Goal of the Test

The primary goal of this A/B test is to determine which marketing strategy most effectively drives sales for the fast food chain's new product. By comparing different promotional campaigns, we aim to identify the one that leads to the highest sales impact across locations.

Given the need for accuracy in multiple pairwise comparisons, we will use a confidence level of 99%.

Target Metric

The dataset offers one main metric:

- **sales_in_thousands**: This reflects the weekly sales amount (in thousands) for each location under each promotional strategy.

As the objective of this test is to identify the promotion with the greatest influence on sales, **total sales** is the target metric that best aligns with the test's long-term goal of maximizing revenue growth. Consequently, **sales_in_thousands** will serve as the primary measure to evaluate each promotion's effectiveness.

Calculations

The table contains the numbers necessary to analyze the A/B test and reach a decision. You can find the query in the appendix

Promotion	avg_sales	std_sales	n_count
Promotion 1	58.09901162790...	16.55378169757...	43
Promotion 2	47.329414893617	15.10895478281...	47
Promotion 3	55.36446808510...	16.76623077402...	47

We can see that promotion 1 has the highest average sales and provides the best value for our target metric.

To check for statistical significance, we use the Evan Miller A/B test calculator. Specifically, we want to use the two-sample t-test calculator, because we are having pairwise comparisons

between 3 promotions. The calculator asks to insert the mean (which is the average sales for each promotion), the standard deviation and the count (which is our number of locations). Inserting those numbers from the above table, we get the following results:

- Promotion 1 vs Promotion 2: p-value ≈ 0.00187
- Promotion 1 vs Promotion 3: p-value ≈ 0.44
- Promotion 2 vs Promotion 3: p-value ≈ 0.0167

Given that our confidence level was 99% (corresponding to alpha of 0.01) we have the following interpretations.

- Promotion 1 vs Promotion 2: The p-value is significantly small below our alpha level of 0.01, indicating that the difference in sales between these two promotions is statistically significant.
- Promotion 1 vs Promotion 3: The p-value is higher than the typical alpha level of 0.01. This suggests that the difference in sales between Promotion 1 and Promotion 3 is not statistically significant.
- Promotion 2 vs Promotion 3: The p-value is slightly above the alpha level of 0.01, suggesting that there isn't a statistically significant difference between these promotions.

Decision

Since Promotion 1 significantly outperformed Promotion 2, and there's no significant difference between Promotion 1 and Promotion 3, Promotion 1 is the recommended campaign. This recommendation is based on its superior performance relative to Promotion 2, and the lack of difference between Promotion 1 and Promotion 3 implies that Promotion 1 remains a strong choice without evidence favoring a switch to Promotion 3.

To ensure optimal long-term results, we might suggest further testing of Promotion 1 under varying conditions (e.g., different markets or demographic segments) to validate its effectiveness across scenarios.

Appendix

```
WITH
  promo_stats AS (
  SELECT
    Promotion,
    AVG(sales_in_thousands) AS avg_sales,
```

```sql
    STDDEV(sales_in_thousands) AS std_sales,
    COUNT(DISTINCT location_id) AS n_count
  FROM
    `tc-da-1.turing_data_analytics.wa_marketing_campaign`
  WHERE
    Promotion IN (1,
      2,
      3)
  GROUP BY
    Promotion )
SELECT
  CONCAT('Promotion ', Promotion) AS Promotion,
  avg_sales,
  std_sales,
  n_count
FROM
  promo_stats;
```