Title: The Power of Advanced Hypothesis Testing

Subtitle: Unveiling Data Insights Through Rigorous Statistical Analysis

ISSUE / PROBLEM

Marketing investments play a crucial role in driving sales, but determining the **optimal allocation of advertising budgets** requires a **statistical approach**. This project seeks to evaluate whether **TV promotion budgets** significantly impact sales **performance**, using **advanced hypothesis testing techniques** to ensure accurate and data-driven decision-making.

IMPACT

The findings from this project have **important implications for marketing strategies**:

- **Optimized budget allocation**: Companies can **strategically allocate advertising funds** to maximize revenue.
- **Data-driven decision-making**: Statistical evidence helps businesses make **informed choices** about marketing investments.
- **Higher return on investment (ROI)**: Understanding the effectiveness of different spending levels ensures **cost-efficient campaigns**.

RESPONSE

This project applies **one-way ANOVA, post hoc Tukey's HSD tests, and regression analysis** to determine whether different levels of **TV advertising budgets** lead to statistically significant variations in **sales revenue**. The study identifies key differences between **high, medium, and low TV promotion budgets**, highlighting the impact of advertising spending on sales outcomes.

KEY INSIGHTS

1**. There is a statistically significant difference in sales among different TV promotion budgets.**

- A **one-way ANOVA test** resulted in an **F-statistic of 1971.46** with a **p-value of 8.81×10^{-256}**, allowing the rejection of the **null hypothesis** that all groups have equal sales.

2. **Post hoc Tukey's HSD test confirms the magnitude of these differences**:

- **High vs. Low TV promotion**: Sales with **low TV promotions** are, on average, **$208.81 million lower** than those with high TV promotions (**95% confidence interval: [$200.99M, $216.64M]**)
- **High vs. Medium TV promotion**: Sales with **medium TV promotions** are, on average, **$101.51 million lower** than those with high TV promotions (**95% confidence interval: [$93.69M, $109.32M]**)

3. **Linear regression confirms a strong relationship between TV promotion budgets and sales.**

- The model achieves an **R^2 value of 0.874**, meaning it explains **87.4% of the variation in sales**.