

## Using MATLAB Statistics Toolbox for Data Analysis in Social Sciences with Chat GPT-3 prompts

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**Abstract:** This paper explores the potential usage of ChatGPT-3, a powerful language model developed by OpenAI, within the MATLAB Statistical Toolbox (ST) for social science research. ChatGPT-3 is a highly advanced model that has shown remarkable performance in a wide range of natural language processing tasks. However, its usage in social science research is still relatively new and has not been widely explored. The main advantage of using ChatGPT-3 in social science research is its ability to process large amounts of unstructured text data, which is becoming increasingly prevalent in social science research. However, there are also some potential disadvantages to using ChatGPT-3, such as its complexity, lack of interpretability, and proprietary nature. This paper aims to provide an overview of the current state of ChatGPT-3 usage in social science research and to discuss the potential advantages and disadvantages of using this model within MATLAB ST. This paper, it is aimed to show how ChatGPT-3 can assist social science researchers in MATLAB ST in the processing of their datasets. Because data analysis can be challenging for social science researchers for several reasons as social science data can often be complex, with multiple variables and multiple levels of analysis. This can make it difficult to analyze and interpret the data in a meaningful way. Therefore, some sample hints, where ChatGPT-3 prompts are used to handle such statistical operations in MATLAB ST, are provided. The comments that ChatGPT-3 gives out are analyzed. It is believed that ChatGPT-3 will be a good assistant for social science researchers in MATLAB ST.

**Keywords:** ChatGPT-3, MATLAB ST in social science, data analysis, Artificial intelligence.

### ChatGPT-3 Sorguları ile Sosyal Bilimlerde Veri Analizi için MATLAB İstatistik Araç Kutusu Kullanımı

**Öz:** Bu makale, OpenAI tarafından geliştirilen güçlü bir dil modeli olan ChatGPT-3'ün sosyal bilim araştırmaları için MATLAB İstatistik Araç Kutusu (İAK) içindeki potansiyel kullanımını araştırmaktadır. ChatGPT-3, çok çeşitli doğal dil işleme görevlerinde dikkate değer performans gösteren oldukça gelişmiş bir modeldir. Bununla birlikte, sosyal bilim araştırmalarında kullanımı hala nispeten yenidir ve geniş çapta araştırılmamıştır. ChatGPT-3'ü sosyal bilim araştırmalarında kullanmanın temel avantajı, sosyal bilim araştırmalarında giderek yaygınlaşan büyük miktarlarda yapılandırılmamış metin verilerini işleyebilmesidir. Ancak, ChatGPT-3'ü kullanmanın karmaşıklığı, yorumlanamazlığı ve tescilli doğası gibi bazı potansiyel dezavantajları da vardır. Bu makale, sosyal bilim araştırmalarında ChatGPT-3 kullanımının mevcut durumuna genel bir bakış sunmayı ve bu modeli MATLAB İAK içinde kullanmanın potansiyel avantajlarını ve dezavantajlarını tartışmayı amaçlamaktadır. Bu yazıda, ChatGPT-3'ün sosyal bilim araştırmacılarına MATLAB İAK 'da veri kümelerini işlemelerinde nasıl yardımcı olabileceğinin gösterilmesi amaçlanmaktadır. Çünkü veri analizi, sosyal bilim araştırmacıları için, sosyal bilim verilerinin çoğu zaman birden çok değişken ve birden çok analiz düzeyi ile karmaşık olabilmesi gibi çeşitli nedenlerle zorlayıcı olabilir. Bu, verilerin anlamlı bir şekilde analiz edilmesini ve yorumlanmasını zorlaştırabilir. Bu nedenle, MATLAB İAK 'da bu tür istatistiksel işlemleri işlemek için ChatGPT-3 istemlerinin kullanıldığı bazı örnek ipuçları sağlanmaktadır. ChatGPT-3'ün verdiği yorumlar analiz edilir. ChatGPT-3'ün MATLAB İAK 'da sosyal bilim araştırmacıları için iyi bir yardımcı olacağına inanılmaktadır.

**Anahtar kelimeler:** ChatGPT-3, sosyal bilimlerde MATLAB İAK, veri analizi, Yapay zeka.

#### 1. Introduction

Statistical Package for the Social Sciences (SPSS) is a popular software for data analysis in the social sciences. SPSS provides a wide range of statistical tools and techniques for analyzing and interpreting data. SPSS performs complex statistical analyses, including regression, factor analysis, and analysis of variance (ANOVA). It also has a range of visualization tools, including histograms, scatterplots, and box plots, which can be used to display and interpret data. However, it is worth noting that SPSS is not the only software available for data analysis in the social sciences. Other popular options include MATLAB, SAS, Stata, and R, each of which has its unique features and capabilities.

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The statistical toolbox (ST) in MATLAB is a powerful tool for analyzing and interpreting data in the social sciences. This toolbox contains a wide range of functions for statistical analysis, including regression, hypothesis testing, and ANOVA. One of the primary benefits of using the statistical toolbox in MATLAB for social science research is its ability to handle large datasets. This is particularly important in the social sciences, where data sets can often be quite large and complex. The statistical toolbox in MATLAB allows users to quickly and easily analyze large datasets, making it an efficient and effective tool for data analysis in the social sciences [1]. In addition to its ability to handle large datasets, the statistical toolbox in MATLAB also has several advanced features that make it well-suited for use in the social sciences. For example, it has functions for modeling complex relationships between variables, such as nonlinear regression and multivariate analysis. It also has functions for analyzing categorical data, such as chi-square tests and logistic regression. One of the most widely used functions in the ST in MATLAB is the regression function. This function allows users to fit a model to their data, allowing them to make predictions about future outcomes based on the relationships between variables. This is an important tool for social scientists, as it allows them to test hypotheses about the relationships between variables and to understand how different variables are related to one another.

Up to now, MATLAB ST was widely used in the social sciences and has been applied in a variety of research studies. For example, a study by [2] used the toolbox to analyze data from a survey of attitudes toward climate change. They found that the toolbox was able to handle the large data set and that the results of the analysis were meaningful. Similarly, a study by [3] used the toolbox to analyze data from an observational study of child development. They found that the toolbox was able to handle the complex data structure and that the results of the analysis were meaningful. MATLAB was used in advanced statistical analyses such as Bayesian statistics, hidden Markov models, and Monte Carlo simulations [4]. These advanced statistical techniques are not easily available in other statistical software packages, making MATLAB a powerful tool for researchers who require these specific capabilities. MATLAB was used to provide a wide range of visualization tools, including 2D and 3D plots, histograms, and heat maps, which enable researchers to easily explore and understand their data. Furthermore, the ability to create custom plots and visualizations using MATLAB's programming language allows for a high degree of flexibility in data visualization [4]. In the field of survey research, MATLAB can be used to analyze survey data and to conduct statistical analyses such as factor analysis, cluster analysis, and structural equation modeling (SEM) [1,10]. In the field of psychology, MATLAB can be used to analyze behavioral data and to conduct statistical analyses such as mixed-design ANOVA, multiple regression, and logistic regression [5]. In the field of economics, MATLAB can be used to analyze financial data and to conduct statistical analyses such as time series analysis, portfolio optimization, and econometric model building [4]. In the field of sociology, MATLAB can be used to analyze social network data and to conduct statistical analyses such as social network analysis, community detection, and diffusion analysis [6]. ChatGPT-3, which is defined as a language model developed by OpenAI that can generate human-like text, can be used to assist social science researchers in using MATLAB ST by providing explanations and examples of how to use the software. One way that ChatGPT-3 can assist beginners in learning MATLAB ST is by providing a general overview of the software and its capabilities. This could include information on the different features and tools available in MATLAB ST, as well as the types of data that can be analyzed using the software. Another way that ChatGPT-3 could assist social science researchers in using MATLAB ST is by providing the codes for using the software. This could include information on how to enter and process data, perform statistical analyses, and create graphs and charts to illustrate findings. ChatGPT-3 could also provide explanations of statistical concepts and techniques that are relevant to using MATLAB ST, such as t-tests, ANOVA, and regression.

Recently, several new works related to the usage of the ChatGPT-3 has been proposed [7, 8]. Frieder et al. [7] investigated the mathematical abilities of two versions of ChatGPT and GPT-4 using various datasets, including newly released datasets named GHOSTS and miniGHOSTS. The authors aimed to determine if these language models can serve as useful assistants to professional mathematicians and evaluates their performance using fine-grained metrics. Authors reported that ChatGPT is effective for querying mathematical facts and serving as a knowledge base, while GPT-4 performs adequately in undergraduate-level mathematics but struggles with more advanced material. In [8], a thorough investigation of the field of complex systems is offered, with ChatGPT serving as a vehicle for displaying the community's collective knowledge. In order to provide responses that reflect the dominant opinions, concepts, and linguistic expressions present within the community, ChatGPT has been trained to absorb linguistic structures and conventions from a sizable collection of internet texts.

In this paper, we propose to use of ChatGPT-3 prompts for using MATLAB ST for social science researchers. There are several reasons why using ChatGPT-3 may be preferable to using YouTube videos or online courses for using MATLAB ST. First of all, one advantage of using ChatGPT-3 for using MATLAB ST is the ability to customize the learning experience to individual needs and goals. With ChatGPT-3, users can input specific

questions or areas of focus, and the system can provide tailored responses and resources. This can be especially useful for those who have specific learning objectives or need to learn at their own pace. Besides, coding with MATLAB ST for data analysis may not be an easy task for social science researchers and it may also take a quite long time to settle a coding sense in a MATLAB environment. Thus, in this paper, we show that the ChatGPT-3 prompts make it quite easy to write the MATLAB segments for data analysis with ST.

In the next sections, the MATLAB ST and ChatGPT-3 terms are introduced briefly. Then, the data analysis with ChatGPT3 prompts for coding with MATLAB ST is introduced. Finally, several discussions and concluding remarks are given.

## 2. MATLAB Statistical Toolbox

The MATLAB statistical toolbox is a powerful tool for data analysis in the social sciences [9]. It offers a wide range of statistical functions and tools that can be used to analyze data from surveys, experiments, and observational studies. The toolbox includes functions for descriptive statistics, inferential statistics, and linear and nonlinear modeling. In addition, it offers a wide range of visualization tools that can be used to display and interpret data. The toolbox also offers a wide range of statistical models that can be used to analyze data in the social sciences. These models include linear and nonlinear models, mixed-effects models, and survival models. These models can be used to analyze a wide range of research questions, such as the effects of a particular treatment or intervention, the relationship between two or more variables, and the predictors of a particular outcome. One of the strengths of the MATLAB statistical toolbox is its visualization capabilities. The toolbox offers a wide range of visualization tools that can be used to display and interpret data. These tools include histograms, scatter plots, box plots, and 3D plots. These tools can be used to explore the data, identify patterns, and communicate the results of the analysis to others.

## 3. ChatGPT-3

ChatGPT-3 is a language model developed by OpenAI. It is one of the largest and most advanced language models to date, with a capacity of 175 billion parameters, and is capable of generating coherent and coherent text on a wide range of topics [10]. ChatGPT-3 works by processing large amounts of text data and learning patterns and relationships between words and sentences. It uses a machine learning technique called pre-training to build a large neural network model that can predict the next word in a sequence of words based on the words that come before it. Once the model has been pre-trained, it can then be fine-tuned for specific tasks, such as translation, summarization, or text generation. This is achieved through the use of "transformer" architecture, which allows the model to process the input text sequentially and capture long-range dependencies between words and sentences [11]. ChatGPT-3 has a wide range of applications, including language translation, text summarization, question answering, and text generation. It has been used to generate news articles, write code, and even generate poetry and music. In addition to its ability to generate text, ChatGPT-3 can also be used to perform natural language processing tasks, such as named entity recognition and part-of-speech tagging.

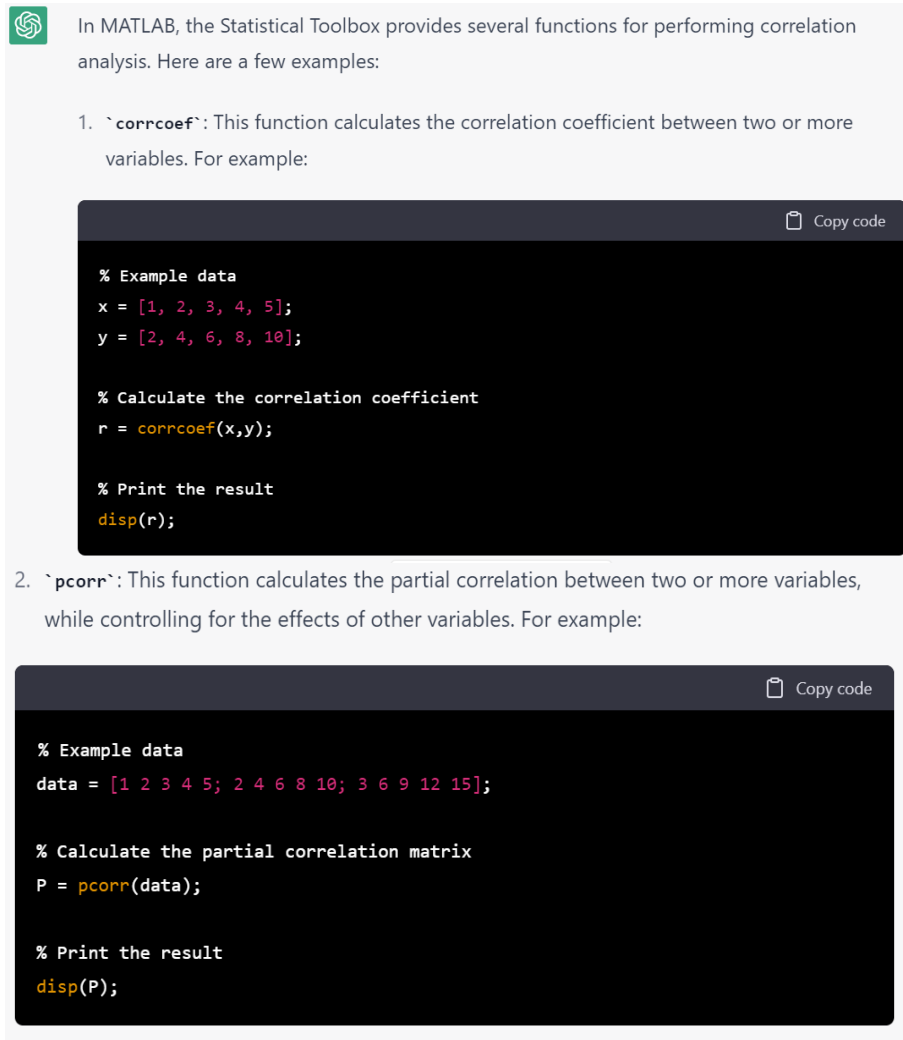
## 4. ChatGPT-3 Prompts for MATLAB ST Analysis

This section introduces several subsections where the ChatGPT-3 prompts are used to help to write the MATLAB ST codes for social science researchers for statistical data analyses. For each section, a brief introduction about the statistical analysis is given and the related ChatGPT-3 prompts and its answer are given, respectively.

### 4.1. Correlation analysis in MATLAB ST

A statistical technique called correlation analysis is used to check the relationship between two continuous variables [13]. It is possible to quantify the strength and direction of a linear link between two variables using a correlation coefficient. The range of the correlation coefficient is from -1 to 1, with -1 denoting a strong inverse association, or the idea that as one variable rises, the other falls. No association between the variables is shown by a value of 0, while a strong positive relationship is indicated by a value of 1, which means that as one variable rises, the other rises as well. The Pearson correlation coefficient, Spearman's rank correlation coefficient, and Kendall's tau are just a few examples of the different correlation coefficients that can be used [14]. When we ask

the ChatGPT-3 “How can I perform correlation analysis with MATLAB Statistical Toolbox?”, its responses as given in Fig. 1.




**Figure 1.** The response of the ChatGPT-3 for the prompt of “How can I perform correlation analysis with MATLAB Statistical Toolbox?”

As seen in Fig. 1, the ChatGPT-3 gives two correlation code examples for two different input datasets. The written codes include explanations for the coders. And the results are shown on the MATLAB screen.

#### 4.2. Regression analysis on MATLAB ST

Regression analysis is a statistical method used to study the relationship between a dependent variable and one or more independent variables [15]. In the social sciences, it is often used to analyze the relationship between a dependent variable such as attitudes, behaviors, or outcomes, and one or more independent variables such as demographic characteristics, socioeconomic status, or other variables that might affect the dependent variable. In addition to predicting the value of the dependent variable based on the values of the independent variables, regression analysis may be used to determine the strength and direction of the link between the dependent and independent variables. It is a method that is frequently used in the social sciences to test hypotheses and comprehend the variables that could affect diverse social phenomena. When a ChatGPT-3 prompt such as “How can I perform regression analysis with MATLAB Statistical Toolbox on a given dataset?”, the following answer is given by it.

 To perform regression analysis on a given dataset using the MATLAB Statistical Toolbox, you will need to follow these general steps:

1. Load the dataset into MATLAB: Use the built-in function `readtable` or `csvread` to load the dataset into MATLAB. For example, if your dataset is stored in a CSV file called "data.csv", you can load it into MATLAB using the following command:

```
data = readtable('data.csv');
```
2. Prepare the predictor and response variables: Depending on the structure of your dataset, you will need to extract the predictor and response variables that you want to use in your regression analysis. For example, if your dataset contains columns called "x" and "y", you can extract them as follows:

```
x = data.x;  
y = data.y;
```
3. Perform the regression analysis: Use the appropriate function from the Statistical Toolbox to perform the regression analysis. For example, you can use the `regress` function to perform a linear regression analysis:

```
b = regress(y,x);
```
4. Examine the results: After the regression analysis is complete, you can examine the results by printing the coefficients, or by plotting the data and the regression line. For example:

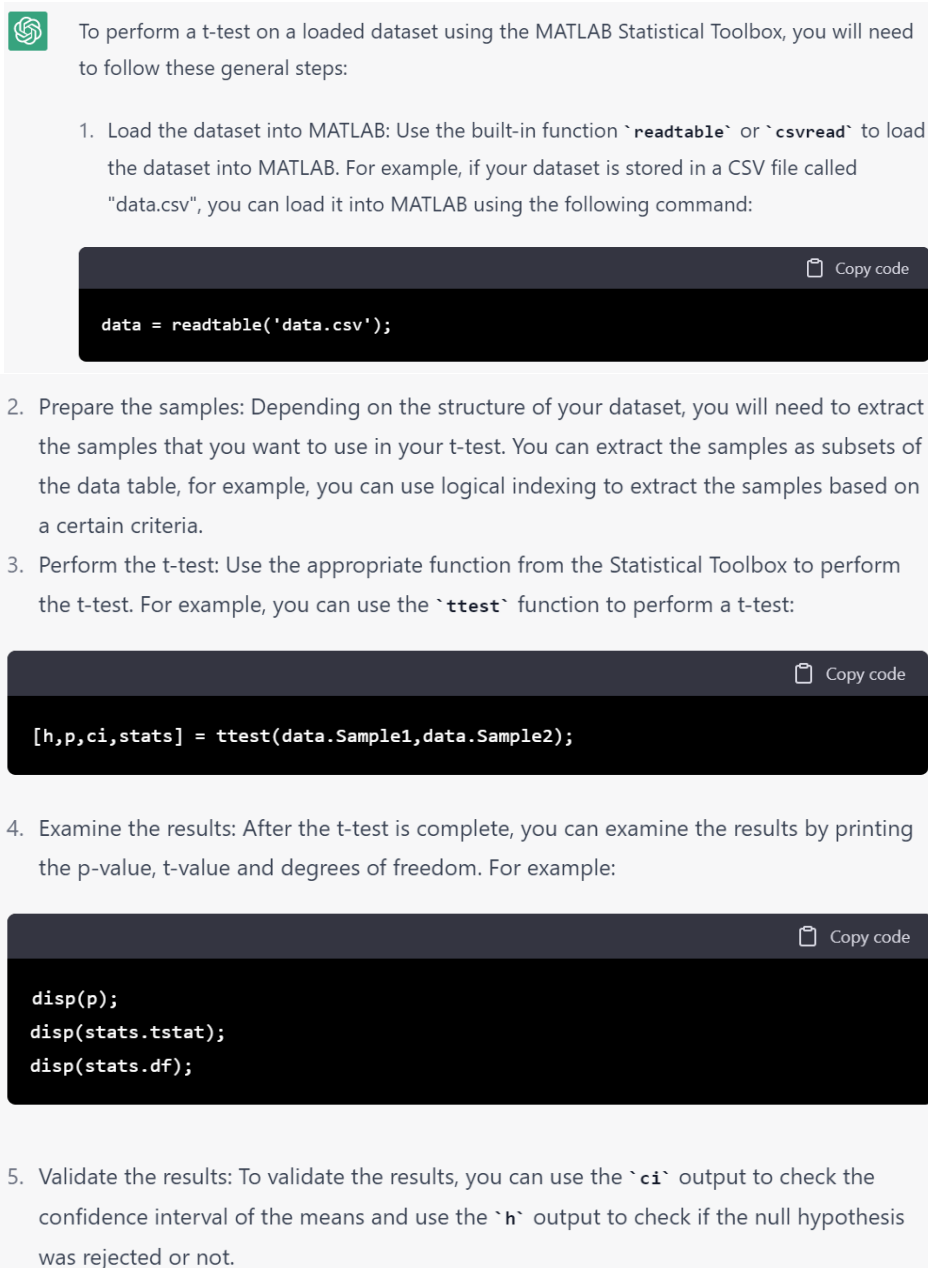
```
disp(b);
```
5. Validate the results: To validate the results, you can use the `residuals` function to check the residuals of the model, and use the `rsquare` function to check the R squared value of the model.

Please note that this is just a general outline and the specific steps may vary depending on the structure of your dataset and the type of regression analysis you want to perform. Also, the dataset you are using might be big and might require preprocessing and cleaning before applying the regression.

**Figure 2.** The response of the ChatGPT-3 for the prompt of “How can I perform regression analysis with MATLAB Statistical Toolbox on a given dataset?”

### 4.3. t-test with MATLAB ST

To evaluate whether there is a significant difference between the means of the two groups, a t-test is a statistical test that is employed [16]. The means of two groups on a certain variable are frequently compared in the social sciences. When the population variance is unknown, the t-test uses the t-distribution, a probability distribution, to describe the distribution of sample mean values. The t-test provides a test statistic that can be used to assess the likelihood that the difference between the means of the two groups is the result of chance when the sample size is small and the population variance is unknown.



The screenshot shows a chat interface with a green OpenAI logo icon. The text reads: "To perform a t-test on a loaded dataset using the MATLAB Statistical Toolbox, you will need to follow these general steps:"

1. Load the dataset into MATLAB: Use the built-in function `readtable` or `csvread` to load the dataset into MATLAB. For example, if your dataset is stored in a CSV file called "data.csv", you can load it into MATLAB using the following command:
 

```
data = readtable('data.csv');
```
2. Prepare the samples: Depending on the structure of your dataset, you will need to extract the samples that you want to use in your t-test. You can extract the samples as subsets of the data table, for example, you can use logical indexing to extract the samples based on a certain criteria.
3. Perform the t-test: Use the appropriate function from the Statistical Toolbox to perform the t-test. For example, you can use the `ttest` function to perform a t-test:
 

```
[h,p,ci,stats] = ttest(data.Sample1,data.Sample2);
```
4. Examine the results: After the t-test is complete, you can examine the results by printing the p-value, t-value and degrees of freedom. For example:
 

```
disp(p);
disp(stats.tstat);
disp(stats.df);
```
5. Validate the results: To validate the results, you can use the `ci` output to check the confidence interval of the means and use the `h` output to check if the null hypothesis was rejected or not.

**Figure 3.** The response of the ChatGPT-3 for the prompt “How can I perform a t-test with MATLAB Statistical Toolbox on a loaded dataset?”

There are several different types of t-tests, including the one-sample t-test, the independent samples t-test, and the paired samples t-test. The specific type of t-test that is used will depend on the research question and the characteristics of the data. Fig. 3 shows the response of the ChatGPT-3 when we ask “How can I perform a t-test with MATLAB Statistical Toolbox on a loaded dataset?”. As seen in Fig. 3, the ChatGPT-3 produces a series of steps for performing the t-test on MATLAB. It also gives a paragraph where some important related notes about the t-test are described.

#### 4.4. ANOVA with MATLAB ST

ANOVA is a statistical technique used to compare the means of two or more groups [17]. It is used to determine whether there are significant differences between the means of the groups, and if so, where those differences lie. There are several types of ANOVA, namely one-way ANOVA, two-way ANOVA, and repeated-measures ANOVA, respectively. While the one-way ANOVA is used to compare the means of two or more groups on a single continuous dependent variable, the two-way ANOVA is used to compare the means of two or more groups on two different independent variables. The repeated-measures ANOVA is also used to compare the means of two or more groups on a single dependent variable, where each subject is measured multiple times. ANOVA is based on the assumption that the data are normally distributed and that the variances of the groups are equal. In Fig. 4, the response of the ChatGPT-3 is given where we asked “How can I perform ANOVA analysis on MATLAB Statistical Toolbox on a loaded dataset?”.



To perform ANOVA analysis on a loaded dataset in MATLAB's Statistical Toolbox, you can use the `anova1` function. The syntax for this function is as follows:

```
[p,tbl,stats] = anova1(y,group)
```

Where:

- `y` is the data vector or matrix to be analyzed,
- `group` is a vector or cell array of grouping variables.

For example, if your data is stored in a matrix called "data" and the grouping variable is stored in a vector called "groups", you would use the following command:

```
[p,tbl,stats] = anova1(data, groups)
```

This will perform an ANOVA analysis on the data, using the groups variable to divide the data into different groups for comparison. The p-value, ANOVA table and statistics will be returned in the variables `p`, `tbl` and `stats` respectively.

**Figure 4.** The response of the ChatGPT-3 for the prompt of “How can I perform ANOVA analysis on MATLAB Statistical Toolbox on a loaded dataset?”

#### 5. Discussions

ChatGPT-3, as a language model, can be used in various ways to support the use of MATLAB's Statistical Toolbox for social science research [18]. ChatGPT-3 can be used to generate code snippets for various statistical

analyses that are commonly used in social science research, such as ANOVA, linear regression, and factor analysis. This can help researchers who are not familiar with MATLAB's syntax to quickly and easily perform the analyses they need. ChatGPT-3 can be used to generate explanations of statistical concepts and techniques that are used in social science research. This can be helpful for researchers who are new to a particular technique or concept and need a quick introduction to it. ChatGPT-3 can be used to generate reports that summarize the results of statistical analyses. This can be helpful for researchers who need to quickly create a report for a grant application or conference presentation. ChatGPT-3 can be used to generate code snippets for creating various types of data visualizations, such as histograms, box plots, and scatter plots, to help researchers explore and understand their data. ChatGPT-3 can be used to guide troubleshooting common issues that researchers may encounter when using MATLAB's Statistical Toolbox, such as how to handle missing data or how to interpret output from a particular function. ChatGPT-3 can be a valuable tool for social science researchers who use MATLAB's Statistical Toolbox by making it easier to perform complex analyses, understand statistical concepts, and communicate results.

Besides, there are a few potential disadvantages of using ChatGPT-3 within MATLAB ST for social science researchers. One disadvantage is that ChatGPT-3 is a highly complex model that may require significant computational resources and expertise to implement and use effectively. Additionally, ChatGPT-3 is a black box model, which means that it is difficult to understand how it is making its predictions and it can lead to a lack of interpretability. Furthermore, ChatGPT-3 is not specifically designed for social science research and may not be well-suited to certain types of data or research questions. Finally, ChatGPT-3 has some difficulties [19]. These difficulties include the model's sporadic difficulties in understanding intricately nuanced contextual nuances, the potential propensity for producing content that is sensitive or inappropriate, obstacles to the seamless maintenance of a coherent conversational trajectory, and the pressing need for meticulous verification of the information it disseminates. The model may also exhibit inclinations toward repetition or prolixity in its responses, and its creative output is prone to following established patterns. The process of clarifying ambiguities, dependent on the wording of input inquiries, coupled with the lack of emotional intelligence, add to the complex interrelationships that underlie the successful application of ChatGPT-3.

## 6. Conclusions

In conclusion, MATLAB is a powerful tool for analyzing data in the social sciences. Its ability to handle large and complex data sets, integrate with other software packages, and provide a wide range of statistical and data analysis functions make it a valuable tool for researchers in the social sciences. Furthermore, the advanced statistical techniques, visualization tools, and flexibility in data visualization available in MATLAB make it a powerful tool for researchers who require specific capabilities. However, its steep learning curve, the difficulty of use for those without a programming background, and high costs are limitations that should be considered when deciding to use MATLAB in a research project. Despite these limitations, the advantages that MATLAB provides in terms of data manipulation, visualization, advanced statistical techniques, and integration with other software packages make it a valuable tool for researchers in the social sciences.

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