Grade 8 Math Claim 4

Primary Claim 4: Modeling and Data Analysis Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems.
Secondary Claim(s): Tasks written primarily to assess Claim 4 will necessarily involve some Claim 1 content targets. Related Claim 1 targets should be listed below the Claim 4 targets in the item form. If Claim 2 or 3 targets are also directly related to the task, list those following the Claim 1 targets in order of prominence.
Primary Content Domain: Each task should be classified as having a primary, or dominant, content focus. The content should draw upon the knowledge and skills articulated in the progression of standards leading up to Grade 8, with strong emphasis on the major work of previous grades.
Secondary Content Domain(s): While tasks developed to assess Claim 4 will have a primary content focus, components of these tasks will likely produce enough evidence for other content domains that a separate listing of these content domains needs to be included where appropriate.
Assessment Targets: Any given task should provide evidence for several of the following assessment targets; each of the following targets should not lead to a separate task. Multiple targets should be listed in order of prominence as related to the task.
Target A: Apply mathematics to solve problems arising in everyday life, society, and the workplace. (DOK 2, 3) Problems used to assess this target for Claim 4 should not be completely formulated (as they are for the same target in Claim 2), and require students to extract relevant information from within the problem and find missing information through research or the use of reasoned estimates. **Target B: Construct, autonomously, chains of reasoning to justify mathematical models used, interpretations made, and solutions proposed for a complex problem. (DOK 2, 3, 4).** At the secondary level, these chains should typically take a successful student 10 minutes to complete. Times will be somewhat shorter for younger students, but still give them time to think and explain. *For a minority of these tasks*, subtasks may be constructed to facilitate entry and assess student progress towards expertise. Even for such "apprentice tasks" part of the task will involve a chain of autonomous reasoning that takes at least 5 minutes. **Target C: State logical assumptions being used. (DOK 1, 2)** Tasks used to assess this target ask students to use stated assumptions, definitions, and previously established results in developing their reasoning. In some cases, the task may require students to provide missing information by researching or providing a reasoned estimate. **Target D: Interpret results in the context of a situation. (DOK 2, 3)** Tasks used to assess this target should ask students to link their answer(s) back to the problem's context. (See Claim 2, Target C for further explication.) **Target E: Analyze the adequacy of and make improvements to an existing model or develop a mathematical model of a real phenomenon. (DOK 3, 4)** Tasks used to assess this target ask students to investigate the efficacy of existing models (e.g., develop a way to analyze the claim that a child's height at age 2 doubled equals his/her adult height) and suggest improvements using their own or provided data.

Other tasks for this target will ask students to develop a model for a particular phenomenon (e.g., analyze the rate of global ice melt over the past several decades and predict what this rate might be in the future).

Longer constructed-response items and extended performance tasks should be used to assess this target.

Target F: Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flowcharts, or formulas). (DOK 1, 2, 3)
Unlike Claim 2 where this target might appear as a separate target of assessment (see Claim 2, Target D), it will be embedded in a larger context for tasks in Claim 4. The mapping of relationships should be part of the problem posing and solving related to Claim 4 Targets A, B, E, and G.

Target G: Identify, analyze and synthesize relevant external resources to pose or solve problems. (DOK 3, 4)
Especially in extended performance tasks (those requiring up to 120 minutes to complete), students should have access to external resources to support their work in posing and solving problems (e.g., finding or constructing a set of data or information to answer a particular question or looking up measurements of a structure to increase precision in an estimate for a scale drawing). Constructed-response items should incorporate "hyperlinked" information to provide additional detail (both relevant and extraneous) for solving problems in Claim 4.

Relevant Verbs:	Model, construct, compare, investigate, build, interpret, estimate, analyze, summarize, represent, solve, evaluate, extend, and apply
DOK Target(s):	1, 2, 3, 4

Claim 4 Rationale:	**Mathematical Practice 2: Reason abstractly and quantitatively.** Mathematically proficient students:
	• make sense of quantities and their relationships in problem situations.
	• bring two complementary abilities to bear on problems involving quantitative relationships:
	  ○ *Decontextualize* (abstract a given situation and represent it symbolically; and manipulate the representing symbols as if they have a life of their own, without necessarily attending to their referents) and
	  ○ *Contextualize* (pause as needed during the manipulation process in order to probe into the referents for the symbols involved).
	• use quantitative reasoning that entails creating a coherent representation of the problem at hand, considering the units involved, and attending to the meaning of quantities (not just how to compute them).
	• know and flexibly use different properties of operations and objects.

	Mathematical Practice 4: Model with mathematics.
	Mathematically proficient students:
	• apply the mathematics they know to solve problems arising in everyday life, society, and the workplace.
	  ○ In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community.
	  ○ By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another.
	• make assumptions and approximations to simplify a complicated situation, realizing that these may need revision later.
	• identify important quantities in a practical situation
	• map relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas.
	• analyze those relationships mathematically to draw conclusions.
	• interpret their mathematical results in the context of the situation.
	• reflect on whether the results make sense, possibly improving the model if it has not served its purpose.
	
	Mathematical Practice 5: Use appropriate tools strategically.
	Mathematically proficient students:
	• consider available tools when solving a mathematical problem. (Tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software.)
	• are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful, recognizing both the insight to be gained and their limitations.
	• detect possible errors by using estimations and other mathematical knowledge.
	• know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data.
	• identify relevant mathematical resources and use them to pose or solve problems.
	• use technological tools to explore and deepen their understanding of concepts.

Allowable Item Types*:	PT, CR, ER, TE

Task Models:	**Make decisions from data:** These tasks require students to select from a data source, analyze the data, and draw reasonable conclusions from it. This will often result in an *evaluation* or a *recommendation*. The purpose of these tasks is not to provide a setting for the student to demonstrate a particular data-analysis skill (e.g. box-and-whisker plots)—rather, the purpose is to draw conclusions in a realistic setting, using a range of techniques. **Make reasoned estimates:** These tasks require students to make reasonable estimates of things they *do* know, so that they can then build a chain of reasoning that gives them an estimate of something they *do not know*. **Plan and design:** Students recognize that planning and designing are problem situations that arise in life and work. Well-posed planning tasks involving the coordinated analysis of time, space, and cost have already been recommended for assessing Claim 2. For Claim 4, the problem will be presented in a more open form, asking the student to identify the variables that need to be taken into account and the information they will need to find. **Evaluate and recommend:** These tasks involve understanding a model of a situation and/or some data about it and making a recommendation. **Interpret and critique:** These tasks involve interpreting some data and critiquing an argument based on it. Again, the purpose of these tasks is not to provide a setting for the student to demonstrate a particular data-analysis skill, but to draw conclusions in a realistic setting, using a range of techniques. Note: This is not a complete list; other types of tasks that fit the criteria above may well be included.
Allowable Tools:	Protractor, ruler, calculator, spreadsheet, mathematical software
Key Nontargeted Constructs:	While a high level of linguistic ability is associated with Claim 4 tasks, students should not be penalized for weaknesses in written expressions (i.e., spelling, punctuation). It is desirable for students to be able to demonstrate reasoning or model an argument via symbols, geometric shapes, tables, diagrams, structured mathematical responses, technology-enhanced tools, etc.
Claim-Specific Attributes:	CR, ER and TE tasks should be designed to take 10 to 20 minutes to solve, while PTs may take up to 120 minutes. A key feature of Claim 4 applied tasks is that the student must solve real-world problems that are not well formulated in mathematical terms and/or are nonroutine. Additionally, students can be expected to make decisions about which information is relevant and how it should be represented. The computational demand on these tasks should focus on the skill level typically expected for Claim 1 tasks for grades lower than

	Grade 8 (though not to the exclusion of Grade 8 skills).
Accessibility Concerns:	Problems involving proofs and conjectures may sometimes be text-heavy. Translation tools and dictionaries should be available to ELL students. Text readers should be available to students as necessary.
Sample Items:	MAT.08.PT.4.APARK.A.270, MAT.08.PT.4.MYPET.A.415, MAT.08.PT.4.WTANK.A.271

*SR = selected-response item; CR = constructed-response item; TE = technology-enhanced item; ER = extended-response item; PT = performance task