

EXPERIMENT & DATA ANALYSIS

Divisions B & C

Southern California Trial Event

1. **DESCRIPTION:** Students will design an experiment and answer questions on data analysis, procedures, and techniques.

A TEAM OF UP TO: 3

APPROXIMATE TIME: 50 minutes

2. **EVENT PARAMETERS:**

- a. Each participant may bring one stand-alone calculator of any type.

3. **THE COMPETITION:**

- a. Participants will be given both parts of the exam at the beginning of the time period.

Part I: Designing an Experiment

- a. Each team of participants must design and write up an experiment that addresses the assigned question/topic area provided by the Event Supervisor. The assigned question/ topic area should be the same for all teams and allow the participants to design experiments involving relationships between independent and dependent variables (i.e., height vs. distance). Participants will not be performing any experiments.
- b. The Event Supervisor will supply a report packet, based on A-E (Division B), A-F (Division C) of the Experimental Design Checklist posted on the event page at soinc.org, for recording their experimental information and data.
- c. At the beginning of the event, participants will receive the assigned question/topic area, list and picture(s) of all available materials, list of measurement equipment, and the report packet. The identity of the materials and the topic will be unknown until the start of the event.
- d. Each team's experiment must use at least two items from the materials list in the design of the experiment.

Part II: Data Analysis

- a. The test will consist of at least three questions from each of the following areas:
 - i. Sampling, correlation vs. causation, precision vs. accuracy, law of large numbers
 - ii. Data tables, graphs, best practices in visualization
 - iii. Statistics Calculations: Statistics of central tendency (i.e. best fit, median, mode, mean, outliers), statistics of variation (i.e. min, max, range, standard deviation, variance)
 - iv. Outliers, trends, sources of error, systematic vs. random error
 - v. **Division C Only:** Reduced chi-squared statistic, goodness of fit, types of noise (white, pink, Brownian), A/B testing, confidence intervals, bootstrapping
 - vi. **Division C Only:** distributions (i.e. uniform, Bernoulli, normal, Poisson, Binomial, Geometric, Chi-squared, Student's t, exponential)
 - vii. **Division C Only:** error propagation formula without using calculus, significant figures
 - viii. **Division C Only:** Least squares linear regression, residual analysis, theory of covariance and correlation

4. **SCORING:**

- a. High score wins; Final Score = Part I score + Part II score
- b. Part I accounts for 35%-45% of the final score. Part II accounts for the remaining of the final score.
- c. Part I scoring will be done using criteria A-F of the Experimental Design Checklist found on soinc.org. Points will be awarded depending upon the completeness of the response. Zero points will be given for no responses as well as illegible or inappropriate responses. Any team not addressing the assigned question/topic area will have their Part I score multiplied by 0.75.
- d. Ties will be broken by:
 - i. Point totals in F. Procedure and Set-Up Diagrams
 - ii. Point totals in C. Variables
 - iii. Selected questions from Part II