Exploratory Data Analysis (EDA) on Anime Data from MyAnimeList – Project Report

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The following personnel are required to approve this document **The approval of the document implies that it meets the required quality, and is complete**	
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Purpose and guidelines of this Document
Justification of comprehension of project scope

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1 Topic Introduction

"Anime" is the term used by Western audiences to describe Japanese animated films and television programs (although it is used to describe any animation in Japan).

At first, animated pieces were known as senga eiga (線画映画, line-drawing film) or senga kigeki (線画喜劇, cartoon comedy film), which were often specified in katakana (cartoon comedy, カートン・コメディ, cartoon comedy).

Between 1907 and 1912 the first animated shorts were made, usually associated with political cartoonists, and in 1933 came the first piece of Japanese animation or spoken Japanese anime, Chikara to Onna Yo no Naka.

It was probably not until 1962 that the word anime began to be used, in a standardized way, in Japan to refer to animated productions. It seems that the film magazine Eiga Hyoron was the first.

During the 1970s some of the most popular anime in the country were born, such as Ashita no Joe (1970, Fuji TV), Arupusu no Shoujo Haiji (Heidi, 1974, Fuji TV), Lupin III (1971, YTV), Gatchaman (1972, Fuji TV), Mazinger Z (1972, Fuji TV), Uchuu Senkan Yamato (1974, YTV), Candy Candy (1976, TV Asahi) or Kidou Senshi Gundam (1979, NBN), but it was not until the 1980s when a real revolution would take place.

The first half of the 1990s saw the emergence of a new type of animation that was ready to blow the brains of viewers and burst the expectations of everything seen until then in cartoons. It was Japanese anime and there is no doubt that the two culprits of this irruption were Dragon Ball and Akira, two authentic bombshells that made us become aware of this new style of animation. These phenomena were accompanied by the arrival of private television stations, with many hours of programming to fill, which were busy with lots of Japanese anime series that were cheap to license. New publishers emerged, acquiring the rights to anime films destined to fill the shelves of video stores in response to this new demand.

Today's teenagers are getting hooked on Japanese anime again. It's happening to them as it happened in the 90s, for example, with Dragon Ball, The Knights of the Zodiac (Saint Seiya) or Chicho Earthquake (Chicho Terremoto - Dash Kappei). Not to mention the Dragon Ball phenomenon. It is true that now there are also many adults who maintain their taste for the series and movies created by the famous Japanese anime studios, and that has an influence.

Anime may be going through one of its best periods in history. The genre has audiences almost everywhere in the world. The stories are reaching diverse audiences and, technology permitting, a series of tools are available to improve manga adaptations or new proposals. A boom.

2 Topic Explanation

Usually when we think of Data Science, Machine Learning or Artificial Intelligence, we think of the models and the wonderful applications, but the first step is usually to explore and clean the data.

The purpose of this EDA is getting insights out of data while exploring it (after doing some Data cleaning/preparation/transformation) in order to answer some previos questions and prove some hypothesis.

The parts in the project are as follows:

- Introduction
- Getting the information
- Data Preparation, Cleaning and Descriptive Analysis
- Data and Visual Analysis
- Conclusions
- Reference

2.1 Structure of the Jupyter File

- Introduction
- Getting the information
- Data Preparation, Cleaning and Descriptive Analysis
    - Importing libraries and checking the raw information
    - Next esteps explanation
    - Cleaning the columns with empty lists
    - About released, Scored_by, Score and Rank
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- Data and visual Analysis
    - One Dimensional-Analysis
        - Numerical Columns
            - N_Episodes
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            - Source
            - Rating
            - Genre
            - Theme
            - Producers
            - Studios
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        - Score and Type
        - Score and Source
        - Score and Number of Episodes
        - Score and Duration of the episodes
        - Score and Rating
        - Score and Genre
        - Score and Theme
        - Score and Producers
        - Score and Studios
- Conclusions

3 Data Collection

The data was collected from the website called MyAnimeList using a unofficial API called Jikan API.

MyAnimeList Website → https://myanimelist.net/

Jikan API → https://docs.api.jikan.moe/

In order to collect it, a script was created (Link).

Imported libraries used in the script:

- import requests, json, os, sys, time
- import pandas as pd
- from datetime import datetime

This script can be used from the jupyter file in case we want to collect data again.

Usually when we make a call to the REST API, we expect to get the entire requested data set. At first the data was collected going anime by anime using ID's. However, this process was taking way too much time. So, some investigation was done and the pagination process was found.

For pagination, if the result includes hundreds or thousands of records, we will likely retrieve the first batch with a limited number of records. This REST API uses the pagination method of splitting data sets into discrete pages – a set of paginated endpoints.

For this reason, in this script there are two loops.

One to go, page by page. (**Annex 1.1**)

The second for loop is to go anime by anime in the page, using a try/except in case there is an error. (**Annex 1.2**)

The main body to collect tha data inside the "Try" generates a dictionary and and append the information to a list. (**Annex 1.3**)

Some of the Keys in the dictionary uses a def due to some of the anime dows not have those fields. (**Annex 1.4**)

After all the information is calledted, we save it in a CSV file. (**Annex 1.5**)

In order to save the file in "src/data" an add the date and time in the name of the csv file, we create the next variables. (**Annex 1.6**)

4 Data Cleaning

The data cleaning process, also known as data scrubbing or data cleansing, can have a huge impact on the reliability and validity of the final data, as it ensures that we are only using the highest-quality data to perform our analysis. By rushing or eliminating the data cleaning step, we run the risk of including false, misleading, or duplicated records in our final dataset. Following a thorough data cleaning process will minimize errors made due to data that is formatted incorrectly.

This of data cleaning, is of utmost importance even though it is time consuming and the least enjoyable task of the data science process.

The process was done as follows:

4.1 Importing libraries and checking the raw information

First we import the necessary libraries and the path variables to folders (**Annex 2.1.1**).

Then we import the dataframe directly from the raw data (**Annex 2.1.2**).

Checking dtype of the columns, the number of null values and percenteage of null values. (**Annex 2.1.3**).

So far now we can see that we can't be completely confident in these results as we can see in the dataframe that there are many columns with empty lists. First, we will have to clean the data, compare it with the previous results to see the change and then we can proceed to analyze.

There are some columns that the information is storage inside a list and we would like to display them by removing brackets and commas from the list. in this way we can later analyze it if needed.

4.2 Next steps explanation

Now we can fully see the work we need to do.

We will remove the column Season due to the high number of missing values.

- In Audience, rating ,Genre, Theme, Studios and Producers we will proceed to change null values to Unknown, due to we do not have that information.
- About released, Scored_by, Score and Rank:
    - Released: We will find the missing values with interpolation
    - Scored_by: We will find the missing values with interpolation
    - Score: We will find the missing values with interpolation
    - Rank: once we have all the values in Scored_by and Score we will use linear regresion to predict the missing values.

- Cover, English_Title and Japanses_Title are not needed, we can also remove these columns.

- Audience column: In the case of Audience, it is basically the Japanese way to classify the people that would watch the anime. From My Anime List a different way of classification (more international style) was created to be more understandable for non japanese. For this reason, we are not going to use Audience and we are going to drop it.

Duration column. We are going to standardize is converting the information into a numeric value representing minutes.

4.3 Cleaning the columns with empty lists

Removing brackets and commas from the columns with lists. (**Annex 2.3.1**)

After doing that, we can see that in the columns "Audience","Genre","Theme","Studios" and "Producers" there are many empty spaces. For the purpose of checking missing data, we will replace them with NaN. However, later we will replace them with "Unknown". (**Annex 2.3.2**)

Let's check again the percenteage of null values. (**Annex 2.3.3**)

4.4 About released, Scored_by, Score and Rank

It is time to deal with the cleaning of Score, Scored_by and Rank values,. We check the number of null values in each of those columns. (**Annex 2.4.1**)

After that we replace teh NaN values to zeros and count how many of them we have. We have 2590 rows with zero values. (**Annex 2.4.2**)

Next we proceed with the interpolation to replace the missing null values in Released, Score and Scored_by. (**Annex 2.4.3**)

It is possible that during the interpolation in scored_by, we suddenly get negative number, so we are going to check the min of Scored_by and in case we have we will convert the Scored_by column to absolute value using abs from numpy. (**Annex 2.4.4**)

Now let's launch the prediction function to replace the zero values in the rank column. We also check how many zero and null values we have now, we can see that we do not have now. (**Annex 2.4.5**)

To finalize with Scored_by, Rank and Released columns, we will chenge the column type to integer. (**Annex 2.4.6**)

4.5 Dealing with Audience and Rating columns

As mentioned before, Audience column is basically the japanese way to classify the people that would watch the anime. From My Anime List a different way of classification (more international style) was created to be more understandable for non japanese.

We can print both columns to see how they are classified, however, the columna audience Will be remove. (**Annex 2.5.1**)

4.6 Removing unnecessary columns

Let's proceed dropping the unnecesary columns for this analysis. (**Annex 2.6.1**)

4.7 Change null values to Unknown

We should not forget to assign Unkowns to all the Nan in the CATEGORICAL VARIABLES columns. (**Annex 2.7.1**)

4.8 Dealing with Zero values in N_Episodes column

Sometimes we do not know the number of episodes or there will be series to be released that they still don't have the decided number of episodes to have.

So, first we check the number of animes with N_Episodes equal to zero

Since the number of animes with zero episodes is low, we can input them without having an impact in the data. (**Annex 2.8.1**)

We are going to Change zero values to the previous column value. (**Annex 2.8.2**)

We check again the number of animes with N_Episodes equal to zero. (**Annex 2.8.3**)

4.9 Standardizing duration column

To finalize, let's change the format in the duration column. Let's leave the columns just with the duration in minutes. (**Annex 2.9.1**)

Now are going to convert the Unknown values to nan in order to be able to interpolate the missing information. (**Annex 2.9.2**)

Replacing zero values to the previous column value. (**Annex 2.9.3**)

4.10 Checking results after the cleaning process

Finally, let's check the result of this cleaning process. As result, we see no null values in the columns and everything looks clean. (**Annex 2.10.1**)

We check the df after being cleaned. (**Annex 2.10.2**)

Let's have a look at the descriptive stats of the records. (**Annex 2.10.3**)

We find out that the max value in Released is 2024, so, let's get the count of values greater than 2022 in the column 'Released to see if this could affect to our analysis. (**Annex 2.10.4**)

4.11 Saving cleaned df using Pickle

We save the file in pickle style for a late review. Why saving it to pickle? Pickle is a serialized way of storing a Pandas dataframe. Basically, you are writing down the exact representation of the dataframe to disk. This means the types of the columns are and the indices are the same. If you simply save a file as csv, you are just storing it as a comma separated list. Depending on your data set, some information will be lost when you load it back up. (**Annex 2.11.1**)

4.12 Opening cleaned df using Pickle

Opening the information from pickle. (**Annex 2.12.1**)

Here is a review of the information got it so far:

Type: There are 7 different categories and the top on is TV.

Source: There are 17 different categories and the top one is Original.

N_Episodes: The average number of episodes is 15 episodes.

Duration: The usual duration of an episode is 24 minutes.

Rating: There are 7 different ratings, and the most common es PG-13 - Teens 13 or older.

Released: There are 206 animes after 2023 for future releases. Because this number is so low we will not allocate them to a different year.

Score: The mean rating of all the anime is around 6.5

For categorical variables, measures like mean, std, quartiles do not make sense, hence those positions are filled using NaN above and for continuous variables, measures like unique, top and frequency don’t make much sense hence those positions are filled using NaN values as well for those respective places.

5 Data and Visual Analysis

For the dataframe, a correlation matrix is made because it has many numerical variables that can be related to each other.
A couple of correlations are detected between score, N_Epsidoes and Duration. They will be analyzed later. (**Annex 3**)

5.1 One Dimensional-Analysis

5.1.1 Numerical Columns

5.1.1.1 N_Episodes

We do a describe and a boxplot to find information about it.
We find that the 75 % of the animes has 13 episodes. This is actually the standard number of episodes for an anime. (**Annex 3.1.1.1**)

5.1.1.2 Duration

First, let's try doing a histplot. (**Annex 3.1.1.2.1**)
At first glance is pretty hard to see using a regular histplot, for this reason we are going to use a logarithmic scale. (**Annex 3.1.1.2.2**)
However, using the logarithmic scale is also pretty hard to ger meaningful information. Let's try a different approach.
We do a .describe() in Duration to check the number of samples, the mean value, the standard deviation, the minimum, maximum, median and the values corresponding to the 25% and 75% percentiles. (**Annex 3.1.1.2.3**)
We have 24105 anime records, 5501 animes with more than 25 minutes and 18604 animes with more than 25 minutes.
For this reason, let's narrow down the graph with anime lower than 26 minutes. (**Annex 3.1.1.2.4**)
Now we can see that the distribution tells us that most of the animes has a duration between 5 and 25 minutes.
However, many of those will belong to OVAS, Specials or Movies, so let's check those to belong to Tv Series (**Annex 3.1.1.2.5**)
Basically, most of the Tv Series animes, 7345 out of 7509, has 25 or less episodes and just 164 with more than 25 minutes. And from those, 6060 have between 10 to 25 minutes.

5.1.1.3 Score

After doing a distplot and a boxplot we can see that Most of the animes are scored between 5 to 8. (**Annex 3.1.1.3.1**) and (**Annex 3.1.1.3.2**)
There are 3938 animes between 5 and 6 points.
There are 15301 animes between 6 and 7 points.
There are 3602 animes between 7 and 8 points.
There are 579 animes between 8 and 9 points. (**Annex 3.1.1.3.3**)

5.1.1.4 Rank

Here we can check the top 20 at the moment. We can see that Bleach: Sennen Kessen-hen is number 1 right now in Total Score and Kaguya-sama wa Kokurasetai is number 3. Both recently released. With time and more votes,

they might keep their position or change it, we wouldn't know for a while. (**Annex 3.1.1.4**)

5.1.1.5 Released

We can see a serious increase in the 80's. At that time, anime became mainstream in Japan, experiencing a boom in production with the rise in popularity of anime like Gundam, Macross, Dragon Ball, and genres such as real robot, space opera and cyberpunk. (**Annex 3.1.1.5.1**)
We can appreciate a decline in releases during 2019 and 2020, this could be duo to the COVID-19 period.
Another possible factor is that during the last years in the anime industry, there are so many copy-and-paste anime. The only difference may be the relationship between characters, slight changes in the plot, and different characters and/or setting. The anime industry has definitely declined in quality and uniqueness throughout the years. However, there are still releasing some great gems that keep the industry still strong, lately examples: My Hero Academia, Attack On Titan, Tokyo Revengers, Jujutsu Kaisen and Kimetsu no Yaiba.
Over here we can see the evolution of type of animes per year. So far TV series were the favorite type from the late 20's, however, since 2020 we can see that ONA is getting more popular. We will need to see what happen in the coming years. (**Annex 3.1.1.5.2**)

5.1.2 Categorical Columns

5.1.2.1 Type

First let's define some of this names:

- Original Net Animation (ONA is an anime that is directly released onto the Internet.
- Original Video Animation (OVA is an animated film or series made specially for release in home-video formats. OVA is created for selling (by Video or DVD). It's intended to the small number of viewer without advertisement. It means more otaku friendly theme.
- Movie are just regular movies of the anime, it could be part of the story or ir could be not.
- TV regular anime series broadcasted on TV.
- Special (aka TV Special) is not weekly. Usually yearly or one shot. It's have only one episode but it had longer length (ex 2 hours). It's still intended for broadcast.
- Music are Anime Music Video (anime music video, better known by the acronym AMV), is a music video generally made with an Anime theme. The main characteristic of AMVs is that they are composed of scenes from one or more anime series or movies accompanied by a song that seeks to synchronize with the rhythm of the latter.

We do a pie plot to see the percentage of each type. (**Annex 3.1.2.1**)
Then we do a value_counts() to see the number for each type.

5.1.2.2 Source

So, what is source material? It's the material that's the source of the story or content used in an anime. Sometimes anime has original stories, which I'll get to in a bit, but often they're based off pre-existing works such as manga, light novels, visual novels, etc.... (**Annex 3.1.2.2.1**)
We can see that most of the anime comes from an original idea (where anime companies write up the plot and design the characters themselves). Manga and game are also a popular source for animes. Of all the anime we have in the list, 24105, there are a total of 14681 that come from an original source, manga or game. This means that 60.90437666685334995 % of the anime belong to this group. (**Annex 3.1.2.2.2**)

5.1.2.3 Rating

These only represent target demographics and don't describe what content is in the anime. (**Annex 3.1.2.3.1**)

- Rated G: General audiences – All ages admitted.
- Rated PG: Parental guidance suggested – Some material may not be suitable for children.
- Rated PG-13: Parents strongly cautioned – Some material may be inappropriate for children under 13.
- Rated R: Restricted – Under 17 requires accompanying parent or adult guardian.
- Rated Rx: Hentai. No one under 18 admitted.
- Rated R+: Means that there is nudity. Restricted – Under 17 requires accompanying parent or adult guardian

PG-13 - Teens 13 or older is the most popular. (**Annex 3.1.2.3.2**)

5.1.2.4 Genre

The different types of anime are in the dozens. If you're an avid watcher of the Big 3 Anime, then you may have come to learn that every show is based on a specific anime genre. (**Annex 3.1.2.4.1**)
Today, anime is available in a wide range of genres such as drama, action, supernatural, and horror, to mention a few. They are made for a young girl or young boy as well as adults. They feature tough female characters and handsome male characters.
We can appreciate that Comedy Genre is the most typical one. (**Annex 3.1.2.4.2**)

5.1.2.5 Theme

Music, School and history theme are the ones with more animes. We remove the unknowns from the countplot to see it better. (**Annex 3.1.2.5**)

5.1.2.6 Producers

Top 10 producers with unknowns and Top 10 producers without unknowns.
NHK, Nippon Hoso Kyokai (Japan Broadcasting Corporation), is the producer with the most anime in the world. However, it is a public entity. So Aniplex would be the first private company that most anime produces.

Really easy to understand why Aniplex is leading the chart. It has tittles like Fullmetal Alchemist: Brotherhood,Sword Art Online, Naruto, Naruto: Shippuuden, Kimetsu no Yaiba, Ao no Exorcist, Nanatsu no Taizai, Bleach, Soul Eater, etc With tittles like this under them, pretty normal that they lead. (**Annex 3.1.2.6**)

5.1.2.7 Studios

Top 10 Studios without unknowns.
Toei Animation is the first private company with the most anime in the world. Not really surprising due to it is a studio nearly as old as anime itself, Toei Animation started as Japan Animated Films in 1948. Becoming a formidable powerhouse in the 1960s, the studio was responsible for classic, influential series such as Dragon Ball, Fist of the North Star, Slam Dunk, Mazinger Z, Galaxy Express 999, One Piece, and Sailor Moon. (**Annex 3.1.2.7**)

5.2 Bi-Dimensional-Analysis

We focus on TV and ONA

In this part we basically do we same steps for each category.
The difference would be with Genre, Theme, Producers and Studios. Those categories could have different items in one cell (because they were lists of items). So, we do a first step of splitting the information, extract the data of a column with respect to another column (so if one cell had more than one producer, we will assign the respective score and scored_by to each of them) and then put them back in a df. Then we do the next 4 steps.

- We can check graphically with a boxplot the Score to see the median.
- Calculate the mean,median, min and max of Score.
- Calculate the mean,median, min and max of Scored_by.
- Check the coefficient of variation of Score and Scored_by.

5.2.1 Score and Type

We do a boxplot to check graphically the information, but it is not clear. (**Annex 3.2.1.1**)
We calculate the mean, median, min and max of Scored_by for each Types. (**Annex 3.2.1.2**)
We calculate the mean, median, min and max of Score for each Types. (**Annex 3.2.1.3**)
We also check the coefficient of variation of Score and Scored_by for each Types. (**Annex 3.2.1.4**)

5.2.2 Score and Source

We do a boxplot to check graphically the information, but it is not clear. (**Annex 3.2.2.1**)
We calculate the mean, median, min and max of Scored_by for each Source. (**Annex 3.2.2.2**)
We calculate the mean, median, min and max of Score for each Source. (**Annex 3.2.2.3**)
We also check the coefficient of variation of Score and Scored_by for each Source. (**Annex 3.2.2.4**)

5.2.3 Score and Rating

We do a boxplot to check graphically the information, but it is not clear. (**Annex 3.2.3.1**)
We calculate the mean, median, min and max of Scored_by for each Rating. (**Annex 3.2.3.2**)
We calculate the mean, median, min and max of Score for each Rating. (**Annex 3.2.3.3**)
We also check the coefficient of variation of Score and Scored_by for each Rating. (**Annex 3.2.3.4**)

5.2.4 Score and Genre

We are going to create an auxiliar dataframe with three columns Genre, Score and Scored_by.
Since the Genre column could have different Genre for one raw, we need to separate and assign to each one of them the respective Score and Scored_by. (**Annex 3.2.4.1**)
We do a boxplot to check graphically the information, but it is not clear. (**Annex 3.2.4.2**)
We calculate the mean, median, min and max of Scored_by for each Genre. (**Annex 3.2.4.3**)
We calculate the mean, median, min and max of Score for each Genre. (**Annex 3.2.4.4**)
We also check the coefficient of variation of Score and Scored_by for each Genre. (**Annex 3.2.4.5**)

5.2.5 Score and Theme

We are going to create an auxiliar dataframe with three columns Theme, Score and Scored_by.
Since the Theme column could have different Theme for one raw, we need to separate and assign to each one of them the respective Score and Scored_by. (**Annex 3.2.5.1**)
We do a boxplot to check graphically the information, but it is not clear. (**Annex 3.2.5.2**)
We calculate the mean, median, min and max of Scored_by for each Theme. (**Annex 3.2.5.3**)
We calculate the mean, median, min and max of Score for each Theme. (**Annex 3.2.5.4**)
We also check the coefficient of variation of Score and Scored_by for each Theme. (**Annex 3.2.5.5**)

5.2.6 Score and Producers

We are going to create an auxiliar dataframe with three columns Producers, Score and Scored_by.
Since the Producers column could have different Producers for one raw, we need to separate and assign to each one of them the respective Score and Scored_by. (**Annex 3.2.6.1**)
We do a boxplot to check graphically the information, but it is not clear. (**Annex 3.2.6.2**)
We calculate the mean, median, min and max of Scored_by for each Producers. (**Annex 3.2.6.3**)

We calculate the mean, median, min and max of Score for each Producers. (**Annex 3.2.6.4**)
We also check the coefficient of variation of Score and Scored_by for each Producers. (**Annex 3.2.6.5**)

5.2.7 Score and Studios

We are going to create an auxiliar dataframe with three columns Studios, Score and Scored_by.
Since the Studio column could have different Studios for one raw, we need to separate and assign to each one of them the respective Score and Scored_by. (**Annex 3.2.7.1**)
We do a boxplot to check graphically the information, but it is not clear. (**Annex 3.2.7.2**)
We calculate the mean, median, min and max of Scored_by for each Studios. (**Annex 3.2.7.3**)
We calculate the mean, median, min and max of Score for each Studios. (**Annex 3.2.7.4**)
We also check the coefficient of variation of Score and Scored_by for each Studios. (**Annex 3.2.7.5**)

6 Hypothesis

We focus on TV and ONA

6.1 Hypothesis 1

[higher number of episodes = higher score]

Let's do a scatterplot to see the relationship between different variables (Score and Duration of the episodes). (**Annex 4.1.1**)

We observe some outliers that do not let us see properly the scatterplot.

There are 144 animes with more than 200 episodes in total. (**Annex 4.1.2**)

Since we have 24 thousand records, we will avoid those 144 animes in the plot. So, we will be able to see it clearly. (**Annex 4.1.3**)

It seems that there is correlation between Score and Number of Episodes. However, let's do some test to prove it.

A Spearman test will be performed to investigate the relationship between Score and Number of Episodes.

I will measure the strength of that relationship. (**Annex 4.1.4**)

A Spearman test is considered as very weak (0 to 0.19)

A Pearson test was performed to investigate the relationship between Score and Number of Episodes Results of the test showed there was a positive, weak correlation between the two variables

Next, we are going to test whether Score and Number of Episodes have a dependency relationship. (**Annex 4.1.5**)

Assumptions:

- Observations in each sample are independent and identically distributed.
- Observations in each sample can be ranked.

Interpretation

- H0: the two samples are independent.
- H1: there is a dependency between the samples.

6.1.1 Conclusion of the Hypothesis 1

After performing the Spearman's dependency test, we have sufficient evidence to reject the null hypothesis and fail to reject the alternative hypothesis.

A Spearman test is considered as very weak (0.20 to 0.39)

Results of the test showed there is a positive, weak correlation/dependency between the two variables

6.2 Hypothesis 2

[longer duration of episodes = higher score]

Let's do a scatterplot to see the relationship between different variables (Score and Duration of the episodes). (**Annex 4.1.1**)

There are 4 animes with a duration of more than 200 minutes. (**Annex 4.1.2**)

We observe 4 outliers that do not let us see properly the scatterplot.

Since there are only 4 outliers, we will discard them from the plotting. (**Annex 4.1.3**)

It seems that there is correlation between Score and Duration of the episodes. However, let's do some test to prove it.

A Spearman test will be performed to investigate the relationship between Score and Duration of the episodes.

I will measure the strength of that relationship. (**Annex 4.1.4**)

The Spearman rank correlation is considered as weak (0.20 to 0.39)

Results of the correlation test showed there was a positive, weak correlation between the two variables

Next, we are going to test whether Score and Duration of the episodes have a dependency relationship. (**Annex 4.1.5**)

Assumptions:

- Observations in each sample are independent and identically distributed (iid).
- Observations in each sample can be ranked.

Interpretation

- H0: the two samples are independent.
- H1: there is a dependency between the samples.

6.2.1 Conclusion of the Hypothesis 2

After performing the Spearman's dependency test, we have sufficient evidence to reject the null hypothesis and fail to reject the alternative hypothesis.

A Spearman test is considered as very weak (0.20 to 0.39)

Results of the test showed there is a positive, weak correlation/dependency between the two variables

7 Other conclusions

Here we are summarized other conclusion we got while doing the analysis.

7.1 From Unidimensional Analysis

7.2 From Numerical One Dimensional-Analysis

Usual length of a series is 11 to 26 episodes

There is a total of 24105 animes, from those, 11040 are Tv Series or ONA.

The number of animes that are Tv Series or ONA with more than 100 episodes is 470 out of 11040. Less or equal to 100 episodes is 10570 out of 11040

Checking the 25th percentile and 75th percentile we get that the Tv Series or ONA animes with less than 100 episodes has between 11 to 26 episodes

The number of animes that are Tv Series or ONA with less or equal to 26 episodes is 7973 out of 11040 and between 1 to 26 is 5378 out of 11040

We can say that 45,8 % of anime are TV Series and ONA, from those:

48,71% has between 11 to 26 episodes

23,51 % les tan 11 episodes

23,52 % between 27 to 100

4,26 % more than 100 episodes

Usual duration of episodes from 15 to 24 minutes duration

Basically, from Tv Series or ONA animes, 9904 out of 11040, have 24 or less minutes and just 1136 with more than 24 minutes.

There are 8678 animes have between 5 to 24 minutes and are Tv Series or ONA

From TV series or ONA:

89,71 % 24 or less minutes duration

10,29 % more than 24 minutes duration

From this:

78,61 % have between 5 to 24 minutes duration

67,31 % have between 15 to 24 minutes duration

Usual score for TV and ONA is between 6.32 and 6.75 points

Checking the boxplot of TV and ONA animes we get that the scores are this:

From TV and ONA:

There are 2755 animes with less than 6.32 points

There are 5549 animes between 6.32 and 6.75 points

There are 2736 animes with more than 6.75 points

It means:

24,96 % with less than 6.32 points

50,26 % between 6.32 and 6.75 points

24,78 % with more than 6.75 points

We can see that Bleach: Sennen Kessen-hen is number 1 right now in total Score and Kaguya-sama wa Kokurasetai number 3. Both of them recently released. With time and more votes, they could maintain their position or change it, we would not know until sometime pass.

2017 was the year that the most anime was released. This was followed by 2017

From 2000 until today 19105 animes has been released, 79,26 % of all anime.

9853 TV series and ONA has been released

2463 Movies has been released

2178 specials have been released

2620 OVAs has been released

1918 music videos have been released

73 Unknown has been released

It means:

51,57 % TV series or ONA

12,89 % are movies

11,4 % are specials

13,71 % are OVAs

10,04 % are music videos

0,39 % does not fall to any category

- We have 24105 anime records, 5501 animes with more than 25 minutes and 18604 animes with more than 25 minutes. Basically, most of the Tv Series animes, 7345 out of 7509, has 25 or less minutes and just 164 with more than 25 minutes. And from those, 6060 have between 10 to 25 minutes.

- Most of the animes get a score between 5 to 8

- Seems that the higher concentration of higher scores are between 12 and 25 episodes

- Number 1 anime Fullmetal Alchemist: Brotherhood

- 2016 was the year that the most anime was released. This was followed by 2017

7.3 From Categorical One Dimensional-Analysis

Most of the anime are TV type (regular series)

Most of the anime comes from an original idea (where anime companies write up the plot and design the characters themselves)

From 11040 animes that belong to TV series and ONA. The 63,85 % come from an original source, manga or game.

38,76 % comes from an Original source

19,21 % comes from a Manga source

5,88 % comes from a game source

PG-13 - Teens 13 or older is the most popular

38,72 % PG-13

26,01 % PG – Children

22,16 % G - All Ages

6,41 % R - 17

Comedy Genre is the most typical

The top 10 genres represent the 91,39 % of all anime

20,73 % comedy

15,57 % fantasy

13,1 % action

10,13 % adventure

7,49 % Sci-Fi

6,13 % Drama

6,04 % Slice of Life

5,67 % Romance

4,24 % Supernatural

2,29 % Mystery

Music, School and history theme are the ones with more animes.

There are 51 different themes

We know 8681 anime themes from TV and ONA type

Top 10 represent 5205, 59,96 % of the total

NHK, Nippon Hoso Kyokai (Japan Broadcasting Corporation), is the producer with the most anime in the world

From TV and ONA: TV Tokyo, Aniplex, AT-X are the top 3

This top 10 (2901) represents the 20,08 %

Toei Animation is the first private company with the most anime in the world

From TV and ONA: Toei Animation, Sunrise, J.C.Staff are the top 3 (no change)

We know 6839 anime Studios from TV and ONA type

This top 10 (2901) represents the 24,87 %

7.4 From Bidimensional Analysis

7.4.1 Most valued Types by users

Taking into account these results, this are the possible ways to go for.

1. If the goal is to reach as many people as possible, even though we might have irregular score, the best three Types to go for are: TV, ONA and Movie.

2. If the goal is about the score there are two options:

Having the best score but not regular, the best three Types to go for are: TV, Movie and Specials.

Not Having the best score but the most regular one, the best three Types to go for are: TV, Special and Music.

However, taking also into account the results of the unidimensional analysis of Types:

- Specials and Music types has less animes then the rest.

- TV, Movie and OVA has mores animes then the rest

- ONA is increasing rapidly thanks to the online distribution companies like Netflix.

We could conclude that, going for TV, Movie and ONA would be the best idea

7.4.2 Best source to create an anime

Taking into account these results, this are the possible ways to go for.

1. If the goal is to reach as many people as possible, even though we might have irregular score, the best three Sources to go for are: Light novel, Original and Manga. If the goal is about the score there are two options:

   - Having the best score but not regular, the best three Sources to go for are: Music, Visual novel and manga.

   - Not Having the best score but the most regular one, the best three Sources to go for are: Original, Game and Novel.

However, taking also into account the results of the unidimensional analysis of Sources:

- Picture book, Book, Radio and Web novel has almost no animes. It would be risky to go for these ones.

- The best idea would be to go for Light novel, Manga and Original Sources

The best idea would be to go for Light novel, Manga and Original Sources

7.4.3 Best Rating to focus

Considering the results, this are the possible ways to go for.

1. If the goal is to reach as many people as possible, even though we might have irregular score, the best three Ratings to go for are: PG - Children, R - 17+ (violence & profanity) and PG-13 - Teens 13 or older.

2. If the goal is about the score there are two options:

   - Having the best score but not regular, the best three Ratings to go for are: R - 17+ (violence & profanity), PG-13 - Teens 13 or older and PG - Children.

   - Not Having the best score but the most regular one, the best three Ratings to go for are: PG - Children or G - All Ages.

7.4.4 Best Genres to use in anime

Taking into account the results, this are the possible ways to go for.

1. If the goal is to reach as many people as possible, even though we might have irregular score, the best three Genres to go for are: Supernatural, Fantasy and Romance

2. If the goal is about the score there are two options:

   - Having the best score but not regular, the best three Genres to go for are: Romance, Sci-Fi and Drama.

   - Not Having the best score but the most regular one, the best three Genres to go for are: Drama, Mystery or Romance.

7.4.5 Best themes to use in anime

Considering the results, this are the possible ways to go for.

1. If the goal is to reach as many people as possible, even though we might have irregular score, the best three themes to go for are: Anthropomorphic, School and Super Power.

2. If the goal is about the score there are two options:

- Having the best score but not regular, the best three Themes to go for are: Mythology, Military and School.

- Not Having the best score but the most regular one, the best three Themes to go for are: Anthropomorphic, Martial Arts and Mecha.

7.4.6 Best producers to hire

Taking into account the results, this are the possible ways to go for.

1. If the goal is to reach as many people as possible, even though we might have irregular score, the best three Producers to go for are: Dentsu, Movic and Aniplex.

2. If the goal is to have more regular score,the best three Producers to go for are: : Sotsu, Lantis and AT-X.

7.4.7 Best studios to hire

It will depend of the goal. Considering the results, this are the possible ways to go for.

1. If the goal is to reach as many people as possible, even though we might have irregular score, the best three Studios to go for are: A-1 Pictures, Madhouse and J.C.Staff.

2. If the goal is about the score there are two options:

   - Having the best score but not regular, the best three studios to go for are: Madhouse, A-1 Pictures and J.C.Staff.

   - Not Having the best score but the most regular one, the best three studios to go for are: Nippon Animation, OLM, DLE.

8 References

MyAnimeList.net	https://myanimelist.net/
from Data to Viz	https://www.data-to-viz.com/#connectedscatter
Seaborn Documentation	https://seaborn.pydata.org/
Matplotlib Documentation	https://matplotlib.org/
Data Visualization con pandas y seaborn	https://medium.com/ironhack/data-visualization-con-pandas-y-seaborn-1044906af34f
The Python Graph Gallery	https://www.python-graph-gallery.com/
Stack Overflow	https://stackoverflow.com/
codificandobits	https://www.codificandobits.com/blog/analisis-exploratorio-de-datos/
Towards data science	https://towardsdatascience.com/beautifying-the-messy-plots-in-python-solving-common-issues-in-seaborn-7372e6479fb
pandas documentation	https://pandas.pydata.org/docs/reference/api/pandas.DataFrame.explode.html

9 Annexes

9.1 Annex 1

9.1.1 Annex 1.1

```
for page in range (1,n_pages +1):
    r_page = requests.get(url + '?page=' + str(page)) # request to a web page (url)
    content = r_page.json()
    print (page)
    data = content["data"]
    time.sleep(1)
```

9.1.2 Annex 1.2

```
for char in data:

    try: # First try yo check if the page exist or not
        # Creation of the necessary dictionary o store the values in each loop # We specify which information to get in each Item

    # Ending of the first try specifying the error
    except:
        if r_page.status_code == 429: #If there is a 429 error we show it on screen and tell us the respuesta.reason
            print (f"El código de estado de la petición es: {r_page.status_code}. Estatus {r_page.reason}. No se puede recoger información de la página {id}\n")
        else:
            #If there is a any other error we show it on screen and tell us the respuesta.reason
            print (f"El código de estado de la petición es: {r_page.status_code}. Estatus {r_page.reason}. No se puede recoger información de la página {id}\n")
        continue
```

9.1.3 Annex 1.3

```
def try_it(i):
    try:
        return i["name"]
    except:
        return None
```

9.1.4 Annex 1.4

```
anime_dict = {"Cover" : char["images"]["jpg"]["large_image_url"] if char["images"]["jpg"]["large_image_url"]  else None,
              "English_Title" : char["title"] if char["title"]  else None,
              "Japanses_Title" : char["title_japanese"] if char["title_japanese"]  else None,
              "Type" : char["type"] if char["type"]  else None,
              "Source" : char["source"] if char["status"] else None,
              "Audience" : [try_it(i) for i in char["demographics"]], # List comprehension calling the Def try_it
              "N_Episodes" : (int(char["episodes"])) if char["episodes"] else 0,
              "Duration" : char["duration"] if char["duration"]  else None,
              "Rating" : char["rating"] if char["rating"] else None,
              "Score" : char["score"] if char["score"]  else None,
              "Scored_by" : char["scored_by"] if char["scored_by"]  else None,
              "Rank" : (int(char["rank"])) if char["rank"] else None,
              "Season" : char["season"] if char["season"] else None,
              "Genre" : [try_it(i) for i in char["genres"]],# List comprehension calling the Def try_it
              "Theme" : [try_it(i) for i in char["themes"]],# List comprehension calling the Def try_it
              "Released" : (int(char["aired"]["prop"]["from"]["year"])) if char["aired"]["prop"]["from"]["year"] else None, # If else in one line
              "Studios" : [try_it(i) for i in char["studios"]],# List comprehension calling the Def try_it
              "Producers" : [try_it(i) for i in char["producers"]]# List comprehension calling the Def try_it
              }

anime_list.append(anime_dict) # Append the loop info to anime_list
```

9.1.5 Annex 1.5

```
# We create df from anime_list and save it in a csv file adding actual date and time variables to the name
anime_df = pd.DataFrame(anime_list)
anime_csv = os.path.join(data_folder,"anime_" + actual_date+ "_" +current_time + ".csv")# Saving the image to the images folder
anime_df.to_csv(anime_csv, sep = ';', index = False)
print(f'anime_{actual_date}{current_time}.csv created\n\n')
```

9.1.6 Annex 1.6

```
'''
Preparing folder variables.
'''
os.chdir(os.path.dirname(sys.path[0])) # This command makes the notebook the main path and can work in cascade.
main_folder = sys.path[0]
data_folder = (main_folder + "\data")

'''
Creating time variables.
'''
current_time = time.strftime("%H_%M_%S",time.localtime())
date = datetime.now()
actual_date = date.strftime("%Y_%m_%d")
```

9.2 Annex 2

9.2.1 Annex 2.1

9.2.1.1 Annex 2.1.1

```
#Library imports
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import os
import sys
import seaborn as sns
from collections import Counter
from utils import utils
from scipy.stats import chi2_contingency
from sklearn.linear_model import LinearRegression
import warnings
import pickle
warnings.simplefilter(action='ignore', category=FutureWarning)
```

9.2.1.2 Annex 2.1.2

	Cover	English_Title	Japanses_Title	Type	Source	Audience	N_Episodes	Duration	Rating	Score	Scored_by	Rank	Season	Genre	Theme	Released	Studios	Producers
5732	https://cdn.myanimelist.net/images/anime/1240/...	Yamato Takeru: After War	ヤマトタケル ～After War～	OVA	Unknown	[]	2	23 min per ep	PG-13 - Teens 13 or older	6.27	215.0	7861.0	NaN	['Action', 'Adventure', 'Fantasy', 'Sci-Fi']	['Mecha', 'Space']	1995.0	['Nippon Animation']	[]
20342	https://cdn.myanimelist.net/images/anime/1432/...	Tunshu Zhen Lequ Sanzijing	豚鼠鎮乐趣三字经	TV	Original	['Kids']	100	14 min per ep	PG - Children	NaN	NaN	16897.0	NaN	['Fantasy']	['Anthropomorphic']	2017.0	[]	[]
1811	https://cdn.myanimelist.net/images/anime/7/688...	Shizuku	しずく	Movie	Original	[]	1	4 min	PG - Children	5.62	1461.0	10963.0	NaN	['Comedy']	[]	1965.0	['Mushi Production']	[]
22675	https://cdn.myanimelist.net/images/anime/1535/...	Sleepless: A Midsummer Night's Dream - The Ani...	SLEEPLESS ～A Midsummer Night's Dream～ The Anim...	OVA	Visual novel	[]	2	16 min per ep	Rx - Hentai	5.71	1052.0	NaN	NaN	['Hentai']	[]	2022.0	['BreakBottle']	['Showten']
4298	https://cdn.myanimelist.net/images/anime/13/12...	Koisuru Tenshi Angelique: Chibi Character Adve...	恋する天使アンジェリーク ちびキャラ Adventure	Special	Unknown	[]	1	4 min	G - All Ages	5.92	227.0	9685.0	NaN	['Adventure', 'Comedy']	[]	2006.0	[]	[]

9.2.1.3 Annex 2.1.3

```
Data columns (total 18 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   Cover           24105 non-null  object
 1   English_Title   24105 non-null  object
 2   Japanses_Title  23914 non-null  object
 3   Type            24029 non-null  object
 4   Source          24105 non-null  object
 5   Audience        24105 non-null  object
 6   N_Episodes      24105 non-null  int64
 7   Duration        24105 non-null  object
 8   Rating          23315 non-null  object
 9   Score           14874 non-null  float64
 10  Scored_by       14874 non-null  float64
 11  Rank            21515 non-null  float64
 12  Season          5348 non-null   object
 13  Genre           24105 non-null  object
 14  Theme           24105 non-null  object
 15  Released        22885 non-null  float64
 16  Studios         24105 non-null  object
 17  Producers       24105 non-null  object
dtypes: float64(4), int64(1), object(13)
memory usage: 3.3+ MB
```

```
Cover              0
English_Title      0
Japanses_Title   191
Type              76
Source             0
Audience           0
N_Episodes         0
Duration           0
Rating           790
Score           9231
Scored_by       9231
Rank            2590
Season         18757
Genre              0
Theme              0
Released        1220
Studios            0
Producers          0
dtype: int64
```

```
Season         77.813732
Score          38.294960
Scored_by      38.294960
Rank           10.744659
Released        5.061191
Rating          3.277328
Japanses_Title  0.792367
Type            0.315287
Studios         0.000000
Theme           0.000000
Genre           0.000000
Cover           0.000000
English_Title   0.000000
Duration        0.000000
N_Episodes      0.000000
Audience        0.000000
Source          0.000000
Producers       0.000000
dtype: float64
```

9.2.2 Annex 2.2

9.2.3 Annex 2.3

9.2.3.1 Annex 2.3.1

```
non_numeric = ["Audience","Genre","Theme","Studios","Producers"]
for column in non_numeric:
    df_copy[column] = df_copy[column].apply(eval).str.join(',') #remove brackets and commas

df_copy.sample(5)
```

9.2.3.2 Annex 2.3.2

```
# Replacing empty space with NaN
list_not_num = ["Audience","Genre","Theme","Studios","Producers"]
df_copy[list_not_num] = df_copy[list_not_num].apply(lambda x: x.str.strip() if isinstance(x, str) else x).replace('', np.nan)
```

9.2.3.3 Annex 2.3.3

```
Season          77.813732
Audience        60.912674
Producers       53.839452
Theme           46.081726
Studios         43.410081
Scored_by       38.294960
Score           38.294960
Genre           19.207633
Rank            10.744659
Released         5.061191
Rating           3.277328
Japanses_Title   0.792367
Type             0.315287
Duration         0.000000
English_Title    0.000000
N_Episodes       0.000000
Source           0.000000
Cover            0.000000
dtype: float64
```

9.2.4 Annex 2.4

9.2.4.1 Annex 2.4.1

```
list_num = ["Rank",'Score','Scored_by',"Released"]
for cat in list_num:
    null_num = df_copy[cat].isna().sum()
    number = df_copy[cat][df_copy[cat] == 0].count()
    print("In the column ndamed",cat,"there are:",number,"of zero values")
    print("In the column ndamed",cat,"there are:",null_num,"of null values")
```

```
In the column ndamed Rank there are: 0 of zero values
In the column ndamed Rank there are: 2590 of null values
In the column ndamed Score there are: 0 of zero values
In the column ndamed Score there are: 9231 of null values
In the column ndamed Scored_by there are: 0 of zero values
In the column ndamed Scored_by there are: 9231 of null values
In the column ndamed Released there are: 0 of zero values
In the column ndamed Released there are: 1220 of null values
```

9.2.4.2 Annex 2.4.2

```
#Replacing nan with ZEROS in numerical columns
list_num = ["Rank"]
for cat in list_num:
    df_copy[list_num] = df_copy[list_num].fillna(0)
```

9.2.4.3 Annex 2.4.3

```
df_copy['Released'] = df_copy['Released'].interpolate(method = "spline", order = 1,  limit_direction = "both", downcast = "infer")
df_copy['Score'] = df_copy['Score'].interpolate(method = "spline", order = 3,  limit_direction = "both", downcast = "infer")
df_copy['Scored_by'] = df_copy['Scored_by'].interpolate(method = "spline", order = 3,  limit_direction = "both", downcast = "infer")
```

9.2.4.4 Annex 2.4.4

```
df_copy['Scored_by'].agg(['min', 'max'])
```

```
-1.581879e+06
 4.128912e+06
Scored_by, dtype: float64
```

```
df_copy['Scored_by'] = np.abs(df_copy['Scored_by']) # convert the Scored_by column to absolute value using abs from numpy
```

9.2.4.5 Annex 2.4.5

```
utils.predict(df_copy)
```

```
list_num = ["Rank",'Score','Scored_by',"Released"]
for cat in list_num:
    null_num = df_copy[cat].isna().sum()
    number = df_copy[cat][df_copy[cat] == 0].count()
    print("In the column ndamed",cat,"there are:",number,"of zero values")
    print("In the column ndamed",cat,"there are:",null_num,"of null values")
```

```
In the column ndamed Rank there are: 0 of zero values
In the column ndamed Rank there are: 0 of null values
In the column ndamed Score there are: 0 of zero values
In the column ndamed Score there are: 0 of null values
In the column ndamed Scored_by there are: 0 of zero values
In the column ndamed Scored_by there are: 0 of null values
In the column ndamed Released there are: 0 of zero values
In the column ndamed Released there are: 0 of null values
```

```
'''
To predict the missing information in the rank column
'''
def predict(df):

    # df with the zero values in rank column
    with_zeros = df[['Score','Scored_by','Rank']].copy()

    # setup x and y for training
    # drop data with zero in the row
    clean_df = with_zeros[with_zeros.Rank  != 0]

    # separate variables into my x and y
    x = clean_df[['Score','Scored_by']].values
    y = clean_df['Rank'].values

    # fit my model (adjusting the parameters in the model to improve accuracy.)
    lm = LinearRegression()
    lm.fit(x, y)

    # get the rows I am trying to do my prediction on
    predict_x = with_zeros[with_zeros['Rank'] == 0][['Score','Scored_by']].values

    # perform my prediction
    lm.predict(predict_x)

    # Get index of missing data
    missing_index = with_zeros[with_zeros['Rank'] == 0].index

    # Replace
    df.loc[missing_index, 'Rank'] = lm.predict(predict_x)
```

9.2.4.6 Annex 2.4.6

```
df_copy[['Scored_by','Rank','Released']] = df_copy[['Scored_by','Rank','Released']].astype('int') # change the type of the column to integer
```

9.2.5 Annex 2.5

9.2.5.1 Annex 2.5.1

```
1  df_copy['Audience'].str.split(',').explode().value_counts()
```

```
Kids       5785
Shounen    2035
Seinen      915
Shoujo      700
Josei       105
Name: Audience, dtype: int64
```

```
1  df_copy['Rating'].str.split(',').explode().value_counts()
```

```
PG-13 - Teens 13 or older         8192
G - All Ages                      7230
PG - Children                     3989
Rx - Hentai                       1455
R - 17+ (violence & profanity)    1376
R+ - Mild Nudity                  1073
Name: Rating, dtype: int64
```

```
1  df_copy.drop(["Audience"] , axis = 1 , inplace = True)
```

9.2.6 Annex 2.6

9.2.6.1 Annex 2.6.1

```
# Dorpping unncesseray columns
df_copy.drop(["Cover" ,"Japanses_Title","Season",] , axis = 1 , inplace = True)
```

9.2.7 Annex 2.7

9.2.7.1 Annex 2.7.1

```
list_num = ["Type",'Rating','Genre',"Released",'Studios',"Producers","Theme"]
for cat in list_num:
    df_copy[cat] = df_copy[cat].fillna('Unknown')
```

9.2.8 Annex 2.8

9.2.8.1 Annex 2.8.1

```
# Get count of animes with N_Episodes equal to zero
count = df_copy["N_Episodes"][df_copy["N_Episodes"] == 0].count()
print("There are",count,"animes with N_Episodes equal to zero")
```

```
There are 867 animes with N_Episodes equal to zero
```

9.2.8.2 Annex 2.8.2

```
#We can see that N_Episodes has a minumin of 0 episodes. That cannot be possible, in this case we are going to Change zero values to the previous column value
N_Episodes = df_copy['N_Episodes']
N_Episodes.replace(to_replace = 0,  method='ffill', inplace=True)
```

9.2.8.3 Annex 2.8.3

```
# Get count of animes with N_Episodes equal to zero
count = df_copy["N_Episodes"][df_copy["N_Episodes"] == 0].count()
print("There are",count,"animes with N_Episodes equal to zero")
```

```
There are 0 animes with N_Episodes equal to zero
```

9.2.9 Annex 2.9

9.2.9.1 Annex 2.9.1

To finalize, let's change the format in the duration column. Let's leave the columns just with the duration in minutes

```
utils.to_minutes(df_copy)
```

```
'''
Convert the string time to just minutes
'''
def to_minutes(df):
    df['Duration'] = df['Duration'].apply(lambda positions : positions.split(' ')).apply(lambda positions : positions[0] if len(positions) <= 1 else
            (int(positions[0]) / 60 if positions[1] == 'sec' else # If position 1 is sec, then we devide position 1 by 60
            (int(positions[0]) if positions[1] == 'min' else # if potision 1 is min, then pring position 0
            (int(positions[0]) * 60 if positions[1] == 'hr' and len(positions) == 2 else # If position 1 is hr and lenght of the string equals 2 (3 w
            (int(positions[0]) * 60 + int(positions[2]) if positions[1] == 'hr' and positions[2] != 'per' and positions[2] != 'min'  else # If positi
            int(positions[0]) * 60  )))))
```

9.2.9.2 Annex 2.9.2

```
df_copy['Duration'] = df_copy['Duration'].replace('Unknown', np.nan)
df_copy['Duration'] = df_copy['Duration'].interpolate(method = "spline", order = 1,  limit_direction = "both", downcast = "infer")
```

```
df_copy[['Duration']] = df_copy[['Duration']].astype('int') # change the type of the column to integer
```

9.2.9.3 Annex 2.9.3

```
Duration = df_copy['Duration']
Duration.replace(to_replace = 0,  method='ffill', inplace=True)
```

9.2.10 Annex 2.10

9.2.10.1 Annex 2.10.1

```
1  print(((df_copy.isnull().sum() / len(df_copy))*100).sort_values(ascending = False))
2  print(f"Total number of records: {len(df_copy)}")
```

```
English_Title     0.0
Type              0.0
Source            0.0
N_Episodes        0.0
Duration          0.0
Rating            0.0
Score             0.0
Scored_by         0.0
Rank              0.0
Genre             0.0
Theme             0.0
Released          0.0
Studios           0.0
Producers         0.0
dtype: float64
Total number of records: 24105
```

9.2.10.2 Annex 2.10.2

```
1  df_copy.sample(5) # printing a sample
```

Python

	English_Title	Type	Source	N_Episodes	Duration	Rating	Score	Scored_by	Rank	Genre	Theme	Released	Studios	Producers
6753	Crayon Shin-chan Movie 20: Arashi wo Yobu! Ora...	Movie	Manga	1	110	G - All Ages	6.72	2716	5293	Comedy	Unknown	2012	Shin-Ei Animation	Unknown
9525	Persona 4 the Golden Animation: Thank you Mr. ...	Special	Game	1	16	PG-13 - Teens 13 or older	6.50	4696	6533	Adventure,Drama,Mystery,Supernatural	Unknown	2014	A-1 Pictures	Unknown
7541	Hiiro no Kakera: Totsugeki! Tonari no Ikemenzu	OVA	Visual novel	1	11	PG-13 - Teens 13 or older	6.71	2598	5378	Comedy,Fantasy	Unknown	2013	Studio Deen	Bandai Visual,Lantis
7794	Hello Kitty no Kurumi Wari Ningyou	OVA	Unknown	1	15	G - All Ages	5.85	147	9984	Fantasy	Unknown	2001	Unknown	Sanrio
3070	Shin Onimusha: Dawn of Dreams the Story	OVA	Game	1	120	PG-13 - Teens 13 or older	5.90	407	9784	Action	Historical,Martial Arts,Mythology,Samurai	2006	Unknown	Capcom

9.2.10.3 Annex 2.10.3

```
df_copy.describe(include = "all")
```

	English_Title	Type	Source	N_Episodes	Duration	Rating	Score	Scored_by	Rank	Genre	Theme	Released	Studios	Producers
count	24105	24105	24105	24105.000000	24105.000000	24105	24105.000000	2.410500e+04	24105.000000	24105	24105	24105.000000	24105	24105
unique	24050	7	17	NaN	NaN	7	NaN	NaN	NaN	1008	800	NaN	1437	4237
top	Genshin Impact	TV	Original	NaN	NaN	PG-13 - Teens 13 or older	NaN	NaN	NaN	Unknown	Unknown	NaN	Unknown	Unknown
freq	6	7509	8920	NaN	NaN	8192	NaN	NaN	NaN	4630	11108	NaN	10464	12978
mean	NaN	NaN	NaN	15.234972	22.656669	NaN	6.453147	5.810970e+04	10794.168720	NaN	NaN	2007.544368	NaN	NaN
std	NaN	NaN	NaN	49.978538	26.334477	NaN	0.718209	2.356684e+05	5918.284321	NaN	NaN	14.557824	NaN	NaN
min	NaN	NaN	NaN	1.000000	1.000000	NaN	1.850000	0.000000e+00	1.000000	NaN	NaN	1917.000000	NaN	NaN
25%	NaN	NaN	NaN	1.000000	5.000000	NaN	6.210000	6.740000e+02	6003.000000	NaN	NaN	2002.000000	NaN	NaN
50%	NaN	NaN	NaN	2.000000	18.000000	NaN	6.530696	3.897000e+03	10551.000000	NaN	NaN	2012.000000	NaN	NaN
75%	NaN	NaN	NaN	13.000000	25.000000	NaN	6.650000	2.706400e+04	15655.000000	NaN	NaN	2017.000000	NaN	NaN
max	NaN	NaN	NaN	3057.000000	1440.000000	NaN	9.110000	4.128912e+06	28237.000000	NaN	NaN	2024.000000	NaN	NaN

9.2.10.4 Annex 2.10.4

```
# Get count of values greater than 2022 in the column 'Released'
count = df_copy["Released"][df_copy["Released"] > 2022].count()
print("There are",count,"animes after 2023 for future releases")
```

```
There are 206 animes after 2023 for future releases
```

9.2.11 Annex 2.11

9.2.11.1 Annex 2.11.1

```
fichero = open(data_folder + "/" +"anime.pkl","wb")
pickle.dump(df_copy,fichero)
fichero.close()
```

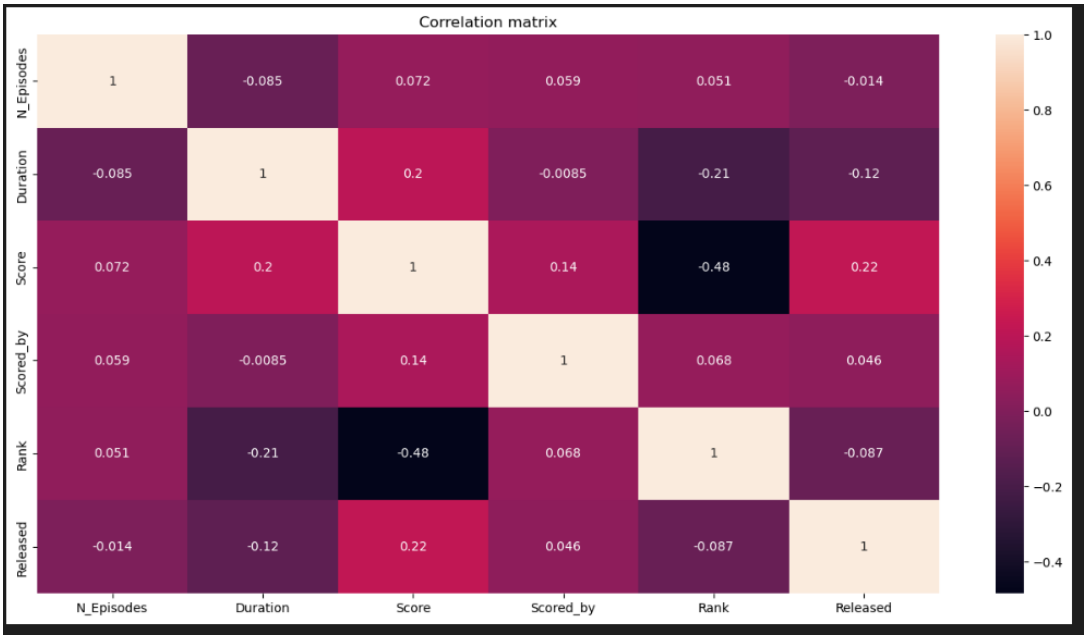
9.2.12 Annex 2.12

9.2.12.1 Annex 2.12.1

```
fichero = open(data_folder + "/" +"anime.pkl","rb")
df_copy = pickle.load(fichero)
fichero.close()
```

9.3 Annex 3

```
# Checking possible correlations for future studies.
plt.rc("figure", figsize=(16,8))

corr = df_copy.corr()
sns.heatmap(corr, annot=True)
plt.title('Correlation matrix')
plt.savefig(os.path.join(img_folder, 'Correlation matrix.png'),dpi=600)# Saving the image to the images folder
plt.show()
plt.close()# Close the plot
```

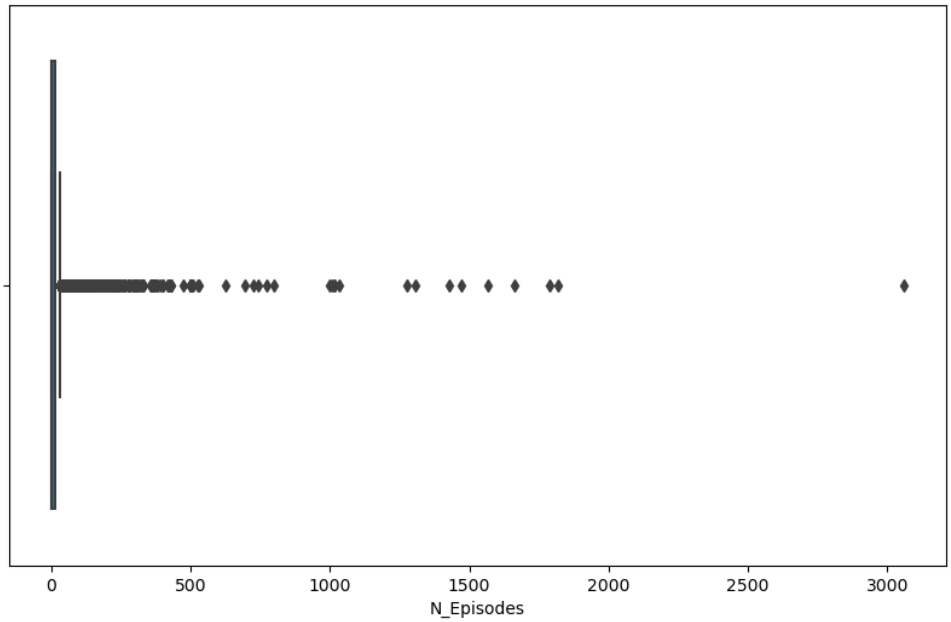


9.3.1 Annex 3.1

9.3.1.1 Annex 3.1.1

9.3.1.1.1 Annex 3.1.1.1

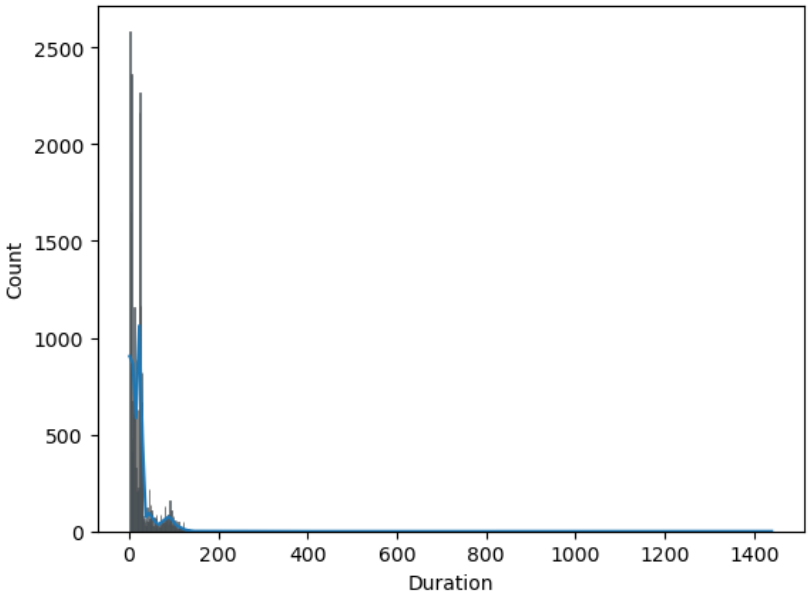
```
count    24105.000000
mean        15.234972
std         49.978538
min          1.000000
25%          1.000000
50%          2.000000
75%         13.000000
max       3057.000000
Name: N_Episodes, dtype: float64
```



9.3.1.1.2 Annex 3.1.1.2

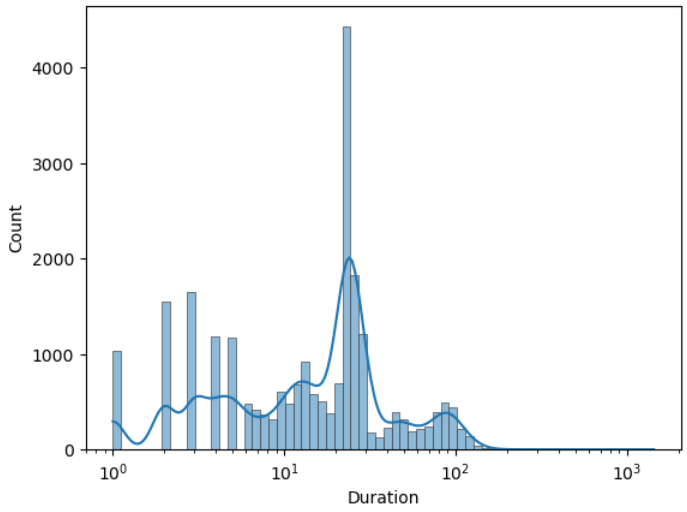
9.3.1.1.2.1 Annex 3.1.1.2.1

```
sns.histplot(data = df_copy , x = 'Duration', kde = True, palette="light:m_r", log_scale=False, edgecolor=".3", linewidth=.5)
plt.savefig(os.path.join(img_folder + "/" + 'histplot_' + "Duration" + '.png'),dpi=600)# Saving the image to the images folder
```



9.3.1.1.2.2 Annex 3.1.1.2.2

```
sns.histplot(data = df_copy , x = 'Duration', kde = True, palette="light:m_r", log_scale=True, edgecolor=".3", linewidth=.5)
plt.savefig(os.path.join(img_folder + "/" + 'histplot_log_scale_' + "Duration" + '.png'),dpi=600)# Saving the image to the images folder
```



9.3.1.1.2.3 Annex 3.1.1.2.3

```
1 df_copy["Duration"].describe()
✓ 0.3s

count    24105.000000
mean        22.656669
std         26.334477
min          1.000000
25%          5.000000
50%         18.000000
75%         25.000000
max       1440.000000
Name: Duration, dtype: float64
```

```
# Get count of animes with more than 25 minutes
count = df_copy["Duration"][df_copy["Duration"] >25].count()
print("There are",count,"animes with more than 25 minutes")
```
✓ 0.5s

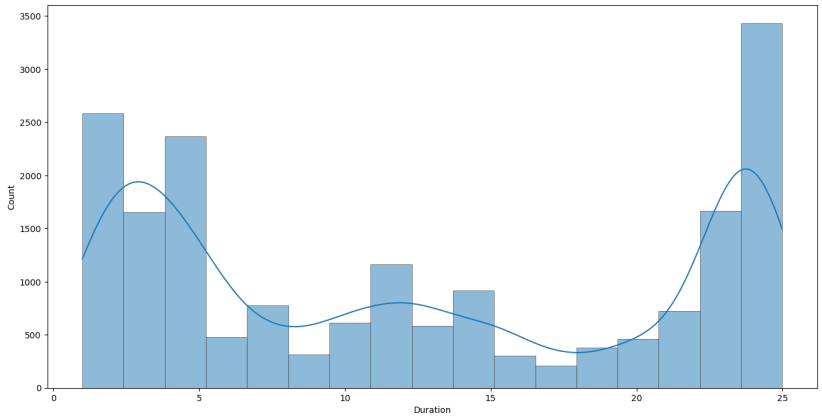
```
There are 5501 animes with more than 25 minutes
```

```
# Get count of animes with more than 25 minutes
count = df_copy["Duration"][df_copy["Duration"] <= 25].count()
print("There are",count,"animes with lee than 26 minutes")
```
✓ 0.4s

```
There are 18604 animes with lee than 26 minutes
```

9.3.1.1.2.4 Annex 3.1.1.2.4

```
unti26 = df_copy[df_copy["Duration"] < 26]
sns.histplot(data = unti26 , x = 'Duration', kde = True, palette="light:m_r", log_scale=False, edgecolor=".3", linewidth=.5)
plt.savefig(os.path.join(img_folder + "/" + 'histplot_less_26_' + "Duration" + '.png'),dpi=600)# Saving the image to the images folder
```



9.3.1.1.2.5 Annex 3.1.1.2.5

```
# Get count of animes with more than 26 minutes and are tv series
count = df_copy["Duration"][(df_copy["Duration"] > 25) & (df_copy["Type"] == "TV")].count()
print("There are",count,"animes with more then 25 minutes and are Tv Series")
```
✓ 0.4s

```
There are 164 animes with more then 25 minutes and are Tv Series
```

```
# Get count of animes with less than 26 minutes and are tv series
count = df_copy["Duration"][(df_copy["Duration"] <= 25) & (df_copy["Type"] == "TV")].count()
print("There are",count,"animes with equal or same as 25 minutes and are Tv Series")
```
✓ 0.4s

```
There are 7345 animes with equal or same as 25 minutes and are Tv Series
```

```
# Get count of animes with more than 10 minutes and are tv series
count = df_copy["Duration"][(df_copy["Duration"] >= 10) & (df_copy["Type"] == "TV")].count()
print("There are",count,"animes with equal or more than 10 minutes and are Tv Series")
```
✓ 0.4s

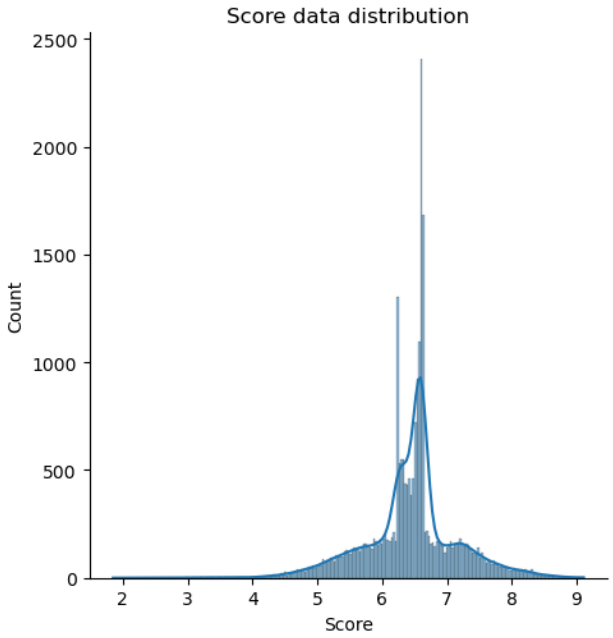
```
There are 6060 animes with equal or more than 10 minutes and are Tv Series
```

```
# Get count of animes that belongs to TV series
tv = df_copy["Type"][df_copy["Type"] == "TV"].count()
print("There are",tv,"animes that belongs to TV series")
```
✓ 0.3s

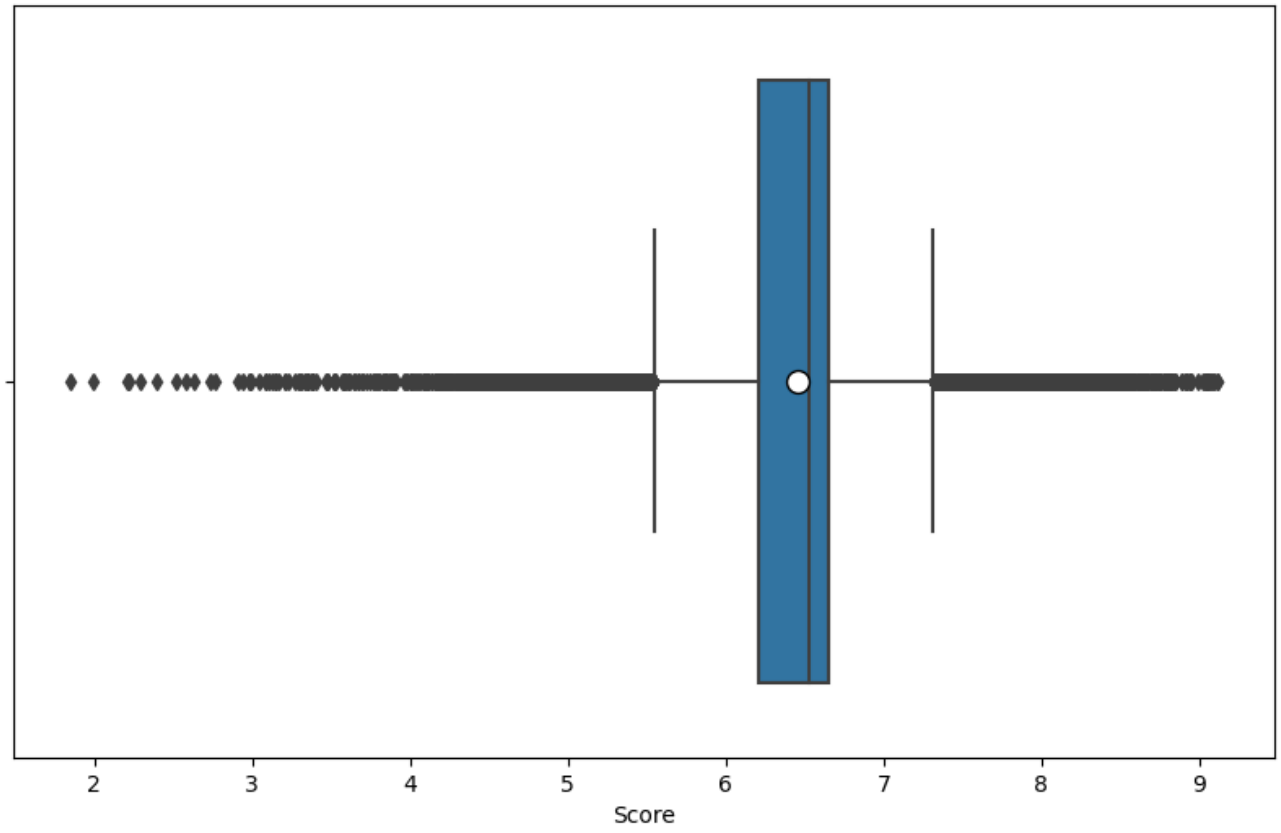
```
There are 7509 animes that belongs to TV series
```

9.3.1.1.3 Annex 3.1.1.3

9.3.1.1.3.1 Annex 3.1.1.3.1



9.3.1.1.3.2 Annex 3.1.1.3.2



9.3.1.1.3.3 Annex 3.1.1.3.3

```
print("There are",len(df_copy[(df_copy['Score'] >= 5) & (df_copy['Score'] <= 6)]),"animes between 5 and 6 points")
print("There are",len(df_copy[df_copy['Score'].between(6,7)]),"animes between 6 and 7 points")
print("There are",len(df_copy[df_copy['Score'].between(7,8)]),"animes between 7 and 8 points")
print("There are",len(df_copy[(df_copy['Score'] >= 8) & (df_copy['Score'] <= 9)]),"animes between 8 and 9 points")
```

9.3.1.1.4 Annex 3.1.1.4

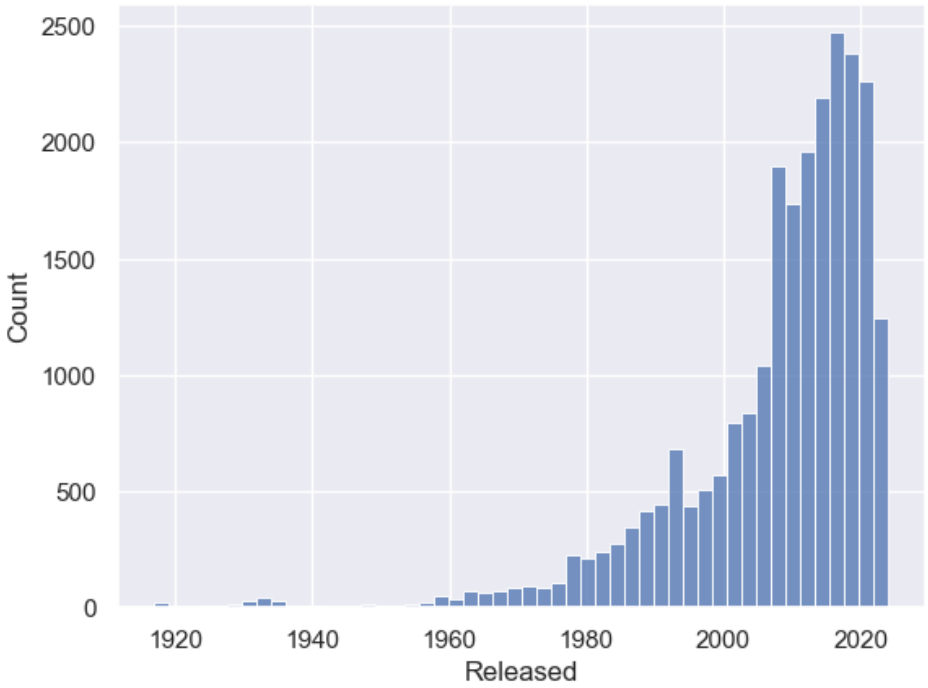
```
df_rank_top = df_copy[df_copy["Rank"] < 21].sort_values(by=["Rank"], ascending=True)
df_rank_top
```

English_Title	Type	Source	N_Episodes	Duration	Rating	Score	Scored_by	Rank	Genre	Theme	Released	Studios	Producers
Bleach: Sennen Kessen-hen	TV	Manga	13	24	R - 17+ (violence & profanity)	9.11	80321	1	Action,Adventure,Fantasy	Unknown	2022	Pierrot	TV Tokyo,Aniplex,Dentsu,Shueisha
Fullmetal Alchemist: Brotherhood	TV	Manga	64	24	R - 17+ (violence & profanity)	9.11	1933742	2	Action,Adventure,Drama,Fantasy	Military	2009	Bones	Aniplex,Square Enix,Mainichi Broadcasting Syst...
Kaguya-sama wa Kokurasetai: Ultra Romantic	TV	Manga	13	23	PG-13 - Teens 13 or older	9.09	373142	3	Comedy,Romance	Psychological,School	2022	A-1 Pictures	Aniplex,Mainichi Broadcasting System,Magic Cap...
Steins;Gate	TV	Visual novel	24	24	PG-13 - Teens 13 or older	9.08	1286088	4	Drama,Sci-Fi,Suspense	Psychological,Time Travel	2011	White Fox	Frontier Works,Media Factory,Movic,AT-X,Kadoka...
Gintama°	TV	Manga	51	24	PG-13 - Teens 13 or older	9.07	227495	5	Action,Comedy,Sci-Fi	Gag Humor,Historical,Parody,Samurai	2015	Bandai Namco Pictures	TV Tokyo,Aniplex,Dentsu
Shingeki no Kyojin Season 3 Part 2	TV	Manga	10	23	R - 17+ (violence & profanity)	9.06	1386387	6	Action,Drama	Gore,Military,Survival	2019	Wit Studio	Production I.G,Dentsu,Mainichi Broadcasting Sy...
Gintama'	TV	Manga	51	24	PG-13 - Teens 13 or older	9.05	217364	7	Action,Comedy,Sci-Fi	Gag Humor,Historical,Parody,Samurai	2011	Sunrise	TV Tokyo,Aniplex,Dentsu,Trinity Sound,Miracle ...
Gintama: The Final	Movie	Manga	1	104	PG-13 - Teens 13 or older	9.05	56776	8	Action,Comedy,Drama,Sci-Fi	Gag Humor,Historical,Parody,Samurai	2021	Bandai Namco Pictures	TV Tokyo,Warner Bros. Japan
Gintama': Enchousen	TV	Manga	13	24	PG-13 - Teens 13 or older	9.04	151944	9	Action,Comedy,Sci-Fi	Gag Humor,Historical,Parody,Samurai	2012	Sunrise	TV Tokyo,Aniplex,Dentsu,Shueisha,Miracle Bus
Hunter x Hunter (2011)	TV	Manga	148	23	PG-13 - Teens 13 or older	9.04	1569486	10	Action,Adventure,Fantasy	Unknown	2011	Madhouse	VAP,Nippon Television Network,Shueisha

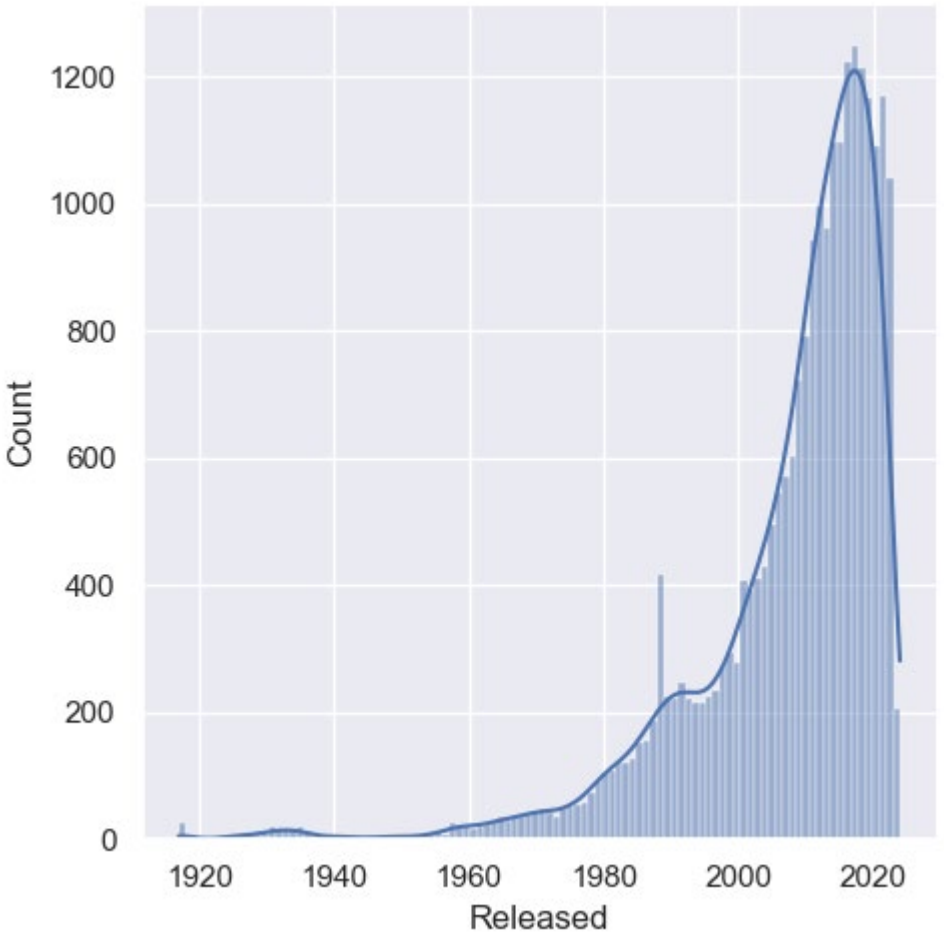
9.3.1.1.5 Annex 3.1.1.5

9.3.1.1.5.1 Annex 3.1.1.5.1

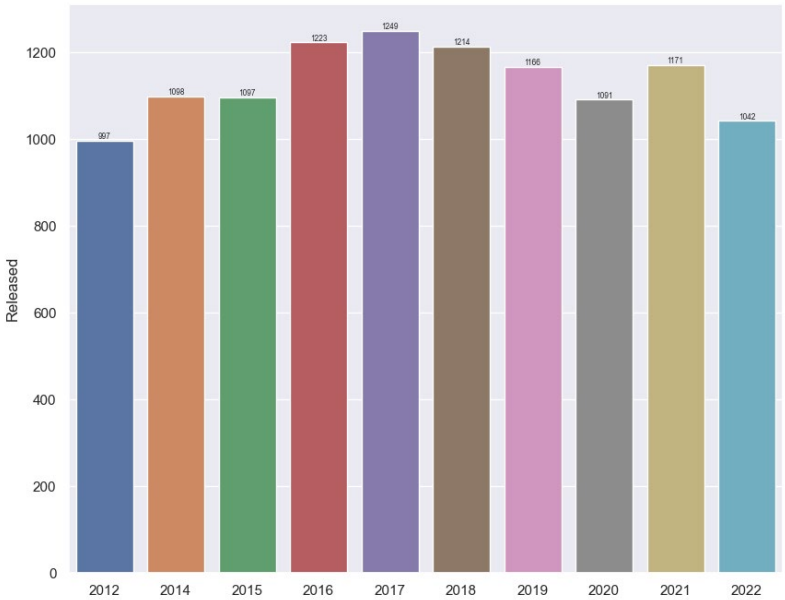
```
# set a grey background (use sns.set_theme() if seaborn version 0.11.0 or above)
sns.set(style="darkgrid")

sns.histplot(data=df_copy, x="Released", bins=50)

plt.savefig(os.path.join(img_folder + "/" + 'histplot_Released.png'),dpi=600)# Saving the image to the images folder
plt.show()
```

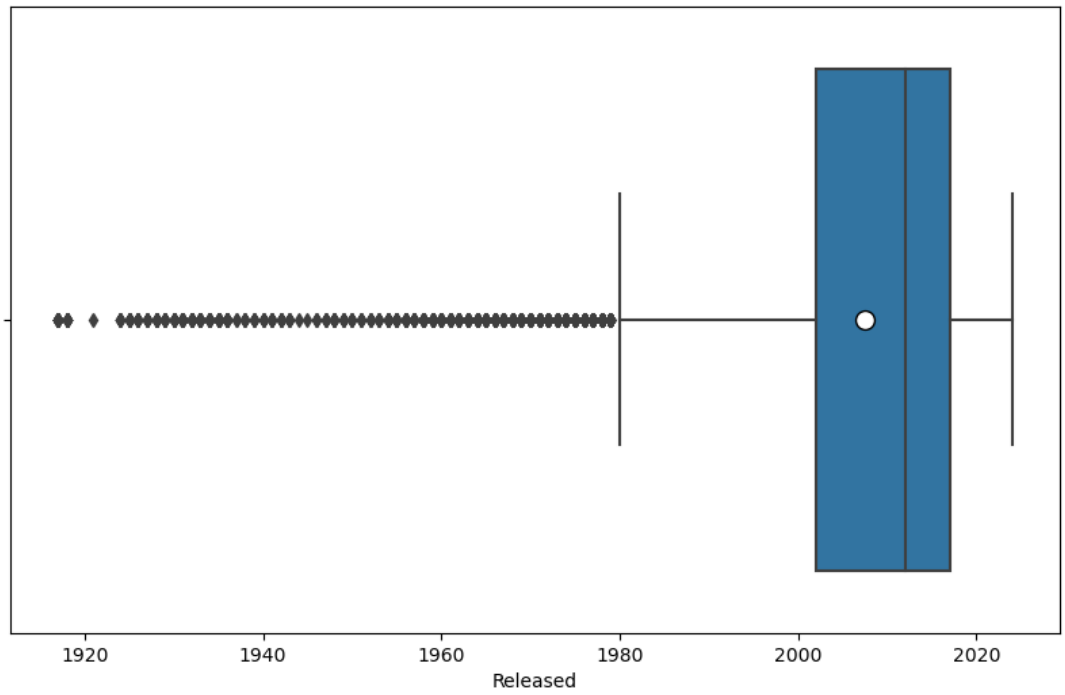



```
sns.displot(data = df_copy , x = 'Released' , kde = True) #anderson darling
plt.savefig(os.path.join(img_folder + "/" + 'displot_Released.png'),dpi=600)# Saving the image to the images folder
```



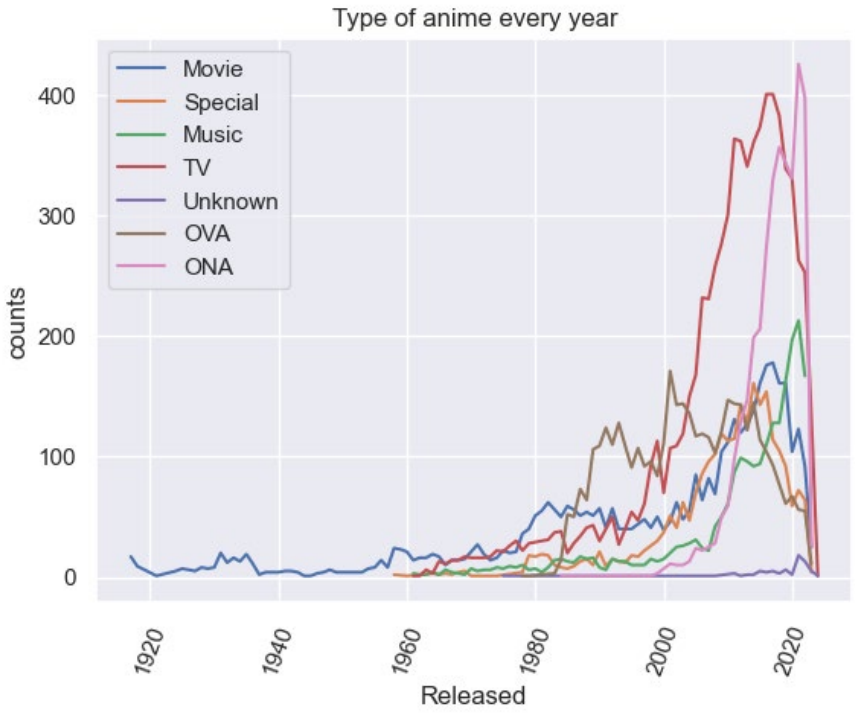

```
utils.barplot_top10(df_copy['Released'],'Released')
```





9.3.1.1.5.2 Annex 3.1.1.5.2

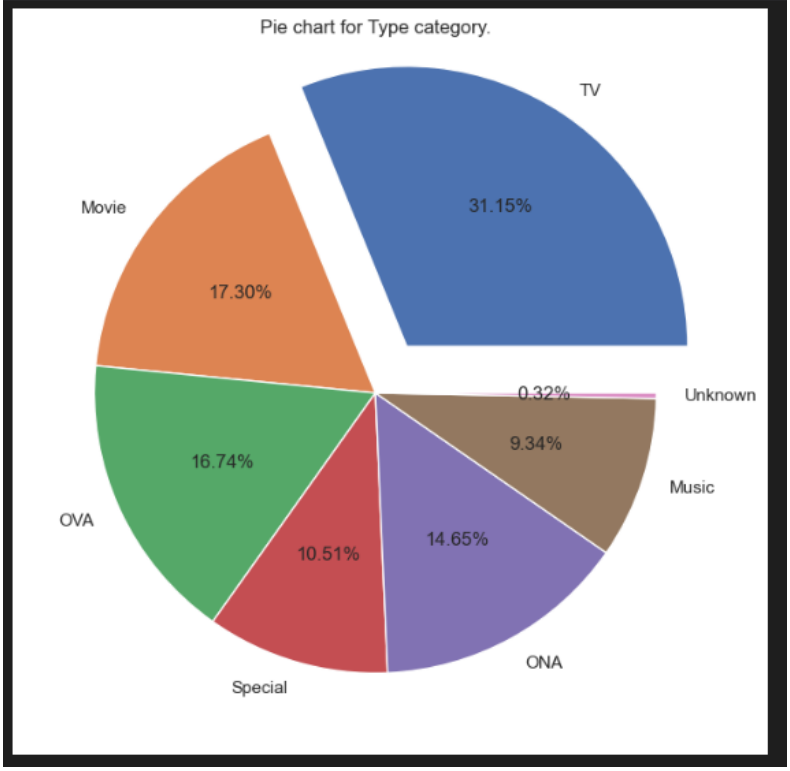
```
df_type_year =(df_copy.assign(genre=df_copy['Type'])
    .groupby(['Released','Type']).size()
    .reset_index(name='counts')
)

sns.lineplot(data=df_type_year, x='Released', y='counts', hue='Type')
plt.tick_params(axis='x', labelrotation = 70)
plt.title('Type of anime every year')
plt.legend(loc='upper left')
plt.savefig(os.path.join(img_folder, 'Lineplot_Type_by_year.png'),dpi=600)# Saving the image to the images folder
plt.show() # Show graphic
```



9.3.1.2 Annex 3.1.1.2

9.3.1.2.1 Annex 3.1.2.1

```
1  utils.pieplot(df_copy["Type"],"Type")
```



9.3.1.2.2 Annex 3.1.2.2

9.3.1.2.2.1 Annex 3.1.2.2.1

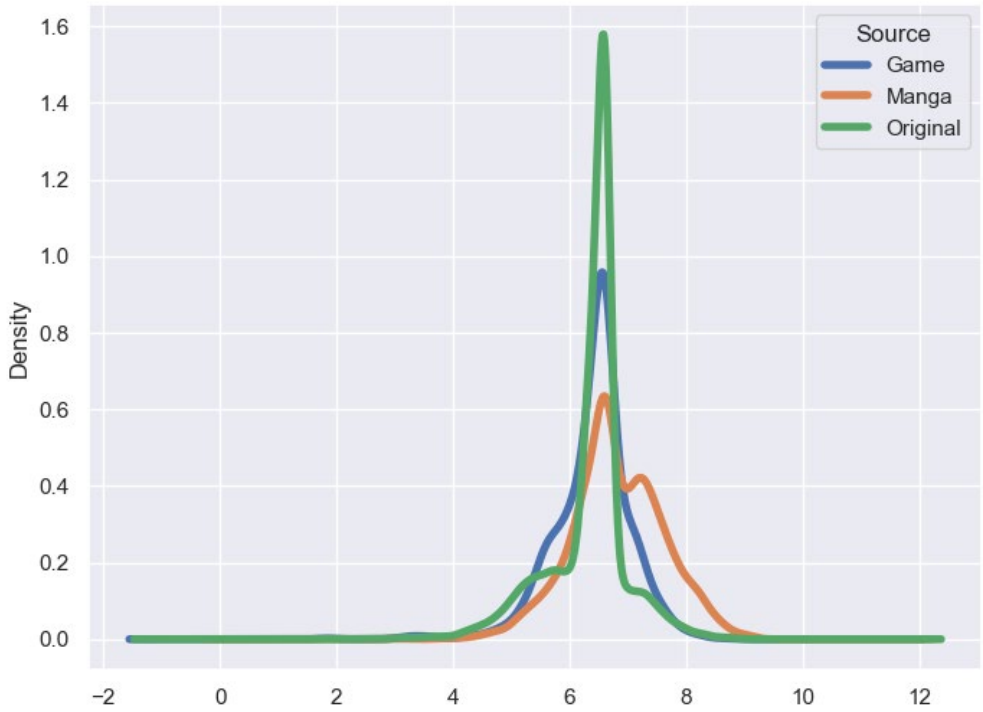
```
1  nsource_top10 = df_copy['Source'].value_counts()
```

```
1  nsource_top10
```

```
Original        8920
Manga           4570
Unknown         3899
Game            1191
Visual novel    1102
Other            964
Light novel      951
Novel            735
Web manga        383
Music            378
4-koma manga     312
Picture book     198
Book             177
Mixed media      125
Web novel        118
Card game         69
Radio             13
Name: Source, dtype: int64
```

9.3.1.2.2.2 Annex 3.1.2.2.2

```
main_sources = df_copy[(df_copy['Source'].isin(['Original', 'Manga',"Game"]))]


# Converting to wide dataframe
data_wide = main_sources.pivot(columns = 'Source',
                               values = "Score")

# plotting multiple density plot
data_wide.plot.kde(figsize = (8, 6),
                   linewidth = 4)
plt.savefig(os.path.join(img_folder, 'density_Source_Score.png'),dpi=600)# Saving the image to the images folder
```



9.3.1.2.2.3 Annex 3.1.2.2.3

```
print("Of all the anime we have in the list,",len(df_copy),",there are a total of",len(main_sources),"that come from an original source, manga or game. This means that",
((len(main_sources) * 100) / len(df_copy)),"% of the anime belong to this group.")
```

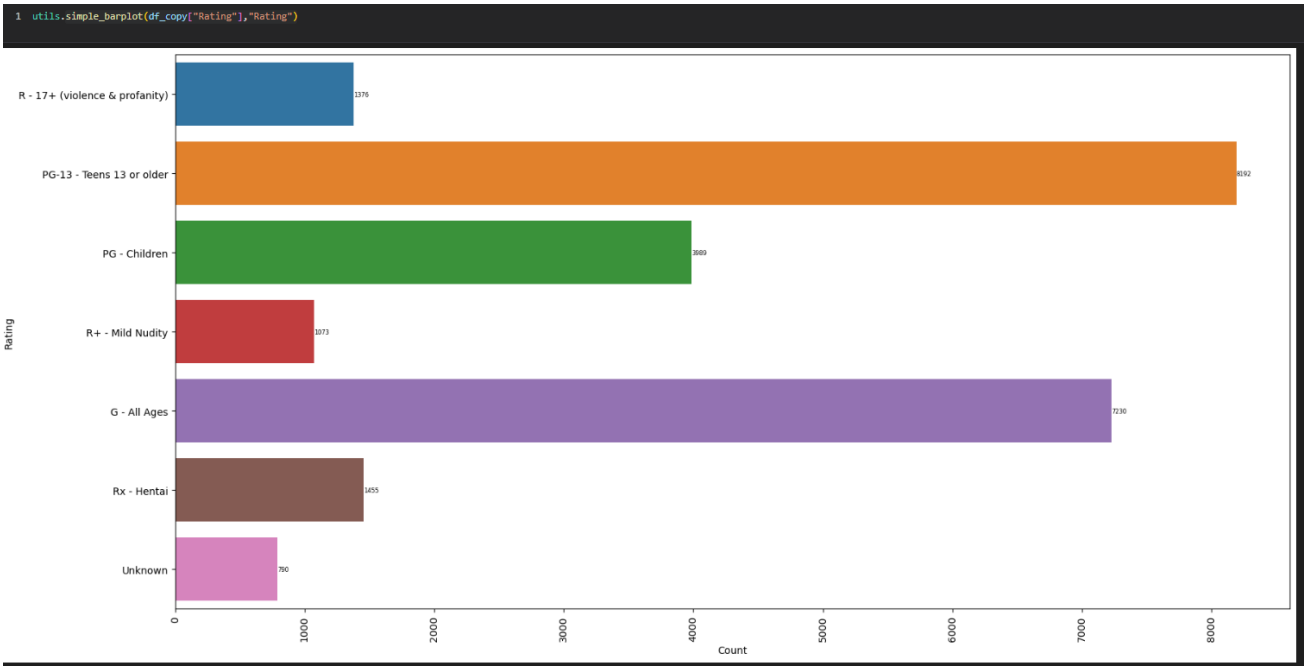
9.3.1.2.3 Annex 3.1.2.3

9.3.1.2.3.1 Annex 3.1.2.3.1

```
1  df_copy["Rating"].value_counts()
```

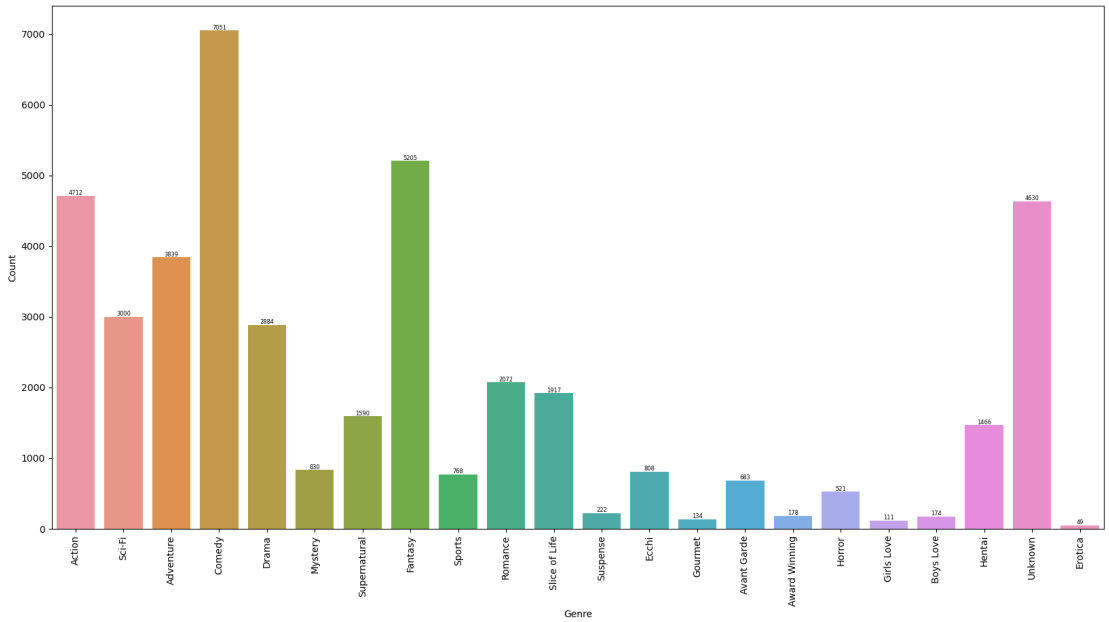
```
PG-13 - Teens 13 or older     8192
G - All Ages                  7230
PG - Children                 3989
Rx - Hentai                   1455
R - 17+ (violence & profanity)1376
R+ - Mild Nudity              1073
Unknown                        790
Name: Rating, dtype: int64
```

9.3.1.2.3.2 Annex 3.1.2.3.2

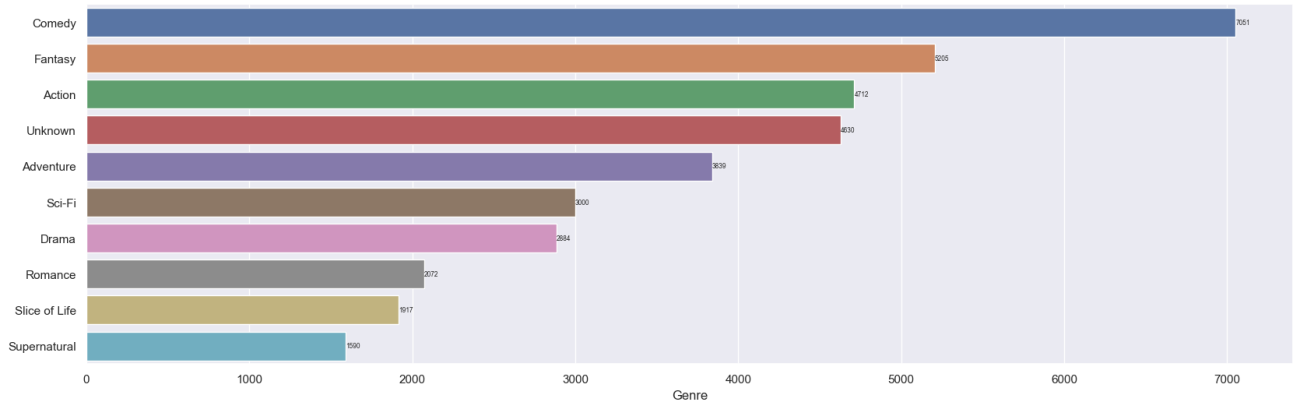


9.3.1.2.4 Annex 3.1.2.4

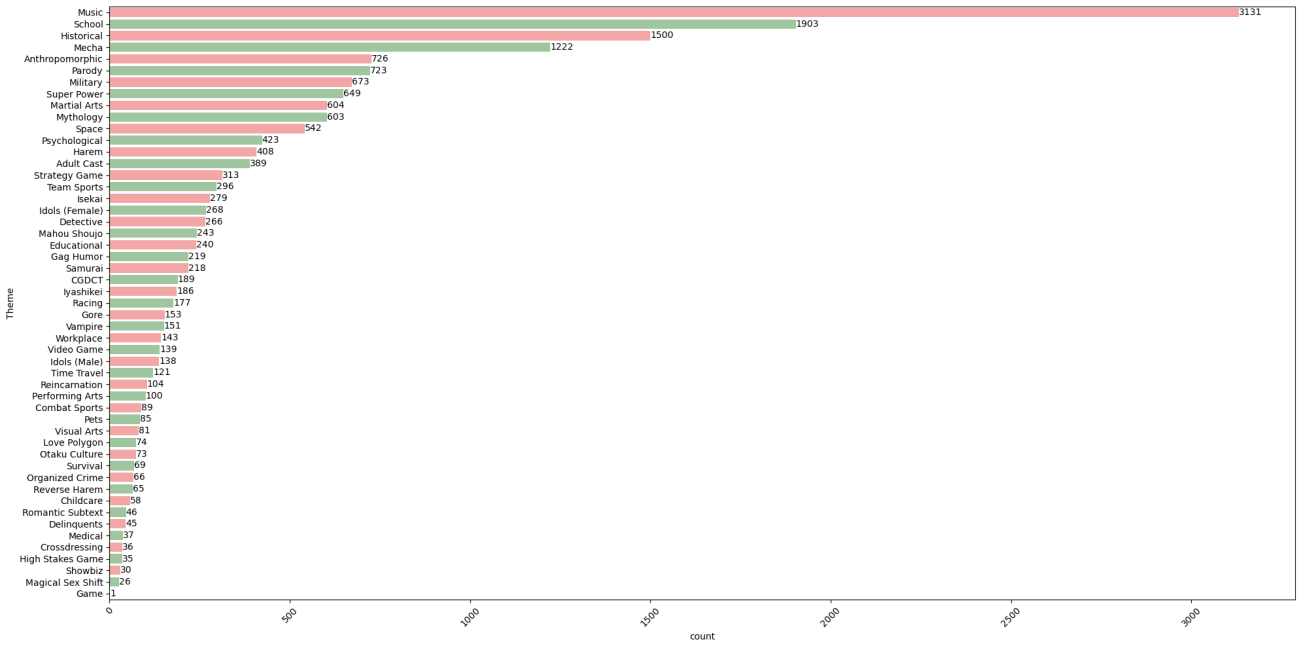
9.3.1.2.4.1 Annex 3.1.2.4.1

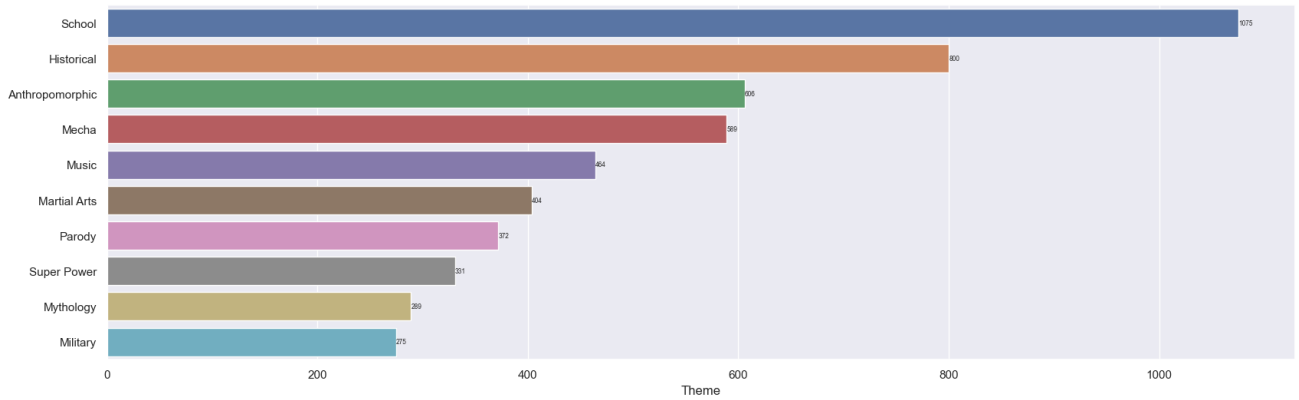


9.3.1.2.4.2 Annex 3.1.2.4.2



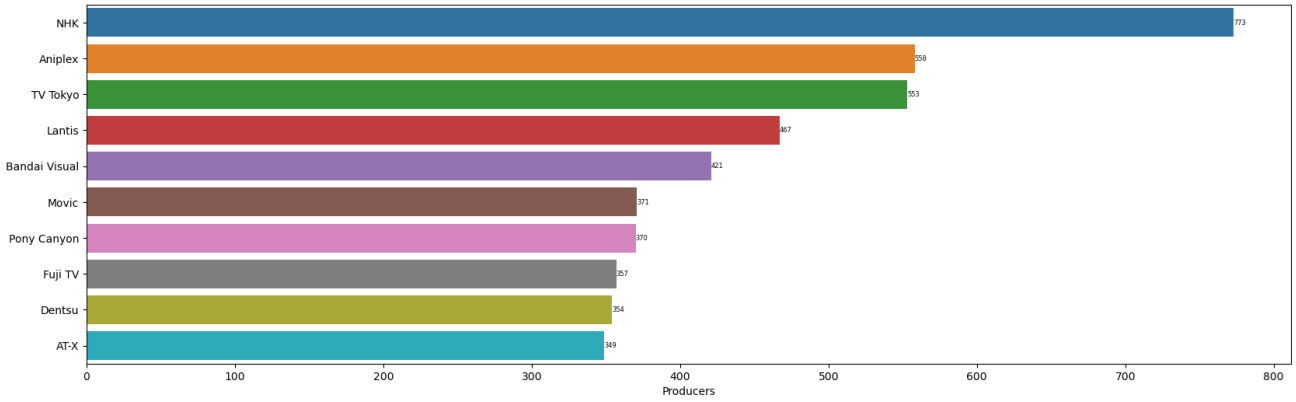
9.3.1.2.5 Annex 3.1.2.5



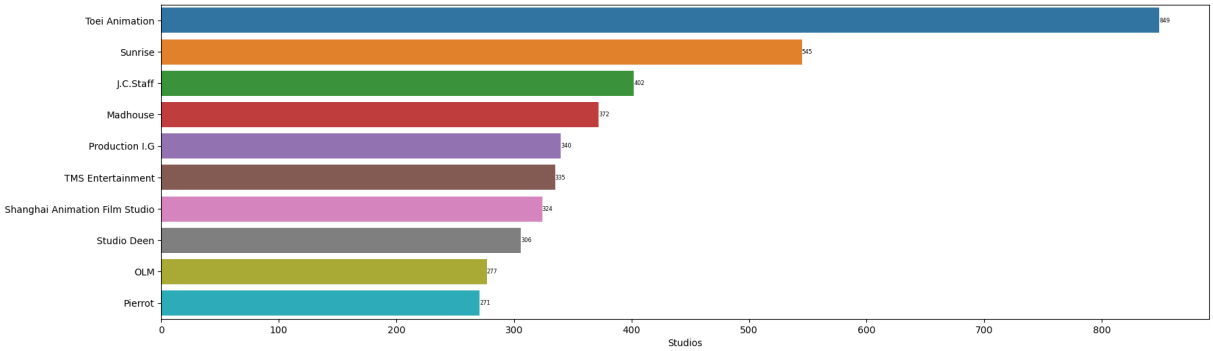


9.3.1.2.6 Annex 3.1.2.6

```
df_copy2 = df_copy.copy()
no_unknown = df_copy2[df_copy2["Producers"] != "Unknown"]
utils.complex_barplot_top10(no_unknown["Producers"],"Producers")
```



9.3.1.2.7 Annex 3.1.2.7



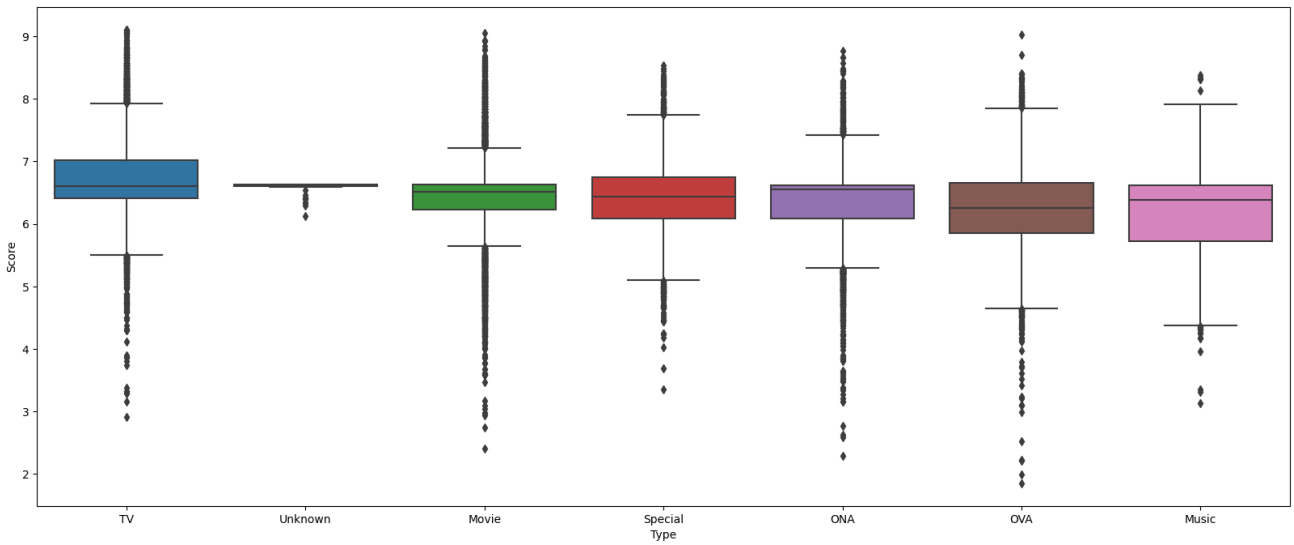
9.3.2 Annex 3.2

```
# Create a copy of df_copy
df_anime = df_copy.copy()

#Since the infomation are in lists we separate the information to have a better analysis of them.
df_anime['Genre_Split'] = df_anime['Genre'].apply(lambda x : x.split(','))

#create a new auxiliar dataframe
df_copy_aux = pd.DataFrame()

#Set the Genre columns with their score
df_copy_aux['Genre'] = pd.Series([x for _list in df_anime['Genre_Split'] for x in _list]) # split the information by comma.
df_copy_aux['Score'] = utils.series_extract(df_anime,'Genre', 'Score') #Funciton to extract the data of a column with respect to another column.
df_copy_aux['Scored_by'] = utils.series_extract(df_anime,'Genre_Split', 'Scored_by') #Funciton to extract the data of a column with respect to another column.
top10 = df_copy_aux[df_copy_aux['Genre'].isin(df_anime['Genre'].str.split(',').explode().value_counts()[0:11].index)] # find the top 10.
```

```python
'''
Function to extract the data of a columns with respect to another column.

'''
def series_extract(df,index_name , target_name): #Col name is the column to which we want to extract the data.

  datos = [] #Store the data
  cont = 0
  index = df.columns.get_loc(target_name) #To know the index of the desired column

  for list_items in df[index_name]:

    for gen in list_items:

        value = df.iloc[cont , index ] #Find the value of the desired column
        datos.append(value) #Store values from the value to the data list

    cont += 1

  return pd.Series(datos)
```

9.3.2.1 Annex 3.2.1

9.3.2.1.1 Annex 3.2.1.1



9.3.2.1.2 Annex 3.2.1.2

	Scored_by			
	mean	median	min	max
Type				
TV	99997.016913	15327.0	7	4125905
ONA	67098.823280	2105.0	0	4128912
Movie	52538.337251	3819.0	0	2113452
OVA	26750.072385	2394.0	1	1650790
Unknown	19307.855263	3274.5	34	279164
Special	19191.662194	2488.0	0	1400265
Music	15936.709147	610.0	8	783563

9.3.2.1.3 Annex 3.2.1.3

	Score			
	mean	median	min	max
Type				
TV	6.715764	6.598315	2.91	9.11000
Unknown	6.584459	6.618241	6.12	6.62804
Movie	6.429894	6.520000	2.40	9.05000
Special	6.420673	6.434526	3.35	8.54000
ONA	6.328962	6.550301	2.29	8.77000
OVA	6.265786	6.260000	1.85	9.03000
Music	6.182972	6.387958	3.13	8.38000

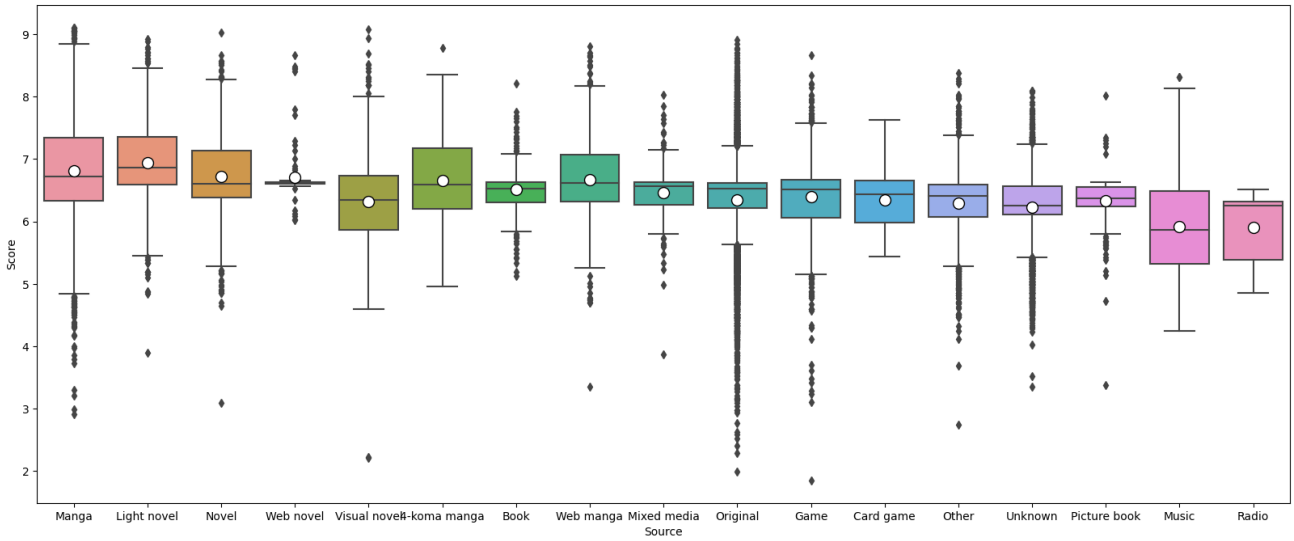
9.3.2.1.4 Annex 3.2.1.4

	Score	Scored_by
Type		
Movie	0.126655	2.867566
OVA	0.117100	4.085621
ONA	0.104425	5.462501
Music	0.104079	3.732160
Special	0.102092	3.977636
TV	0.094912	2.994734
Unknown	0.014019	2.495653

9.3.2.2 Annex 3.2.2

9.3.2.2.1 Annex 3.2.2.1

```
mean = df_copy.groupby(['Source'] , as_index=False).agg({'Score' : 'mean'}).sort_values('Score' , ascending = False)
utils.box_bidi(df_copy,mean,'Source','Score')
```



9.3.2.2.2 Annex 3.2.2.2

	Scored_by			
	mean	median	min	max
Source				
Light novel	146210.152294	65540.0	7	2011482
Original	119810.304043	11575.0	3	4128912
Manga	91086.734088	14125.0	0	3371923
Visual novel	73485.048913	25497.5	496	1286088
Unknown	64832.646254	4035.5	16	4125905
Other	63392.270661	4615.5	7	4027113
Book	52629.859155	5131.0	121	705389
Web manga	52412.276316	7132.0	26	2047625
4-koma manga	43968.164894	10587.5	124	537536
Picture book	40291.690000	7945.0	63	657301

9.3.2.2.3 Annex 3.2.2.3

	Score			
	mean	median	min	max
Source				
Manga	6.981560	6.870000	2.91	9.11
Light novel	6.970362	6.940000	3.90	8.89
Novel	6.832315	6.627491	4.86	8.57
Web novel	6.714725	6.616334	6.02	8.66
Visual novel	6.674177	6.645000	4.60	9.08
4-koma manga	6.672974	6.623396	4.96	8.78
Book	6.669103	6.587008	5.19	8.21
Web manga	6.665539	6.611648	4.70	8.81
Mixed media	6.484475	6.571006	3.87	8.03
Original	6.453939	6.582378	2.29	8.91

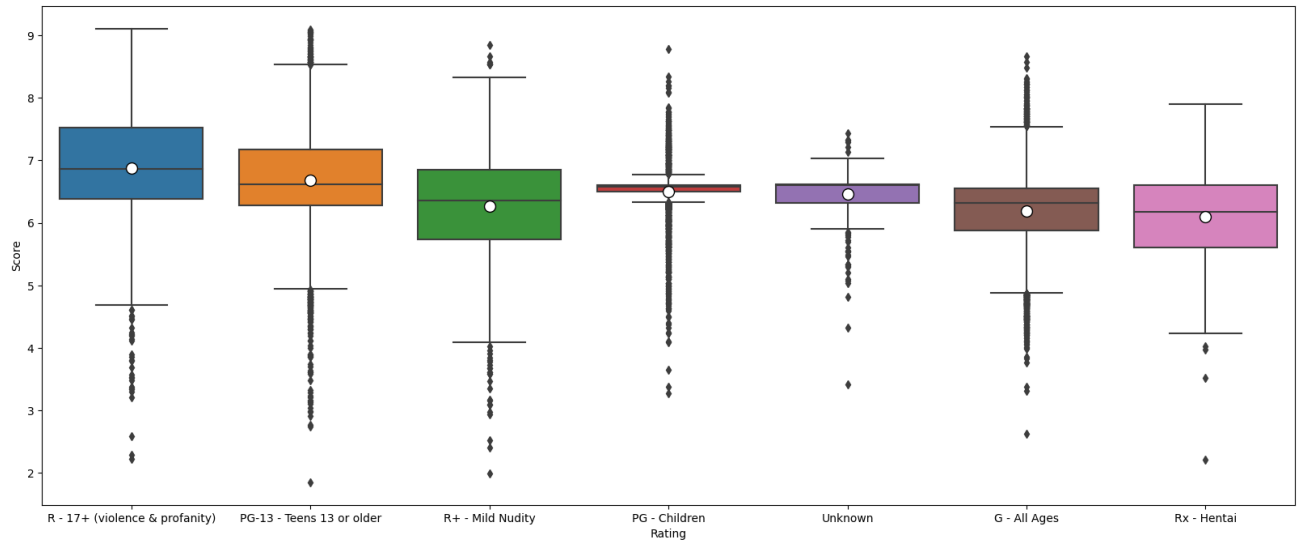
9.3.2.2.4 Annex 3.2.2.4

Source	Score	Scored_by
Music	0.118245	2.601476
Visual novel	0.111071	2.008400
Manga	0.109810	2.520211
Web manga	0.107046	3.229489
4-koma manga	0.105223	1.909162
Light novel	0.096906	1.535603
Other	0.096399	4.621674
Original	0.093591	3.653130
Game	0.093299	5.299941
Novel	0.091210	3.067088

9.3.2.3 Annex 3.2.3

9.3.2.3.1 Annex 3.2.3.1

```
mean = df_copy.groupby(['Rating'] , as_index=False).agg({'Score' : 'mean'}).sort_values('Score' , ascending = False)
utils.box_bidi(df_copy,mean,'Rating','Score')
```



9.3.2.3.2 Annex 3.2.3.2

	Scored_by			
	mean	median	min	max
Rating				
PG - Children	137004.455001	14269.0	4	4127786
R - 17+ (violence & profanity)	93470.055233	15635.0	3	2554804
G - All Ages	42597.671369	1493.0	1	4128912
R+ - Mild Nudity	42325.785648	5638.0	6	1581878
Unknown	41535.712658	4252.5	2	1556639
PG-13 - Teens 13 or older	40835.374268	4435.0	0	3688044
Rx - Hentai	3350.725086	1820.0	113	191517

9.3.2.3.3 Annex 3.2.3.3

	Score			
	mean	median	min	max
Rating				
R - 17+ (violence & profanity)	6.882970	6.865000	2.22	9.11
PG-13 - Teens 13 or older	6.683179	6.623080	1.85	9.09
PG - Children	6.495474	6.577830	3.27	8.78
Unknown	6.463277	6.599874	3.41	7.44
R+ - Mild Nudity	6.265436	6.360000	1.99	8.85
G - All Ages	6.185382	6.316877	2.63	8.66
Rx - Hentai	6.098950	6.170000	2.21	7.90

9.3.2.3.4 Annex 3.2.3.4

	Score	Scored_by
Rating		
R - 17+ (violence & profanity)	0.137730	1.909184
R+ - Mild Nudity	0.121579	1.748941
PG-13 - Teens 13 or older	0.111630	2.855835
G - All Ages	0.093640	5.072982
Rx - Hentai	0.093119	1.518774
PG - Children	0.046958	3.202293
Unknown	0.040753	2.705322

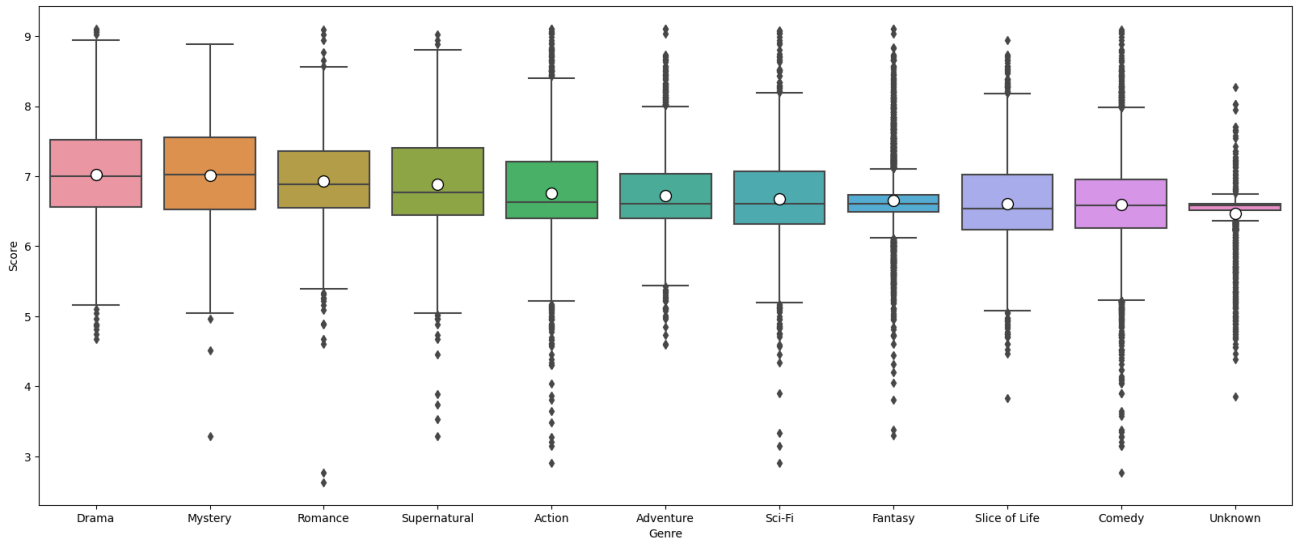
9.3.2.4 Annex 3.2.4

9.3.2.4.1 Annex 3.2.4.1

```python
# Create a copy of df_copy
df_anime = df_copy.copy()

#Since the infomation are in lists we separate the information to have a better analysis of them.
df_anime['Genre_Split'] = df_anime['Genre'].apply(lambda x : x.split(','))

#create a new auxiliar dataframe
df_copy_aux = pd.DataFrame()

#Set the Genre columns with their score
df_copy_aux['Genre'] = pd.Series([x for _list in df_anime['Genre_Split'] for x in _list]) # split the information by comma.
df_copy_aux['Score'] = utils.series_extract(df_anime,'Genre', 'Score') #Funciton to extract the data of a column with respect to another column.
df_copy_aux['Scored_by'] = utils.series_extract(df_anime,'Genre_Split', 'Scored_by') #Funciton to extract the data of a column with respect to another column.
top10 = df_copy_aux[df_copy_aux['Genre'].isin(df_anime['Genre'].str.split(',').explode().value_counts()[0:11].index)] # find the top 10
```

9.3.2.4.2 Annex 3.2.4.2

```python
mean = top10.groupby(['Genre'] , as_index=False).agg({'Score' : 'mean'}).sort_values('Score' , ascending = False)
utils.box_bidi(df_copy_aux,mean,'Genre','Score')
```



9.3.2.4.3 Annex 3.2.4.3

	Scored_by			
	mean	median	min	max
Genre				
Unknown	163978.337007	14006.5	3	4127786
Fantasy	95315.199395	10673.0	7	4125905
Supernatural	94591.516646	18639.0	22	3688044
Romance	89381.473684	21719.0	6	2011482
Drama	80719.304868	12836.0	22	2554804
Mystery	79976.242563	17548.0	26	1250813
Action	79699.152617	7411.0	6	2554804
Adventure	68579.464250	5500.0	14	3298982
Comedy	68234.668013	8013.0	0	4128912
Sci-Fi	56985.771067	7484.0	17	1866134

9.3.2.4.4 Annex 3.2.4.4

	Score			
	mean	median	min	max
Genre				
Drama	7.139107	7.17	4.85	8.94
Romance	7.112974	7.15	4.85	8.85
Sci-Fi	7.095158	7.11	3.33	8.94
Mystery	7.085973	7.08	4.85	8.75
Adventure	7.082613	7.12	3.33	8.85
Action	7.048747	7.07	3.33	8.94
Supernatural	7.044198	7.04	4.85	8.94
Fantasy	7.042160	7.08	3.33	8.94
Comedy	7.038904	7.05	4.45	8.94
Unknown	7.035665	7.03	4.88	8.70

9.3.2.4.5 Annex 3.2.4.5

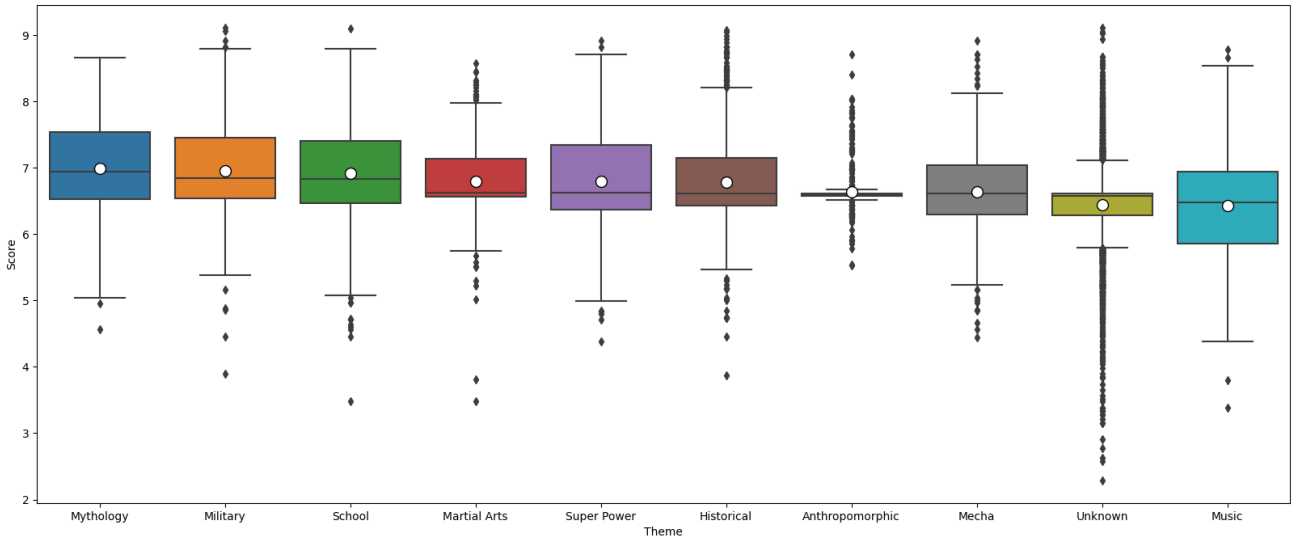
	Score	Scored_by
Genre		
Adventure	0.096610	2.842514
Action	0.096544	2.644240
Sci-Fi	0.095413	2.829930
Comedy	0.093376	3.566060
Fantasy	0.093103	3.299691
Supernatural	0.092302	2.458614
Slice of Life	0.091559	2.512193
Romance	0.090977	1.860675
Unknown	0.088482	3.433236
Mystery	0.088289	1.893790
Drama	0.087834	2.532582

9.3.2.5 Annex 3.2.5

9.3.2.5.1 Annex 3.2.5.1

```
# Create a copy of df_copy
df_anime = df_copy.copy()

#Since the infomation are in lists we separate the information to have a better analysis of them.
df_anime['Theme_Split'] = df_anime['Theme'].apply(lambda x : x.split(','))

#create a new auxiliar dataframe
df_copy_aux = pd.DataFrame()

#Set the Theme columns with their score
df_copy_aux['Theme'] = pd.Series([x for _list in df_anime['Theme_Split'] for x in _list]) # split the information by comma.
df_copy_aux['Score'] = utils.series_extract(df_anime,'Theme', 'Score') #Funciton to extract the data of a column with respect to another column.
df_copy_aux['Scored_by'] = utils.series_extract(df_anime,'Theme_Split', 'Scored_by') #Funciton to extract the data of a column with respect to another column.
top10 = df_copy_aux[df_copy_aux['Theme'].isin(df_anime['Theme'].str.split(',').explode().value_counts()[0:11].index)] # find the top 10
```

9.3.2.5.2 Annex 3.2.5.2



9.3.2.5.3 Annex 3.2.5.3

	Scored_by			
	mean	median	min	max
Theme				
Anthropomorphic	229096.374587	33403.0	56	4118873
School	109032.196279	30600.0	26	1898783
Super Power	106806.537764	17631.0	41	2047625
Military	97044.083636	12954.0	101	2554804
Unknown	91419.017403	8194.0	0	4128912
Mythology	77054.844291	12320.0	33	1189886
Mecha	52369.015280	4086.0	17	1913288
Parody	51652.462366	4397.0	79	2047625
Historical	46719.970000	4049.5	33	1817526
Martial Arts	41977.829208	2577.5	95	1811391

9.3.2.5.4 Annex 3.2.5.4

	Score			
	mean	median	min	max
Theme				
Mythology	6.989786	6.940000	4.56	8.66
Military	6.947124	6.840000	3.90	9.11
School	6.911449	6.830000	3.48	9.09
Martial Arts	6.797020	6.626496	3.48	8.57
Super Power	6.794365	6.625554	4.38	8.91
Historical	6.776242	6.611502	3.87	9.07
Anthropomorphic	6.637774	6.596083	5.53	8.71
Mecha	6.628445	6.605534	4.44	8.91
Unknown	6.442912	6.572731	2.29	9.11
Music	6.426945	6.474730	3.38	8.78

9.3.2.5.5 Annex 3.2.5.5

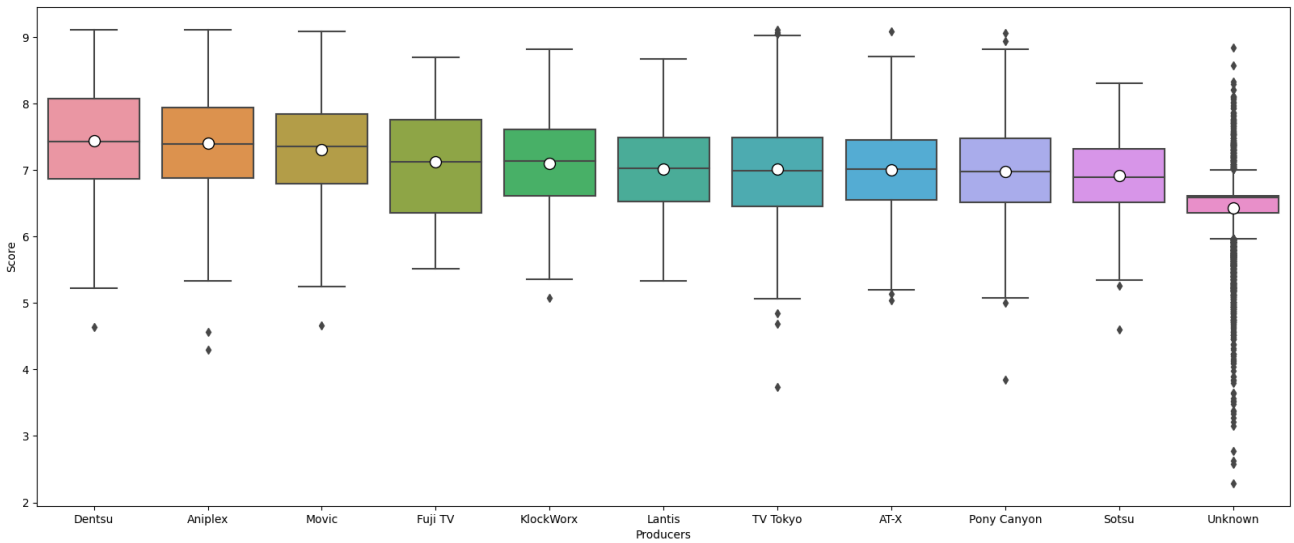
Theme	Score	Scored_by
Music	0.137337	3.487015
Parody	0.130750	3.019024
Military	0.116770	2.948196
Super Power	0.111847	2.489321
Mythology	0.109115	2.160243
School	0.104907	1.875456
Historical	0.103498	2.895665
Mecha	0.096682	3.316836
Martial Arts	0.088937	4.061181
Unknown	0.086369	3.824974
Anthropomorphic	0.044044	3.098722

9.3.2.6 Annex 3.2.6

9.3.2.6.1 Annex 3.2.6.1

```
# Create a copy of df_copy
df_anime = df_copy.copy()

#Since the infomation are in lists we separate the information to have a better analysis of them.
df_anime['Producers_Split'] = df_anime['Producers'].apply(lambda x : x.split(','))

#create a new auxiliar dataframe
df_copy_aux = pd.DataFrame()

#Set the producers columns with their score
df_copy_aux['Producers'] = pd.Series([x for _list in df_anime['Producers_Split'] for x in _list]) # split the information by comma.
df_copy_aux['Score'] = utils.series_extract(df_anime,'Producers', 'Score') #Funciton to extract the data of a column with respect to another column.
df_copy_aux['Scored_by'] = utils.series_extract(df_anime,'Producers_Split', 'Scored_by') #Funciton to extract the data of a column with respect to another column.
top10 = df_copy_aux[df_copy_aux['Producers'].isin(df_anime['Producers'].str.split(',').explode().value_counts()[0:11].index)] # find the top 10

```

9.3.2.6.2 Annex 3.2.6.2



9.3.2.6.3 Annex 3.2.6.3

	Scored_by			
	mean	median	min	max
Producers				
Dentsu	240536.630769	66326.0	251	2554804
Movic	219161.701195	89526.0	228	1898783
Aniplex	213673.638728	84219.0	117	2011482
KlockWorx	183066.379630	84585.0	424	1162643
AT-X	140642.223270	73130.0	169	1442254
Pony Canyon	126837.506073	38033.0	104	2554804
Lantis	115706.581699	46276.5	282	2047625
Fuji TV	114898.162698	24013.0	131	1250813
Unknown	104899.947853	8165.0	0	4128912
TV Tokyo	79604.432018	14281.5	121	2047625

9.3.2.6.4 Annex 3.2.6.4

	Score			
	mean	median	min	max
Producers				
Dentsu	7.437690	7.430	4.64	9.11
Aniplex	7.398784	7.385	4.30	9.11
Movic	7.301389	7.350	4.66	9.08
Fuji TV	7.116930	7.125	5.51	8.69
KlockWorx	7.099676	7.135	5.08	8.81
Lantis	7.011064	7.030	5.33	8.67
TV Tokyo	7.009788	6.990	3.74	9.11
AT-X	7.002381	7.015	5.04	9.08
Pony Canyon	6.979278	6.970	3.85	9.06
Sotsu	6.913255	6.890	4.60	8.30

9.3.2.6.5 Annex 3.2.6.5

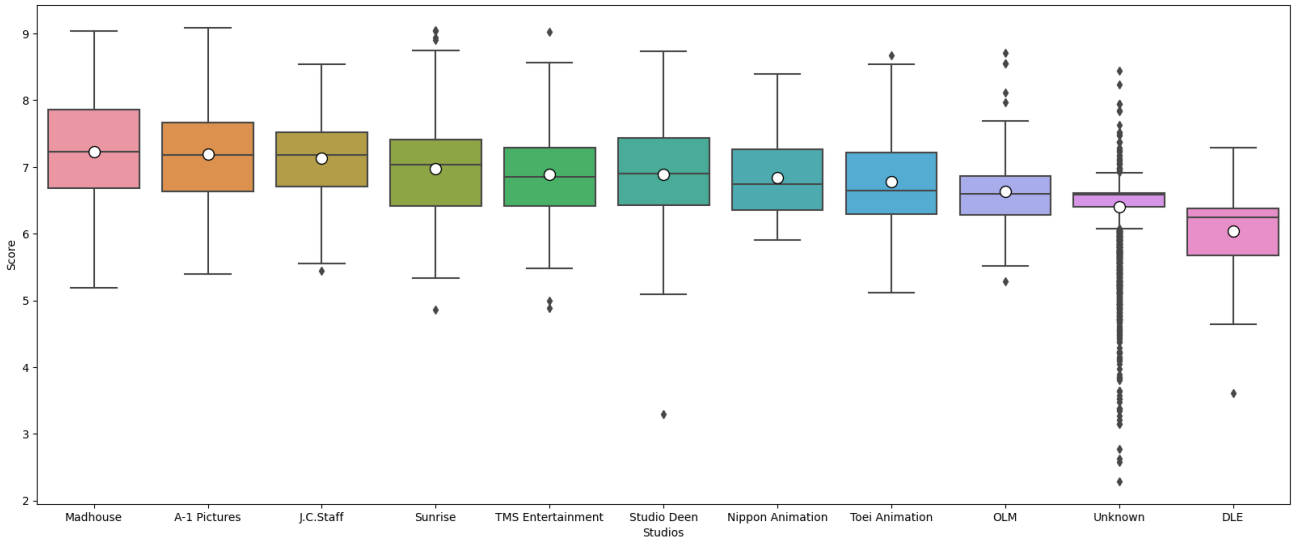
	Score	Scored_by
Producers		
Pony Canyon	0.114996	2.195403
TV Tokyo	0.110534	2.597241
Dentsu	0.110205	1.623508
Fuji TV	0.110024	1.895414
Aniplex	0.107323	1.510647
KlockWorx	0.101429	1.333703
Movic	0.099257	1.420165
AT-X	0.098207	1.405940
Lantis	0.095012	1.798485
Sotsu	0.093173	1.580820
Unknown	0.077503	3.889998

9.3.2.7 Annex 3.2.7

9.3.2.7.1 Annex 3.2.7.1

```
# Create a copy of df_copy
df_anime = df_copy.copy()

#Since the infomation are in lists we separate the information to have a better analysis of them.
df_anime['Studios_Split'] = df_anime['Studios'].apply(lambda x : x.split(','))

#create a new auxiliar dataframe
df_copy_aux = pd.DataFrame()

#Set the Studios columns with their score
df_copy_aux['Studios'] = pd.Series([x for _list in df_anime['Studios_Split'] for x in _list]) # split the information by comma.
df_copy_aux['Score'] = utils.series_extract(df_anime,'Studios_Split', 'Score') #Funciton to extract the data of a column with respect to another column.
df_copy_aux['Scored_by'] = utils.series_extract(df_anime,'Studios_Split', 'Scored_by') #Funciton to extract the data of a column with respect to another column.
top10 = df_copy_aux[df_copy_aux['Studios'].isin(df_anime['Studios'].str.split(',').explode().value_counts()[0:11].index)] # find the top 10
```

9.3.2.7.2 Annex 3.2.7.2



9.3.2.7.3 Annex 3.2.7.3

	Scored_by			
	mean	median	min	max
Studios				
A-1 Pictures	226296.566667	67312.5	117	2011482
Madhouse	136257.818750	27311.0	185	2520521
Unknown	122209.659570	10789.0	0	4128912
J.C.Staff	120269.840909	50072.0	38	1288419
Studio Deen	60644.154286	13955.0	126	1162643
TMS Entertainment	54347.591549	7320.0	86	928782
Sunrise	41013.260090	3657.0	117	1298956
DLE	33921.013889	2676.0	105	1023343
Toei Animation	33364.295302	3125.5	30	1392685
OLM	24756.507143	4657.0	113	378009

9.3.2.7.4 Annex 3.2.7.4

	Score			
	mean	median	min	max
Studios				
Madhouse	7.229300	7.23000	5.19	9.04
A-1 Pictures	7.193980	7.18500	5.40	9.09
J.C.Staff	7.136574	7.18500	5.44	8.54
Sunrise	6.971141	7.03000	4.86	9.05
TMS Entertainment	6.891308	6.85000	4.88	9.02
Studio Deen	6.885022	6.90000	3.30	8.74
Nippon Animation	6.835087	6.74000	5.90	8.40
Toei Animation	6.778345	6.65000	5.11	8.67
OLM	6.636592	6.59500	5.28	8.71
Unknown	6.404769	6.58208	2.29	8.44

9.3.2.7.5 Annex 3.2.7.5

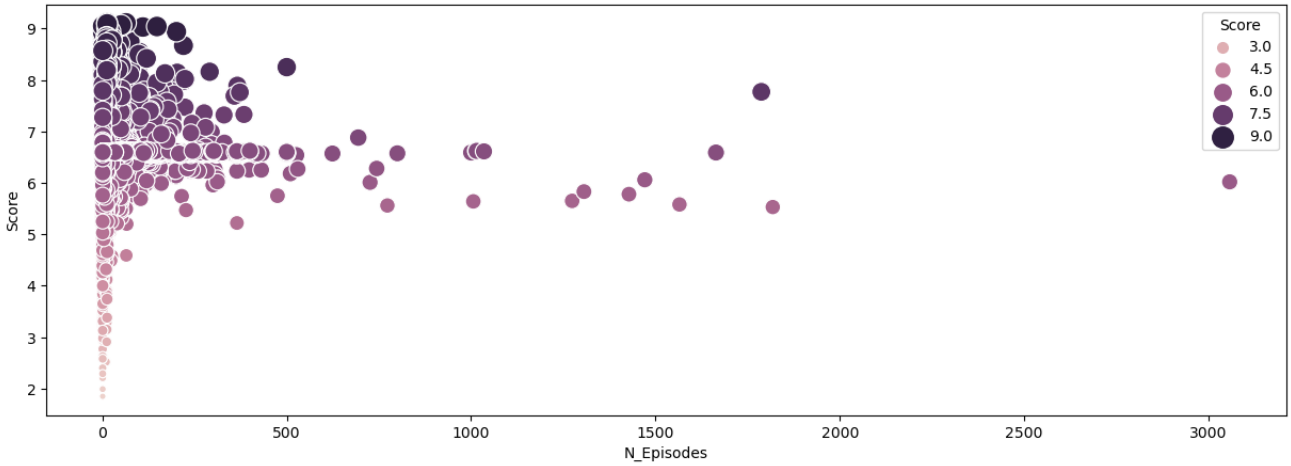
	Score	Scored_by
Studios		
Madhouse	0.113166	2.483079
Studio Deen	0.109497	2.249221
Sunrise	0.105083	3.412560
A-1 Pictures	0.102353	1.523294
TMS Entertainment	0.101846	2.235107
Toei Animation	0.092047	3.846230
J.C.Staff	0.090889	1.628922
DLE	0.090169	2.999470
OLM	0.085565	2.378649
Nippon Animation	0.081828	3.181660

9.4 Annex 4

9.4.1 Annex 4.1

9.4.1.1 Annex 4.1.1

```
utils.scat(df_copy,"N_Episodes","Score","N_Episodes_VS_Score")
```

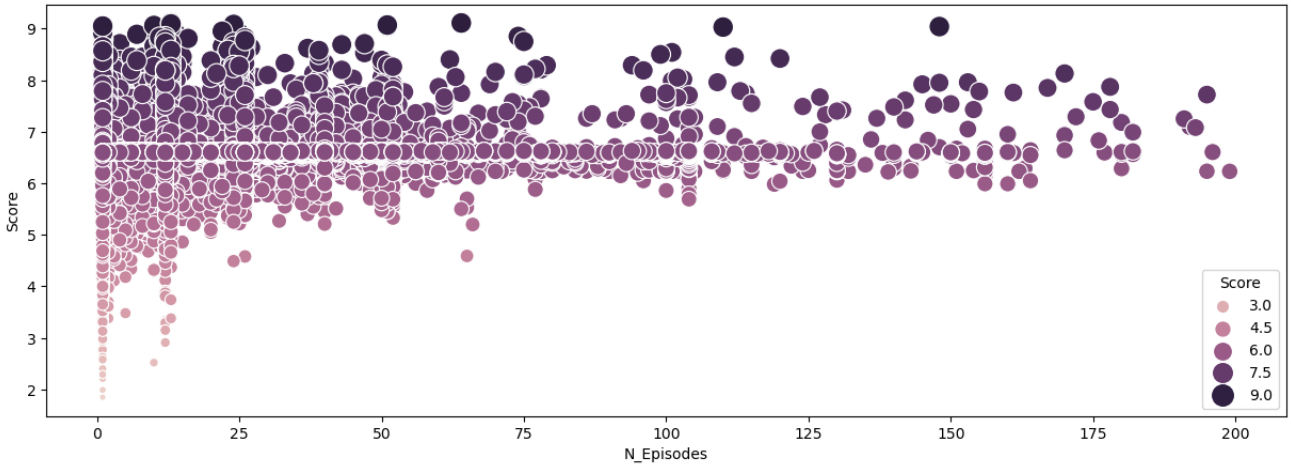


9.4.1.2 Annex 4.1.2

```
# Get count of values greater than 2022 in the column 'Released'
count = df_copy["N_Episodes"][df_copy["N_Episodes"] > 200].count()
print("There are",count,"animes with more than 200 episodes")
```

9.4.1.3 Annex 4.1.3

```
until2000 = df_copy[df_copy["N_Episodes"] < 200] #there are a couple of outliers, it is better to do not take them into account
utils.scat(until2000,"N_Episodes","Score","N_Episodes_VS_Score_Less200")
```



9.4.1.4 Annex 4.1.4

```
# Spearman's Rank Correlation Test
# Revisamos la correlacion
df_copy['N_Episodes'].corr(df_copy['Score'] , method = 'spearman')
```

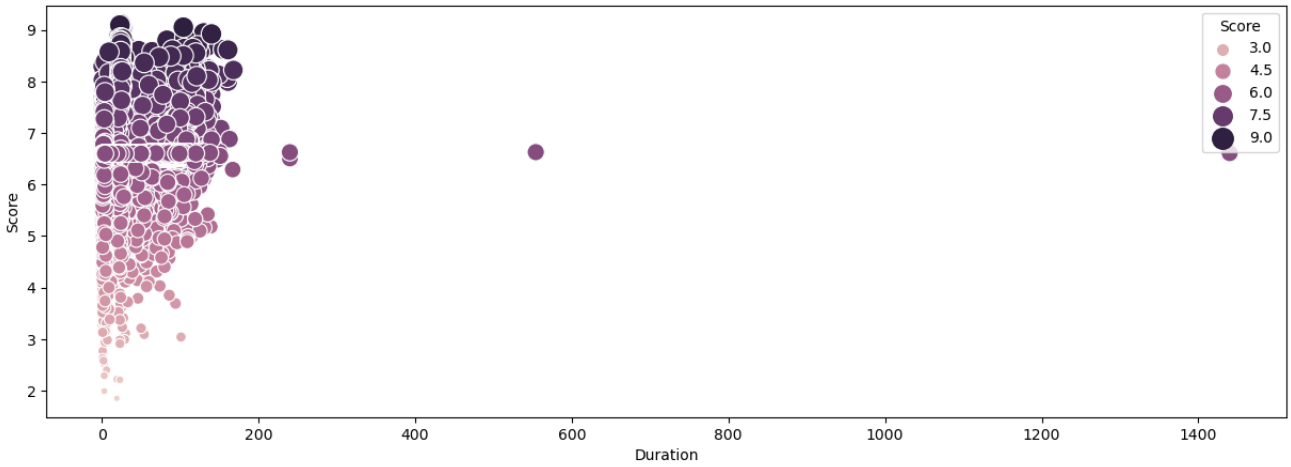
9.4.1.5 Annex 4.1.5

```
# Pearson's dependency test
from scipy.stats import pearsonr
data1 = df_copy['N_Episodes']
data2 = df_copy['Score']
stat, p = pearsonr(data1, data2)
print('stat=%.3f, p=%.3f' % (stat, p))
```

9.4.2 Annex 4.2

9.4.2.1 Annex 4.1.1

```
utils.scat(df_copy,"Duration","Score","Duration_VS_Score")
```

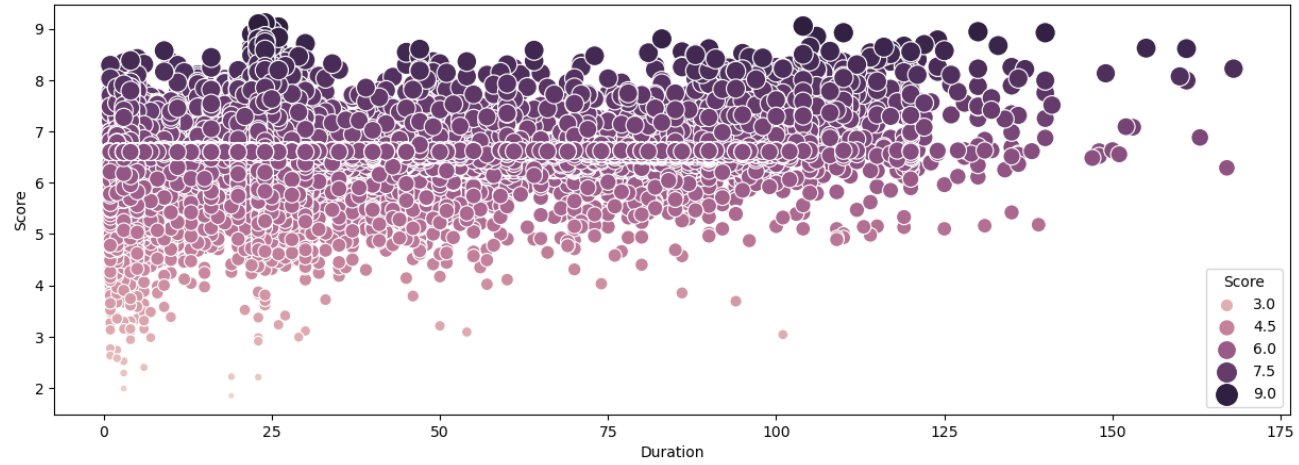


9.4.2.2 Annex 4.1.2

```
# Get count of values greater than 2022 in the column 'Released'
count = df_copy["Duration"][df_copy["Duration"] > 200].count()
print("There are",count,"animes with a duration of more than 200 minutes")
```

9.4.2.3 Annex 4.1.3

```
until400 = df_copy[df_copy["Duration"] < 200] #there are a couple of outliers, it is better to do not taking them into account
utils.scat(until400,"Duration","Score","Duration_VS_Score_less 200")
```



9.4.2.4 Annex 4.1.4

```
# Spearman's Rank Correlation Test
# Revisamos la correlacion
df_copy['Duration'].corr(df_copy['Score'], method = 'spearman')
```

9.4.2.5 Annex 4.1.5

```
# Spearman' dependency test
from scipy.stats import spearmanr
data1 = df_copy['Score']
data2 = df_copy['Duration']
stat, p = spearmanr(data1, data2)
print('stat=%.33f, p=%.3f' % (stat, p))
```

Thank you for your time and attention!

Please do not hesitate to contact us if you have any questions about information highlighted in this document.

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