Generative AI in Research

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What is ChatGPT?

Generative AI

Program-controlled process that produces, manipulates, and synthesizes data

Generative AI creates new material, discriminative AI categorizes

Generative AI has existed for decades (the dialogue bot Eliza, MIT 1966)

Modern versions such as ChatGPT/Dall-E are **prediction machines**

What is ChatGPT?

ChatGPT (Generative Pre-trained Transformer) is a language model (LLM) developed by OpenAI to understand and generate text

It predicts subsequent words in a given context to create human-like text

ChatGPT uses the Transformer architecture, a deep learning method that enables the model to understand patterns, context, and language structure from large amounts of text

ChatGPT is fine-tuned with Reinforcement Learning from Human Feedback (RLHF)

LLM as of Summer 2023

MODEL	RUNS CODE	SEE IMAGES	READS FILES	INTERNET CONNECTION	PERSONALITY	WHAT IS IT	WHEN TO USE IT
ChatGPT/ GPT-3.5				No	Neutral, bland	This is the free version of ChatGPT that came out in November. It is very fast and pretty solid at writing and coding tasks.	It is fast and cheap and capable, but other models are now better. Also, It is not connected to the internet, so don't use it like a search engine.
ChatGPT/ GPT-4		Soon		No	Helpful, a little preachy	Currently available to paying customers. The most powerful LLM for most purposes. Does a lot.	Better at everything (writing, coding, summarizing) than GPT-3.5 Still not connected to the internet.
ChatGPT/ Code Interpreter/ Plugins	Yes		Yes	Limited	Helpful sometimes witty	Adds new capabilities to ChatGPT. Plugins and web browsing still have rough edges. Code Interpreter lets the AI run Python code & work with files.	Code Interpreter is great for working with data of all sorts, and is the most generally impressive AI implementation so far. Plugins are generally not that useful, yet. The web browsing is being updated.
Bing (Uses GPT-4 in creative & precise modes)		Yes	Yes	Yes	Friendly but also somewhat insane	Connected to the internet. It is GPT-4 with a grab-bag of powerful features. The weirdest model. Creative mode lets you use GPT-4 and is free.	Does a remarkably wide range of stuff, from working as a browser companion to creating art. Is connected to the internet. Has a strong, weird personality.
Bard	Yes	Yes		Yes	None	Bard is a name for a variety of models used by Google. Current offerings are are weak, but improving over time	This should be your last choice of AIs for now, but recent updates show promise. High levels of hallucination.
Claude 2			Yes	No	Pleasant when not scolding	Almost as powerful at GPT-4, but built to be "safer" and more pleasant to use. Has 100k context window - enough "memory" to hold a book.	Terrific on working with large documents, due to its extended context window and ability to upload content. it is very new so it is unclear how it stacks up.

LLM as of now

Closed-source vs. Open-weight models (MMLU, 5-shot)

- Closed-source models
- Open-weight models

Models shown include:
- GPT-4 (OpenAI)
- Claude 3 Opus (Anthropic)
- Gemini Ultra (Google)
- Claude 2 (Anthropic)
- Claude 1.3 (Anthropic)
- Mixtral 8x22B (Mistral)
- Qwen1.5 72B (Qwen)
- Yi-34B (01.AI)
- Command R+ (Cohere)
- Flan-PaLM (Google)
- DBRX Instruct 132B (Databricks)
- Mixtral 8x7B (Mistral)
- PaLM (Google)
- U-PaLM (Google)
- Falcon 180B (TII)
- Llama 2 70b (Meta)
- Chinchilla (Google)
- LLaMA 65b (Meta)
- Flan-T5 11B (Google)

X-axis: **Release Date** (2022-04 to 2024-04)
Y-axis: **MMLU (5-shot)** (0.50 to 0.85)

Examples of what LLMs are good at

Writing assistant: Improves writing, generates content, and translates

Coding: Assists in code development and problem-solving

Pedagogy: Answers questions and creates practice material

Data analysis: Generates insights from large data sets and text blobs

Customer service and technical support: Manages, for example, automated customer interactions and can provide technical support

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Why bother?

Helps you become more productive

Noy and Zhang (2023): RCT, "mid-level writing tasks", "college students"

- "Time taken **decreases by 0.8 SDs** and **output quality rises by 0.4 SDs**"
- "**Inequality between workers decreases**, as ChatGPT compresses the productivity distribution by benefiting low-ability workers more"
- "Restructures tasks towards idea-generation and editing and away from rough-drafting"
- "Exposure to ChatGPT increases **job satisfaction** and self-efficacy"

Brynjolfsson et al (2023): "staggered adoption", "customer service agents"

- "Access to the tool **increases productivity**, as measured by issues resolved per hour, by **14 percent** on average, with the **greatest impact on novice and low- skilled workers**, and **minimal impact on experienced and highly skilled workers**"
- "The AI model **disseminates the potentially tacit knowledge of more able workers** and helps newer workers move down the experience curve"

Dell'Acqua (2023): pre-registered RCT with BCG, " realistic, complex, and knowledge-intensive tasks", "consultants"

- "the capabilities of AI create a "**jagged technological frontier**" where some tasks are easily done by AI, while others, though seemingly similar in difficulty level, are outside the current capability of AI."

- "consultants using AI were **significantly more productive** (they completed 12.2% more tasks on average, and completed task 25.1% more quickly), and produced **significantly higher quality results** (more than 40% higher quality compared to a control group)"

- Consultants across the skills distribution benefited significantly from having AI augmentation, with **those below the average performance threshold increasing by 43% and those above increasing by 17% compared to their own scores**

Helps you become more creative

Haase and Hanel (2023)

- "9.4 percent of humans were more creative than the most creative GAI, GPT-4"

Guzik et al (2023)

- " Artificial Intelligence (AI), specifically GPT-4, was found to **match the top 1% of human thinkers on a standard creativity test**. The AI application ChatGPT, developed using GPT-4, **excelled in fluency and originality in the Torrance Tests of Creative Thinking**, a widely recognized tool for assessing creativity."

- "AI outperformed the majority of college students in the national creativity test"

How to work with ChatGPT

What works

Generate new research ideas

- Brainstorming

- Evaluate ideas

- Develop counterarguments and write short "referee reports"

Help with writing text

- Write and summarize the text

- Edit and correct text

- Evaluate the style and clarity of the text

- Create memorable titles

- Generate tweets

What works

Summarize literature

- Summarize text and write summaries (jenni.ai)
- Find relevant research
- Format references
- Translate text from other languages
- Explain text

Coding and data analysis

- Write code
- Explain code
- Translate code from one language to another
- Find errors in the code

How to interact with ChatGPT4

"Promptcrafting"

- Explain the context, the task, the style, and the length (be the opposite of vague)
- Be as specific and detailed as possible
- Give examples

Other hints

- Is your personal assistant ("I want you to act as X")
- The most important thing is just to get started, multiple interactions often yield the same result
- Ask for multiple alternative answers
- Don't give up when you get a bad answer!
- Example prompts: https://sites.google.com/view/lastunen/ai-for-economists

The OpenAI Platform

My GPTs

Create a GPT `Beta`
Customize a version of ChatGPT for a specific purpose

Made by OpenAI

DALL·E
Let me turn your imagination into imagery
By ChatGPT

Data Analysis
Drop in any files and I can help analyze and visualize your data
By ChatGPT

ChatGPT Classic
The latest version of GPT-4 with no additional capabilities
By ChatGPT

Game Time
I can quickly explain board games or card games to players of any age. Let the games begin!
By ChatGPT

The Negotiator
I'll help you advocate for yourself and get better outcomes. Become a great negotiator.
By ChatGPT

Creative Writing Coach
I'm eager to read your work and give you feedback to improve your skills.
By ChatGPT

Cosmic Dream
Visionary painter of digital wonder
By ChatGPT

Tech Support Advisor

Try Proofreader Pal!

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Examples

Create a first draft

1. Set a timer for 30 minutes and just write without structure (or dictate)
2. Copy to ChatGPT4 with the following prompt:

   "Please remove redundant words from the following passage and make it coherent and cohesive."

Improve argumentation

- *"Please critique the following passage and let me know if my argument is clear enough or not."*

Examples

Understanding concepts

- *"Please explain the following passage in simple words. I am having difficulty understanding X."*

Structure an article

- *" Prepare an outline for a journal article/dissertation on X. You can specify the number of chapters."*

Come up with titles

- *"Here is my abstract, please provide ten remarkable and memorable title suggestions"*

Format references

- *"Here is my reference list, translate into the Chicago Manual of Style format"*

Examples

Write and e-mail

"Context: Arranging an economic conference on labor and finance in Stockholm

Task: Please draft an invitation email asking if prominent researcher X would like to attend and present a paper."

Translate

- *"Translate this text from english to Swedish:"*

Policy conclusions

- *"Provide ten policy conclusions from this introduction to my academic article:"*

Custom instructions

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Custom instructions ⓘ

What would you like ChatGPT to know about you to provide better responses?

I am a professor in economics doing empirical research in labor and corporate finance. I am based in Stockholm. I code using Stata.

131/1500   Hide tips 🚫

Thought starters
- Where are you based?
- What do you do for work?
- What are your hobbies and interests?
- What subjects can you talk about for hours?
- What are some goals you have?

How would you like ChatGPT to respond?

When replying, I want you to use the guidelines suggested by Deirdre McCloskey in her book "Economical Writing". But don't say that you are.

140/1500

Thought starters
- How formal or casual should ChatGPT be?
- How long or short should responses generally be?
- How do you want to be addressed?
- Should ChatGPT have opinions on topics or remain neutral?

Enable for new chats ⬤

Cancel   Save

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Data analysis

My GPTs

 Create a GPT [Beta]
Customize a version of ChatGPT for a specific purpose

Made by OpenAI

DALL·E Let me turn your imagination into imagery		By ChatGPT
Data Analysis Drop in any files and I can help analyze and visualize your data		By ChatGPT
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Game Time I can quickly explain board games or card games to players of any age. Let the games begin!		By ChatGPT
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Creative Writing Coach I'm eager to read your work and give you feedback to improve your skills.		By ChatGPT
Cosmic Dream Visionary painter of digital wonder		By ChatGPT
Tech Support Advisor		

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X1

How do house price increases impact entrepreneurship among young people?

Increases in house prices can affect entrepreneurship among young people in several ways:

1. **Barrier to Entry**: High house prices may limit the ability to access capital, as homes are often used as collateral for loans. This constraint may inhibit young entrepreneurs from starting new businesses.

2. **Opportunity Cost**: Rising house prices may push young individuals to prioritize homeownership over entrepreneurial pursuits, as the fear of being priced out of the housing market increases.

3. **Wealth Effect**: For those who already own property, increased house prices can create a sense of additional wealth, possibly enhancing risk-taking and entrepreneurial activities.

4. **Regional Disparities**: High house prices in urban centers might push young entrepreneurs to less expensive areas, affecting the geographical distribution of startups.

5. **Rent Pressure**: In areas with soaring house prices, rental costs may also rise. This increased expenditure may reduce available capital for entrepreneurial activities, particularly for those who are renting living or working spaces.

In summary, while rising house prices might encourage some young property owners to venture into entrepreneurship, they can generally pose barriers to entry, alter priorities, and change geographical business dynamics for young potential entrepreneurs.

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X1   Yes, I know about these methods. Can you suggest concrete examples of policy changes or shocks from Sweden that could be used?

Certainly! Here are some concrete examples of policy changes, shocks, or regional variations that could be used as instrumental variables or focal points for causal analysis in Sweden:

1. **Municipal Zoning Laws**: Changes in zoning regulations within specific municipalities might create exogenous variation in housing prices, enabling you to examine their impact on entrepreneurship.

2. **Property Tax Reforms**: Any substantial reforms or adjustments to property taxation could serve as an instrumental variable, affecting housing prices but arguably unrelated to entrepreneurship directly.

3. **Rent Control Policies**: Sweden's history of rent control might provide opportunities to explore how adjustments in such policies have influenced house prices in different regions.

4. **Infrastructure Investments**: Major investments in public transportation or other infrastructure might affect property values in specific areas. For example, the expansion of the Stockholm metro system.

5. **Urban Renewal Projects**: Specific urban renewal or redevelopment projects can create localized changes in property values, such as the redevelopment of certain districts in Malmö or Gothenburg.

6. **Environmental Regulations**: Introduction or changes in environmental regulations, such as those affecting building codes, may have localized effects on housing prices.

7. **Housing Subsidy Programs**: Programs aimed at assisting homeownership among certain demographics, such as first-time buyers, may also lead to localized changes in housing prices.

8. **Financial Crisis Impact**: The effects of the global financial crisis on Sweden's housing market could provide an interesting shock to study, especially as they varied regionally.

9. **Interest Rate Changes by Riksbank**: The central bank's decisions on interest rates could provide a broader macroeconomic tool to explore how they have indirectly impacted house prices.

10. **Migration Patterns**: Sweden's varying migration patterns (both internal and international) might offer opportunities to study how population shifts affect housing demand and prices in different regions.

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BO0101A5_20230823-062511.xlsx
Spreadsheet

It looks like you've uploaded a file named `BO0101A5_20230823-062511.xlsx`. How can I assist you with it?

Its a file of newly produced houses across swedish municipalities across years. Do you understand the structure of the data?

I will need to inspect the file to understand its structure. Let me take a quick look at the contents.

Finished working   Show work ⌄

The data appears to represent the number of newly built apartments in different Swedish municipalities across various years. The structure includes:

- Municipality names in the first column, starting from the third row.
- The type of housing (e.g., "flerbostadshus") in the second column.
- The number of newly built apartments for each year from 1975 to 2022 in the subsequent columns.

Please confirm if this understanding is correct, and let me know how I can assist you with this data.

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X1 Let's run a diff-in-diff analysis looking at how the removal of property taxes in 2008 differentially affected new appartments in stockholm relative to malmö, göteborg and uppsala. Give me the regression output and plot the year times treated coefficients with confidence intervals over time in a graph

Certainly! We'll conduct a difference-in-differences (DiD) analysis to estimate the effect of the removal of property taxes in 2008 on new apartments in Stockholm, relative to the other cities: Malmö, Göteborg, and Uppsala.

For the DiD analysis, we'll consider the following variables:

- **Outcome Variable (Y):** Number of new apartments
- **Treatment Variable (D):** Binary variable indicating whether the municipality is Stockholm (1) or one of the control cities (0)
- **Post-Treatment Variable (P):** Binary variable indicating whether the year is after the removal of property taxes in 2008 (1) or before (0)
- **Interaction Term (DP):** Interaction between the treatment and post-treatment variables

The regression model we'll estimate is:

$$Y_{it} = \alpha + \beta_1 D_i + \beta_2 P_t + \beta_3 (D_i \times P_t) + \gamma X_{it} + \epsilon_{it}$$

where Y_{it} is the outcome for municipality i in year t, D_i is the treatment variable, P_t is the post-treatment variable, and X_{it} are other controls (e.g., year fixed effects).
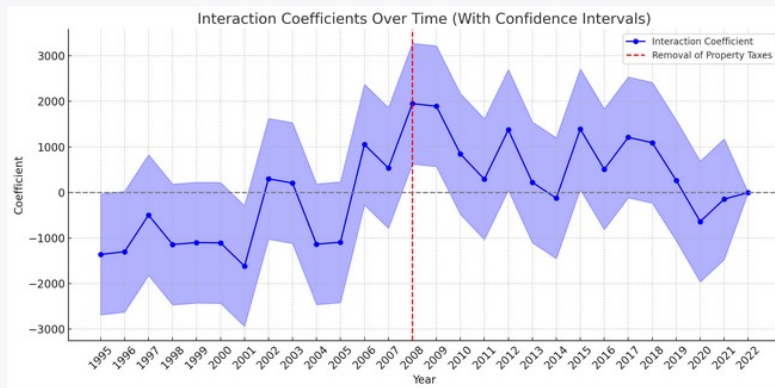
The coefficient β_3 on the interaction term will give us the differential effect of the treatment on the treated group (Stockholm) relative to the control group (Malmö, Göteborg, Uppsala) after the removal of property taxes.

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We'll proceed with the difference-in-differences (diff-in-diff) regression by explaining the "New Apartments" variable with year dummies, a treated dummy (for Stockholm), and their interactions. Then we'll plot the interaction coefficients.

Finished working   Show work ⌄

Interaction Coefficients Over Time (With Confidence Intervals)

Here's the plot showing the interaction coefficients over time from the difference-in-differences (diff-in-diff) regression. The regression explains new apartments with year dummies, a treatment dummy (for Stockholm), and their interactions.

- The blue line represents the interaction coefficients, capturing the differential effect on new apartments in Stockholm compared to Gothenburg, Malmö, and Uppsala for each year.
- The shaded area represents the confidence intervals for these coefficients.
- The red dashed line marks the year 2008 when the removal of property taxes occurred.
- The grey dashed line at zero serves as a reference line.

This plot visualizes how the policy change in 2008 affected the number of new apartments in Stockholm relative to the other cities.

Please let me know if there's anything else you'd like to know or do!

Certainly! Below is the Stata code to clean the dataset and produce the final figure. Note that this code assumes that you have the raw dataset in Excel format and that you've imported it into Stata.

Copy code

```stata
* Import the dataset (replace "your_dataset.xlsx" with your actual file name
import excel "your_dataset.xlsx", firstrow

* Keep only the relevant columns: Year, Municipality, New_Apartments
keep Year Municipality New_Apartments

* Filter for years starting from 1995
gen year_filter = (Year >= 1995)
keep if year_filter == 1
drop year_filter

* Generate the treatment variable for Stockholm, Gothenburg, Malmo, and Upps
gen Treatment = .
replace Treatment = 1 if Municipality == "0180 Stockholm"
replace Treatment = 0 if Municipality == "1480 Göteborg" | Municipality == "

* Convert New_Apartments and Year to integers (if they are not already)
destring New_Apartments, replace
destring Year, replace

* Run the diff-in-diff regression
gen year_dummies = "Year_" + string(Year)
gen interaction_term = year_dummies + "*" + string(Treatment)

regress New_Apartments i.year_dummies##i.Treatment

* Generate the plot using coefplot (assuming you have installed the coefplot
coefplot, vertical drop(_cons) title(Interaction Coefficients Over Time (Wit
```

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Takeaways

Researchers

- Change your workflow to use ChatGPT4/Claude/Gemeni (set as homepage in the browser)
- It is an investment, you become more productive in the long run
- Through experimentation, you learn what works (don't get upset at bad answers)
- Use Custom Instructions and learn Data Analysis
- Subscribe to Ethan Mollick's newsletter: www.oneusefulthing.org
- Korinek, Anton. 2023. "Generative AI for Economic Research: Use Cases and Implications for Economists." *Journal of Economic Literature*, 61 (4): 1281-1317.
- Make sure your RAs know ChatGPT4/Claude/Gemeni

Teaching

- Mollick, Ethan R. and Mollick, Lilach, Using AI to Implement Effective Teaching Strategies in Classrooms: Five Strategies, Including Prompts (March 17, 2023). The Wharton School Research Paper