Encouraging Two-Year College Students in Mathematical Modeling

Ben Galluzzo

COMAP
Math for Decision Makers

Consortium for Mathematics and Its Applications

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UTAH TECH UNIVERSITY

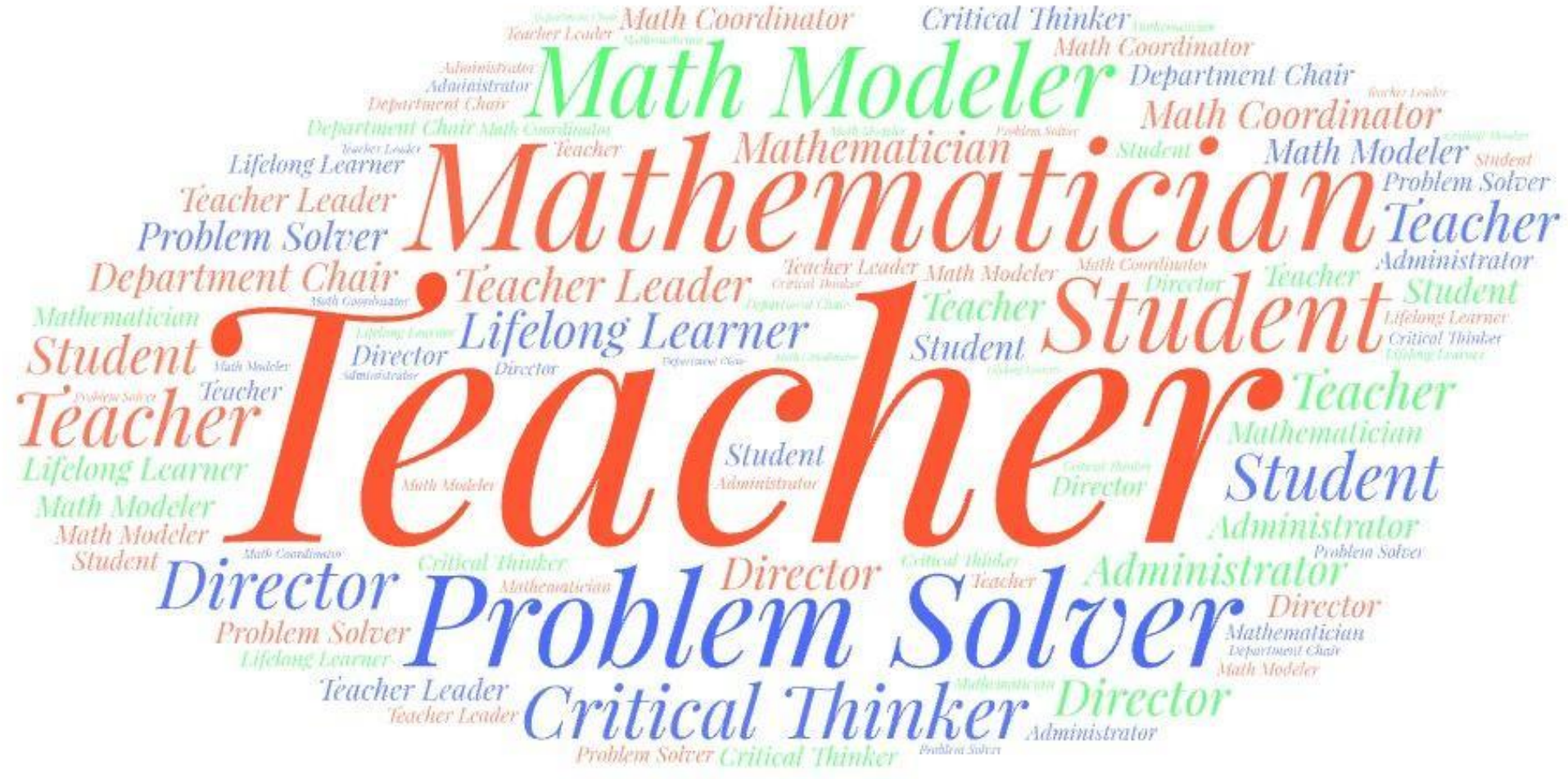
15th November 2025

Welcome – our plan

- Introductions
- What is Math Modeling (MM)?
- How can you (and your students) engage* in MM?
- How can we work and learn together?

*We'll explore a variety of jumping *in* approaches.

Who are we?


Teacher
Mathematician
Math Modeler
Problem Solver
Critical Thinker
Student
Director
Lifelong Learner
Teacher Leader
Department Chair
Math Coordinator
Administrator

I need a drink...


vs.

vs.

vs.


vs.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vs. ?

Which to choose?

Is this modeling?


vs.

vs.

vs.


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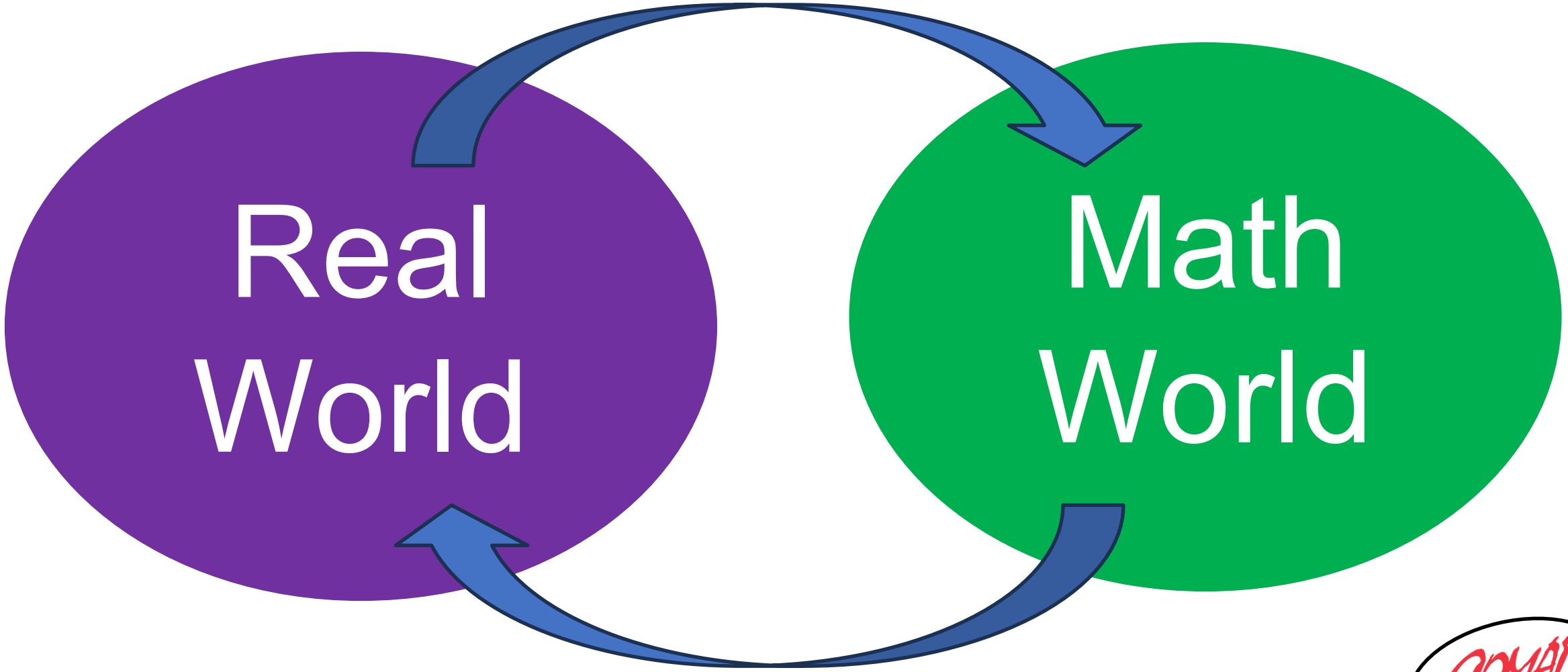
vs.

vs. ?

Which to choose?

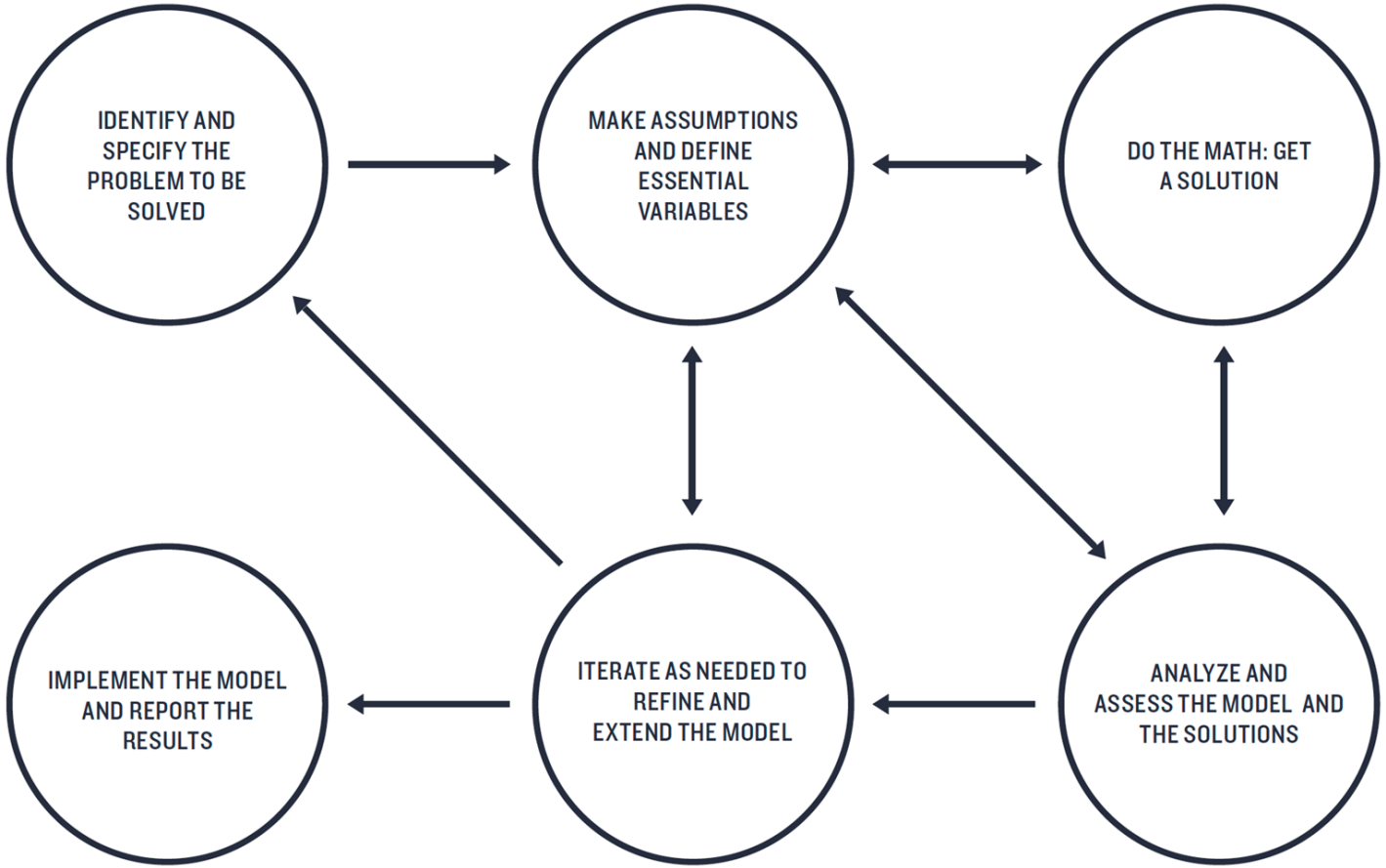
Mathematical Modeling Process



Adapted from H. Pollock

Mathematical Modeling: What is it?

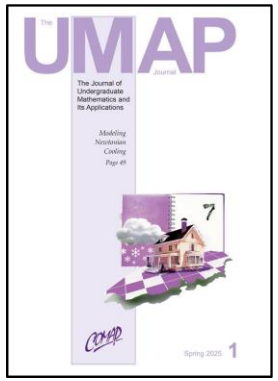
A process using mathematics to represent, analyze, predict, simulate, control, optimize, or otherwise provide insight into real world phenomena, both natural and societal.



Mathematical Modeling Mindset

More than a process, this mindset is shaped by a set of interconnected habits and ways of thinking. Including, but not limited to…

- Curiosity and Inquiry
- Simplification and Assumption-Making
- Mathematical Representation
- Pattern Recognition and Systems Thinking
- Data and Computational Thinking
- Technological Fluency



- Mathematical Versatility
- Creativity and Adaptability
- Evaluation and Revision
- Metacognition and Reflection
- Collaboration and Communication
- Tolerance for Imperfection

UMAP 46.1, COMAP, Spring 2025

What is a Modeling Problem?

300 ÷ 25 =

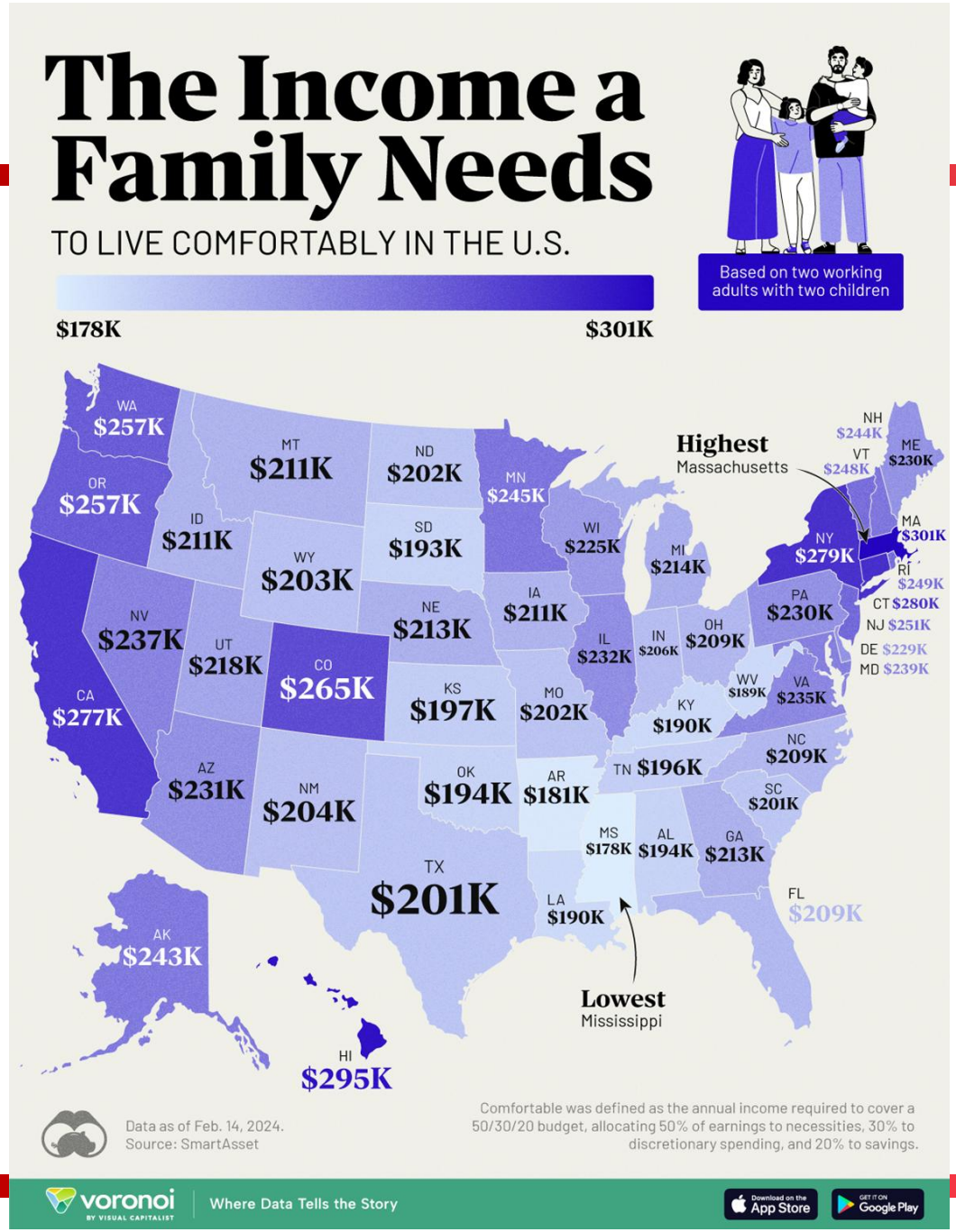
295 ÷ 25 =

Our school has 300 students. A bus holds 25 students. How many buses are needed to take the students on a field trip?

Our school has 295 students. A bus holds 25 students. How many buses are needed to take the students on a field trip?

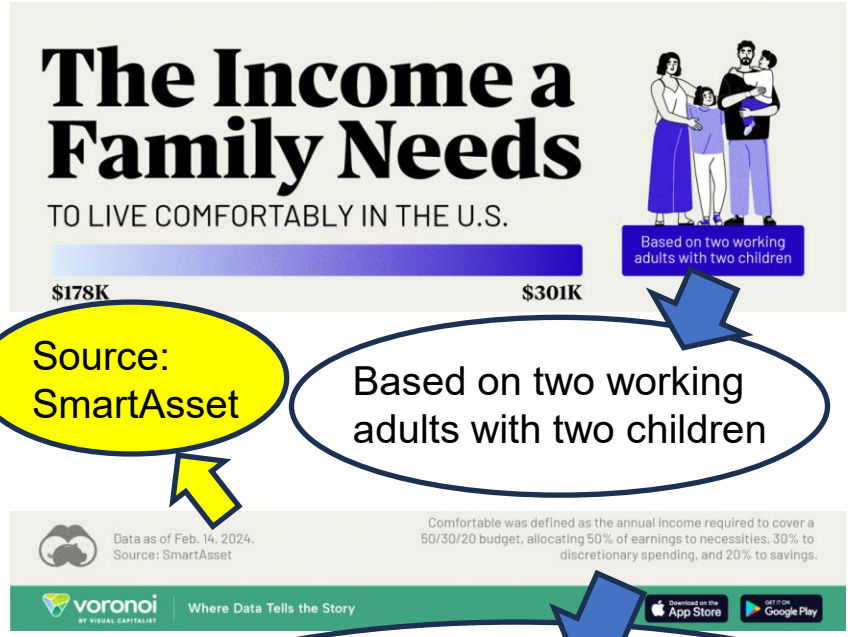
Our school has 295 students. What is the best way to transport students on a field trip?

Access to MM?



M. Smith, www.visualcapitalist.com (link)

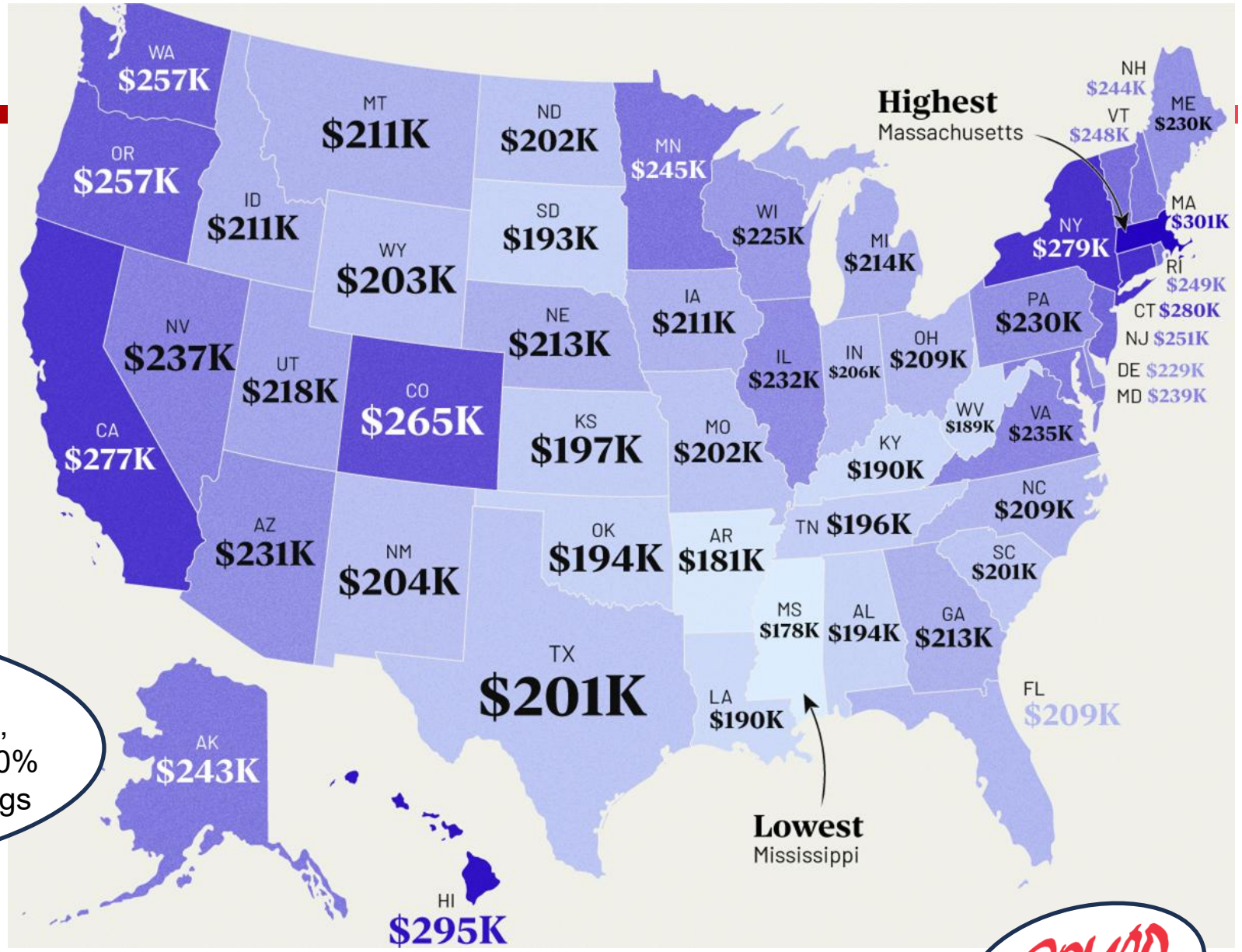
MM Mindset



Source: SmartAsset

Based on two working adults with two children

Comfortable was defined as the annual income required to cover a 50/30/20 budget, allocating 50% of earnings to necessities, 30% to discretionary spending, and 20% to savings



M. Smith, www.visualcapitalist.com

MM Mindset

Salary Needed to Live Comfortably – 2024 Study

Updated on March 19, 2024
Written by Jaclyn DeJohn
Edited by Arturo Conde, CEPF®

SHARE

While cost of living premiums and inflation metrics capture the price increases in goods and services, they do not necessarily account for all the additional costs needed to live comfortably – such as a buffer from the stress of living paycheck to paycheck.

The 50/30/20 budget recommends that

Salary Needed to Live Comfortably in U.S. Cities

Cities are ranked by the lowest annual salary needed for a single adult to live in sustainable comfort using the 50/30/20 budgeting rule.

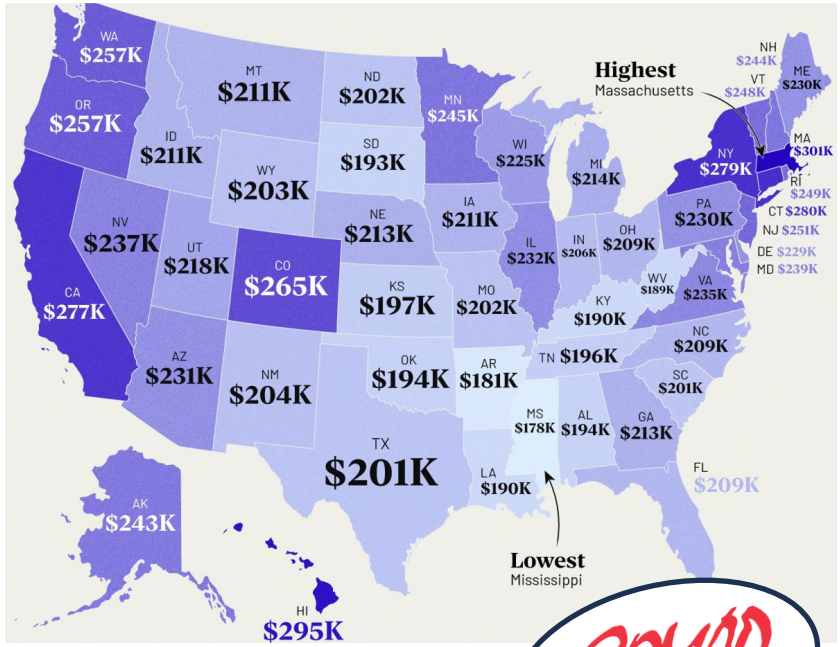
New York

Rank	City	Hourly wage needed for a single adult	Salary needed for a single adult	Total salary needed for two working adults with two children
33	Buffalo, New York	$42.28	87,942	233,958
99	New York City, New York	$66.62	138,570	318,406

This study considered 99 of the largest U.S. cities and used the latest data from the MIT Living Wage Calculator, last updated on Feb. 14, 2024.

Source: SmartAsset 2024 Study • Get the data • Embed

smartasset™



J. DeJohn, www.SmartAsset.com (link)

Numbers in the News

0. Which article?
1. **What happened?**
2. **Where's the math?** (and if you know it, **Where's the modeling?**)
3. **What do you think?**
    - Do you believe the reported result? Why or why not?
    - Why does the article matter to you (i.e., your group)? More generally, why should anyone care about this?
    - Could the number(s) or mathematical method(s) in the article be used to examine other real-world problems? If so, share a few thoughts.

Student Research League

2025 SRL Problem: Affordable Housing Challenge

- Design a **data-driven strategy** for a U.S. city (population ≥ 100,000).
- Use metrics to **identify housing needs** and underserved populations.
- State a clear **strategic goal** addressing housing inequality.
- Build and assess **mathematical models** with financial analysis.
- Develop a **step-by-step implementation plan** for the city council.
- Identify stakeholders, anticipate barriers, and propose solutions.

2024 SRL Problem: Watts the Buzz on Sustainable Future

- Create a **mathematical modeling plan** to transition a city (population ≥ 50,000) to renewable energy.
- Conduct a **local renewable resource assessment** (solar, wind, hydro, etc.).
- Propose a **system design** using one or multiple renewable sources with percentage breakdowns.
- Perform a **cost–benefit analysis** over the lifespan of current vs. new energy systems.
- Analyze **environmental impacts** and long-term benefits of the transition.
- Develop a **realistic implementation strategy**, identifying barriers and solutions.

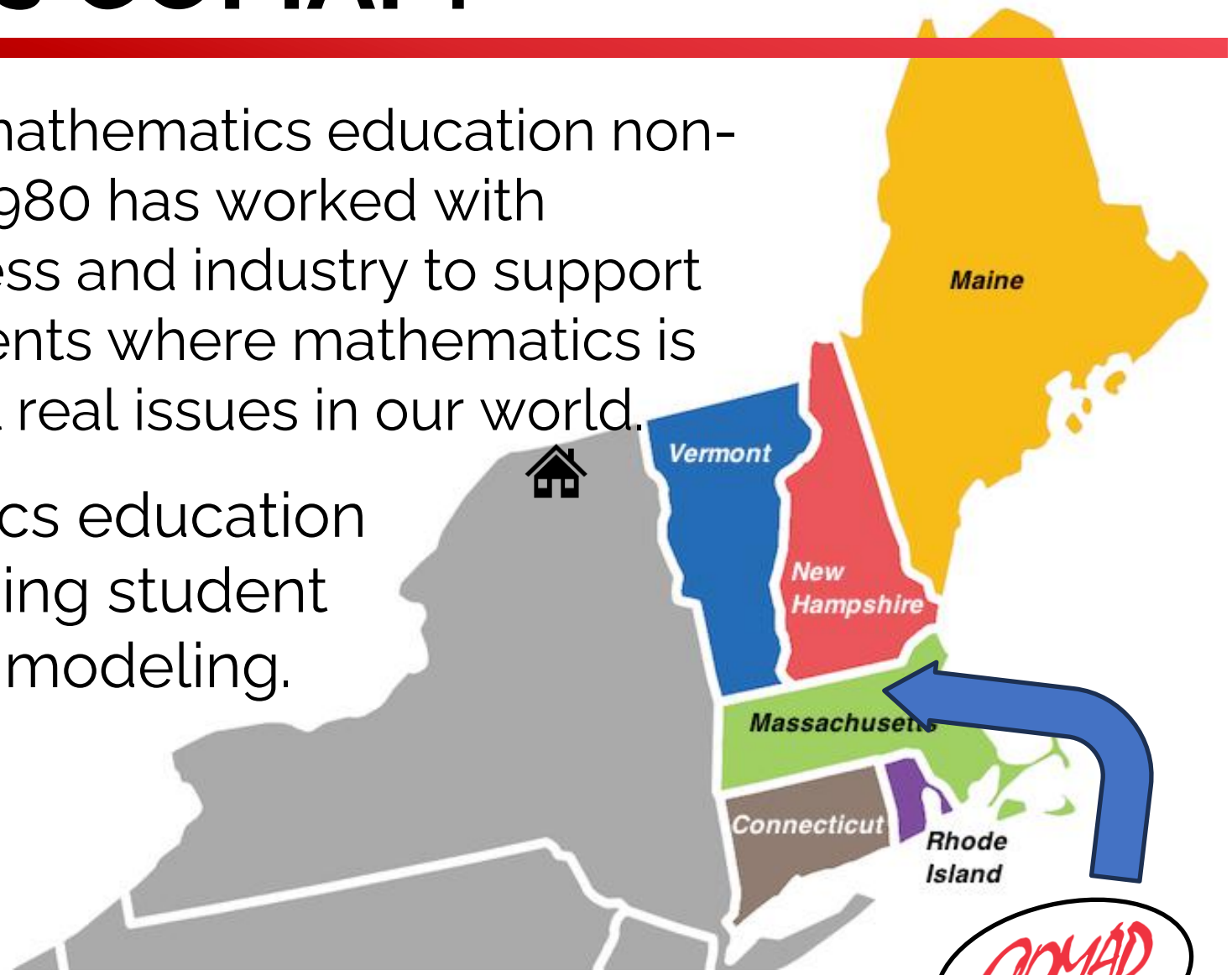
AMATYC Student Research League

From Competitions

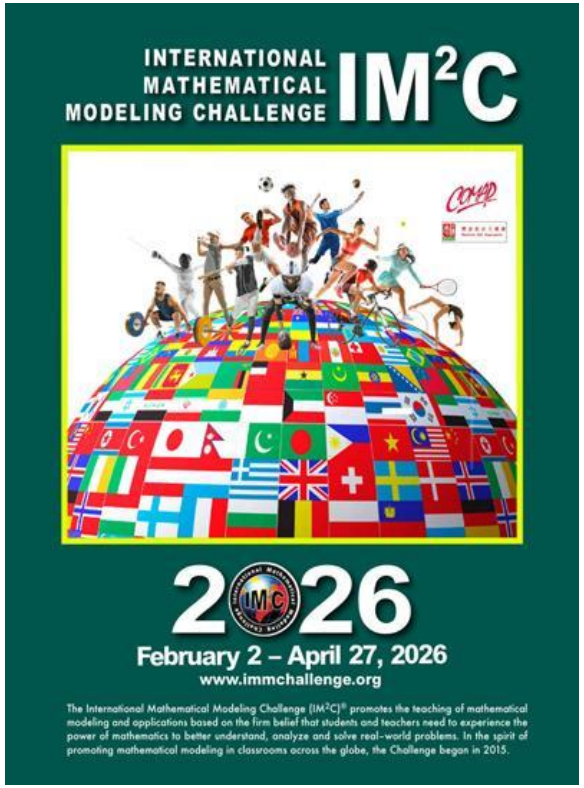
What (& where) is COMAP?

COMAP is an award-winning mathematics education non-profit organization that since 1980 has worked with teachers, students, and business and industry to support and create learning environments where mathematics is used to investigate and model real issues in our world.

Mission Improve mathematics education with an emphasis on increasing student proficiency in mathematical modeling.



COMAP Contests



COMAP Contests MCM/ICM

Students work in teams of (up to) 3
100-hour competition window

- **MCM Problem A (continuous)**
- **MCM Problem B (discrete)**
- **MCM Problem C (data insights)**
- **ICM Problem D (operations research/network science)**
- **ICM Problem E (sustainability)**
- **ICM Problem F (policy)**

$100 registration fee

MCM/ICM

Problem B: Creating Sudoku Puzzles, 2008

Develop an algorithm to construct Sudoku puzzles of varying difficulty. Develop metrics to define a difficulty level. The algorithm and metrics should be extensible to a varying number of difficulty levels. You should illustrate the algorithm with at least 4 difficulty levels. Your algorithm should guarantee a unique solution. Analyze the complexity of your algorithm. Your objective should be to minimize the complexity of the algorithm and meet the above requirements.

Sample problem titles:

- Problem: A The Ultimate Brownie Pan, 2013
- Problem: C Momentum in Tennis, 2024
- Problem: D The Influence of Music, 2021
- Problem: E Drowning in Plastic, 2020
- Problem: F The Future of the Olympics, 2023

Curriculum

Challenge

Creativity

AMATYC Student Research League

Perform a cost-benefit analysis on whether changing to an electric vehicle for a specific usage is feasible.

- Are electric vehicles the best choice for the future environmentally and/or economically?
- What infrastructure is necessary to facilitate the change?

Source:
https://cdn.ymaws.com/amatyc.org/resource/resmgr/student_research_league/srl_problem_2022.pdf

"Skills" require to be successful in the real world

Communication

Collaboration

Confidence

Critical Thinking

Content Knowledge

Creativity

Curiosity

Competence

Cooperation

Conflict Management

What is missing?

?

?

?

?

Which do you think are most important?

SKILLS ON THE RISE 2025

LinkedIn

Sponsored by: workday.

The five fastest-growing skills by country

Spain

1. Communication
2. Customer service
3. AI literacy
4. Strategic thinking
5. Image editing

United Kingdom

1. Relationship building
2. Strategic thinking
3. AI literacy
4. Communication
5. Large language models (LLM) utilization

United States

1. AI literacy
2. Conflict mitigation
3. Adaptability
4. Process optimization
5. Innovative thinking

France

1. Customer service management
2. Data analysis
3. Communication
4. AI literacy
5. Adaptability

Germany

1. Client management
2. AI literacy
3. Strategic thinking
4. Large language models (LLM) proficiency
5. Stakeholder management

India

1. Innovative thinking / creativity and innovation
2. Code review
3. Problem-solving
4. Prescreening
5. Strategic thinking

Australia

1. AI literacy
2. Communication
3. Strategic thinking
4. Large language models (LLM) proficiency
5. Adaptability

Brazil

1. AI literacy
2. Communication
3. Strategic thinking
4. Customer retention
5. Trade policy

Source: https://www.linkedin.com/business/talent/blog/learning-and-development/skills-on-the-rise

The five fastest-growing skills by country: US

United States

1. AI literacy
2. Conflict mitigation
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Source: https://www.linkedin.com/business/talent/blog/learning-and-development/skills-on-the-rise

Fastest-growing skills = MM Mindset?

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United States

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Source: https://www.linkedin.com/business/talent/blog/learning-and-development/skills-on-the-rise

- Curiosity and Inquiry
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- Mathematical Representation
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- Data and Computational Thinking
- Technological Fluency
- Mathematical Versatility
- Creativity and Adaptability
- Evaluation and Revision
- Metacognition and Reflection
- Collaboration and Communication
- Tolerance for Imperfection

Return (or revenge?) of the water bottles


vs.

vs.

vs.


vs.


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vs.

vs. ?

Which to choose?

Wait! We're done! They've solved it!

The New York Times — Opinion — Search All NYTimes.com

WORLD U.S. N.Y. / REG BUSINE TECHNOL SCIENC HEALT SPORT OPINIO ARTS STYLE TRAVE JOBS REAL ESTATE

EDITORIALS COLUMNISTS CONTRIBUTORS LETTERS THE PUBLIC EDITOR GLOBAL OPINION

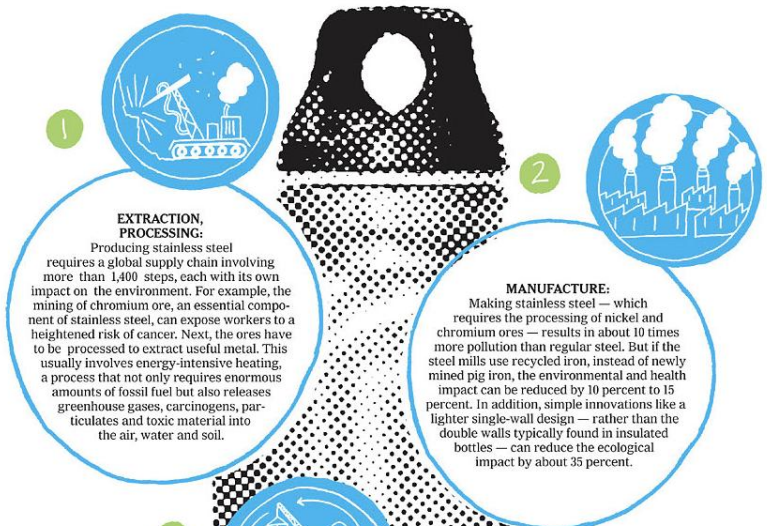
OP-CHART

How Green Is My Bottle?

By DANIEL GOLEMAN and GREGORY NORRIS

Earth Day is this Wednesday, and all things "green" will be celebrated. But it's worth asking: how environmentally friendly are "green" products, really?

Consider, for example, this paragon of eco-virtue: the stainless steel water bottle that lets us hydrate without discarding endless plastic bottles. Using a method called life cycle assessment, we have evaluated the environmental and health impact of a stainless steel thermos — from the extraction and processing of its ingredients, to its manufacture, distribution, use and final disposal. There were some surprises. What we think of as "green" turns out to be less so (and, yes, sometimes more so) than we assume.



April 19, 2009 NYTimes (link)

Perhaps not…

The Best Water Bottles

Updated September 16, 2024

Sav

Photo: Michael Hession

September 16, 2024 NYTimes Wirecutter (link)

COMAP - overview of activities

- 5 international mathematical modeling contests
- Publish *Consortium* and *UMAP* journals
- A large and expanding library of curricular resources
  - Books
  - Modules
  - Articles
  - Video series

- Develop, promote, and support math modeling education initiatives and communities.
- Many resources available for free at www.comap.org/session

Questions / Comments / Ideas…

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Compete.
Solve. Create.

What Makes a Game Fun? (Cornhole)

Extra slides!

AMATYC Recap

AMATYC Cornhole Rules

Day	Hit the Board	Land on the Board	In the Hole	Toss restrictions
Thursday	1 point	2 points	3 points	8 bags, no restrictions
Friday	1 point	2 points	3 points	4 bags short, 4 bags long
Saturday	1 point (short)	2 points (short)	3 points (short)	8 bags, no restrictions
	2 points (long)	3 points (long)	4 points (long)	

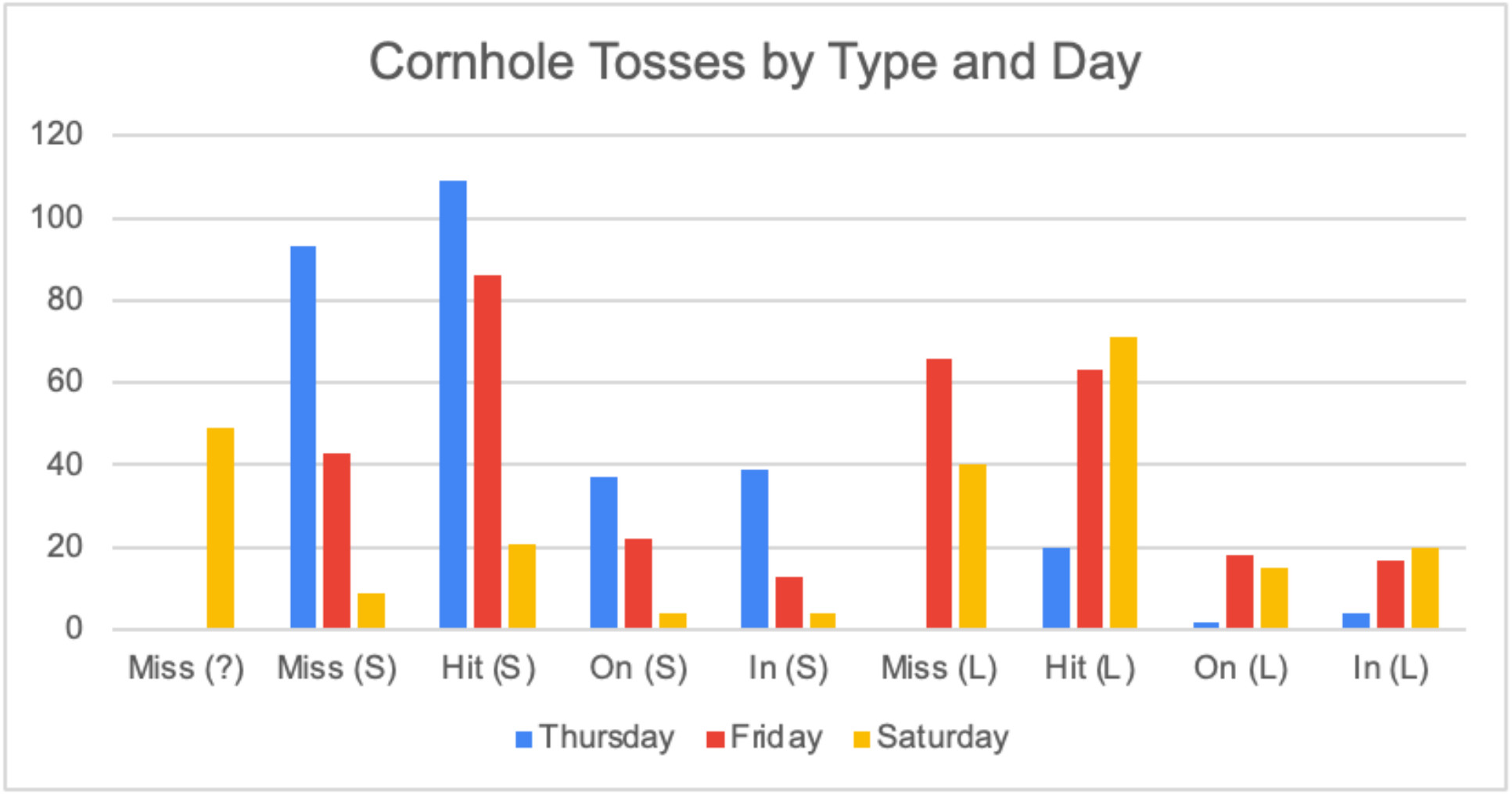
Short board is 5.5' to front edge

Long board toss is 7.5' to front edge

Extra slides!

AMATYC Recap

Cornhole Results



Extra slides!

AMATYC Recap

Cornhole Results