Artificial Intelligence Applications and Sustainability

Michael Aviles

MaCS Scholars Research Internship Report (Summer 2025 – Spring 2026)

Faculty Mentor: Dr. Cyril S. Ku (Professor of Computer Science)

The research goal for this internship was to find out how companies were having an increase in AI usage ever since the introduction of LLM's (Large Language Models). We began the project in collaboration with the Cotsakos College of Business. There, I was instructed on how to create an account with Bloomberg and how to access the Bloomberg terminal. My first task was finding a way to extract company documents in large amounts from Bloomberg into a shared OneDrive folder. The specific report that we focused on for this step was the companies' annual reports from S&P 500 companies from a specific year range.

The challenge that occurred with this data collection was that it was nearly impossible to automate this process. I attempted to create a site crawler that would automatically crawl through the company's websites and extract the specific document that I needed. The script also included an automatic file sorting system for the outputs if a document is not found. However, I ran into some challenges with this, mainly revolving around the need for an API key to do it through ChatGPT, as I was provided a limited number of tokens with the API that I was using to crawl the internet. Using a Bloomberg API to pull the documents was also explored, but due to clerical issues, we weren't able to get approval to continue down this route. The manual route was also revealing another problem: not all of the companies on the S&P 500 make their documents public for download, and not all companies have existed for the same number of years.

I was then told to focus on a different dataset. For the research project that we have submitted to NJDBA, we chose to pivot towards publications on "Use of AI and Agents in Entrepreneurship and Sustainability Management". For this part of the research, I was tasked with

generating figures to be used within the research paper. Using the dataset that I was given, I used my experience in SAS statistics software to visualize our data into a bar graph. To do this, I had AI look at our spreadsheet of data and count how many articles were published for each year from 2020 to 2025. From this, I used SAS code to generate a bar graph of the data to visualize it. From doing this, I noticed that there was a potential trend that could be analyzed from the data.

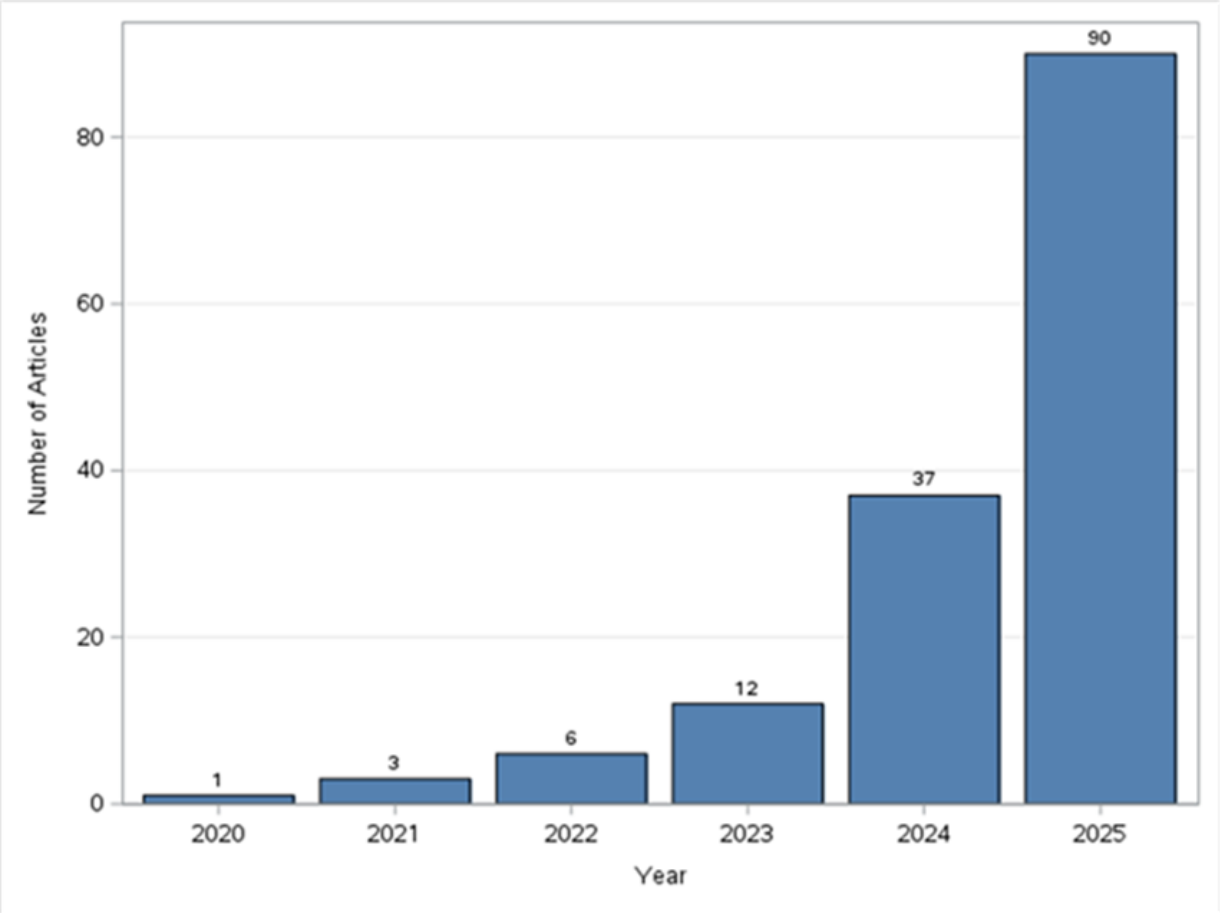
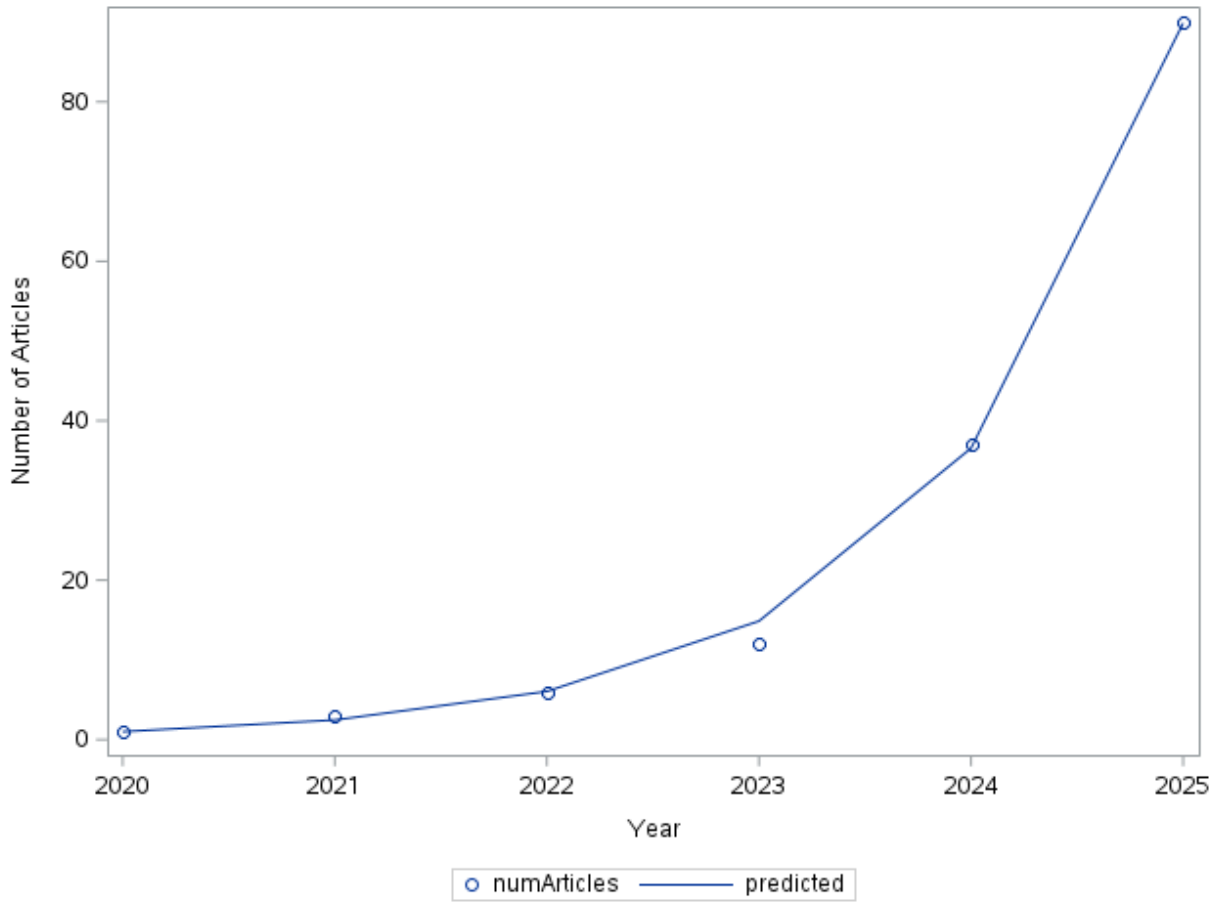


Figure 1. Publication trend by year (Years of publications)

To confirm this, I began by approximating a curve on the data that we had using Demos to create a close line of best fit. After seeing how closely the data lined up with my approximate line of best fit, I used SAS code to calculate an official line of best fit and graph it.



I then performed a statistical analysis of the SAS output data and established an equation for the line of best fit. The bar graph was included in the paper, but the regression analysis was not yet included because it opens up opportunities for branching off into more research into trend analysis in the increasing usage of AI. For full documentation on this process, please refer to the link below (the entire documentation is in the Appendix):

https://docs.google.com/document/d/1wfH7frgSCB7bJVDb7Ponhe7iyN3iiYcBcQJoYF-0V8A/edit?tab=t.0

Obs	year	numArticles
1	2020	1
2	2021	3
3	2022	6
4	2023	12
5	2024	37
6	2025	90

The NLIN Procedure
Dependent Variable numArticles
Method: Gauss-Newton

Iterative Phase		
Iter	a	Sum of Squares
0	0.1000	9657.3
1	2.3341	484.4
2	2.4708	14.2577
3	2.4589	8.7236
4	2.4588	8.7230

NOTE: Convergence criterion met.

Estimation Summary	
Method	Gauss-Newton
Iterations	4
Subiterations	1
Average Subiterations	0.25
R	7.561E-6
PPC(a)	4.703E-8
RPC(a)	0.000051
Object	0.000066
Objective	8.723013
Observations Read	6
Observations Used	6
Observations Missing	0

Note: An intercept was not specified for this model.

Source	DF	Sum of Squares	Mean Square	F Value	Approx Pr > F
Model	1	9650.3	9650.3	5531.50	<.0001
Error	5	8.7230	1.7446		
Uncorrected Total	6	9659.0			

Parameter	Estimate	Approx Std Error	Approximate 95% Confidence Limits	
a	2.4588	0.00684	2.4412	2.4764

Approximate Correlation Matrix	
	a
a	1.0000000

There were many team meetings that were held that helped provide me with insight into how research is conducted. I collaborated with all members of the team and had to communicate effectively to meet deliverable deadlines and standards. The meetings were usually held in Zoom

format, but I also went in person to the business campus and the Computer Science Department for any further discussion on what I needed to do for specific deliverables. Our plans to move forward are to potentially explore submissions to different conferences. This was also the first published conference research that I have participated in, and I am grateful for the opportunities. It was overall a great experience in research that I would be honored to continue with Dr. Ku and the team. Our team produced two refereed conference presentations at the NJBDA 2026 symposium.

Peer-Reviewed Conference Presentations

[1] Kashyap, R., Siqueira, A. C., Ku, C. S., Saghiri, A. M., & Aviles, M. (2026, May 20). Orchestrating Sustainability: *A Multi-Agent Approach to AI-Driven Environmental ESG Performance.* The 13th NJBDA (New Jersey Big Data Alliance) Annual Symposium, Rowan University, Glassboro, New Jersey, USA.

[2] Siqueira, A. C., Kashyap, R., Saghiri, A. M., Ku, C. S., & Aviles, M. (2026, May 20). *Use of Artificial Intelligence and AI Agents in Entrepreneurship and Sustainability Management.* The 13th NJBDA (New Jersey Big Data Alliance) Annual Symposium, Rowan University, Glassboro, New Jersey, USA.

Appendix

Nonlinear Regression Analysis Documentation for Approximate Trend Line of Articles Per Given Year

1.) Using Desmos, I approximated a trend line to be about $2.35^{(x-1)}$, where the x-axis represents the years (2020-2025), and y represents the number of articles for each of the years (in the form of coordinates starting at 1 for graphability on Desmos specifically).

Year	numArticle
1	1
2	3
3	6
4	12
5	37
6	90

2.) Due to how close visually my estimated trend line was, I decided to use SAS to get a close estimation of the trend for an increase in AI Business Related ESG studies published from 2020-2025.
3.) The code that was done is below (Special Thanks/credit to Professor Luis Nuñez for the guidance for the exponential regression analysis!)

/* Version 1 with regular numbers (I then realized I should make it years so I can make the graphs within SAS, which looks more professional*/

```
data a;
input year numArticles@@;
datalines;
1 1
2 3
3 6
4 12
5 37
6 90
;
run;

proc print data=a;
run;

proc nlin data=a;
parameters a=0.1;
model numArticles=a**(year-1);
run;
```

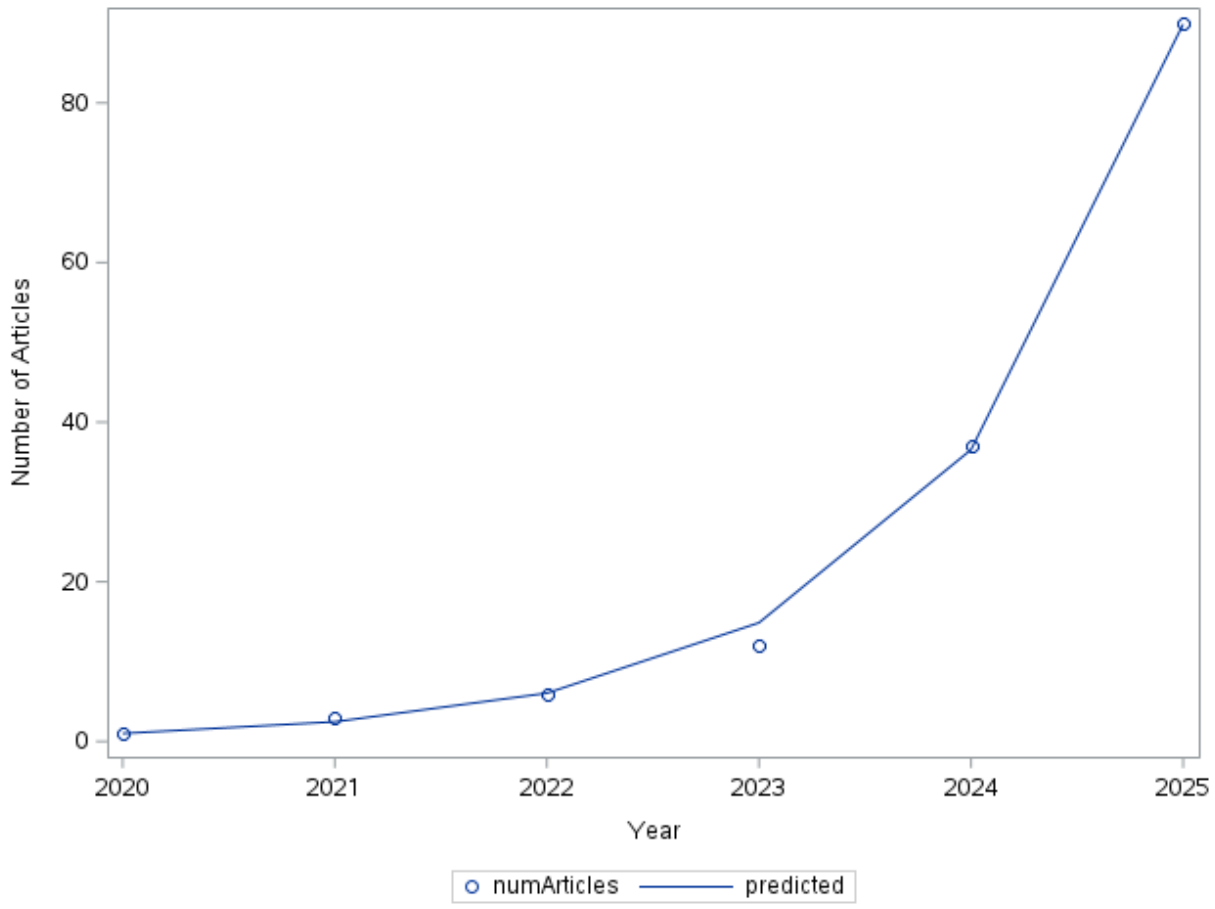
/* REVISED FINAL VERSION USING AI TO ADD THE GRAPHS FOR THE MATH AND DO IT BY YEAR INSTEAD OF 1 TO 6 I MADE IT 2020 - 2025 FOR THE YEAR COLUMN*/

```
data a;
input year numArticles@@;
```

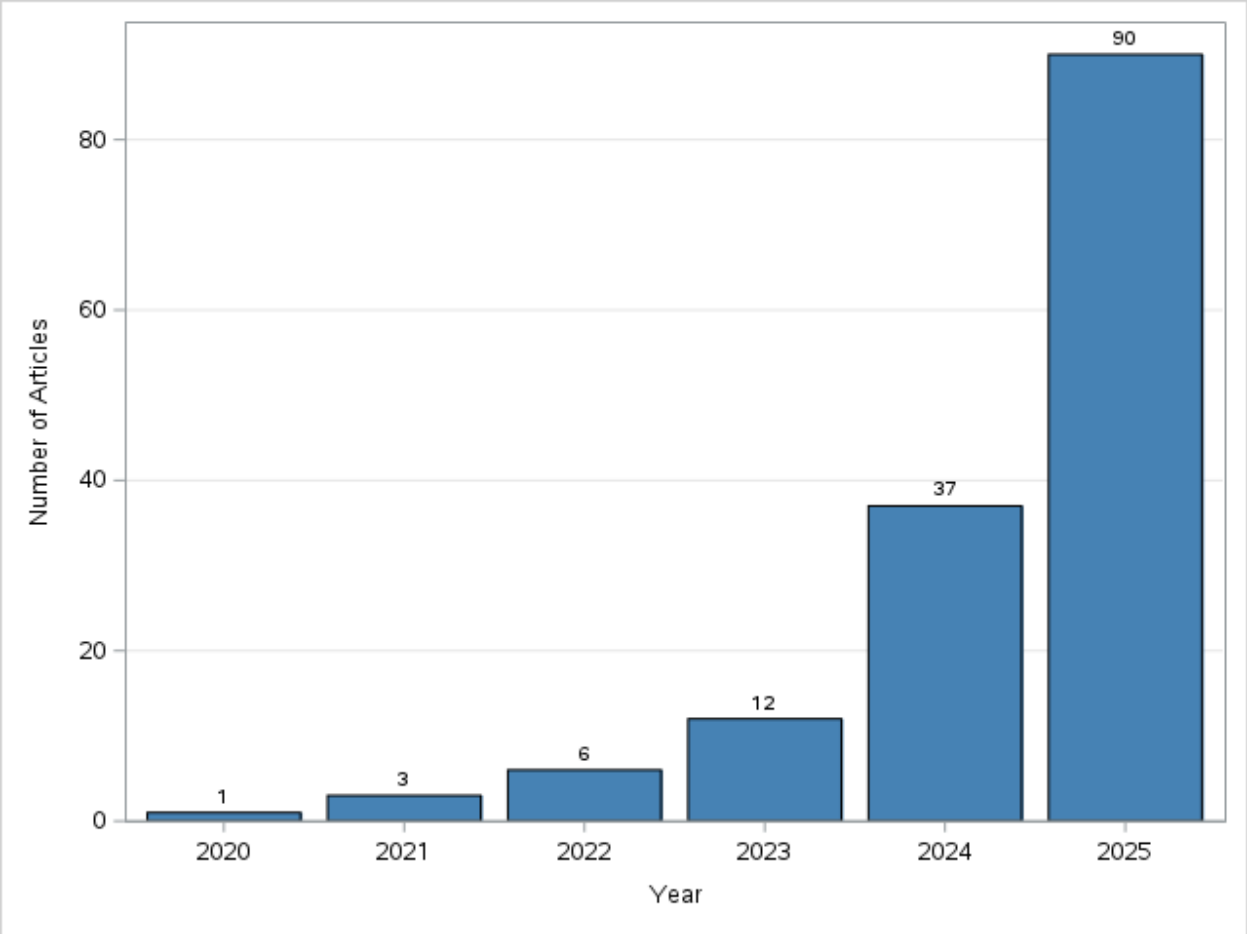
```
datalines;
2020 1
2021 3
2022 6
2023 12
2024 37
2025 90
;
run;

proc print data=a;
run;

proc nlin data=a;
parameters a=0.1;
model numArticles = a**(year-2020);
output out=a_fit p=predicted;
run;

/* ChatGPT AI Helped Me With This Part Just For Visualizing It For The Graphs.
The rest were by hand*/
proc sgplot data=a_fit;
scatter x=year y=numArticles;
series  x=year y=predicted;
xaxis label="Year";
yaxis label="Number of Articles";
run;

proc sgplot data=a;
vbar year / response=numArticles datalabel fillattrs=(color=steelblue);
xaxis label="Year" integer;
yaxis label="Number of Articles" grid;
run;
```

4.) The results screen for this code is at the end of this document
5.) The results of the non-linear regression with a CI (Confidence Interval) of 95% was as follows:
    a.) The estimate for a where a represents the exponential growth factor $a^{(x-1)}$ was $a = 2.4588$.
    b.) The 95% CI was $2.4412 \leq a \leq 2.4764$ with an estimated error of 0.00684.
    c.) The estimated exponential growth equation would therefore be as follows $f(x) = 2.4588^{(x-2020)}$

MODEL 1


80
60
40
20
0
Number of Articles
2020
2021
2022
2023
2024
2025
Year
numArticles
predicted

MODEL 2


Number of Articles
0
20
40
60
80
1
3
6
12
37
90
2020
2021
2022
2023
2024
2025
Year

VERSION 1 OUTPUT

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FINAL VERSION OUTPUT

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