**Course: INDE 6333 - Probability Stat for Engineers**

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**Final Project**

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### Step 1: Select a Project Topic

For this statistical analysis project, I selected a topic that aligns with both engineering relevance and practical application in the field of electronic maintenance. The focus of the project is:

- Topic: Common failure types in electronic device repairs
- Objective: To analyze and understand the frequency of repair issues across different types of electronic devices and determine whether device type affects the likelihood of successful repair.
- Scope of Analysis: Descriptive statistics, frequency analysis by device type and problem type, and repair success rate.
- Testing Focus: To assess whether the type of electronic device is associated with the likelihood of successful repair.

This topic fits within the suggested categories of real-world engineering problems and is highly relevant to reliability and performance assessment in consumer electronics repair processes.

### Step 2: Gather or Use Existing Data

For this project, I used a publicly available dataset from Kaggle titled "Repair Phone Technician", which contains real-world records of electronic device repairs. The dataset was created by Mohamed Amine Soltani and is accessible at:

https://www.kaggle.com/datasets/mohamedaminesoltani/repair-phone-technician/data

Dataset Overview:

Total Records: 528

Key Columns:

- Name: Device model or brand name
- Type: Device type (SMARTPHONE, PAD, CELL)
- Problem: Problem type reported (e.g., lcd, charge, touch)
- Fixed YES/NO: Indicates whether the device was successfully repaired

Why this dataset?

- It is relevant to engineering analysis in electronics reliability and performance.

- It allows for statistical analysis on categorical data using frequency and proportion.
- It provides an opportunity to test hypotheses regarding device-type-specific repair success.

**Step 3: Perform Statistical Analysis**

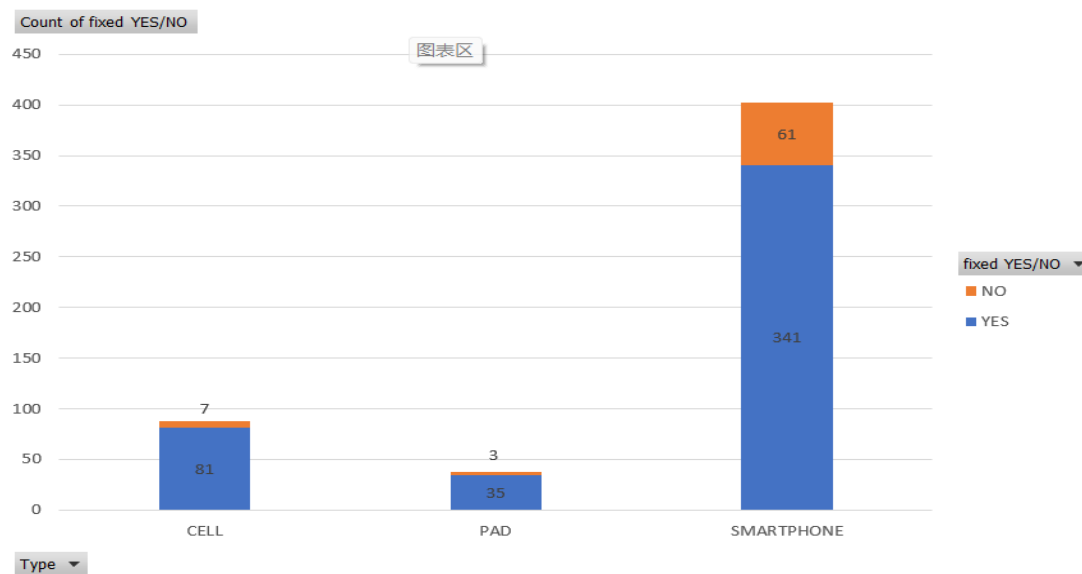1. Descriptive Statistics

Device Types:

- SMARTPHONE: 402 cases
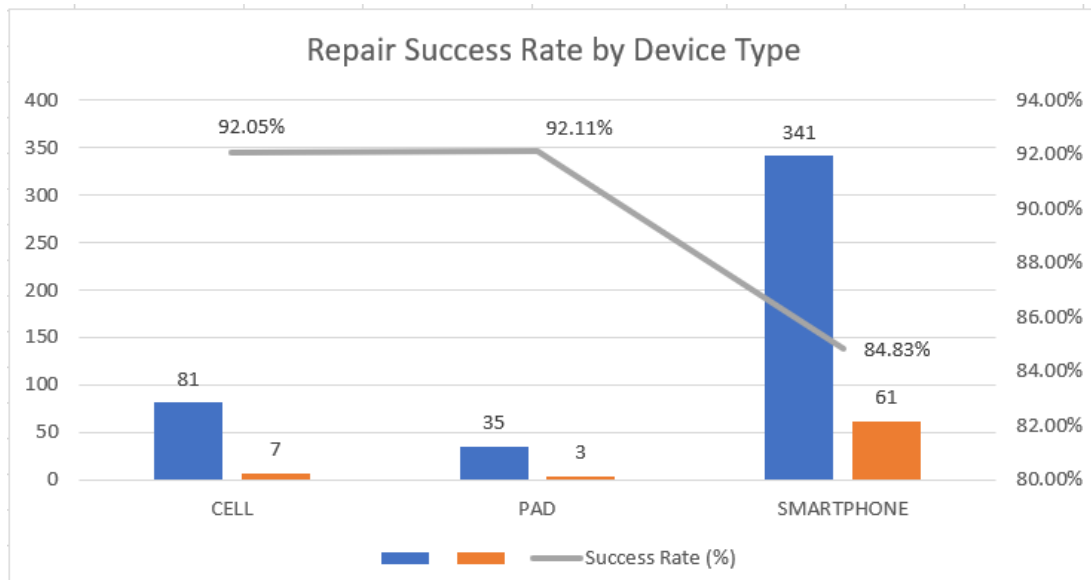
- CELL: 88 cases

- PAD: 38 cases

Repair Outcomes:

- Total repairs: 528

- Successes ("YES"): 457

- Failures ("NO"): 71

Success Rates by Device:

- SMARTPHONE: 341/402 ≈ 84.83%
- CELL: 81/88 ≈ 92.05%
- PAD: 35/38 ≈ 92.11%
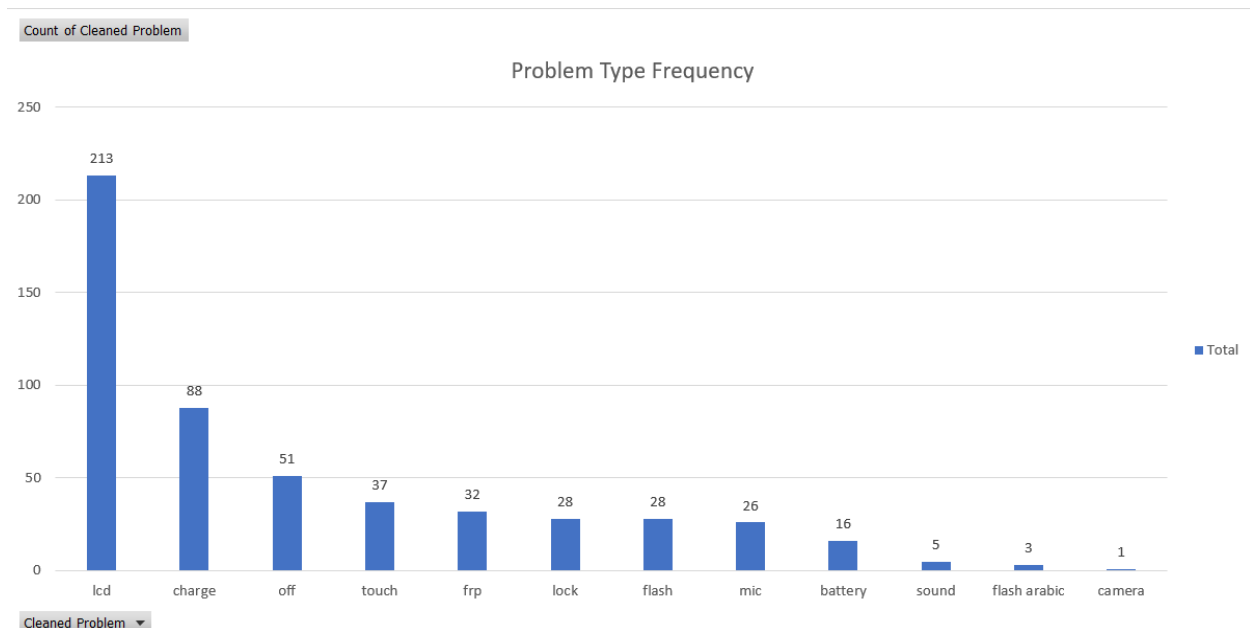
Repair Success Rate by Device Type

These success rates suggest that CELL and PAD have higher repair success rates compared to SMARTPHONE.

2. Frequency Analysis

Most common problems:

- LCD issues: 213 occurrences
- Charging issues: 88
- Device won't turn on (off): 51
- Touch screen issues: 37



Problem Type Frequency

3. Hypothesis Testing

We conducted a Chi-Square Test to examine whether the repair success rate is associated with device type.

- Null Hypothesis (H₀): Device type has no effect on repair success rate.
- Alternative Hypothesis (H₁): Repair success rate varies by device type.

Chi-square statistic $(x^2) = \frac{\Sigma(O-E)^2}{E} = 1.0294 + 2.2783 + 1.0067 = 4.3144$

SMARTPHONE: $\frac{(341-347.94)^2}{347.94} + \frac{(61-54.06)^2}{54.06} \approx 1.0294$

CELL: $\frac{(81-76.17)^2}{76.17} + \frac{(7-11.83)^2}{11.83} \approx 2.2783$

PAD: $\frac{(35-32.89)^2}{32.89} + \frac{(3-5.11)^2}{5.11} \approx 1.0067$

Degrees of freedom (df) $= (3-1)(2-1) = 2$

P-value: 0.1155 (From Excel) > 0.05

Since the p-value is greater than 0.05, we fail to reject the null hypothesis. This suggests that the difference in repair success rates among device types is not statistically significant.

**Summary**

The goal of this statistical analysis project was to explore whether the type of electronic device impacts the likelihood of successful repair. Using a real-world dataset of 528 repair records from Kaggle, we conducted descriptive statistics, frequency analysis, and a Chi-Square test of independence.

The descriptive analysis showed that while PAD and CELL devices exhibited slightly higher repair success rates than SMARTPHONES, the differences were not statistically significant.

Our hypothesis testing with a chi-square statistic of $x^2 =$ **4.3144** and **df = 2** produced a **p-value of 0.1155**, which is greater than the common significance level of 0.05. Thus, we failed to reject the null hypothesis.

**Conclusion:**

There is no statistically significant association between the type of device and the success of repair. Although different device types may appear to have varying success rates, this variation is not enough to conclude that device type affects repair outcomes from a statistical standpoint.

This result is important in engineering decision-making, as it emphasizes that while device type may be perceived to influence repair success, process improvements or technician training should be uniformly prioritized rather than targeted by device category.