



Personalized Economics Education using AI



Justin Wolfers and Joshua Hill
Online webinar | March 5, 2024

Repairing the old model: Assessment with integrity

- How can we assess students with integrity when they have access to AI?



Evolution: Develop new tools for teaching

- How can we use AI to teach more effectively?



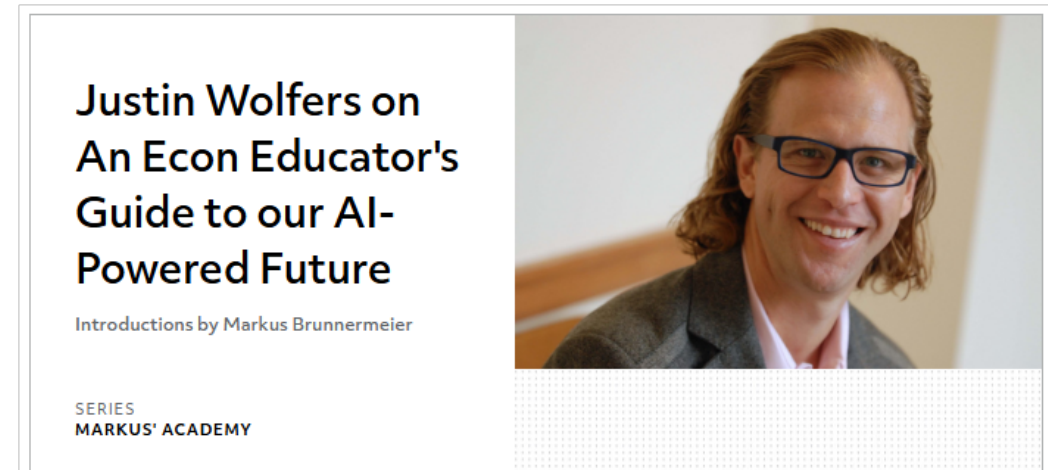
Revolution: Overhauling the substance

- Reinventing the curriculum: What skills should we teach?

Repairing the old model: Assessment with integrity

- How can we assess students with integrity when they have access to AI?

Past webinars



Repairing the old model: Assessment with integrity

- How can we assess students with integrity when they have access to AI?



Evolution: Develop new tools for teaching

- How can we use AI to teach more effectively?



Revolution: Overhauling the substance

- Reinventing the curriculum: What skills should we teach?

≡ Bloomberg

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Opinion | Adrian Wooldridge, Columnist

Can Oxford and Cambridge Save Harvard From ChatGPT?

Their time-tested tutorial system offers top US universities a way to blunt AI cheating and revive real learning.

August 23, 2023 at 12:00 AM EDT

Are tutorials the answer?



“A tutorial is the weekly meeting all students have with a tutor and usually one or two other students, at which you are expected to talk in depth about your ideas and opinions relating to that week's reading or problems.”

-- The New College [website](#)

An Oxford tutorial

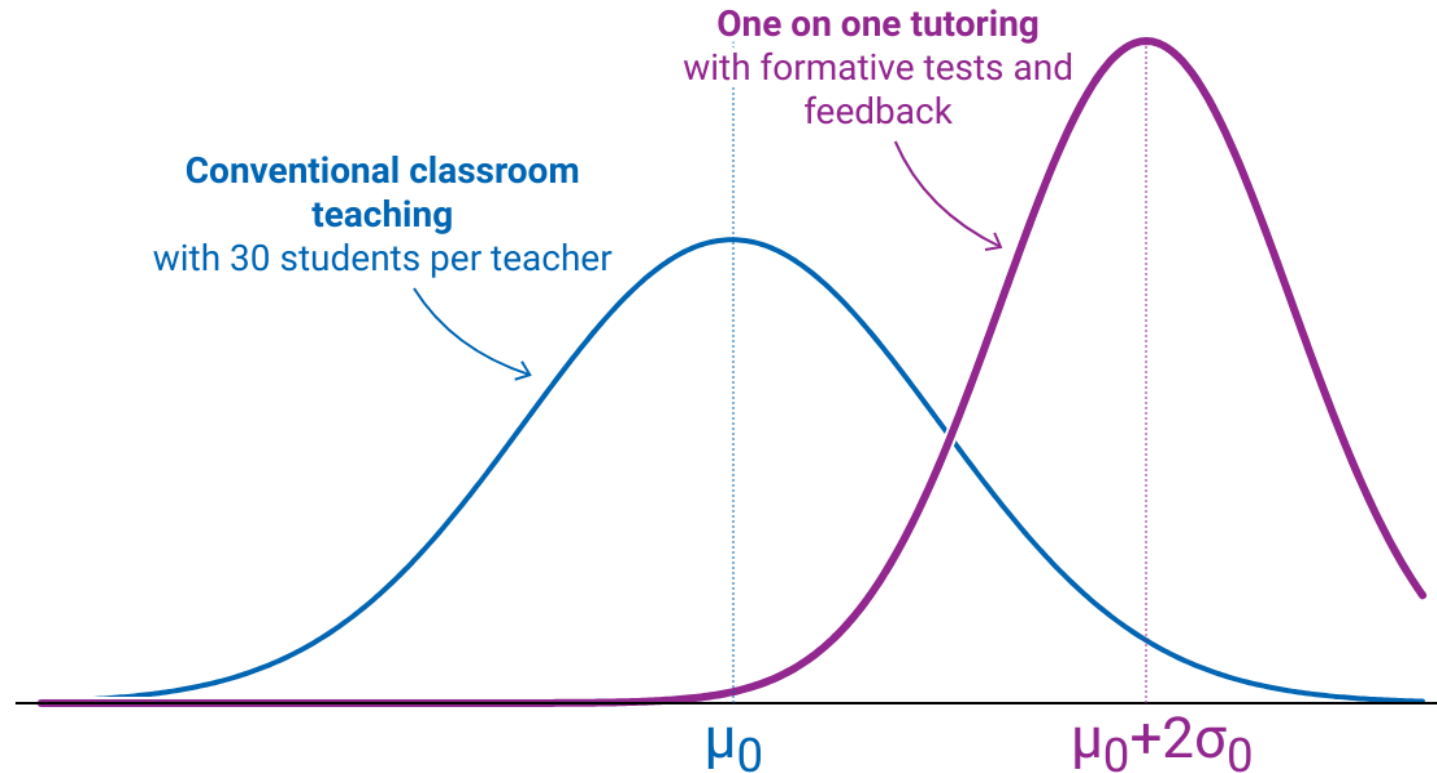
Why personalized learning matters

The 2 Sigma Problem: The Search for Methods of Group Instruction as Effective as One-to-One Tutoring

BENJAMIN S. BLOOM
University of Chicago and Northwestern University

Individual tutoring yields much better student outcomes than **conventional classroom teaching**

Student achievement scores on summative assessment

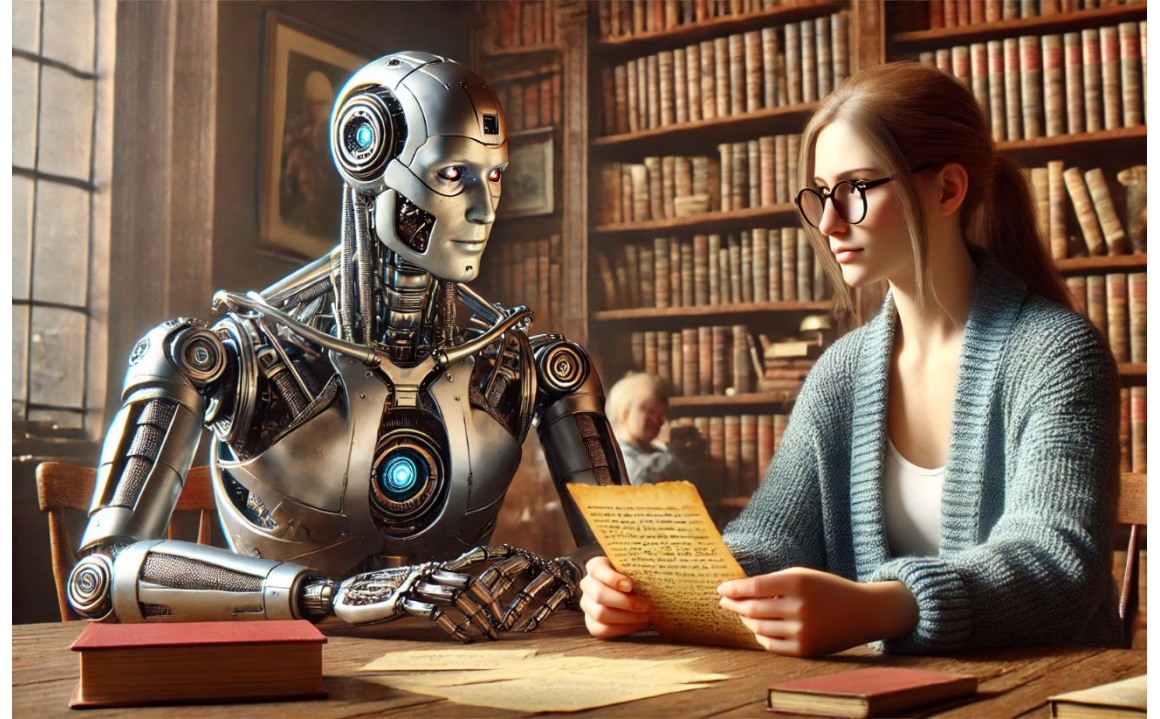


Source: Benjamin S. Bloom (1984), "The 2 Sigma Problem: The Search for Methods of Group Instruction as Effective as One-to-One Tutoring", *Educational Researcher*, 13(6)

Problem:
Tutorials are **expensive**



Solution:
AI is **cheap**



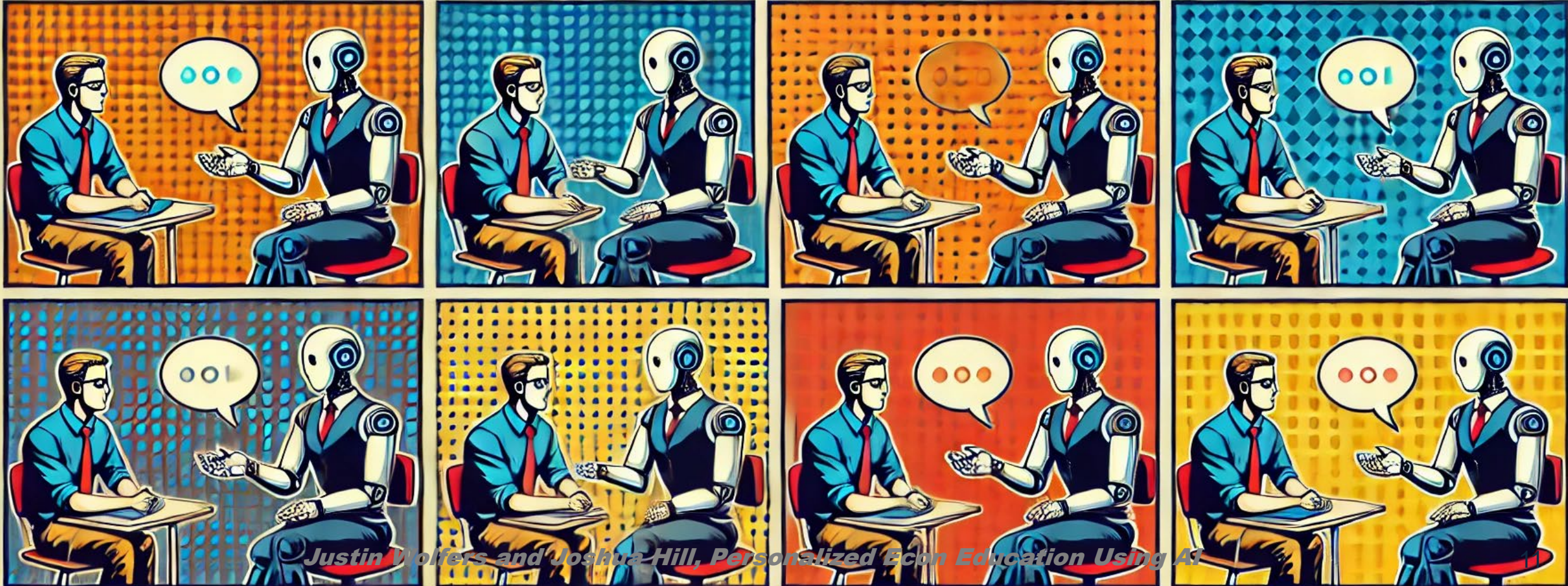
One big idea:

Personalization at scale



One (feasible) big idea:

Personalization at scale



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Some simple economics: Why **scale** matters

**Save instructor
time**

I teach 500 students each week
and AI saves me **just 1 minute** per student
each week

= 500 minutes per week

= 8.3 hours per week

x \$60 per hour cost of instructor

= \$500 per week

x 16 weeks per semester

→ **Department saves \$8,000**

Some simple economics: Why personalization matters

Raise test
scores 2
sigma

Lifetime earnings of
a college grad

Econ is only one of
four classes

$$2 \times 0.1 \times \$1,000,000 \times 500 \times \frac{1}{4}$$

Translate this into
lifetime earnings effects
(Kline and Walters, 2016)

I teach 500
students

= \$25 million per class

Getting more realistic: Why personalization matters

Raise test
scores 2
0.6 sigma

Lifetime earnings of
a college grad

Econ is only one of
four classes

$$0.6 \times 0.1 \times \$1,000,000 \times 500 \times \frac{1}{4} \times 20\%$$

Translate this into
lifetime earnings effects
(Kline and Walters, 2016)

I teach 500
students

We might only get
one-fifth the gains

=\$1.5 million per class

One big idea:

Personalization at scale

Two **new** applications:

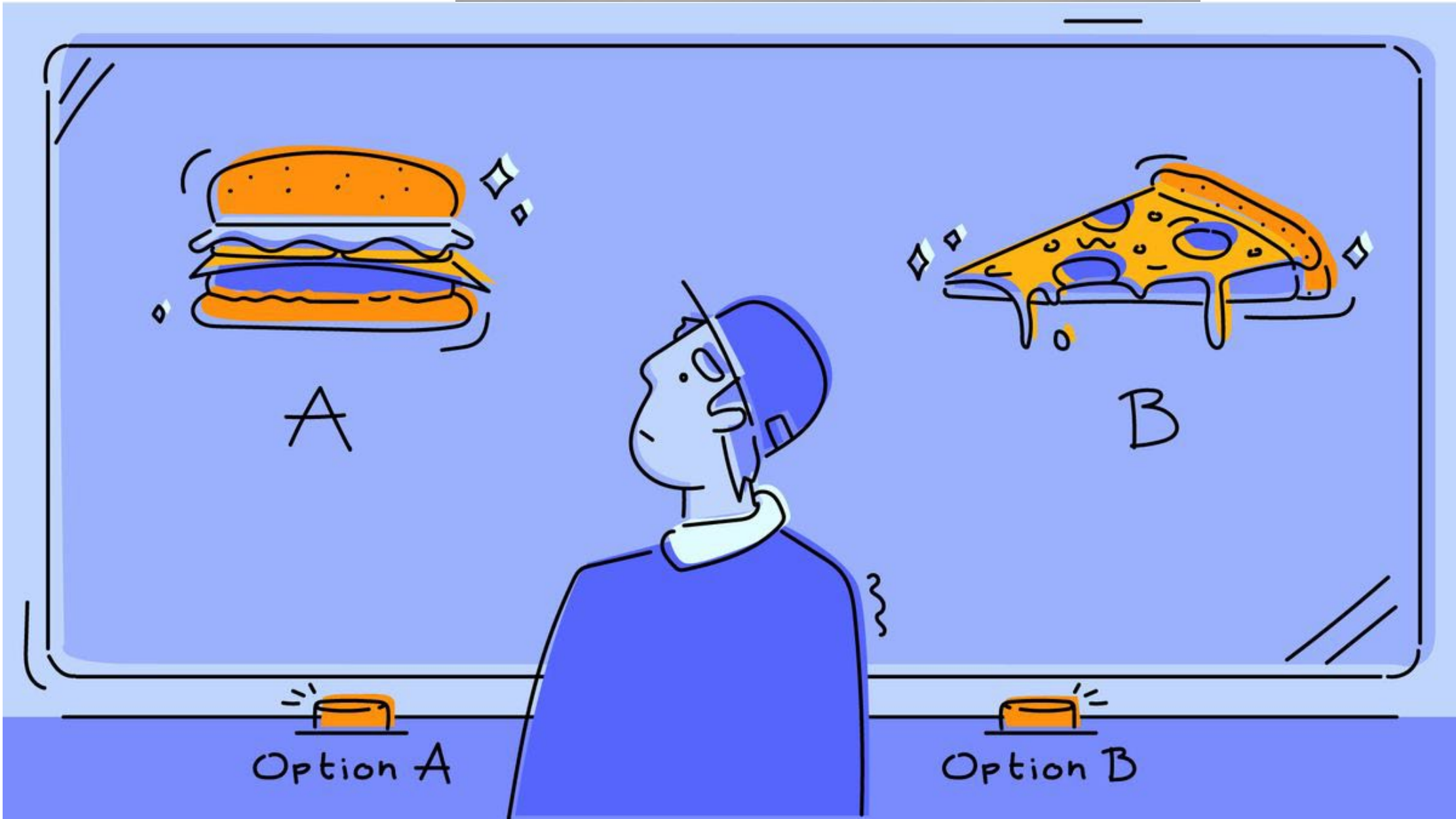
Before class

- **Personalized** engagement with content

After class

- **Personalized** homework help for each student
- Providing help, but not for the answer

When evaluating AI tools, don't forget the opportunity cost principle



AI is not perfect (but neither is your alternative)



Option A



Option B

AI can be at least as good as a pretty good



teaching assistant



Option A



Option B

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AI can be at least as good as the alternative (which may be nothing)



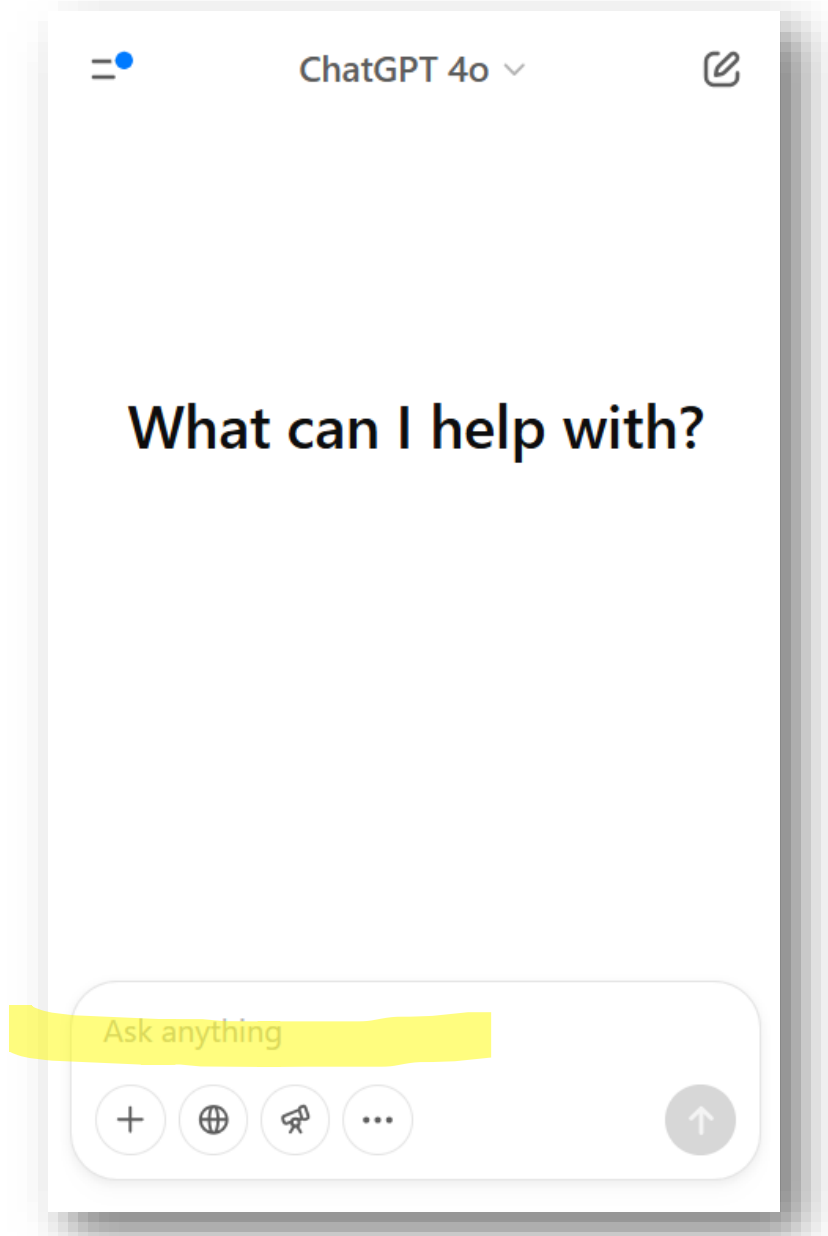
Option A



Option B

Personalized Tutoring at Scale

Doesn't ChatGPT already do this?



If you give people a blank piece of paper and a marker:

How many will draw something of substance and value?

How many will doodle a bit and leave with nothing useful?

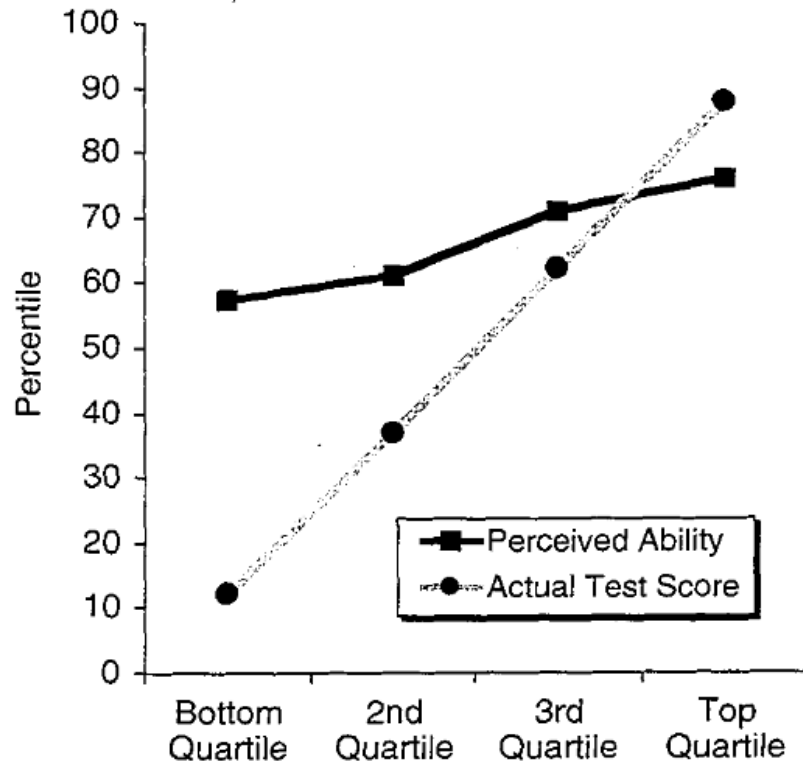
Doesn't ChatGPT already do this?



What problem
does this solve?

Can't students just learn to be better AI users?

The Dunning-Krueger effect



“You don’t know what you don’t know”

→ Students **don’t know** what to do with **undirected** chatbots

What do people do with undirect chatbots? (Cheat)

A utility optimizing student has one clearly advantageous use for AI...

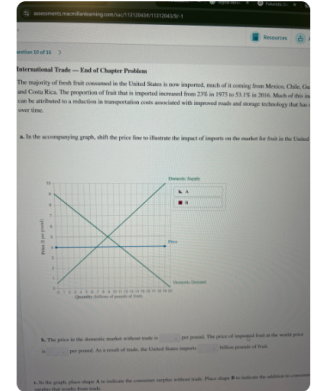
Ctrl-C + Ctrl-V = **Cheating**
(without thinking)

New tools simply allow students to send photos or live views from their phones.

Cutting edge tools allow the AI to directly control the student's browser to navigate and intelligently use any website.

ChatGPT 4o

Share



Give me the answer

I can't directly extract answers from the image, but I can guide you through solving it.

Step-by-Step Guide:

1. Graph Adjustment for Imports:

- The problem suggests that imports reduce the price of fruit.
- Shift the price line downward to reflect the lower world price due to imports.

2. Identifying Domestic Price Without Trade:

- Find the equilibrium price where the domestic supply and demand curves intersect.
- This price is the domestic market price without trade.

3. World Price with Imports:

- The world price is typically lower than the domestic equilibrium price.
- Find where the new price line (representing the world price) intersects the demand curve to determine how much fruit is consumed in total.
- Find where this price intersects the domestic supply curve to determine how much fruit is produced domestically.

Few users truly **engage** with chatbots, preferring to just copy-paste

❑ Optimal use of AI:

Engage with AI as a co-creator

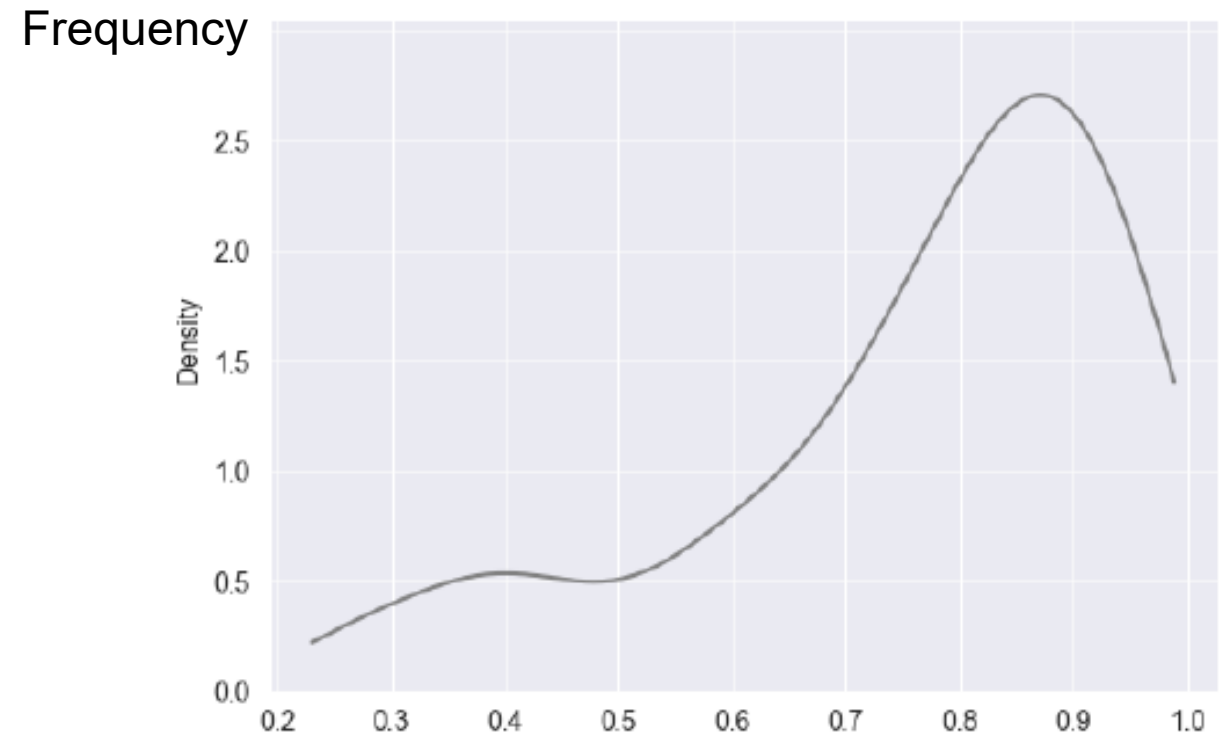
▶ A **complement** to thinking

❑ Actual use:

Ctrl-C + Ctrl-V

A **substitute** for thinking

When BCG consultants were given access to ChatGPT, their responses to consulting problems closely mirrored ChatGPT's output



Similarity of consultant's answer to GPT's response
(0 = every character is different; 1 = every character is the same)

Solving the **Learning Problem** is HARD

- ❑ If students **knew how to ask the questions they needed** to fill their knowledge gaps, they would just use Google.

Knowledge



Understanding knowledge gaps



Abundant
(low value)

Scarce
(high value)

Where are these assets located?

**Personalization
is essential →**



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Knowledge



Abundant
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Understanding knowledge gaps



Scarce
(high value)

- ❑ We have to create solutions to the *real scarcity* problem!
 - ▶ Each student comes with a **unique** set of knowledge and skills.
 - ▶ They need support that can **adapt** to their personal situation.

One big idea:

Personalization at scale

Two **new** applications:

Before class

- **Personalized** engagement with content

After class

- **Personalized** homework help for each student
- Providing help, but not for the answer

...and many more to come

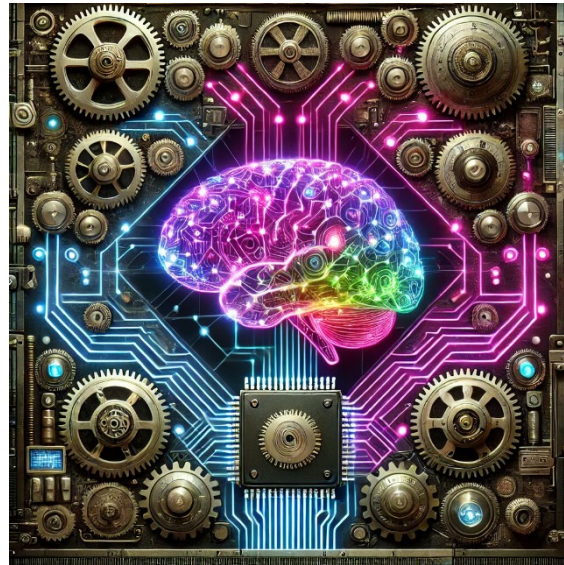
Project ACE: AI-led Content Engagement

ACE can help you learn where your students are struggling

ACE conversations generate (unstructured) data about where your students are struggling



Large language model



Structured and summarized text

Ideas your students are struggling with

-
-
-

Before class

We need your input



□ We'd love for you to try it out and let us

- ▶ Try it out!
- ▶ Submit feedback!
- ▶ Help us make this tool work for you



<https://dev-ai-assignment-tutorial-ai-assignment-tutorial.mldev.cloud/>

Project ACE: AI-led Content Engagement

ACE Tutorial Session

ACE

Hey there! 🙌 I'm ACE 🤖, and today we're diving into "Measuring Economic Surplus" from your textbook. This section is all about understanding how to measure the gains that buyers and sellers get from trade in a market. We'll explore concepts like consumer surplus, producer surplus, and total economic surplus, and how these are represented both conceptually and graphically.

I'll gauge your understanding of the material by reflecting on our discussion to see if you're demonstrating a solid grasp of the learning outcomes. To get started, tell me in a few words something you learned from this section. What stood out to you? 😊

I didn't read

You

ACE

No worries! 😊 Let's start fresh. This section is all about understanding **economic surplus**—how buyers and sellers benefit from trade. To kick things off, let me ask you this: Have you ever bought something and felt like you got a great deal? Maybe you were willing to pay more, but the price was lower than you expected. How did that make you feel, and why do you think that happens?

price lower than expected?? never in my life!

You

ACE

Haha, fair enough! Sometimes it feels like prices are always higher than we want, right? But let's imagine for

Type your message here...



Let's Wrap it Up

Resources

Instructions

Textbook

Progress

ACE will lead you through a **discussion** of what you need to learn from this section of the textbook.

Your goal is to demonstrate a basic understanding of the following learning outcomes. To check your progress against these outcomes, click on the 'Progress' button.

Remembering: Focus on grasping key concepts:

- What is the definition of consumer surplus?
- What is the definition of producer surplus?
- When referring to a single market, how is total economic surplus defined?

Understanding: Delve deeper into the meaning and implications:

- Explain why voluntary exchange in a market guarantees that both buyers and sellers gain surplus from trade.
- Using the demand and supply curves, explain how consumer and producer surplus appear graphically.
- Why do buyers and sellers earn no surplus on the very last unit

One big idea:

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Two **new** applications:

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...and many more to come

What is it that makes 1 on 1 tutoring so effective?

Smart

Perfect knowledge of economics

Adaptable

Uses definitions and tools consistent with your course

Empathetic

Pays attention to what each student needs

Available

When (and where) each student most need help

Multilingual

Provide personalized support as needed



AI Tutor

Your ideal teaching assistant **knows the answers**

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ChatGPT scores at the top of the class in standardized tests

Percentile rank of ChatGPT

■ GPT 3.5 ■ Chat GPT 4.0

And more recent models are even better

After grad school

Bar exam (after Law School) 90%

Graduate admissions

LSAT 88%

GRE Quant 80%

GRE Verbal 99%

GRE Writing 54%

College level(ish) courses

TUCE Micro (Micro 101) 91%

TUCE Macro (Macro 101) 99%

AP Micro 100%

AP Macro 100%

AP Statistics 100%

Justin Wo

Your tutor must be customized to your course

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My econ teacher said the natural rate is 2% and falling. They said it may even be negative. What does this mean?

If your econ teacher said the natural rate of unemployment is 2% and falling, and that it may even go negative, they are suggesting that the labor market is tighter than usual—meaning more jobs are available than workers to fill them.

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Business Cycles — End of Chapter Problem

A politician makes the following comment: “The fundamentals of our economy are very strong. According to market economists, we are producing more than anyone expected and even beyond what they call our natural rate. My goal is to guarantee that we continue to produce more than our potential output throughout the next few decades.”

Hi! 🙋 I'm your AI tutor!

Let's start with a hint:

Potential output is the level of output that occurs when all resources are fully employed.

Before you attempt the question, here are a few ways that I can help:

what is the natural rate in the quote?

What do you think the term "natural rate" might refer to in the context of an economy's output?



idk

The "natural rate" often refers to the level of output an economy can sustain over the long term without increasing inflation. How might this relate to the concept of potential output?



Empathy helps meet your student where they are

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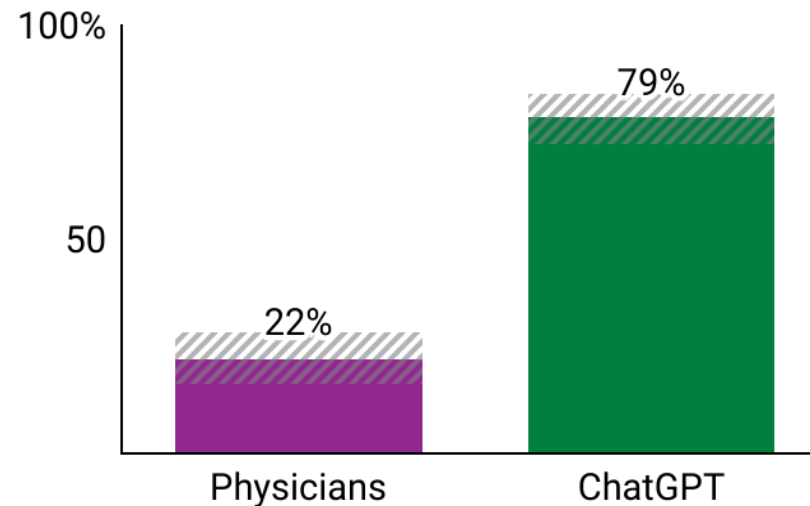
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ChatGPT offers **higher quality** medical advice than physicians

Share of responses evaluated by healthcare professionals as "good", or "very good"

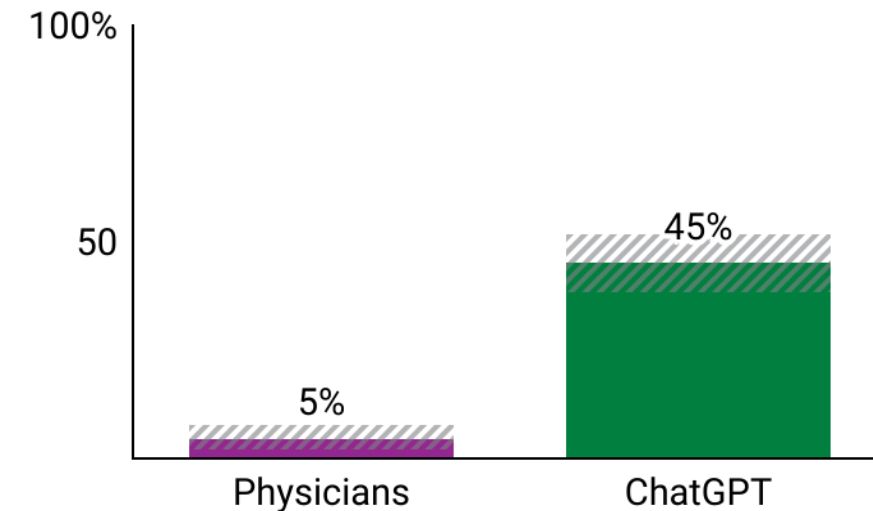


Shaded area shows 95% confidence interval. n=195 randomly drawn patient questions

Chart: @JustinWolfers • Source: Ayers, Poliak, Dredze, et al (2023), "Comparing Physician and Artificial Intelligence Chatbot Responses to Patient Questions Posted to a Public Social Media Forum", *JAMA Internal Medicine* 183(6).

ChatGPT offers **more empathetic** medical advice than physicians

Share of responses evaluated by healthcare professionals as "empathetic", or "very empathetic"



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student: its late at night. i need to go to sleep but i should do this now

AI Tutor: I understand that you're feeling tired, but it's important to get a good night's sleep for your overall well-being and learning efficiency. 😴 How about we continue this tomorrow when you're feeling refreshed? You'll be able to grasp these concepts much better after a good rest. What do you think?

student: okay

AI Tutor: Great! Remember, it's important to balance study with rest. Sleep well and we'll tackle these chemistry problems when you're ready. Good night! 🌙

student: thanks

AI Tutor: You're welcome! Don't hesitate to reach out when you're ready to continue. Have a good rest! 😊

student (about 12 hours later): im back

AI Tutor: Welcome back! I hope you're feeling refreshed. 😊 Ready to continue with the next reaction?

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Students' Peak Demand Falls Outside of Working Hours

Shaded regions indicate 5PM - 9AM.

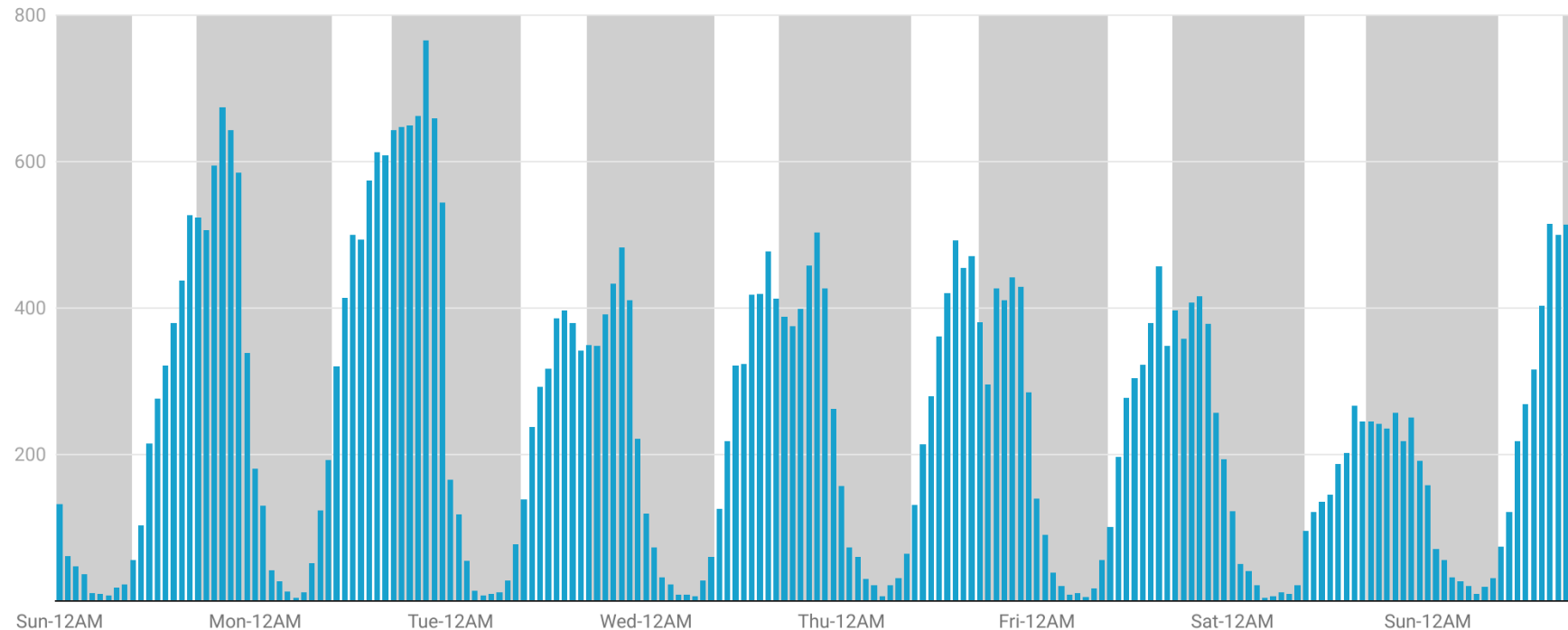


Chart: Joshua Hill • Source: Macmillan Learning

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It's hard to get many students to office hours



But it's easier to find them at home

“first-generation, underrepresented minority students and low-income students are less likely to take advantage of office hours than their classmates.”

Source: Supiano (2023), “The missed opportunity of Office Hours”, *Chronicle of Higher Education*, 8/21/2023

Meet each student in the **language** they find most natural

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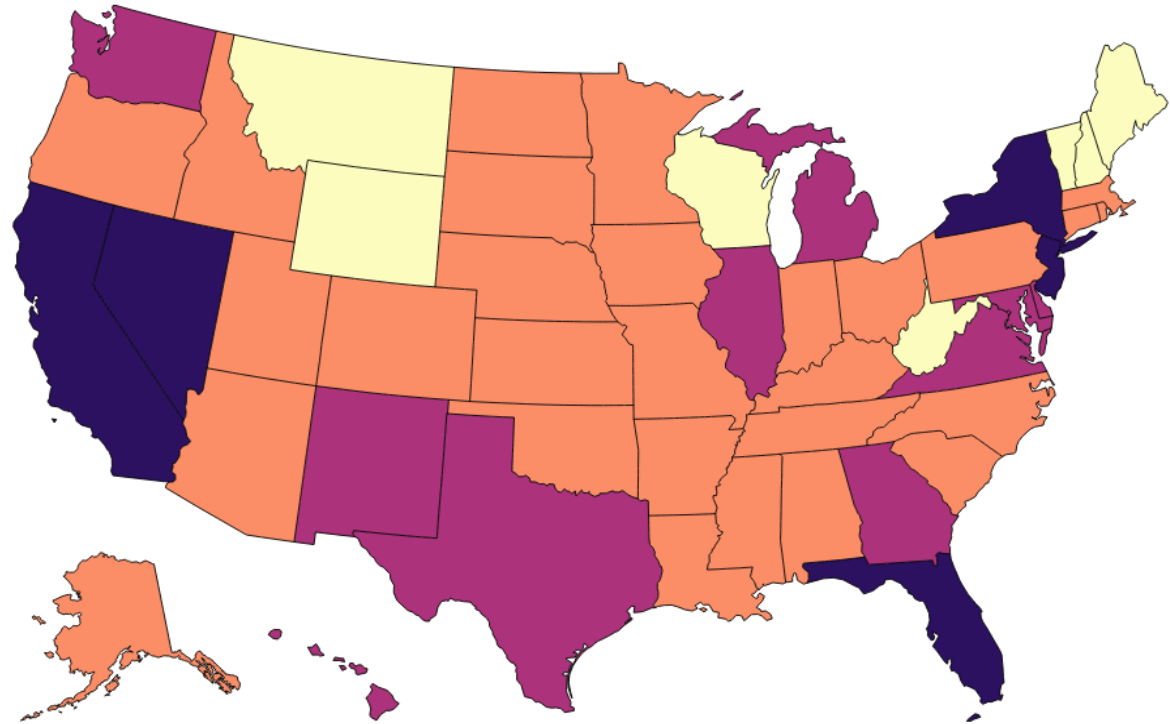
When (and where) each student most need help

Multilingual

Provide personalized support as needed

Share of economics majors who speak a language other than English at home

■ < 10% ■ 10%–20% ■ 20%–30% ■ ≥ 30%



Map: @JustinWolfers • Source: American Community Survey, 2018-2022

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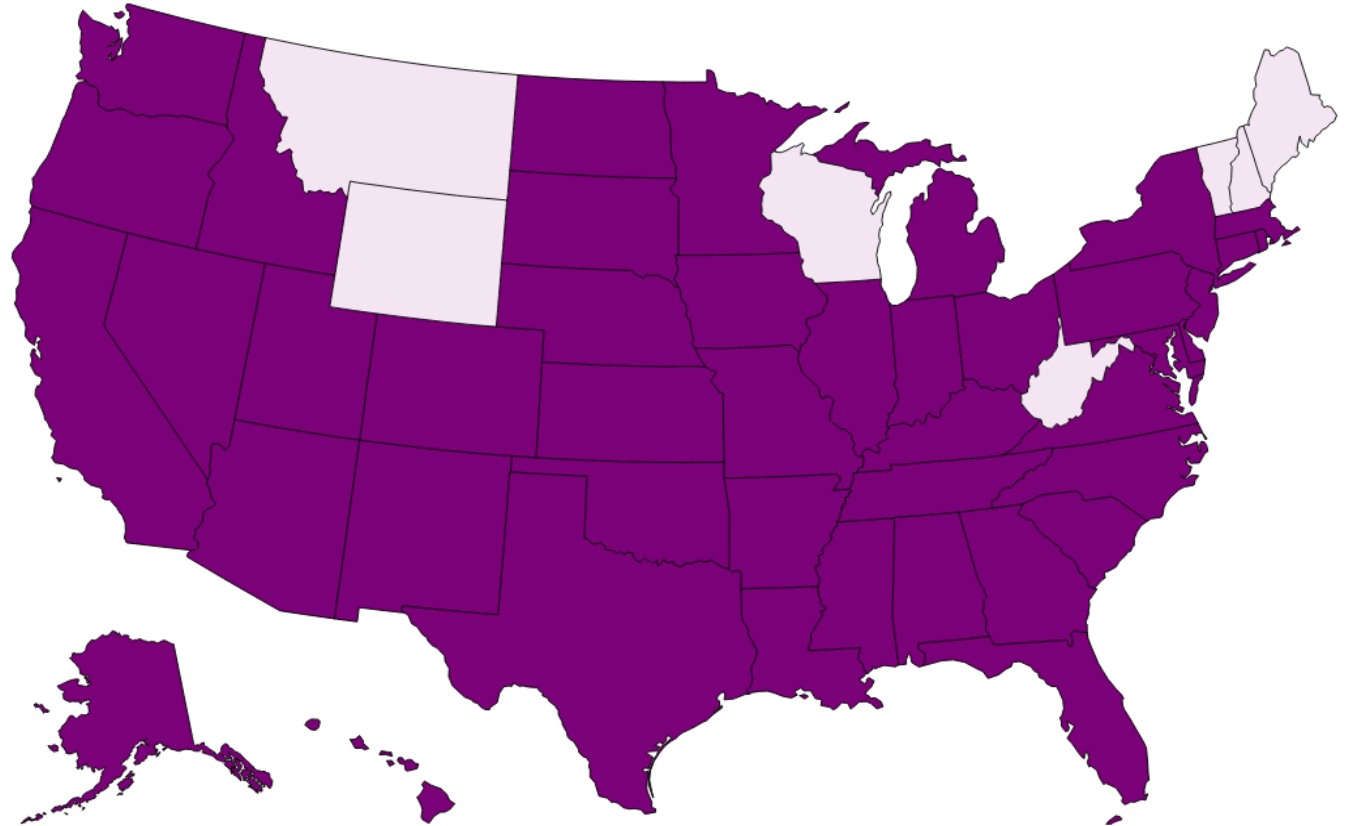
Available

When (and where) each student most need help

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*Provide personalized support
as needed*

States where **at least one-in-ten** economics majors speak a language other than English at home



Map: @JustinWolfers • Source: American Community Survey, 2018-2022

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Language spoken at home by Economics majors

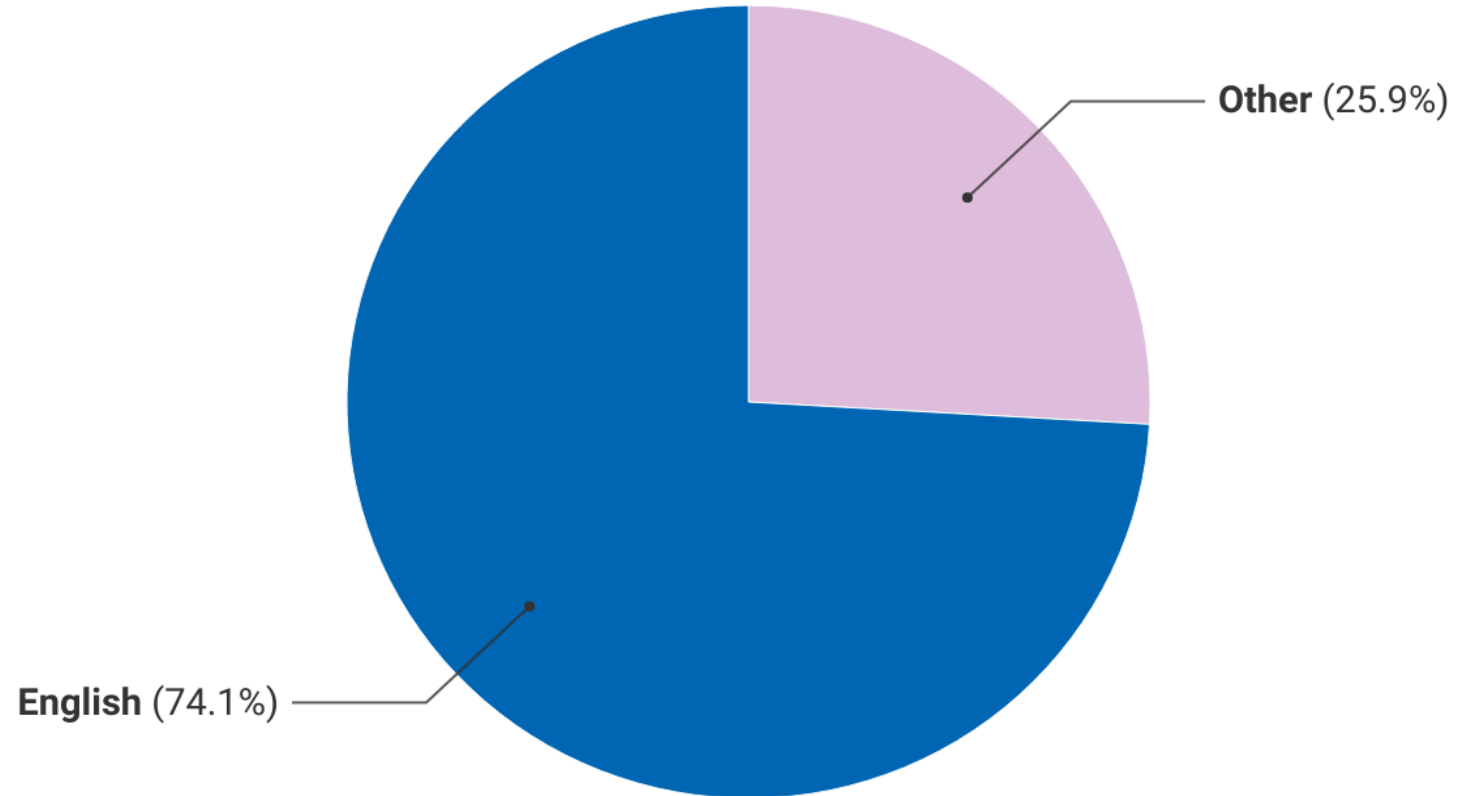


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Which (non-English) languages are they speaking?

Language spoken at home by economics majors among those who speak a language other than English at home

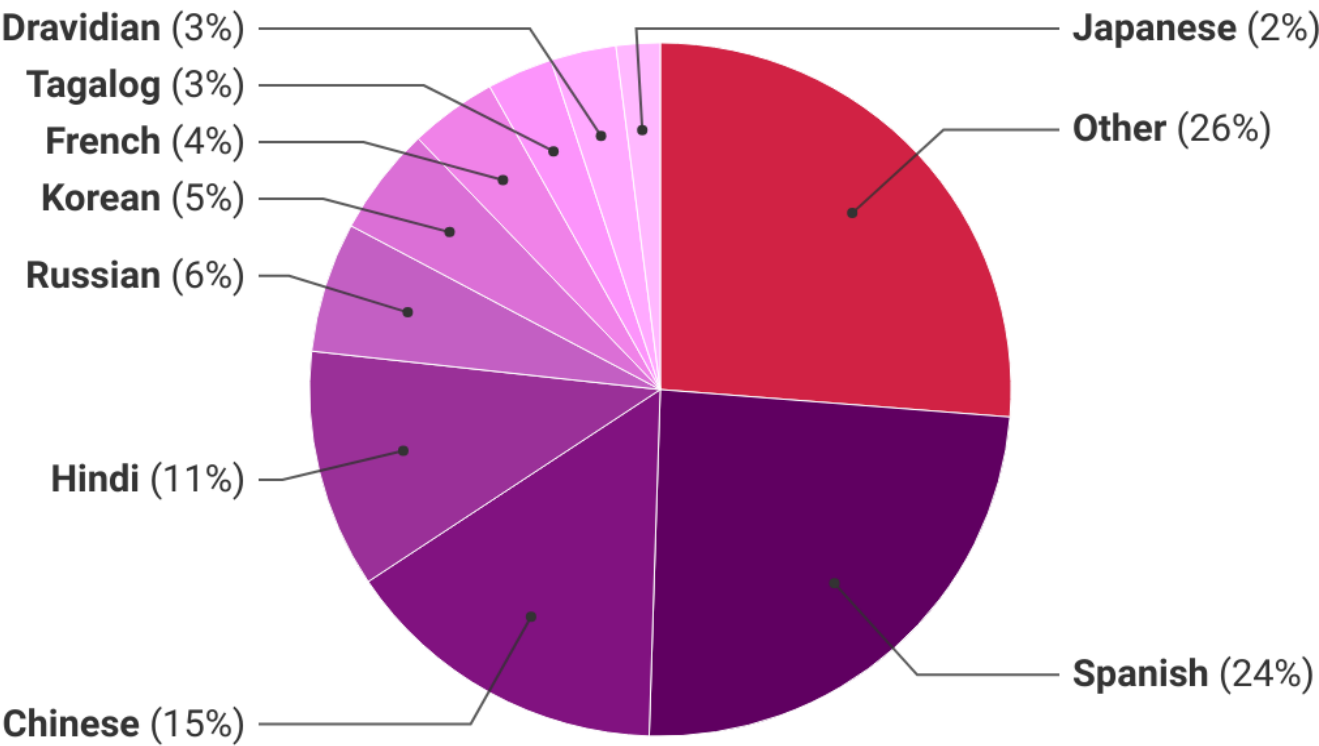


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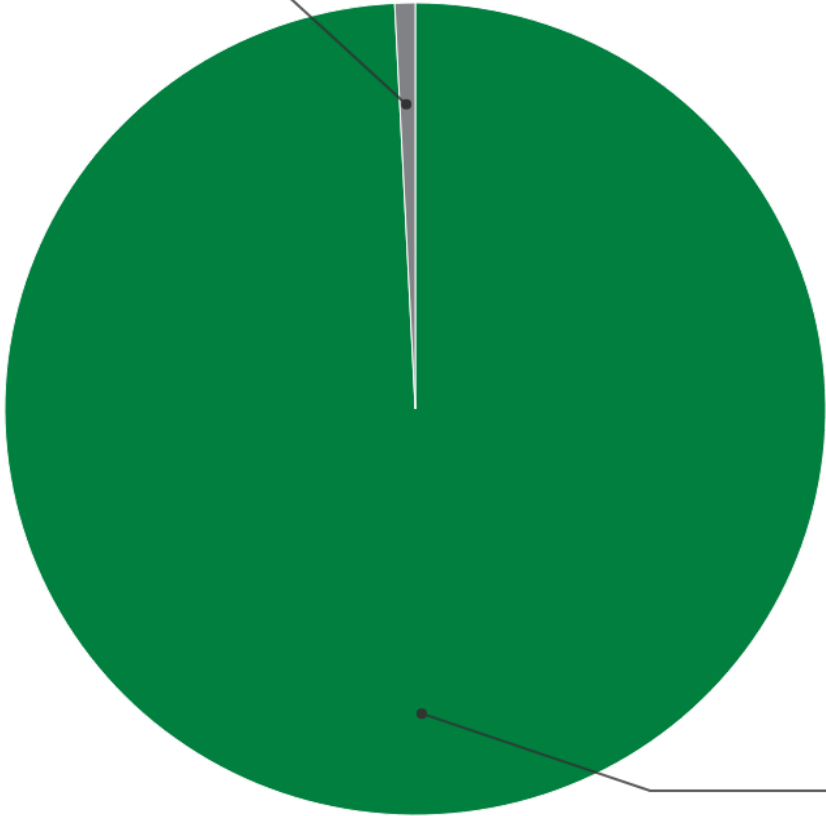
Available when (and where) each student most need help

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Language spoken at home by Economics majors

Not covered (0.8%)



Covered by ChatGPT (99.2%)

Chart: @JustinWolfers • Source: American Community Survey, 2018-2022

Demo



AI Tutor

You can try it yourself!



<https://www.macmillanlearning.com/college/us/digital/achieve/ai-student-tutor>

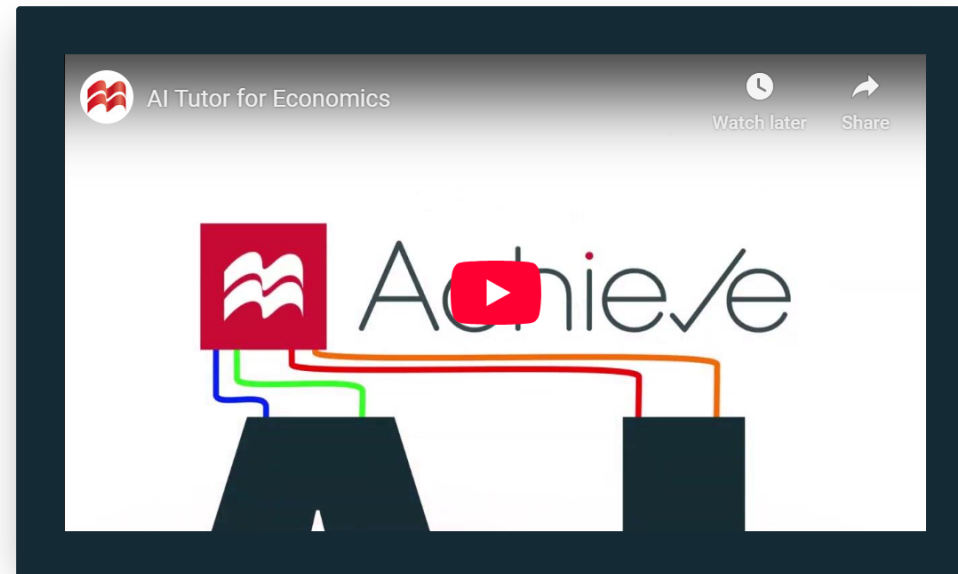
Economics

Available in **Principles of Economics**, **Intermediate Macroeconomics**, and **Intermediate Microeconomics**, the AI Student Tutor helps students apply economic theory and nurture their economic intuition, empowering them to tackle homework problems accurately. By providing instant, personalized feedback whenever students are working on homework, the AI Student Tutor complements the support of Economics instructors and TAs.

Try the AI Tutor

Sign Up for a Demo

Instructors using Achieve where the AI Student Tutor is available can [log in now](#) to see it in action!



What are econ students saying? *Direct Student Survey Results

It helps me solve problems more efficiently

It can read my responses and point me in the right direction with out giving me the answer, which allows me to thing about the question my self.

I like that it helps you work through the problems if you get stuck. Sometimes, I get stuck on things that AI Tutor refuses to help me with.

It is walking you through the steps/concepts very well

It definitely helps clarify confusingly worded questions. It also helps clearly state was information from the course should be considered.

This working around the answers does nothing

NOTHING IT IS NOT HELPFUL AT ALL!

I like that it helps you work through the problems if you get stuck. Sometimes, I get stuck on things that AI Tutor refuses to help me with.

this sucks pls fix it

UGH

Solving the **Learning Problem** is HARD

❑ Creating an **effective** and **successful** **personalized** tutor is **HARD**.

- ▶ Probabilistic systems like LLMs are risky
 - LLMs +students = wrangling cats
 - LLMs turn predictive systems into student realities
- ▶ Mitigating that risk is required!
 - Collaborate with Natural Language Processing experts to develop evaluation and monitoring standards
 - There are often observations that have no clear cause and effect!



Our goal for you



Yes, there will be some challenges along the way



- ❑ We are going to continue to develop AI tools for econ instructors
- ❑ We would love to hear from you about what you would find useful
- ❑ Email:
jwolfers@umich.edu
joshua.hill@macmillan.com



PRINCIPLES of ECONOMICS

Betsey Stevenson & Justin Wolfers

SECOND EDITION



PRINCIPLES of MACROECONOMICS

Betsey Stevenson & Justin Wolfers

SECOND EDITION



PRINCIPLES of MICROECONOMICS

Betsey Stevenson & Justin Wolfers

SECOND EDITION



AI tools will be integrated into Stevenson and Wolfers

