**Hypothesis Testing and Statistical Analysis Report**

**1. Introduction**

This report focuses on testing three hypotheses based on the sales data from the **Sales\_Products\_2015\_2017** table. The primary goal is to determine the relationships between variables such as product prices and sales quantities, sales performance across territories, and the impact of seasonal trends on product categories. The results of the statistical tests are used to provide actionable insights and recommendations for improving business performance.

**2. Hypothesis Testing Report**

**Hypothesis 1: Higher Product Prices Correlate with Lower Sales Quantities**

* **Methodology**: To test the relationship between product prices and sales quantities, we performed a **Pearson Correlation** analysis. Pearson's correlation assesses the linear relationship between two continuous variables.
* **Null Hypothesis (H₀)**: There is no significant correlation between product prices and sales quantities.
* **Alternative Hypothesis (H₁)**: There is a significant negative correlation between product prices and sales quantities.
* **Results**:
  + **Pearson Correlation Coefficient**: -0.36
  + **P-value**: 2.19e-05 (very close to 0)

**Conclusion**: Since the p-value is much smaller than the significance threshold of 0.05, we **reject the null hypothesis**. The negative correlation coefficient (-0.36) suggests a significant negative relationship between product prices and sales quantities. As prices increase, sales quantities tend to decrease, indicating price sensitivity.

**Hypothesis 2: Sales Performance Varies Significantly Across Different Territories**

* **Methodology**: We used a **One-Way ANOVA (Analysis of Variance)** to determine whether there are statistically significant differences in sales performance across various territories.
* **Null Hypothesis (H₀)**: Sales performance is the same across all territories.
* **Alternative Hypothesis (H₁)**: Sales performance varies significantly across different territories.
* **Results**:
  + **F-statistic**: 101.89
  + **P-value**: 4.04e-188 (extremely small)

**Conclusion**: The very low p-value indicates that we can **reject the null hypothesis**. This means that sales performance **does vary significantly** across different territories. Some territories outperform others, showing significant disparities in sales volume.

**Hypothesis 3: Sales are Higher for Certain Product Categories Due to Seasonal Trends**

* **Methodology**: A **Chi-Square Test of Independence** was used to evaluate the relationship between product categories and seasonal trends. This test determines whether sales distribution by season is independent of product categories.
* **Null Hypothesis (H₀)**: Sales for product categories are not affected by seasonal trends.
* **Alternative Hypothesis (H₁)**: Sales for certain product categories are significantly associated with seasonal trends.
* **Results**:
  + **Chi-Square Statistic**: 250.08
  + **P-value**: 3.94e-51 (extremely small)

**Conclusion**: The p-value is extremely small, which allows us to **reject the null hypothesis**. This means there is a **significant association** between product categories and seasonal sales, indicating that certain categories perform better in specific seasons.

**3. Statistical Analysis Report: Key Findings and Interpretations**

Based on the hypothesis tests performed, here are the key findings:

**Finding 1: Price Sensitivity Exists for Products**

The negative correlation between product prices and sales quantities (-0.36) suggests that as prices increase, the number of units sold decreases. This implies that customers are price-sensitive, and pricing strategy plays a key role in driving product sales.

**Finding 2: Territory Performance is Unequal**

The ANOVA results show that sales performance is not consistent across territories. This indicates that some regions are significantly outperforming others. Understanding the underlying factors contributing to high-performing regions can help replicate success in lower-performing areas.

**Finding 3: Seasonal Trends Impact Product Category Sales**

The strong association between product categories and seasons suggests that certain product categories sell better during specific times of the year. This trend can be leveraged for more targeted marketing campaigns and inventory management during peak seasons.

**4. Recommendations Based on Statistical Insights**

**Recommendation 1: Optimize Pricing Strategy Based on Product Sensitivity**

Given the significant negative correlation between price and quantity, consider:

* **Dynamic Pricing**: Adjust prices dynamically based on customer demand and competition.
* **Promotions**: Use targeted promotions or discounts on price-sensitive products to drive higher sales volumes, particularly for products showing steep declines in sales as prices increase.

**Recommendation 2: Focus Resources on High-Performing Territories**

Since sales performance varies significantly across territories, it is important to:

* **Invest in High-Performing Regions**: Focus marketing efforts and resources on high-performing territories to further capitalize on their potential.
* **Analyze Low-Performing Regions**: Conduct a deeper analysis of the low-performing regions to identify potential barriers to sales and address them through localized marketing or product customization.

**Recommendation 3: Align Marketing and Inventory with Seasonal Trends**

The significant association between product categories and seasons presents an opportunity to:

* **Seasonal Marketing**: Plan targeted marketing campaigns around peak seasons for specific product categories. For example, products that perform well in summer or winter can be promoted more heavily during those periods.
* **Inventory Management**: Stock products based on seasonal demand, ensuring that popular seasonal products are always available during peak times.

**5. Conclusion**

The statistical analysis of product prices, territory performance, and seasonal trends provided valuable insights into the business. Each hypothesis was tested using appropriate statistical methods, leading to actionable insights that can help optimize pricing strategies, resource allocation across territories, and seasonal marketing campaigns.

By implementing the recommendations, the business can capitalize on pricing strategies, improve sales in underperforming territories, and drive growth by aligning product offerings with seasonal trends