### Quantitative and Mathematical Reasoning

#### Definition

Students analyze, explore, and develop arguments through the use of mathematical and/or statistical reasoning; demonstrate an appreciation of the application of quantitative and mathematical reasoning to the broader world.

#### Interpretation

**Ability to explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words):**

- **Capstone 4:** Provides accurate explanations of information presented in mathematical forms. Makes appropriate inferences based on that information.
- **Milestones 3:** Provides accurate explanations of information presented in mathematical forms. 
- **Benchmark 2:** Provides somewhat accurate explanations of information presented in mathematical forms, but occasionally makes minor errors related to computations or units.
- **Attempts to explain information presented in mathematical forms, but draws incorrect conclusions about what the information means.**

#### Representation

**Ability to convert relevant information into various mathematical forms (e.g., equations, graphs, diagrams, tables, words):**

- **Capstone 4:** Skillfully converts relevant information into an insightful mathematical portrayal in a way that contributes to a further or deeper understanding. 
- **Milestones 3:** Competently converts relevant information into an appropriate and desired mathematical portrayal. 
- **Calculations and computations attempted are essentially all successful and sufficiently comprehensive to solve the problem.**
- **Completes conversion of information but resulting mathematical portrayal is only partially appropriate or accurate.**

#### Calculation and Computation

**Calculations and computations attempted:**

- **Capstone 4:** Uses the quantitative analysis of data as the basis for deep and thoughtful judgments, drawing insightful, carefully qualified conclusions from this work.
- **Milestones 3:** Uses the quantitative analysis of data as the basis for competent judgments, drawing reasonable and appropriately qualified conclusions from this work.
- **Milestones 2:** Uses quantitative information in connection with the argument or purpose of the work, though data may be presented in a less than completely effective format or some parts of the explication may be uneven.
- **Attempts to explain information presented in mathematical forms, but draws incorrect conclusions about what the information means.**

#### Application / Analysis

**Ability to make judgments and draw appropriate conclusions based on the quantitative analysis of data, while recognizing the limits of this analysis:**

- **Capstone 4:** Uses quantitative information, but does not effectively connect it to the argument or purpose of the work.
- **Milestones 3:** Uses quantitative information, but does not effectively connect it to the argument or purpose of the work.
- **Milestones 2:** Uses the quantitative analysis of data as the basis for routine (without inspiration or nuance, ordinary) judgments, drawing plausible conclusions from this work.
- **Calculations and computations attempted but are both unsuccessful and are not comprehensive.**

#### Communication

**Expressing reasoning and quantitative evidence in support of the argument or purpose of the work:**

- **Capstone 4:** Student develops a complete and valid argument along with evidence and/or justification to support a proposition/conjecture or conclusion.
- **Milestones 3:** Student develops an adequately complete and valid argument along with evidence and/or justification to support a proposition/conjecture or conclusion.
- **Milestones 2:** Student commits minor errors in the development of an argument that supports a proposition/conjecture or conclusion.
- **Attempts to explain information presented in mathematical forms, but draws incorrect conclusions about what the information means.**

#### Logical and Mathematical Reasoning

**Ability to make and evaluate important assumptions in estimation, modeling, and data analysis:**

- **Capstone 4:** Explicitly describes assumptions and provides compelling rationale for why each assumption is appropriate. Shows awareness that confidence in final conclusions is limited by the accuracy of the assumptions.
- **Milestones 3:** Explicitly describes assumptions and provides compelling rationale for why assumptions are appropriate.
- **Milestones 2:** Explicitly describes assumptions.
- **Attempts to describe assumptions.**