How to Cite:
Asmaa, D. (2025). Scientific research methods: Comparing traditional techniques and AI in academic writing with an econometric application. *International Journal of Economic Perspectives*, *19*(1), 230–241. Retrieved from https://ijeponline.org/index.php/journal/article/view/857

Scientific research methods: Comparing traditional techniques and AI in academic writing with an econometric application

Mrs. DEHKAL Asmaa
Lecturer Class A, University of Mustapha Stambouli, Mascara, Laboratory of MCDL, University of Mustapha Stambouli Mascara, Faculty of Economics & Management (Algeria)

***Abstract*---**AI research aims to push the boundaries of what machines can accomplish autonomously, often drawing from interdisciplinary fields such as computer science, mathematics, neuroscience, and cognitive psychology. Research, on the other hand, encompasses a wider range of activities, including theoretical exploration, empirical studies, experimentation, and innovation across diverse domains. While AI research contributes to technological advancements and automation, research in other fields extends beyond technology to address societal challenges, scientific inquiries, and cultural developments. Therefore, while AI is a crucial component of contemporary research efforts, research itself encompasses a broader spectrum of intellectual inquiry and exploration. The aim of this research paper is to compare the steps of scientific research between the conventional method and artificial intelligence tools.

***Keywords*---**AI, research, CHATGPT4.0.

Introduction

Artificial Intelligence (AI) and research are distinct yet interconnected domains within the realm of technology and innovation. AI refers to the development of systems and algorithms that enable computers to perform tasks that typically require human intelligence, such as problem-solving, learning, and decision-making. It focuses on creating intelligent machines that can mimic cognitive functions. On the other hand, research encompasses a broader scope, involving systematic investigation, experimentation, and analysis aimed at expanding knowledge in various fields. While AI often serves as a tool within research endeavors, research itself involves the exploration of new ideas, theories, and methodologies across disciplines beyond AI. Research can involve AI techniques to

***Corresponding author**: Asmaa, D., Email: a.dehkal@univ-mascara.dz*
Submitted: 09 November 2024, Revised: 18 December 2024, Accepted: 23 January 2025

advance its objectives, but it also encompasses areas unrelated to AI, such as scientific, social, or humanities research. In essence, AI is a subset of the broader landscape of research, representing a specialized field dedicated to creating intelligent systems.

First, we will try to define the research, then we will compare the two approaches to end the research paper with an example in the field of econometrics

I. Meaninig and Definitions of Research

Word 'Research' is comprises of two words : « Re » and « Search ». It means to search again. So research means a systematic investigation or activity to gain new knowledge of the already existing facts (Pandey.P & Pandey.M.M, 2015, p. 8).

So, Research is a systematic, formal and intensive process of carrying on the scientific method of analysis There are many ways of obtaining knowledge. They are intuition, revelation, and authority, logical manipulation of basic assumptions, informed guesses, observation, and reasoning by analogy. One of the branches of research known as empirical research is highly goal-oriented technique (Pandey.P & Pandey.M.M, 2015, p. 10).

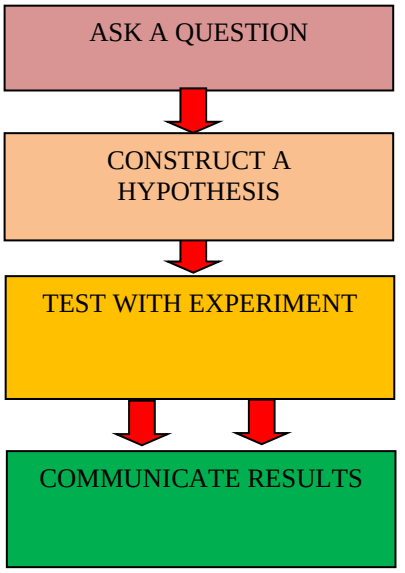
We will present some famous definitions of research :

1. For Redman & Mori, "Research is a systematic effort to gain new knowledge."
2. P.V. Younge, "Social research may be defined as a scientific undertaking which by means of logical and systematized techniques aims to discover new facts or verify and test old facts, analyse their sequences, interrelationships and casual explanation which were derived within an appropriate theoretical frame of reference, develop new scientific tools, concepts and theories which would facilitate reliable and valid study of human behavior."
3. J. Francis Rummel, "Research is an endeavor / attempt to discover, develop and verify knowledge. It is an intellectual process that has developed over hundreds of years ever changing in purpose and form and always researching to truth."

II. Comparative study between classical method and AI

The scientific method serves as a structured approach to investigation, facilitating the exploration of observations and the pursuit of answers to questions through experimentation. The interactive diagram below present the scientific method and how it is applied to an experiment.

Diagram 01:



The scientific method didn't emerge from a single mind but evolved over centuries of deliberation on the most effective means of unraveling the mysteries of the natural world. Aristotle[1], advocated for the application of observation and reasoning in deciphering nature's workings, laying a foundational principle. Hasan Ibn al-Haytham, or Alhazen, an Arab Muslim mathematician and scientist, is often credited as the pioneer who emphasized the significance of experimentation. Subsequently, a diverse array of scholars like Roger Bacon, Thomas Aquinas, Galileo Galilei, Francis Bacon, Isaac Newton, John Hume, and John Stuart Mill contributed to the discourse on scientific methodology, shaping our contemporary understanding. Today's scientists persist in advancing and honing the scientific method through innovative techniques and exploration into new realms of science.

Today we are witnessing a fundamental revolution in the field of technology, And with the appearance of Artificial intelligence[2], which has worked on transforming scientific research as well as everyday life, from communications to transportation to health care and more (CAITECH, 2024).

As for the uses of artificial intelligence that have amazed machine users, they have gone beyond what is known and are now being used in sensitive fields that can dispense with humans. While scientists and engineers explore AI's potential to advance discovery and technology, smart technologies also directly influence our daily lives. Already, AI is used in medicine, transportation, robotics, science, education, the military, surveillance, finance and its regulation, agriculture, entertainment, retail, customer service, and manufacturing.

---

[1] Ancient Greek philosopher

[2] It originated in the 1950s and can be used to describe any application or machine that mimics human intelligence. This includes both simple programs, such as a virtual checkers player, and sophisticated machines, such as self-driving cars.

Experts in AI expect it to become ever more influential in our lives, a transformation that raises hopes and concerns.

Artificial intelligence, commonly abbreviated as AI, has become a topic of intense interest and debate. The widespread adoption of technologies such as ChatGPT (GPT = generative pre-trained transformer), developed by OpenAI, reflects this growing fascination. With over 100 million users worldwide, ChatGPT represents a significant segment of the global population. Despite receiving numerous accolades for its innovation, concerns linger about the potential misuse of AI. Critics argue that AI might be exploited for malevolent purposes, leading to job displacement, dissemination of inaccurate information, and even facilitating academic or professional dishonesty. Reports of such incidents have surfaced in the short period since the emergence of recent AI chatbots. Amidst these apprehensions, there arises a pressing need to explore the constructive applications of AI, particularly in fields like scientific paper writing (Ciaccio.E.J, 2023). Artificial intelligence tools for higher education and scientific research professionals, which is easy to handle and gives its user time :

- Gradescope
- Quillbot
- Ai algorithm selection
- Duolingo
- Learning management system
- Adaptive learning
- Carnegie Learning
- ClassPoint AI
- Grammarly
- OpenAI (CHATGPT)
- Canva
- Cognii
- Content creation tools
- Education Copilot
- Querium Corporation
- SlidesAI
- Smart Sparrow
- Turnitin
- TutorMe
- Formative AI
- Knowji
- Curipod
- Ivy chatbot
- Quizizz

III. Academic Writing and AI (CHATGPT) – An Applied Example Of Econometrics

In first time, Econometrics is *the application of statistical and mathematical models to economic data for the purpose of* testing theories, hypotheses, and future trends (investopedia, 2023).

Econometrics[3], as a discipline, serves as a vital bridge between economic theory and empirical analysis. By employing a wide array of statistical techniques, econometricians aim to rigorously test and refine economic theories using real-world data. These methods encompass a range of tools including frequency distributions, probability theory, statistical inference, correlation analysis, and regression analysis. Through the careful application of these techniques, econometricians can derive meaningful insights into economic phenomena, uncover causal relationships, and inform policy decisions.

- **Example**

We want to study the impact of education on economic well-being according to the autoregressive distributed gaps (ARDL) model,

- **Method with eviews 12**

The first step to econometric methodology is to obtain and analyze a set of data and define a specific hypothesis that explains the nature and shape of the set. This data may be, for example, the historical prices for a stock index, observations collected from a survey of consumer finances, or unemployment and inflation rates in different countries. Then, we might test the idea with the dependent variable and the independent. Third step we choose a model like Regression Models. We follow the following steps :

1. **Data of study**

The variables of the study include the per capita share of the total raw local Nang, which was estimated as a dependent variable that expresses economic well-being, in addition to estimating the independent variables. In our study, we relied on the Human Development Index, public expenditures directed to education, and the number of students enrolled in primary and secondary education. Annual time series were determined for the period extending from 1990-2021

2. **Study of the stability of time series**

The goal of this step is to determine the existence of a relationship in the long run, and accordingly we test the unit root using the augmented Dickey Fuller Test.

3. **Test Bonds test ARDL**
4. **Estimation results in the short and long term**
5. **Model equation according to ARDL methodology**

We extract the equation from eviews 12

PIBH = C(1)*PIBH(-1) + C(2)*PIBH(-2) + C(3)*PIBH(-3) + C(4)*PIBH(-4) + C(5)*IDH + C(6)*IDH(-1) + C(7)*IDH(-2) + C(8)*IDH(-3) + C(9)*IDH(-4) + C(10)*ELEVESECO + C(11)*ELEVESECO(-1) + C(12)*ELEVEPRIM + C(13)*ELEVEPRIM(-1) + C(14)*ELEVEPRIM(-2) + C(15)*ELEVEPRIM(-3) + C(16)*DEPEDU + C(17)*DEPEDU(-1) + C(18)*DEPEDU(-2) + C(19)

6. **Determine the optimal number of lag periods for variables**

[3] Econometrics was pioneered by Lawrence Klein, Ragnar Frisch, and Simon Kuznets. All three won the Nobel Prize in economics for their contributions.

Table 01 : optimal number of lag periods for variables

Dependent Variable: PIBH
Method: ARDL
Date: 05/06/23 Time: 21:35
Sample (adjusted): 1994 2021
Included observations: 28 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): IDH DEPEDU ELEVEPRIM ELEVESECO
Fixed regressors: C
Number of models evalulated: 2500
Selected Model: ARDL(4, 4, 2, 3, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
PIBH(-1)	0.429578	0.280399	1.532025	0.1599
PIBH(-2)	-1.303013	0.543294	-2.398358	0.0400
PIBH(-3)	-0.413498	0.461970	-0.895076	0.3941
PIBH(-4)	0.411992	0.264026	1.560422	0.1531
IDH	-8.281635	5.035282	-1.644721	0.1344
IDH(-1)	6.696219	3.981689	1.681753	0.1269
IDH(-2)	18.31725	9.575333	1.912962	0.0880
IDH(-3)	-1.580906	3.600778	-0.439046	0.6710
IDH(-4)	-6.648201	2.610637	-2.546582	0.0314
DEPEDU	-0.094776	0.097109	-0.975974	0.3546
DEPEDU(-1)	0.036457	0.065880	0.553386	0.5935
DEPEDU(-2)	0.135939	0.060653	2.241240	0.0517
ELEVEPRIM	-0.380451	0.401700	-0.947104	0.3683
ELEVEPRIM(-1)	-0.239371	0.336935	-0.710437	0.4954
ELEVEPRIM(-2)	0.565654	0.273926	2.064992	0.0689
ELEVEPRIM(-3)	0.190924	0.171760	1.111570	0.2951
ELEVESECO	-0.166691	0.249225	-0.668837	0.5204
ELEVESECO(-1)	-0.836848	0.397299	-2.106343	0.0645
C	21.05757	15.18980	1.386297	0.1990

R-squared	0.996151	Mean dependent var	8.333728
Adjusted R-squared	0.988452	S.D. dependent var	0.150508
S.E. of regression	0.016174	Akaike info criterion	-5.188652
Sum squared resid	0.002354	Schwarz criterion	-4.284656
Log likelihood	91.64113	Hannan-Quinn criter.	-4.912292
F-statistic	129.3896	Durbin-Watson stat	2.460479
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

Source: Reviews 12

7. The error correction model, the short-run relationship, and the long-run relationship form of the ARDL model

Table 02 : Estimating the autoregressive model for distributed time gaps (1, 3, 2, 4, 4)

ARDL Cointegrating And Long Run Form
Dependent Variable: PIBH
Selected Model: ARDL(4, 4, 2, 3, 1)
Date: 05/06/23 Time: 21:41
Sample: 1990 2021
Included observations: 28

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PIBH(-1))	1.304520	0.543276	2.401211	0.0398
D(PIBH(-2))	0.001506	0.403207	0.003736	0.9971
D(PIBH(-3))	-0.411992	0.264026	-1.560422	0.1531
D(IDH)	-8.281635	5.035282	-1.644721	0.1344
D(IDH(-1))	-18.317246	9.575333	-1.912962	0.0880
D(IDH(-2))	1.580906	3.600778	0.439046	0.6710
D(IDH(-3))	6.648201	2.610637	2.546582	0.0314
D(DEPEDU)	-0.094776	0.097109	-0.975974	0.3546
D(DEPEDU(-1))	-0.135939	0.060653	-2.241240	0.0517
D(ELEVEPRIM)	-0.380451	0.401700	-0.947104	0.3683
D(ELEVEPRIM(-1))	-0.565654	0.273926	-2.064992	0.0689
D(ELEVEPRIM(-2))	-0.190924	0.171760	-1.111570	0.2951
D(ELEVESECO)	-0.166691	0.249225	-0.668837	0.5204
CointEq(-1)	-1.874942	0.661387	-2.834862	0.0196

Cointeq = PIBH - (4.5349*IDH + 0.0414*DEPEDU + 0.0729*ELEVEPRIM -0.5352*ELEVESECO + 11.2311)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
IDH	4.534926	1.105894	4.100686	0.0027
DEPEDU	0.041399	0.068712	0.602498	0.5617
ELEVEPRIM	0.072938	0.157133	0.464184	0.6535
ELEVESECO	-0.535238	0.187503	-2.854554	0.0189
C	11.231055	5.201899	2.159030	0.0592

Source: Reviews 12

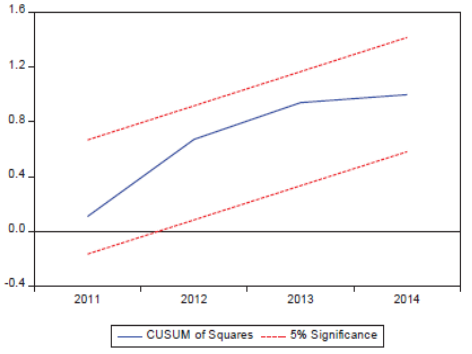
Based on the results of the error correction estimation, there is a short-term dynamic relationship between the GDP per capita and the explanatory variables, and this is due to the estimated error, which is negative and statistically significant. The error correction factor (-1.87) measures the speed of returning to equilibrium in the long run, which confirms the existence of a long-term equilibrium relationship between variables.

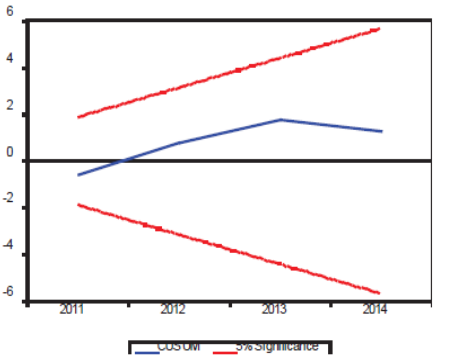
8- Model stability test

In this step, we relied on two tests of the structural stability of short- and long-term transactions:

- Testing the cumulative sum of recursive residuals (CUSUM).
- Testing the Cumulative Sum of Squares of Residual Residuals (CUSUM of Squares).

The results of the two tests are shown in the following two figures:



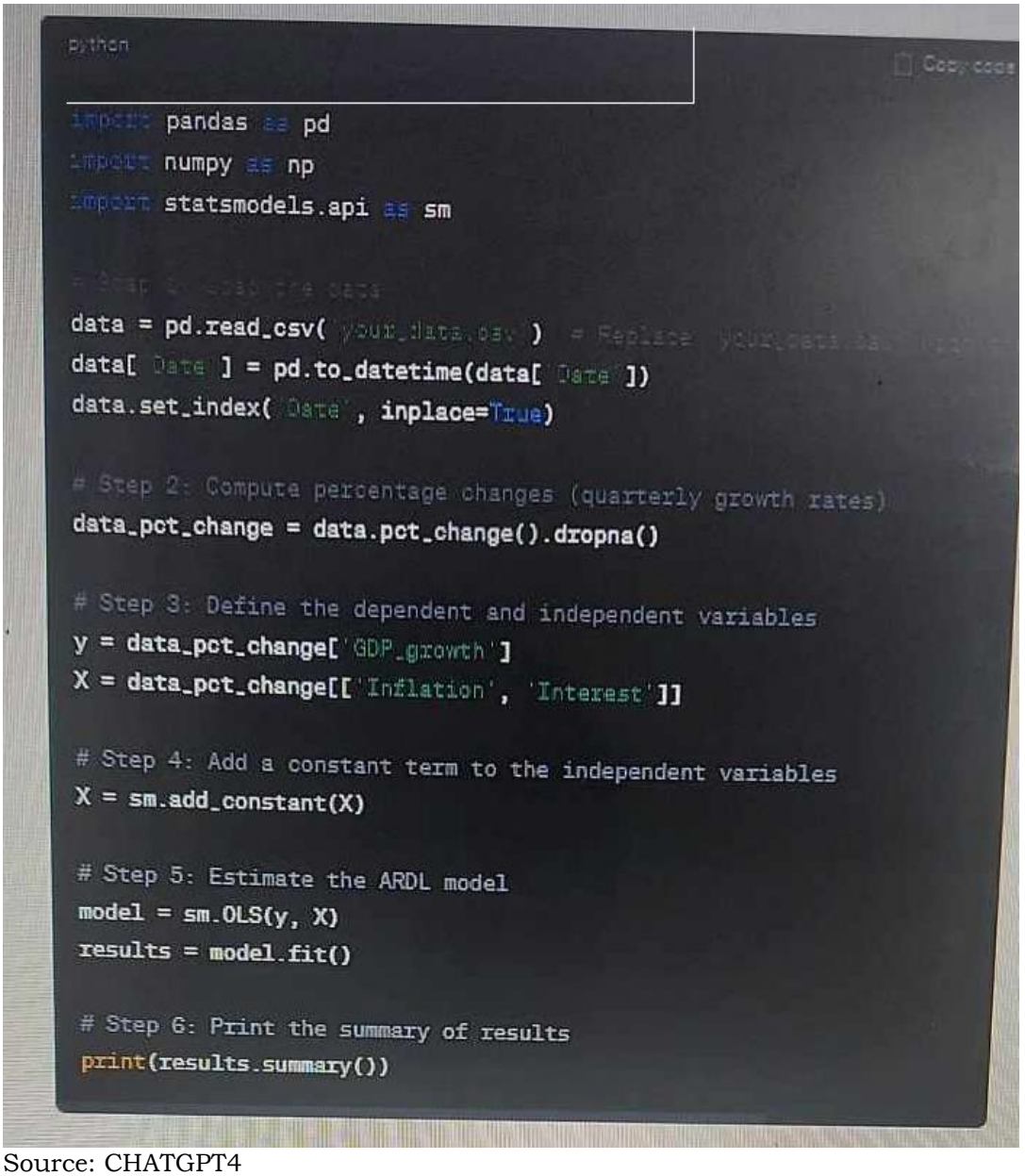


Source: Reviews 12

As previously mentioned, there are several steps in the model through which the researcher uses his gains in the field of statistics. And applies it in the program (eviews 12)

- **Method with CHATGPT 4.0**

ChatGPT-4.0 is an advanced language model developed by OpenAI. It has been trained on a vast amount of text data and can generate human-like responses to a wide range of prompts and questions. With its enhanced capabilities, ChatGPT-4.0 can understand complex queries, provide accurate information, and offer valuable insights in the domain of econometrics (Laurent.S, 2023). Let's consider a real-world example of using the ARDL model to study the relationship between inflation, interest rates, and GDP growth in Algeria. here's an example of how you could implement the ARDL model using Python with the '**statsmodels'** library:



```python
import pandas as pd
import numpy as np
import statsmodels.api as sm

# Step 1: Load the data
data = pd.read_csv('your_data.csv')  # Replace 'your_data.csv' with your file path
data['Date'] = pd.to_datetime(data['Date'])
data.set_index('Date', inplace=True)

# Step 2: Compute percentage changes (quarterly growth rates)
data_pct_change = data.pct_change().dropna()

# Step 3: Define the dependent and independent variables
y = data_pct_change['GDP_growth']
X = data_pct_change[['Inflation', 'Interest']]

# Step 4: Add a constant term to the independent variables
X = sm.add_constant(X)

# Step 5: Estimate the ARDL model
model = sm.OLS(y, X)
results = model.fit()

# Step 6: Print the summary of results
print(results.summary())
```

Source: CHATGPT4

1. **Load the data : we** use Pandas to read the dataset from a CSV file named '**your_data.csv**'. Adjust the filename/path as per your dataset.
   The dataset is assumed to have a column named '**Date**' containing dates and other columns such as '**GDP_growth**', '**Inflation**', and '**Interest**' representing the variables of interest.
2. **Compute percentage changes**
   We compute the percentage changes (quarterly growth rates) for each variable using the' **pct_change'** method in Pandas.

‘**dropna’** is called to remove any rows with missing values that result from computing percentage changes.

3. **Define the dependent and independent variables**
   We define the dependent variable (**y**) as '**GDP_growth**', which represents the quarterly growth rate of GDP
   The independent variables (**X**) include '**Inflation**' and '**Interest**', representing the quarterly growth rates of inflation and interest rates, respectively.
4. **Add a constant term**
   We add a constant term to the independent variables using **sm.add_constant()**. This ensures that the regression model includes an intercept term.
5. **Estimate the ARDL model**
   We use Ordinary Least Squares (OLS) regression from the **statsmodels** library to estimate the ARDL model
   The OLS model is specified using **sm.OLS(y, X)** where **y** is the dependent variable and **X** is the matrix of independent variables.
6. **Print the summary of results**
   We print the summary of regression results using **results.summary()**. This provides information such as coefficients, standard errors, t-statistics, p-values, and goodness-of-fit statistics.
   Make sure to replace '**your_data.csv**' with the actual path to your dataset file. Also, ensure that you have the necessary libraries (**pandas**, **numpy**, **statsmodels**) installed in your Python environment. You can install them using pip if needed.

Source: CHATGPT4.0

This code provides a basic framework for estimating the ARDL model in Python. Adjustments may be needed based on your specific dataset and analysis requirements. Additionally, consider adding further diagnostics and checks for model assumptions to ensure the validity of your results.

For this application, we used in this article the interpretation of CHATGPT 4.0 « After estimating the ARDL model, it's important to interpret the results to understand the relationship between the variables. Focus on interpreting the coefficients of the independent variables (inflation and interest rates) to assess their impact on GDP growth. A positive coefficient suggests a positive relationship, meaning an increase in the independent variable leads to an increase in GDP growth, while a negative coefficient implies the opposite. Additionally, examine the statistical significance of the coefficients, which is indicated by the associated p-values. A p-value less than a chosen significance level (e.g., 0.05) suggests that the coefficient is statistically significant, meaning the relationship is unlikely to be due to random chance. Furthermore, consider the magnitude of the coefficients to

gauge the strength of the relationship. Finally, assess the overall fit of the model by examining goodness-of-fit statistics such as R-squared, which measures the proportion of variance in the dependent variable explained by the independent variables ».

With couples of clicks we obtain our model.

IV. Discussions and Conclusion

Your outlined benefits of using ChatGPT-4.0 in econometrics programming highlight its potential to significantly enhance various aspects of research and analysis in the field. Here's a more detailed expansion on the benefits and considerations:

Enhanced Data Manipulation: ChatGPT-4.0 can indeed streamline data manipulation tasks, allowing researchers to focus more on analysis rather than data cleaning and organization. With its assistance, researchers can efficiently handle large datasets, saving time and ensuring data integrity.

Syntax Assistance: Real-time syntax assistance provided by ChatGPT-4.0 can be invaluable, especially for researchers who may not be as familiar with programming languages or specific software packages. It can help prevent syntax errors and improve code efficiency.

Model Development and Estimation: ChatGPT-4.0's guidance in model development and estimation is particularly beneficial for researchers navigating the complexities of econometric analysis. Its insights can aid in selecting appropriate models, addressing common issues, and interpreting results accurately.

Advanced Techniques and Algorithms: The ability of ChatGPT-4.0 to provide insights into advanced econometric techniques and algorithms can empower researchers to explore cutting-edge methods and broaden their analytical toolkit.

Code Optimization: Optimization of code is crucial for efficiency in programming, and ChatGPT-4.0's suggestions for code optimization can help researchers improve the performance of their scripts and algorithms.

Integration of Multiple Tools: ChatGPT-4.0's assistance in integrating multiple software tools can streamline workflows and facilitate seamless data analysis across different platforms.

However, it's important to acknowledge the limitations of ChatGPT-4.0 and exercise caution in relying solely on its suggestions. While it can provide valuable assistance, researchers should validate its suggestions, especially when it comes to critical decisions in data analysis and interpretation. Additionally, ensuring the systematic testing of generated code and maintaining a strong understanding of econometrics principles and programming languages remain essential for robust research outcomes.

Which requires adherence and always referring to academic methodological research.

References Sources

CAITECH. (2024). *California Institute of Technology*. Consulted 02 10, 2024, sur https://scienceexchange.caltech.edu/topics/artificial-intelligence-research/artificial-intelligence-vs-machine-learning

Ciaccio.E.J. (2023). Use of artificial intelligence in scientific paper writing. *ELSEVIER , 41*, 02.

investopedia. (2023). Consulted 02 10, 2024, on https://www.investopedia.com/terms/e/econometrics.asp

Laurent.S. (2023). *timberlake*. Consulted 02 10, 2024, on https://www.timberlake.co.uk/news/chatgpt-4-0/

Pandey.P, P., & Pandey.M.M. (2015). RESEARCH METHODOLOGY:TOOLS AND TECHNIQUES. (B. CENTER, Éd.) 118.

OPEN AI, https://chat.openai.com/