Claim 4: Modeling and Data Analysis

The Smarter Balanced summative mathematics assessment and its relationship to instruction

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What is Claim 4?

- Analyze real-world scenarios
- Construct and use mathematical models to interpret and solve complex problems
- Bridge between “school math” and the “real world”
- Modeling is a mathematical practice at all levels and a category in the high school standards.
- Claim 4 are not well-posed as in Claim 2.

More Information

- More information about modeling for Claim 4 is available online in the Mathematics Content Specifications.

Claim 4 requires use of content in the Standards

- Making assumptions and approximations to simplify a complicated situation
- Adjustments to these assumptions and approximations may be needed
- Standards suggest the model or ask students to create one

Primary emphases by grade

Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	High School	High School
3.OA.A	4.OA.A	5.NBT.B	6.RP.A	7.RP.A	8.EE.3	N-Q.A	S-ID.A
3.OA.D	4.NF.B	5.NF.A	6.NS.A	7.NS.A	8.EE.4	A-SSE.B	S-ID.B
3.MD.A	4.MD.A*	5.NF.B	6.NS.C	7.EE.B	8.EE.B	A-CED.A	S-IC.1
3.MD.C	4.MD.B*	5.MD.A*	6.EE.B	7.G.A*	8.EE.C	A-REI.A	S-IC.B
3.MD.D*	4.MD.C*	5.MD.B*	6.EE.C	7.G.B*	8.F.B*	A-REI.B	F-LE.A
		5.MD.C	6.G.A*	7.SP.A*	8.G.B	A-REI.C	F-LE.B
		5.G.A*	6.SP.A*	7.SP.B*	8.G.C*	F-IF.B	F-TF.5
			6.SP.B*	7.SP.C*	8.SP.A*	F.-IF.C	G-GMD.3
						F-BF.A	G-MG

*Denotes additional and supporting clusters

Claim 4 is based on the Mathematical Practices

- Mathematical Practices 2, 4, and 5 are foundational support for Claim 4.
  - 2. Reason abstractly and quantitatively.
  - 4. Model with mathematics.
  - 5. Use appropriate tools strategically.

Additional information on Claim 4 and the Mathematical Practices

- The Smarter Balanced Content Specifications, with additional information on how these practices inform Claim 4, is available online.

Modeling and Data Analysis: A variety of skills

- Mathematics is a tool to analyze complex, real-world situations.
- Creating and using a model to solve problems is one skills.
- Targets are the same for all grades
- Some targets in Claim 4 resemble those in Claim 2 or 3 but are applied to different situations.

Target A: Solving real-world problems

- *Apply mathematics to solve problems arising in everyday life, society, and the workplace.*
- Students can be expected to solve problems that involve
  - extracting relevant information from within the problem,
  - finding missing information through research or the use of reasoned estimates, or
  - identifying extraneous information.

Conclusion

Grade 4

Eva has 4 quarters, 7 dimes, and 8 nickels. She wants to buy a different gift for each of her 3 friends.

Click on the gifts in the table to show 3 gifts that Eva could buy.

Gift	Cost
Balloon	60 ¢
Eraser	35 ¢
Gumball	25 ¢
Kazoo	75 ¢
Mood ring	50 ¢
Pencil	35 ¢
Sticker	20 ¢

Grade 6

Alice, Raul, and Maria are baking cookies together.

They need $\frac{3}{4}$ cup of flour and $\frac{1}{3}$ cup of butter to make one batch of cookies.

They each brought the ingredients they had at home.

- Alice brought 2 cups of flour and $\frac{1}{4}$ cup of butter
- Raul brought 1 cup of flour and $\frac{1}{2}$ cup of butter
- Maria brought $1\frac{1}{4}$ cups of flour and $\frac{3}{4}$ cups of butter.

Assume the students have plenty of the other ingredients (sugar, salt, baking soda, etc.) they need to make the cookies.

What is the maximum number of whole batches of cookies they can make with the ingredients they brought from home?

Target B: Construct chains of reasoning

- *Construct, autonomously, chains of reasoning to justify mathematical models used, interpretations made, and solutions proposed for a complex problem.*

- The student:
  - justifies the mathematical model(s) used,
  - justifies the interpretation(s) shown, and/or
  - justifies the solution(s) given to a complex problem.

Target C: State logical assumptions

- *State logical assumptions being used.*
- Tasks ask student 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.

Assumptions

Grade 7

Ramos flips a coin 100 times and records the results in a table.

100 Coin Flips

Result of Flip	Number of Times
Heads	74
Tails	26

He then asks you to guess the result of the next two flips. You assume [heads and tails are equally likely; heads are 3 times as likely as tails] when your friend flips the coin. Based on this assumption, which would be the most likely for the next two flips?

A. two heads
B. two tails
C. one head and one tail

Grade 11

A store manager did a study to determine the amount of money the first 50 customers spent in her store.
The data are approximately normally distributed with a mean of $34.10 and a standard deviation of $11.25.

The formula for normalizing data is:

$$Z = \frac{X - \mu}{\sigma}$$

- Z is the normal score
- X is a discrete data value
- μ is the mean
- σ is the standard deviation

***Part A*:**
In the first box, enter the probability that a customer spent over $45.

***Part B*:**
In the second box, enter the probability that a customer spent less than $12.

***Part C*:**
In the third box, enter the probability that a customer spent between $12 and $45.

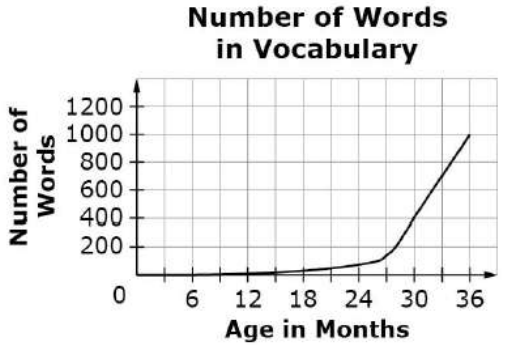
Target D: Interpret results in context

- *Interpret results in the context of a situation.*
- Tasks should ask students to link their response back to the problem's context, e.g., a judgment by the student of how to express an answer to a division problem or a rationalization for the domain of a function being limited to positive integers.
- Works with Target A: *Apply mathematics to solve problems arising in everyday life, society, and the workplace.*

Context

- Grade 8

This graph shows the average number of words in a child's vocabulary from birth to 36 months.

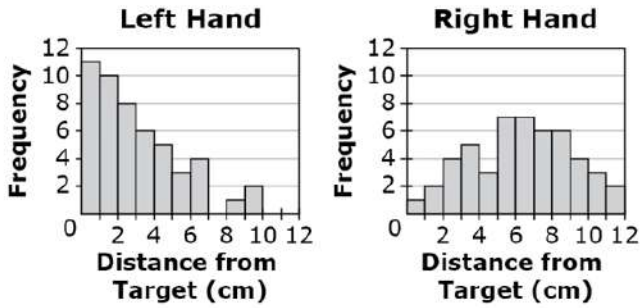


Which statement is the **most reasonable** explanation for the shape of the graph?

A. Children begin to show significant growth in vocabulary after 12 months.
B. Children begin speaking around 26 months and stop learning new words at 36 months.
C. Children are constantly adding new words to their vocabulary from the moment they are born.
D. Children do not begin talking for several months, but then begin to pick up words very quickly.

- Grade 11

Lisa was throwing a dart at a target. She threw 50 times with her left hand and 50 times with her right hand. The histograms show the distance Lisa missed the target by each time.



Which statement is an appropriate inference based on the median of each data set?

A. Lisa has better aim with her left hand because the median for her left hand is greater than the median for her right hand.
B. Lisa has better aim with her right hand because the median for her left hand is less than the median for her right hand.
C. Lisa has better aim with her left hand because the median for her left hand is less than the median for her right hand.
D. Lisa has better aim with her right hand because the median for her left hand is greater than the median for her right hand.

Target E: Analyze a model or develop one

- *Analyze the adequacy of and make improvements to an existing model or develop a mathematical model of a real phenomenon.*
- Works with Target B: *Construct, autonomously, chains of reasoning to justify mathematical models used, interpretations made, and solutions proposed for a complex problem.*
- Student creates or justifies a model

Model

Grade 3

Joe is building a play area for his dog. The play area is made up of grass and dirt.

- The grass area is rectangular. It has a width of 2 meters and a length of 3 meters.
- The dirt area is rectangular. It has a width of 2 meters and a length of 5 meters.

Complete the equation that can be used to find the total play area including grass and dirt. Drag numbers from the palette to complete the equation.

(__ × __) + (__ × __) = _____ square meters

Grade 8

The table shows the relationship between the average number of hours students study for a mathematics test and their average grade.

Hours Studying	Average Grade
0	62
1	78
2	85
5	74

Which type of function is most likely to model these data?

A. linear function with positive slope
B. linear function with negative slope
C. non-linear function that decreases then increases
D. non-linear function that increases then decreases

Target F: Identify and map relationships

- *Identify important quantities in a practical situation and map their relationships (e.g., using diagrams, two-way tables, graphs, flowcharts, or formulas).*
- Often assessed with Target A: *Apply mathematics to solve problems arising in everyday life, society, and the workplace* and Target C: *State logical assumptions being used.*

Target G: Using external resources

- *Identify, analyze, and synthesize relevant external resources to pose or solve problems.*
- This target is measured in performance tasks only
- Students will have access to external resources

More information on Claim 4 examples

- More example items for each target are available online in the Claim 4 item specifications.
  - Begin by selecting a grade to explore, then select mathematics. Finally select the claim to explore.

How Claim 4 informs assessment

- Connection between “school” and “real world”
- Students have to apply their mathematics at a deeper level than in Claim 1.
- Requires flexible item development
- Claims 2 and 4 are combined for reporting purposes.
- Together Claim 2 and 4 account for one-fourth of the summative test.

More information on Claim 4 assessment

- More information about Claim 4 on the summative assessment, both the computer-adaptive and the performance task portions, is available online in the Test Blueprints.

How Claim 4 informs instruction

- Students need to deal with problems that are not neatly packaged.
- Textbook problems do not often mirror authentic tasks in mathematics.
- Modeling often involves working with incomplete or “messy” sets of numbers or where estimations must be made.
- Performance tasks are a model for the types of tasks students should see in the classroom.
- Students ability to model and analyze data develops alongside their mathematical understanding.

Further help

- We encourage you to view the videos for Claims 1 through 3 to get a more complete picture of the skills and practices students should develop.