Why Test Data Statistically and Mathematically?

Statistical and mathematical testing provides an objective, data-driven framework for analyzing trends and relationships, especially in research involving large or complex datasets. Here's why these tests are essential for our research:

1. **Objective Evaluation**:
    - Human intuition can be biased, especially when dealing with large datasets. Statistical tests remove subjectivity by providing a quantitative, evidence-based way to evaluate data.
    - In our study, for example, we might **think** that films that pass the Bechdel Test are more likely to also pass the Mako Mori Test. However, statistical tests like the **Chi-Square Test** provide objective evidence, showing whether this relationship is significant based on the data rather than assumptions or expectations.

2. **Detecting Patterns and Trends**:
    - Data may not always reveal obvious patterns. Statistical tests (such as regression analysis) help uncover trends over time or relationships between variables that aren't immediately apparent.
    - For our research, these tools can show whether passing the Bechdel or Mako Mori Test correlates with higher ratings or profits **(RQ2)**, or whether there is a significant relationship between passing the Bechdel Test and passing the Mako Mori Test **(RQ1)**. By using statistical analyses, we can objectively evaluate these patterns instead of relying solely on intuition.

3. **Quantifying Relationships**:
    - Relationships between variables often exist, but they need to be quantified to provide clear, evidence-based insights. For example, the **Phi coefficient** can measure the strength of association between **passing the Bechdel Test** and **passing the Mako Mori Test**, while **multiple regression analysis** can quantify how much passing these tests influences **ratings** or **profits**.
    - This approach provides clarity and numerical insight, avoiding vague conclusions and allowing us to understand the true impact of these relationships in our dataset.

4. **Testing Hypotheses**:
    - Statistical testing allows for the rigorous **testing of hypotheses**. For instance, we can hypothesize that films passing the Bechdel Test are more likely to pass the Mako Mori Test or that passing either test correlates with higher ratings or profits. Tests like the **Chi-Square** and **multiple regression analysis** either support or reject these hypotheses with objective evidence.

- These tests provide **p-values**, indicating whether our results are significant or likely due to random chance, adding credibility to our conclusions.

5. **Ensuring Accuracy**:
   - Drawing conclusions from descriptive statistics alone (like averages or counts) can lead to inaccuracies. Statistical tests account for variation and randomness, ensuring our conclusions are reliable.
   - For example, when analyzing the relationship between passing the Bechdel and Mako Mori tests and film success (in terms of ratings or profits), statistical tests ensure that any observed differences reflect true relationships, not random variations in the sample. This approach provides a more accurate foundation for our conclusions.

6. **Providing Confidence in Results**:
   - Statistical tests provide measures like **confidence intervals** and **p-values**, which quantify how certain wecan be about our results.
   - This adds reliability to our findings, allowing us to make claims such as, "There's a 95% probability that the relationship between passing the Bechdel Test and higher film ratings is not due to random chance".

7. **Supporting Deeper Analysis**:
   - Beyond simple group comparisons, advanced techniques like **multiple regression** allow us to model the effects of multiple variables (e.g., passing the Bechdel and Mako Mori tests) on film success measures like ratings or profits.
   - For instance, multiple regression can predict the impact of passing each test on a film's rating, accounting for the influence of both variables simultaneously. This provides more nuanced insights, allowing us to explore how test performance relates to success indicators in a comprehensive way.

8. **Identifying Statistical Significance**:
   - Even if we observe differences in our data, it's important to know whether they're **statistically significant**. Tests like **Chi-Square** and **regression analysis** confirm whether observed relationships are meaningful or simply due to random variation.

This ensures that our findings, such as the relationships between Bechdel and Mako Mori Test performance and measures of success (like ratings or profits), are real and substantial, not just random fluctuations.

Statistical Tests That Will be Used

Here's a breakdown of the key statistical tests we are applying in our research, how to perform them, what they receive as input and how they contribute to answering our research questions:

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1. Chi-Square Test for Independence (or Ordinal Chi-Square)

- **Purpose**: To test whether there is a statistically significant association between two categorical variables - in this case, performance on the Bechdel Test and the Mako Mori Test.
- **Receives**:
    - **Contingency table:** two categorical variables representing whether a film passes the Bechdel Test and whether it passes the Mako Mori Test.
- **Outputs**:
    - **Chi-square statistic** and **p-value**, determining if there's a significant relationship.
- **How it helps**: For **RQ1**, it tests if there is a statistically significant relationship between passing the Bechdel Test and the Mako Mori Test. A significant result suggests that passing one test might be associated with an increased likelihood of passing the other.

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2. Phi Coefficient

- **Purpose**: Measures the strength of association from the Chi-Square test.
- **Receives**:
    - The **Chi-square statistic** and the **contingency table**.
- **Outputs**:
    - **Phi Coefficient** (-1 to 1) that shows the strength of association. Positive values indicate a positive association, and negative values indicate an inverse relationship..
- **How it helps**: For **RQ1**, if the Chi-Square test shows significance, the Phi coefficient quantifies the strength of the relationship between passing each test, allowing you to assess how closely linked the test outcomes are.

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3. Odds Ratio and Confidence Interval

- **Purpose**: To measure the likelihood of a film passing one test given that it passes the other, quantifying the association between the two tests.
- **Receives**:
    - Counts for each outcome from the contingency table.
- **Outputs**:

    - **Odds ratio:** The ratio of odds, indicating how much more likely a film is to pass one test given that it passes the other.
    - **Confidence interval (CI):** Provides an estimated range for the odds ratio, indicating the precision of the result.
- **How it helps**: For **RQ1**, the odds ratio provides an intuitive measure of association strength. A high odds ratio indicates that passing one test strongly predicts passing the other.

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4. Multiple Regression for Rating

- **Purpose**: To analyze how passing the Bechdel and Mako Mori tests independently contributes to a film's rating.
- **Receives**:
    - **Independent variables:** Binary columns indicating passing Bechdel and Mako Mori.
    - **Dependent variable:** Film rating (continuous).
- **Outputs**:
    - **Regression coefficients for Bechdel and Mako Mori:** Show the effect size of each test outcome on the rating.
    - **P-values:** Indicate the statistical significance of each predictor.
    - **R-squared value:** Shows the percentage of variance in rating explained by the model.
- **How it helps**: For **RQ2**, this model quantifies the contribution of passing each test to the film’s rating, allowing you to assess if test performance influences critical reception.

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5. Multiple Regression for Profit

- **Purpose**: To analyze how passing the Bechdel and Mako Mori tests independently contributes to a film's profit.
- **Receives**:
    - **Independent variables:** Binary columns indicating passing Bechdel and Mako Mori.
    - **Dependent variable:** Film profit (continuous).
- **Outputs**:
    - **Regression coefficients for Bechdel and Mako Mori:** Show the effect size of each test outcome on profit.
    - **P-values:** Indicate the statistical significance of each predictor.
    - **R-squared value:** Shows the percentage of variance in profit explained by the model.

- **How it helps**: For **RQ2**, this model quantifies the financial impact of passing each test, providing insight into whether test performance is associated with box office success.

By applying these statistical and mathematical methods, we add rigor, precision, and credibility to our research findings. These tests allow us to support or refute our hypotheses with clear, objective evidence, ensuring that our conclusions about gender representation in cinema are reliable and scientifically valid.