

Can AI do my job?

Hmmm...

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Data Science - Artificial
Intelligence

- ◆ AI tools now exist which are designed to automate data analysis tasks
- ◆ Here we investigate OpenAI's Advanced Data Analysis module...
- ◆ ... and ask how close tools like this are to replacing human analysts

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Artificial Intelligence (AI) tools can now perform a variety of tasks which used to be impossible for computers. Here we investigate the performance of cutting-edge AI technology on a complex data-analysis project.

For this experiment, we gave the Advanced Data Analysis module of ChatGPT an open source dataset and asked it to perform an Exploratory Data Analysis (EDA). Performing an EDA is a common activity performed by Data Scientists whenever they are first given a dataset. It is also a good challenge for AI since performing an EDA is a multi-step process so it's more complex than simply doing one single task.

Rather meanly, we also asked a human analyst to perform the same work to give a comparison point. See inside this piece for an in-depth analysis of the performance of AI on this task.

How did AI do?

Worryingly well. The tool is still some way from being able to do a full Data Scientist's job but the performance at this challenging task was excellent.

The AI system needed quite a lot of babysitting in order to make it complete the task. Thus, from the perspective of a manager delegating a task, this is currently far less efficient than simply asking a competent human to go off and independently do the analysis and then report back.

However, from the perspective of the person performing the analysis using this or other similar tools is going to lead to dramatic productivity improvements. The AI tool was able to produce a thorough EDA in less than an hour of interacting with the tool. Furthermore, unlike a human, the AI does not get bored and so writes code which is consistently documented, it discusses the findings with detailed explanation throughout the analysis, and the charts and visualisations produced along the way are formatted professionally.

So can AI do my job? Thankfully not yet, but it's getting rather close for comfort.

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I, Data Scientist

Huge changes

Generative AI (GenAI) models have seen amazingly fast improvements over the last year. Unlike previous improvements in automation technology, these GenAI models are most immediately helpful for knowledge work tasks. This has resulted in vast amounts of hyperbolic commentary about the coming robot jobs apocalypse¹.

We do not believe that GenAI will lead to large-scale job losses (see [Will AI take your job](#) or [Generative AI: The rise of the machines](#) for more detail on this point). Artificial Intelligence tends to automate specific tasks rather than roles so it is more likely that GenAI will also take a range of tasks from knowledge workers, but not their entire role. What is clear, however, is that the day-to-day activities of many knowledge workers are likely to see dramatic shifts over the coming years.

Feeling brave

At the risk of talking ourselves out of a job, in this piece we report the results of an experiment in which we compared the performance of Chat GPT's "Advanced Data Analysis" module to the equivalent performance from a human analyst. Details are below, but the short summary is that the performance of AI is already very good and is steadily improving. It's still a long way from being able to replace the role of a Data Scientist, but it's already performing at the level that will significantly improve the productivity of a human analyst.

The experiment

We took a publically available dataset – the Zillow Home Value Index data at state level – and asked both a human Data Scientist and ChatGPT to perform an Exploratory Data Analysis (EDA) on this dataset.

This is a good challenge for the AI tool since:

- ◆ The instruction is a bit vague
- ◆ To do a proper EDA requires a multi-step analysis
- ◆ The data is given in an atypical format²

There is, however, one issue whereby this challenge might give an unfair advantage to ChatGPT: the dataset is publically available and relatively well known so it's possible that previous code examples which analysed this dataset were part of the training data for ChatGPT.

¹ For example, searching for this term on Google currently returns over 40-million results

² The timeseries data is given in rows (where each timestep is a new column) whereas it would be more typical when analysing a dataset using pandas (the python package which ChatGPT used) to consider a dataframe where the indices were timesteps.

Areas where AI struggled

Long periods of activity

Our first attempt at getting AI to perform this task was simply to load the dataset into the chat and ask it to perform an EDA on the dataset. This did not work well. This approach typically ended with ChatGPT performing several bits of exploratory analysis before crashing. It is unclear whether these issues were caused by the length of the text response or the intensity of code calculations being performed in a short period of time. Either way, this approach always led to frustration.

After some experimentation, it was found that the best performance was achieved by asking ChatGPT to first list out the steps it would perform as part of the EDA³ and then proceed step-by-step, but *waiting to proceed* from one step until receiving confirmation from the human to continue. This resolved the issues with crashing. But it did mean that far more human input was needed in order to get a good response from the AI tool.

Different behaviour from one run to the next

We performed multiple iterations of this experiment. In general, the performance improved in later iterations as we got better at prompting ChatGPT to perform this analysis. Notwithstanding this trend, we saw significant variation in the performance of ChatGPT at individual tasks in the EDA.

For example, on some iterations of the experiment ChatGPT noticed when loading the data that each column was a separate timestep and suggested reformatting the data to make it easier to analyse whereas on other iterations it struggled until we specifically pointed this out.

Similarly, at many points in the analysis the code generated would result in an error being thrown. ChatGPT would often do an excellent job at correcting such syntax errors – presumably many such examples were encountered in the training process. However, on some instances where the approach being taken was simply the wrong way to analyse the data and was thus leading to faulty analysis we found it almost impossible to correct the derailed train-of-thought. At such times it was easier to simply start a new chat and begin the analysis again from the beginning rather than continuing to argue with the AI system.

Areas where AI excelled

One area where the AI system was far better than the human was in documenting the code and in laying out a discussion of the plan of action. These documentation tasks are something that humans often find rather tedious. However, such documentation can make collaboration significantly easier since other people do not have to decipher your code to understand the steps in your analysis. Ironically, one area where AI code generation tools may help is in making code easier to read by other humans and thus improving collaborative efforts.

Areas where humans excelled

One area where the humans were better than the AI was in time series analysis / implementation. The AI seemed unable to critically assess the performance of candidate models here. In particular, the AI system seems to lack the appropriate degree of scepticism of the results of its analysis. However, even though the AI tool performed poorly here, the code and models it produced allowed the human analysts to understand potential shortcomings and gave a starting point on how to improve them, so this was still helpful to human analysts.

³ The response from ChatGPT is detailed in the Appendix.

Summary

The performance of this AI data analysis tool is already good enough that we were impressed. The performance is still some ways away from being able to replace human analysts since (i) the analysis tool still needs a lot of babysitting, and (ii) the output produced needs to be assessed by a human analyst who is competent enough to identify when the AI tool has taken the wrong path. Nonetheless, this tool is already at the level where it can dramatically increase the productivity of data scientists.

We provide more details of the analysis performed by both human and AI during this experiment. If you would like to see full details of the analysis performed by the AI tool, please contact the authors.

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The full note contains a section comparing the performance of AI and the human analyst on various specific parts of the analysis in order to assess the pros and cons of both approaches.

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