

EXPERIMENT & DATA ANALYSIS

Divisions B & C

2023 Virginia Regional 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.
- b. Each **team** may bring one 8.5" x 11" sheet of paper, which may be in a sheet protector sealed by tape or laminated, that may contain information on both sides in any form and from any source without any annotations or labels affixed.

3. **THE COMPETITION:**

Participants will be given the full event time to work on both parts of the test.

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 an online report template in Scilympiad based on A-E (Division B) or A-F (Division C) of the Experimental Design Checklist posted on the event page at soinc.org, for recording their experimental information and data. No setup diagrams will be required.
- 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 ten total questions representative 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 remainder of the final score.
- c. Part I scoring will be done using criteria A-E (Div. B) or A-F (Div. C) 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 E. (Div. B) or F. (Div. C) Procedure
 - ii. Point totals in C. Variables
 - iii. Selected questions from Part II