MARKETING SPEND, PRICING STRATEGY, AND THEIR IMPACT ON SALES: AN ECONOMETRIC MODEL IN EXCEL

1. Background and Problem Statement:

A retail brand operating across multiple states wanted to assess how **marketing expenditure**, **discounts**, and **unit prices** jointly impact weekly sales revenue. The firm had 48 weeks of historical data but lacked access to R, Stata, or Python. They needed a fully Excel-based **econometric analysis**, including diagnostics for model robustness.

2. Objectives:

- Estimate the effect of marketing spend, price per unit, and discounts on weekly sales revenue
- Build and validate a multiple linear regression model using only Excel
- Apply **log transformation** to improve model fit and interpret elasticity
- Identify potential heteroskedasticity and outliers using Excel-native methods

3. Methodology:

3.1 Dataset Overview

- **Time Frame:** 48 weeks of data
- **Variables:**
    - Sales_Revenue (₹ lakhs per week)
    - Marketing_Spend (₹ lakhs)
    - Unit_Price (₹ per item)
    - Discount_Percentage (%)

3.2 Data Preparation in Excel

- Cleaned data using conditional formatting and removed 2 weeks with stockout issues
- Created Log_Sales_Revenue and Log_Marketing_Spend columns
- Used =LN() function for log transformation

- Checked for correlation using =CORREL() to guide initial model choice

3.3 Model Development

- Used **Excel Data Analysis Toolpak → Regression**
- Dependent variable: Log_Sales_Revenue
- Independent variables: Log_Marketing_Spend, Unit_Price, Discount_Percentage
- Created **residual column** to evaluate fit
- Evaluated variance spread using residual vs. fitted value plots

4. Results and Interpretation:

4.1 Regression Output

Variable	Coefficient	p-Value	Interpretation
Intercept	2.71	0.000	Baseline log revenue
Log_Marketing_Spend	0.62	0.001	1% increase in marketing spend → 0.62% increase in revenue
Unit_Price	–0.048	0.045	₹1 increase in price reduces sales by 4.8% (elastic demand)
Discount_Percentage	0.025	0.037	1% increase in discount boosts revenue by 2.5%

- **$R^2 = 0.83$**, **Adjusted $R^2 = 0.81$**
- All coefficients statistically significant at the 5% level
- Marketing spend showed **strong elasticity**, discounts had moderate impact
- Price sensitivity confirmed for product category

4.2 Diagnostics

- Residual vs. fitted plot showed mild **funnel shape**, indicating **heteroskedasticity**
- Applied **log transformation** to stabilize variance – improvement in R^2 observed
- No major outliers; verified using z-score thresholding (ABS(z) < 2.5)

5. Excel Deliverables:

- Cleaned dataset with formulas for z-scores, logs, and predictions
- Regression summary table with significance and R^2 values
- Diagnostic charts:
    - Residuals vs. Predicted
    - Actual vs. Predicted (log-transformed)
    - Line chart of sales over time with annotations on major discount campaigns

6. Recommendations:

- **Prioritize marketing spend**, especially during promotional windows, to maximize marginal revenue
- Adjust unit prices cautiously—demand shows high elasticity
- Use targeted **discount strategies**, preferably under 10%, to lift revenue without eroding margin
- Model should be updated monthly with fresh data; consider testing lag variables next

7. Stakeholder Relevance:

Academic:

- Demonstrates practical use of log-linear models in Excel
- Introduces basic heteroskedasticity checks and corrective modeling

Corporate:

- Helps retail firms quantify **ROI on marketing spend** and understand **pricing dynamics**
- Builds confidence in Excel as a robust platform for regression-based forecasting