wide analysis to uncover internal and external factors affecting performance.
- Gather qualitative data through customer surveys and feedback to gain insights into changing consumer behaviors.

Additional Areas for Further Investigation:

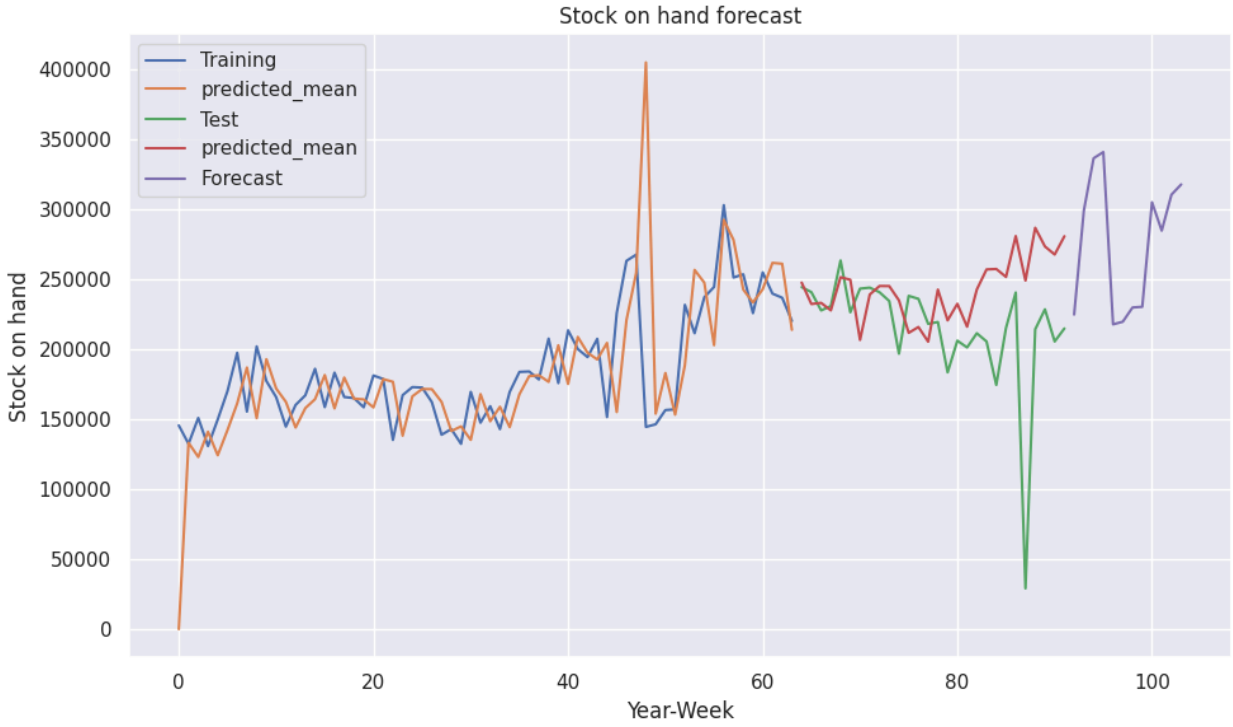
1. **Customer Behavior and Preferences:**
    - Analyze customer purchasing patterns and preferences to tailor product offerings and marketing strategies effectively.
2. **Supply Chain Efficiency:**
    - Evaluate the supply chain for potential improvements to reduce lead times, costs, and enhance flexibility in responding to demand changes.
3. **Competitive Analysis:**
    - Study competitors' strategies, pricing, and product offerings to identify opportunities for differentiation and improvement.

Forecasting with Machine Learning

Given the critical decisions outlined in the strategy, forecasting the next three months of revenue and stock on hand using machine learning techniques can be helpful. We decided to use SARIMAX for our forecasting model as it has capabilities for seasonal and trend-based forecasts. The following key reasons highlight the importance of implementing this forecasting model:

1. **Enhancing Marketing and Inventory Decisions:** SARIMAX can provide **seasonal and trend-based forecasts** for high-revenue products like Toy Robot, PlayDoh Playset, and Rubik's Cube. This will enable **more targeted marketing campaigns** around periods of expected high sales and **better alignment of inventory levels**, preventing over- or under-stocking issues.
2. **Preventing Overstock and Stockouts:** Forecasting demand helps optimize inventory for high-volume products. SARIMAX can capture seasonal patterns, allowing businesses to **align stock levels with demand**, reducing stocking costs and avoiding lost sales from being out of stock.
3. **Investigating Revenue and Profit Declines:** By forecasting revenue over the next three months, businesses can anticipate **continued trends in the declining revenues** observed from early 2022 to mid-2023. This insight will be crucial in determining whether the decline is a **temporary seasonal dip** or requires a **long-term strategic intervention**.

Stock on hand forecasting



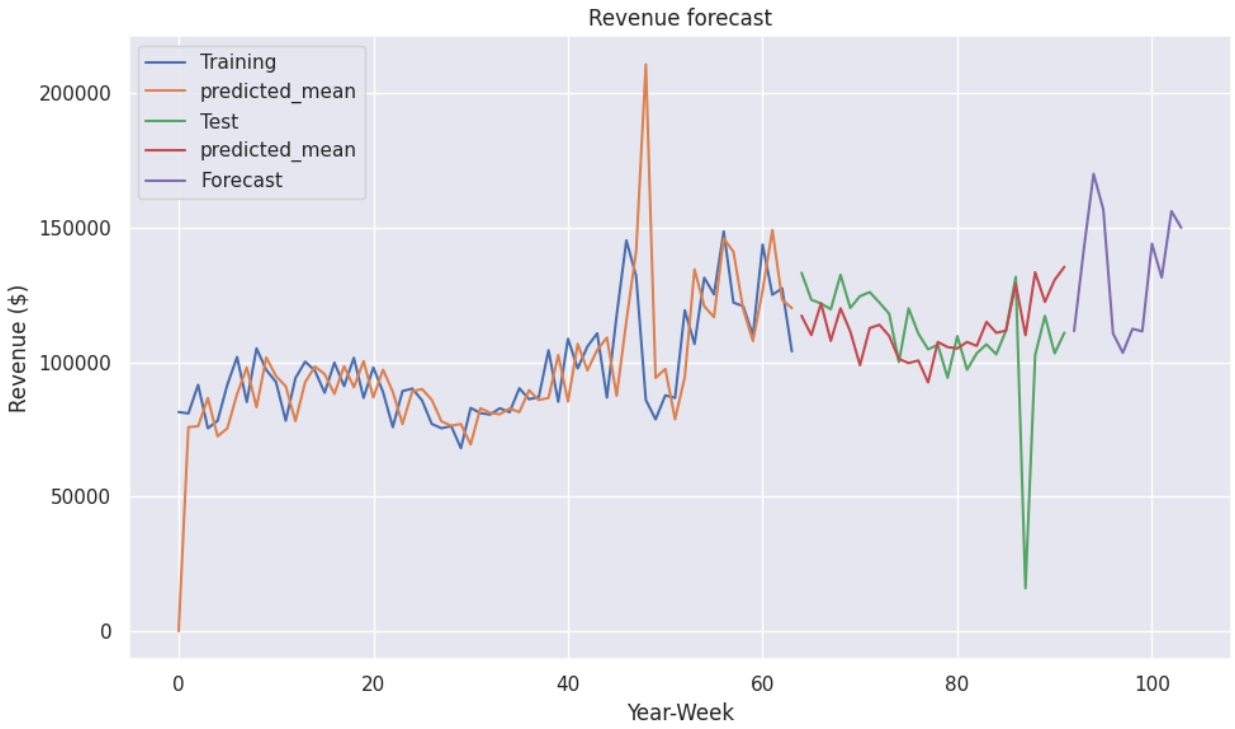
Key findings:

1. **Future Stock Forecast:**
    - The **forecasted stock levels** (purple line) show a gradual increase in the future, with a clear upward trend starting after week 80.
    - This increase could suggest that stock levels are expected to rise, possibly indicating planned restocking or anticipated increases in demand.
    - There are periods of small fluctuations, which suggest the model accounts for some volatility in stock, although no sharp spikes or drops are predicted.
2. **Sharp Spike and Decline (Historical Anomalies):**
    - Around week 40, there is a sharp spike in stock levels followed by a rapid drop, likely due to an **outlier event** such as a large restock or a data issue. The model seems to have adjusted after this event, as the prediction returns to a normal trend afterward.
    - Another **significant spike** is observed around week 85, unlike week 45, week 85 shows a **sharp downward spike** in stock levels, indicating **sudden stock depletion**.
    - Such anomalies could be further investigated to understand the root cause, whether from external events (e.g., a sales promotion or supply chain issue) or an internal system glitch.

Decisions to Consider:

1. **Optimize Inventory Management:** Given the forecasted steady stock levels, this indicates that inventory management is aligned with anticipated demand. However, given the periodic spikes, it may be worthwhile to review **supply chain efficiency** and address any factors leading to stock volatility.
2. **Prepare for Increased Stock Demand:** The upward trend in the forecast suggests that there may be **increased demand** or planned restocking in the coming weeks. Inventory and supply chain teams should ensure that adequate resources and stock are available to meet this demand without overstocking.
3. **Investigate Anomalies:** The sharp spikes observed in historical data (e.g., around week 45, or 85) should be investigated to ensure that such occurrences are not disruptive in the future. This might involve looking into **demand surges** or **supply chain irregularities** during that period.

Revenue forecasting



Key Findings:

1. **Revenue Growth Patterns:**
    - The overall trend shows gradual **revenue growth** from the initial weeks until around week 50, after which there is some fluctuation. However, the forecast suggests that future revenues will stabilize around a higher value, following the spikes and dips observed in the data.
2. **Upward Revenue Spike Around Week 45:**
    - A **sharp revenue spike** can be observed around week 45, reaching above $200,000. This is followed by a sudden decline.
    - The same spike is also seen in the training data, but to much lower degrees, indicating and hinting at potential that could be used but was underutilized.
3. **Downward Spike in Week 85:**
    - Similar to the stock forecast, there is a **downward spike** in revenue around week 85. The same spike is also seen in the test data, but to much lower degrees, possibly because of better management or just bad model performance.
4. **Post-Spike Stabilization:**
    - After these spikes, revenue returns to a more **moderate and stable level** with small fluctuations. The **forecast** for the next few weeks shows a gradual increase after a small dip.
    - This suggests that while spikes can cause temporary deviations, revenue tends to stabilize over time, indicating resilience in sales.

Decisions to Consider:

1. **Analyze Revenue Spikes and Seasonality:**
    - The **spike around week 45** and subsequent decline should be investigated. If it correlates with a **seasonal promotion or event**, repeating this strategy could boost revenue during similar periods. Identifying these **high-revenue weeks** can help in planning future marketing campaigns.
    - **Seasonal forecasting** can be applied to better anticipate demand spikes and adjust stock levels accordingly.
2. **Manage Supply Chain and Inventory:**
    - The **downward revenue spike in week 85** suggests a potential **stockout or supply chain disruption**, which could be preventing revenue from reaching its potential.

Conclusion

The comprehensive analysis of Maven Toys' sales records over the past two years reveals several insights and actionable opportunities aimed at reversing declining revenue and profitability trends.

Key Insights:

1. **Product Performance:** High-revenue products such as Toy Robot, PlayDoh Playset, and Rubik's Cube significantly contribute to overall revenue due to their premium pricing and substantial unit sales. Conversely, low-cost, high-volume products like PlayDoh Can and Barrel O' Slime maintain strong sales volumes but offer lower per-unit profitability. High-margin items like Jenga and Plush Pony, despite lower sales volumes, present substantial profit opportunities.
2. **Category Analysis:** The Electronics category stands out as the most profitable and highest revenue-generating segment, albeit with lower unit sales. In contrast, Art & Crafts consistently underperforms across all metrics, suggesting limited consumer interest or ineffective marketing strategies. Sports & Outdoors, while showing high sales volumes, suffer from low profit margins, indicating potential inefficiencies.
3. **Store Performance:** There is significant variation in store performance based on location. Airport and Residential stores have high normalized revenue per store, benefiting from high traffic and targeted customer demographics. Downtown stores, despite leading in total units sold, show lower revenue per store when normalized, pointing to possible oversaturation or suboptimal store management. Commercial stores lag behind other locations in revenue performance, necessitating strategic reassessment.

Strategic Recommendations:

1. **Store Expansion and Optimization:** Expand the number of Airport and Residential stores, leveraging their high revenue per store metrics. Concurrently, optimize Downtown store operations to improve per-store revenue performance, potentially through tailored marketing strategies or product assortments.
2. **Category Reassessment:** Reevaluate the Art & Crafts category by reducing inventory and reallocating resources to more profitable segments like Electronics and Toys. Investigate underlying causes of underperformance to determine whether to revitalize or phase out certain products.
3. **Investigate Declining Revenue Sources:** Conduct in-depth investigations into the sharp revenue declines in Airport stores post-July 2023 and the overall downward trend in revenue and profits. Identifying and addressing the root causes, whether they are operational inefficiencies, market saturation, or shifting consumer behaviors, is crucial for reversing negative trends.

Areas for Further Investigation:

- **Customer Behavior and Preferences:** Deepen the understanding of customer purchasing patterns to tailor product offerings and marketing strategies effectively.
- **Supply Chain Efficiency:** Evaluate and enhance supply chain processes to reduce lead times, lower costs, and increase flexibility in responding to demand fluctuations.
- **Competitive Landscape:** Analyze competitor strategies to identify differentiation opportunities and areas for improvement.
- **Technological Integration:** Assess the effectiveness of current sales platforms and explore digital transformation opportunities to enhance customer experience and sales efficiency.