Business Case: Data Exploration and Visualization

Introduction :

Netflix is one of the most popular media and video streaming platforms globally, offering more than 10,000 movies and TV shows. As of mid-2021, Netflix had over 222 million subscribers worldwide. The provided dataset contains detailed information about each title on Netflix, including attributes like cast, director, release year, genre, and more.

Bussiness Problem :

The goal of this project is to analyze Netflix's catalog to generate actionable insights that can help the company decide:

- What types of shows or movies to produce next.
- How to expand its presence and grow its business in different countries.

Objective :

The objective of this project is to perform data exploration and visualization on Netflix's dataset to identify meaningful trends, patterns, and business insights that can support strategic decisions regarding content creation, audience targeting, and regional growth.

Concepts used :

Concept	Description / Use
Exploratory Data Analysis (EDA)	The process of understanding data — summarizing, cleaning, and identifying patterns or relationships before modeling.
Data Cleaning	Handling missing values, duplicates, incorrect formats, and inconsistent entries.
Data Profiling	Converting categorical data to category types and splitting multi-value columns (like genre or cast).
Feature Extraction	Extracting additional features such as *year, month,* or *duration type* for deeper analysis.
Statistical Summary	Using functions like `.describe()` to understand data distribution (mean, median, mode, count).

Setting up the Libraries :

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score
from sklearn.preprocessing import LabelEncoder
from sklearn.metrics import precision_score, recall_score, f1_score
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, confusion_matrix, classification_report
from sklearn.metrics import precision_recall_curve, confusion_matrix, classification_report, accuracy_score
```

Dataset Link :

```
!wget https://d2beiqkhq929f0.cloudfront.net/public_assets/assets/000/000/940/original/netflix.csv - netflix.csv
```

```
--2025-11-04 11:37:56--  https://d2beiqkhq929f0.cloudfront.net/public_assets/assets/000/000/940/original/netflix.csv
Resolving d2beiqkhq929f0.cloudfront.net (d2beiqkhq929f0.cloudfront.net)... 108.157.172.10, 108.157.172.183, 108.157.172.173,
Connecting to d2beiqkhq929f0.cloudfront.net (d2beiqkhq929f0.cloudfront.net)|108.157.172.10|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 3399671 (3.2M) [text/plain]
Saving to: ‘netflix.csv’

netflix.csv         100%[===================>]   3.24M  2.52MB/s    in 1.3s

2025-11-04 11:37:59 (2.52 MB/s) - ‘netflix.csv’ saved [3399671/3399671]

--2025-11-04 11:37:59--  http://-/
Resolving - (-)... failed: Name or service not known.
wget: unable to resolve host address ‘-’
--2025-11-04 11:37:59--  http://netflix.csv/
Resolving netflix.csv (netflix.csv)... failed: Name or service not known.
wget: unable to resolve host address ‘netflix.csv’
FINISHED --2025-11-04 11:37:59--
Total wall clock time: 2.2s
Downloaded: 1 files, 3.2M in 1.3s (2.52 MB/s)
```

```
df=pd.read_csv('/content/netflix.csv')
```

```
df
```

	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	des
0	s1	Movie	Dick Johnson Is Dead	Kirsten Johnson	NaN	United States	September 25, 2021	2020	PG-13	90 min	Documentaries	As lif
1	s2	TV Show	Blood & Water	NaN	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, TV Dramas, TV Mysteries	par
2	s3	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...	NaN	September 24, 2021	2021	TV-MA	1 Season	Crime TV Shows, International TV Shows, TV Act...	To p fan
3	s4	TV Show	Jailbirds New Orleans	NaN	NaN	NaN	September 24, 2021	2021	TV-MA	1 Season	Docuseries, Reality TV	flirta to do
4	s5	TV Show	Kota Factory	NaN	Mayur More, Jitendra Kumar, Ranjan Raj, Alam K...	India	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, Romantic TV Shows, TV ...	I
...	...	...	...	...	...	...	...	...	...	...	...	
8802	s8803	Movie	Zodiac	David Fincher	Mark Ruffalo, Jake Gyllenhaal, Robert	United States	November 20, 2019	2007	R	158 min	Cult Movies, Dramas, Thrillers	ca rep

Next steps: Generate code with df New interactive sheet

Dataset Overview :

Attribute	Description
Show_ID	Unique ID for every movie/TV show
Type	Identifies whether it's a Movie or TV Show
Title	Name of the movie or show
Director	Director's name
Cast	Actors involved in the movie/show
Country	Country where the movie/show was produced
Date_Added	Date when it was added to Netflix
Release_Year	Year of release
Rating	TV rating (like TV-MA, PG, etc.)
Duration	Total duration (minutes or seasons)
Listed_in	Genre or category
Description	Short summary of the movie/show

Data Profiling :

```
df.head()
```

	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	descript
0	s1	Movie	Dick Johnson Is Dead	Kirsten Johnson	NaN	United States	September 25, 2021	2020	PG-13	90 min	Documentaries	As her fa nears end c life, film
1	s2	TV Show	Blood & Water	NaN	Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, TV Dramas, TV Mysteries	cros paths party, a C Tow
2	s3	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas,	NaN	September 24, 2021	2021	TV-MA	1 Season	Crime TV Shows, International	To protec family fr

Next steps: Generate code with df New interactive sheet

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 8807 entries, 0 to 8806
Data columns (total 12 columns):
 #   Column        Non-Null Count  Dtype 
---  ------        --------------  ----- 
 0   show_id       8807 non-null   object
 1   type          8807 non-null   object
 2   title         8807 non-null   object
 3   director      6173 non-null   object
 4   cast          7982 non-null   object
 5   country       7976 non-null   object
 6   date_added    8797 non-null   object
 7   release_year  8807 non-null   int64 
 8   rating        8803 non-null   object
 9   duration      8804 non-null   object
 10  listed_in     8807 non-null   object
 11  description   8807 non-null   object
dtypes: int64(1), object(11)
memory usage: 825.8+ KB
```

```
df.shape
```

```
(8807, 12)
```

```
df.describe(include='object')
```

	show_id	type	title	director	cast	country	date_added	rating	duration	listed_in	description
count	8807	8807	8807	6173	7982	7976	8797	8803	8804	8807	8807
unique	8807	2	8807	4528	7692	748	1767	17	220	514	8775
top	s8807	Movie	Zubaan	Rajiv Chilaka	David Attenborough	United States	January 1, 2020	TV-MA	1 Season	Dramas, International Movies	Paranormal activity at a lush, abandoned

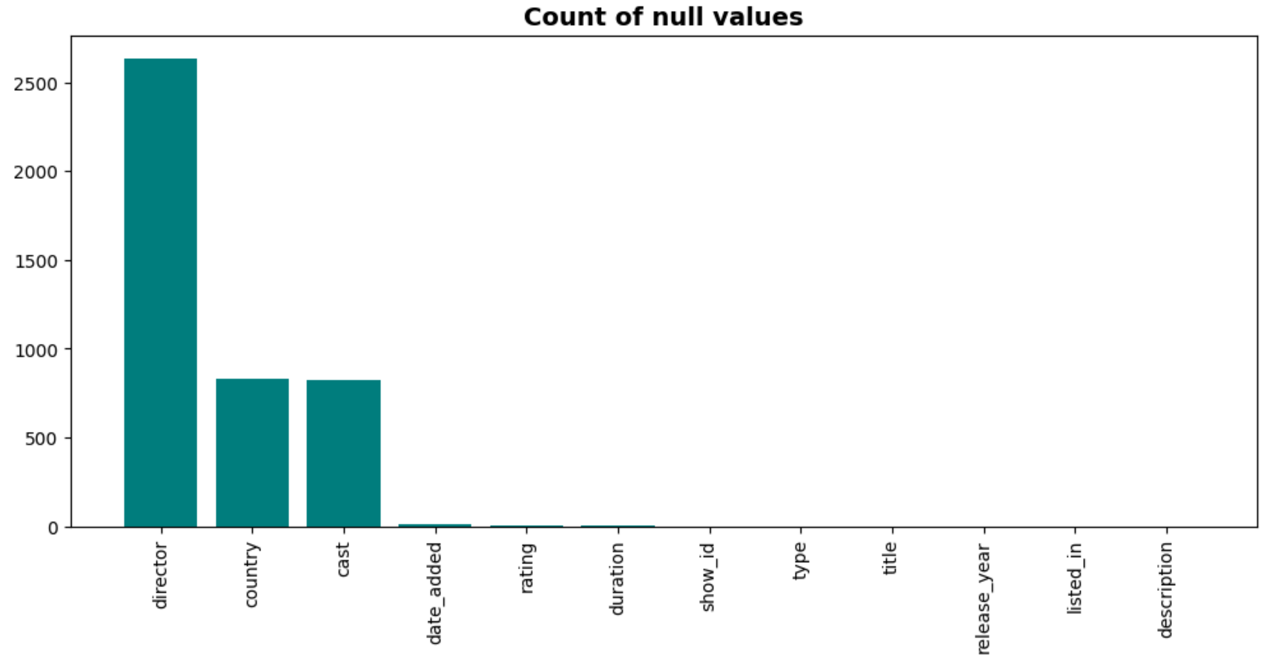
```
df.describe().T
```

	count	mean	std	min	25%	50%	75%	max
release_year	8807.0	2014.180198	8.819312	1925.0	2013.0	2017.0	2019.0	2021.0

```
null_details = df.isna().sum() / len(df) * 100
print('\033[1m' + 'Percentages of null' + '\033[0m')
print(null_details.sort_values(ascending = False)[:6])
```

```
Percentages of null
director      29.908028
country        9.435676
cast           9.367549
date_added     0.113546
rating         0.045418
duration       0.034064
dtype: float64
```

```
null_values = df.isna().sum().sort_values(ascending=False)
plt.figure(figsize= (12,5))
plt.bar(null_values.index,null_values , color='teal')
plt.xticks(rotation = 90)
plt.title('Count of null values' , fontsize = 14 , fontweight = 'bold')
plt.show()
```



```
df['type'].value_counts(normalize=True)
```

	proportion
type	
Movie	0.696151
TV Show	0.303849

dtype: float64

Observation:

- The dataset has 8,800 records and 11 columns
- Most of the null values are from director, country, cast
- The dataset is imbalanced where 70 % of data is into Movies and 30% into TV Show

Data Cleaning :

```
df.isna().sum()
```

```
                    0
     show_id        0
        type        0
       title        0
    director     2634
        cast      825
     country      831
  date_added       10
release_year        0
      rating        4
    duration        3
   listed_in        0
 description        0

dtype: int64
```

```
df['director']
```

```
              director
   0   Kirsten Johnson
   1               NaN
   2   Julien Leclercq
   3               NaN
   4               NaN
 ...               ...
8802     David Fincher
8803               NaN
8804   Ruben Fleischer
8805      Peter Hewitt
8806       Mozez Singh
8807 rows × 1 columns

dtype: object
```

```
df['director'].fillna('unknown' , inplace = True)
```

```
df.isna().sum()
```

```
                0
show_id         0
type            0
title           0
director        0
cast          825
country       831
date_added     10
release_year    0
rating          4
duration        3
listed_in       0
description     0

dtype: int64
```

```
df['cast']
```

```
                                                  cast
0                                                  NaN
1     Ama Qamata, Khosi Ngema, Gail Mabalane, Thaban...
2        Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...
3                                                  NaN
4        Mayur More, Jitendra Kumar, Ranjan Raj, Alam K...
...                                                ...
8802     Mark Ruffalo, Jake Gyllenhaal, Robert Downey J...
8803                                               NaN
8804  Jesse Eisenberg, Woody Harrelson, Emma Stone, ...
8805     Tim Allen, Courteney Cox, Chevy Chase, Kate Ma...
8806  Vicky Kaushal, Sarah-Jane Dias, Raaghav Chanan...
8807 rows × 1 columns

dtype: object
```

```
df['cast'].fillna('unknown' , inplace = True)
```

```
df.isna().sum()
```

```
                0
show_id         0
type            0
title           0
director        0
cast            0
country       831
date_added     10
release_year    0
rating          4
duration        3
listed_in       0
description     0

dtype: int64
```

```
df['country']
```

```
        country
   0    United States
   1    South Africa
   2    NaN
   3    NaN
   4    India
 ...    ...
8802    United States
8803    NaN
8804    United States
8805    United States
8806    India
8807 rows × 1 columns

dtype: object
```

```
df['country'].mode()
```

```
   country
0  United States

dtype: object
```

```
df['country'].fillna('United States',inplace=True)
```

```
df.isna().sum()
```

```
                0
show_id         0
type            0
title           0
director        0
cast            0
country         0
date_added      10
release_year    0
rating          4
duration        3
listed_in       0
description     0

dtype: int64
```

```
df['date_added'].mode()
```

```
   date_added
0  January 1, 2020

dtype: object
```

```
df['date_added'].fillna(' January 1, 2020',inplace=True)
```

```
/tmp/ipython-input-133653104.py:1: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through cha
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col]


  df['date_added'].fillna(' January 1, 2020',inplace=True)
```

```
df.isna().sum()
```

```
                 0
   show_id       0
      type       0
      title      0
    director     0
      cast       0
    country      0
  date_added     0
 release_year    0
     rating      4
    duration     3
   listed_in     0
  description    0

dtype: int64
```

```
df['rating'].mode()
```

```
    rating
0   TV-MA

dtype: object
```

```
df['rating'].fillna('0 TV-MA',inplace=True)
```

```
/tmp/ipython-input-1318977687.py:1: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through ch
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col]


  df['rating'].fillna('0 TV-MA',inplace=True)
```

```
df.isna().sum()
```

```
                 0
   show_id       0
      type       0
      title      0
    director     0
      cast       0
    country      0
  date_added     0
 release_year    0
     rating      0
    duration     3
   listed_in     0
  description    0

dtype: int64
```

```
df['duration'].mode()
```

```
   duration
0  1 Season

dtype: object
```

```
df['duration'].fillna(' 1 Season',inplace=True)
```

```
/tmp/ipython-input-3454873123.py:1: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through ch
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col]


  df['duration'].fillna(' 1 Season',inplace=True)
```

```
df.isna().sum()
```

```
              0
show_id       0
type          0
title         0
director      0
cast          0
country       0
date_added    0
release_year  0
rating        0
duration      0
listed_in     0
description   0

dtype: int64
```

```
df
```

	show_id	type	title	director	cast	country	date_added	release_year	rating	duration	listed_in	des
0	s1	Movie	Dick Johnson Is Dead	Kirsten Johnson	unknown	United States	September 25, 2021	2020	PG-13	90 min	Documentaries	As lit
1	s2	TV Show	Blood & Water	unknown	Khosi Ngema, Gail Mabalane, Thaban...	South Africa	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, TV Dramas, TV Mysteries	par
2	s3	TV Show	Ganglands	Julien Leclercq	Sami Bouajila, Tracy Gotoas, Samuel Jouy, Nabi...	United States	September 24, 2021	2021	TV-MA	1 Season	Crime TV Shows, International TV Shows, TV Act...	To p fan
3	s4	TV Show	Jailbirds New Orleans	unknown	unknown	United States	September 24, 2021	2021	TV-MA	1 Season	Docuseries, Reality TV	flirt to do
4	s5	TV Show	Kota Factory	unknown	Mayur More, Jitendra Kumar, Ranjan Raj, Alam K...	India	September 24, 2021	2021	TV-MA	2 Seasons	International TV Shows, Romantic TV Shows, TV ...	
...	...	...	...	...	...	...	...	...	...	...	...	
					Mark							

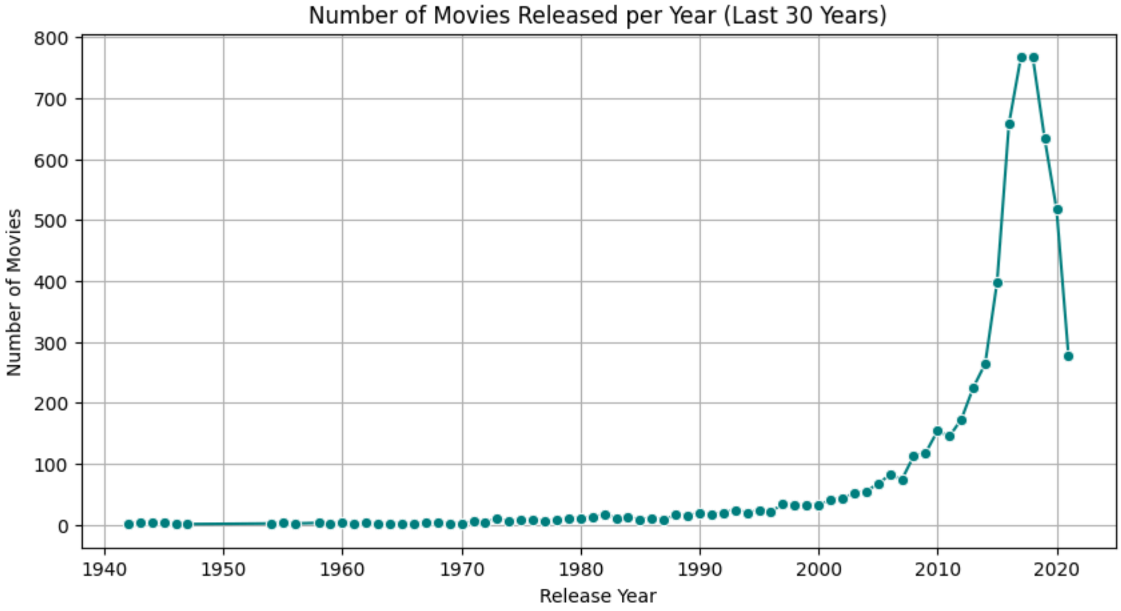
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 8807 entries, 0 to 8806
Data columns (total 12 columns):
 #   Column        Non-Null Count  Dtype 
---  ------        --------------  ----- 
 0   show_id       8807 non-null   object
 1   type          8807 non-null   object
 2   title         8807 non-null   object
 3   director      8807 non-null   object
 4   cast          8807 non-null   object
 5   country       8807 non-null   object
 6   date_added    8807 non-null   object
 7   release_year  8807 non-null   int64 
 8   rating        8807 non-null   object
 9   duration      8807 non-null   object
 10  listed_in     8807 non-null   object
 11  description   8807 non-null   object
dtypes: int64(1), object(11)
memory usage: 825.8+ KB
```

Uni-Variate Analysis :

How has the number of movies released per year changed over the last 20-30 years.

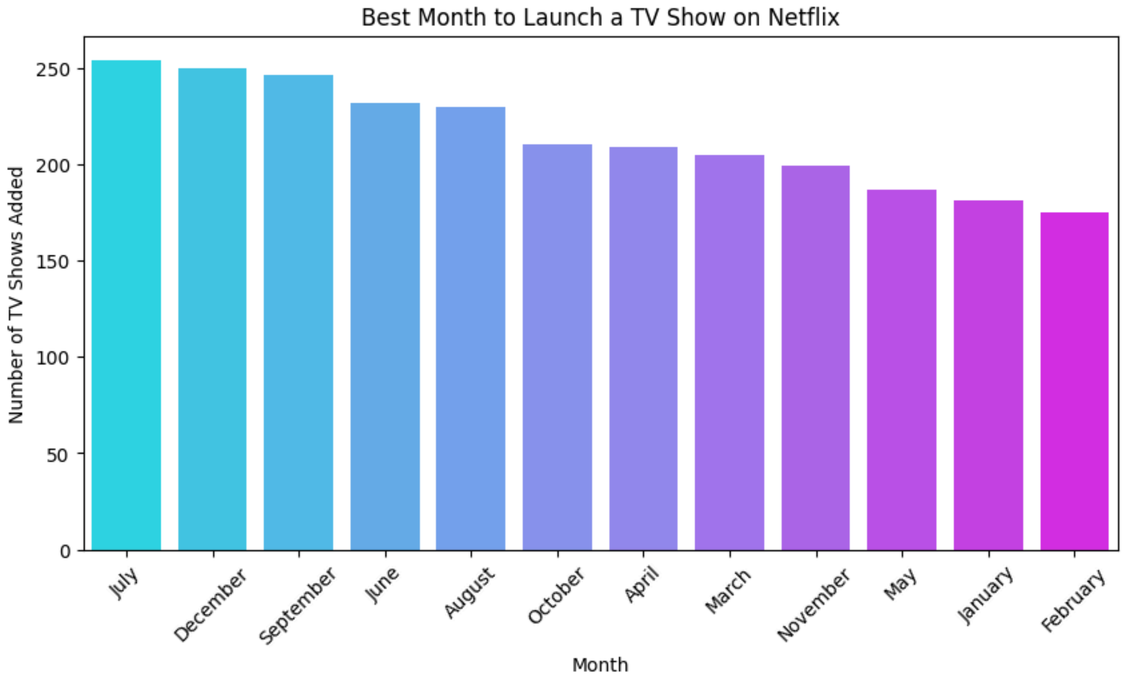
```
movies = df[df['type'] == 'Movie']
movies_per_year = movies['release_year'].value_counts().sort_index()

plt.figure(figsize=(10,5))
sns.lineplot(x=movies_per_year.index, y=movies_per_year.values, color='teal', marker='o')
plt.title('Number of Movies Released per Year (Last 30 Years)')
plt.xlabel('Release Year')
plt.ylabel('Number of Movies')
plt.grid(True)
plt.show()
```



What is the best Month to launch a TV show?

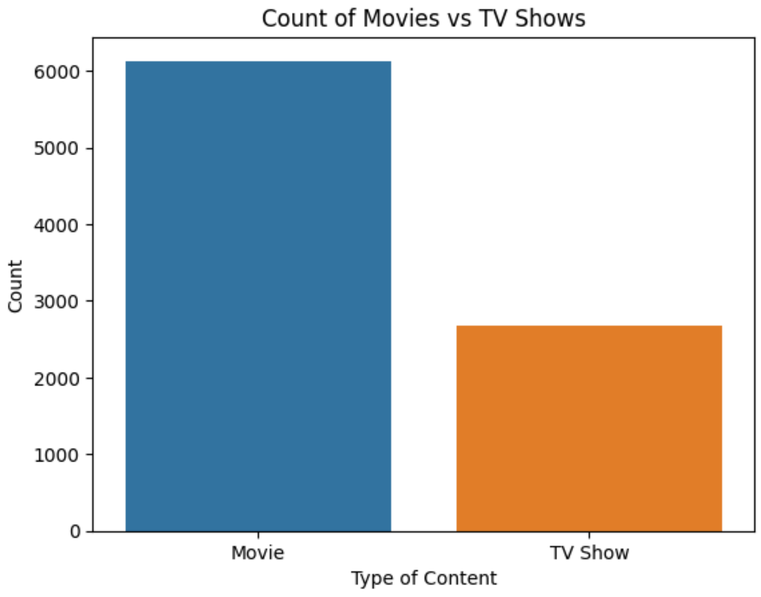
```
df['date_added'] = pd.to_datetime(df['date_added'], errors='coerce')
df['month_added'] = df['date_added'].dt.month_name()
tv_shows = df[df['type'] == 'TV Show']
month_counts = tv_shows['month_added'].value_counts()
```

```
plt.figure(figsize=(10,5))
sns.barplot(x=month_counts.index, y=month_counts.values, hue=month_counts.index, palette='cool', legend=False)
plt.title('Best Month to Launch a TV Show on Netflix')
plt.xlabel('Month')
plt.ylabel('Number of TV Shows Added')
plt.xticks(rotation=45)
plt.show()
```



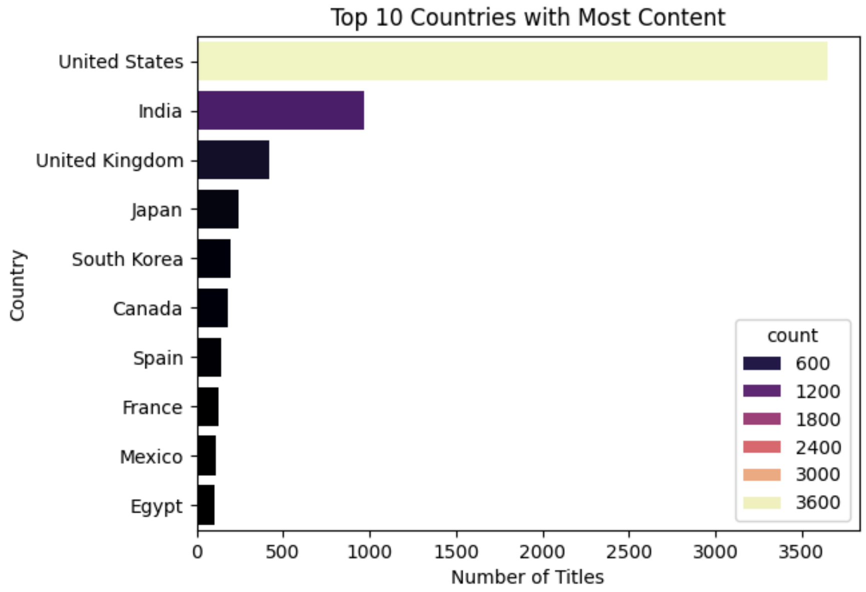
What is the most common type of content on Netflix — Movies or TV Shows?

```
sns.countplot(data=df, x='type', hue='type')
plt.title('Count of Movies vs TV Shows')
plt.xlabel('Type of Content')
plt.ylabel('Count')
plt.show()
```



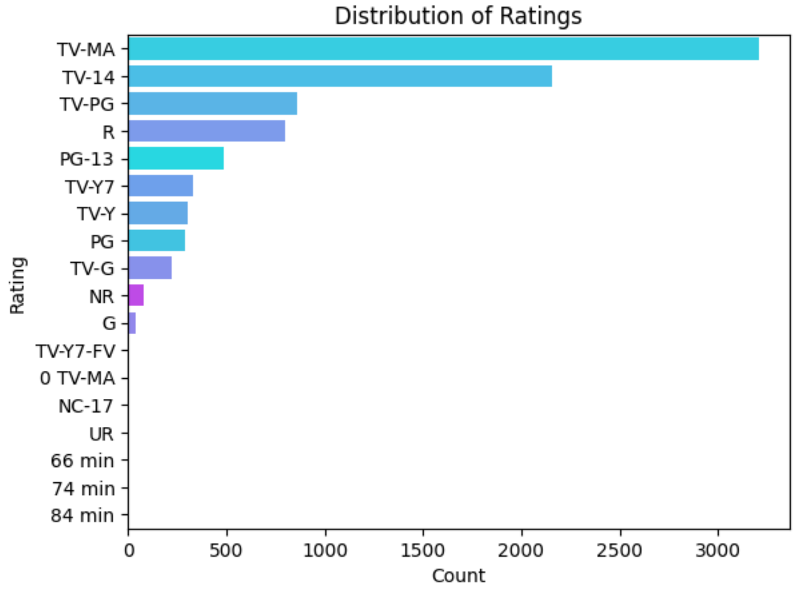
Which country has the highest number of shows?

```
top_countries = df['country'].value_counts().head(10)
sns.barplot(x=top_countries.values, y=top_countries.index,hue=top_countries,palette='magma')
plt.title('Top 10 Countries with Most Content')
plt.xlabel('Number of Titles')
plt.ylabel('Country')
plt.show()
```



What is the most common rating on Netflix?

```
sns.countplot(y=df['rating'], order=df['rating'].value_counts().index, hue=df['rating'],palette='cool')
plt.title('Distribution of Ratings')
plt.xlabel('Count')
plt.ylabel('Rating')
plt.show()
```



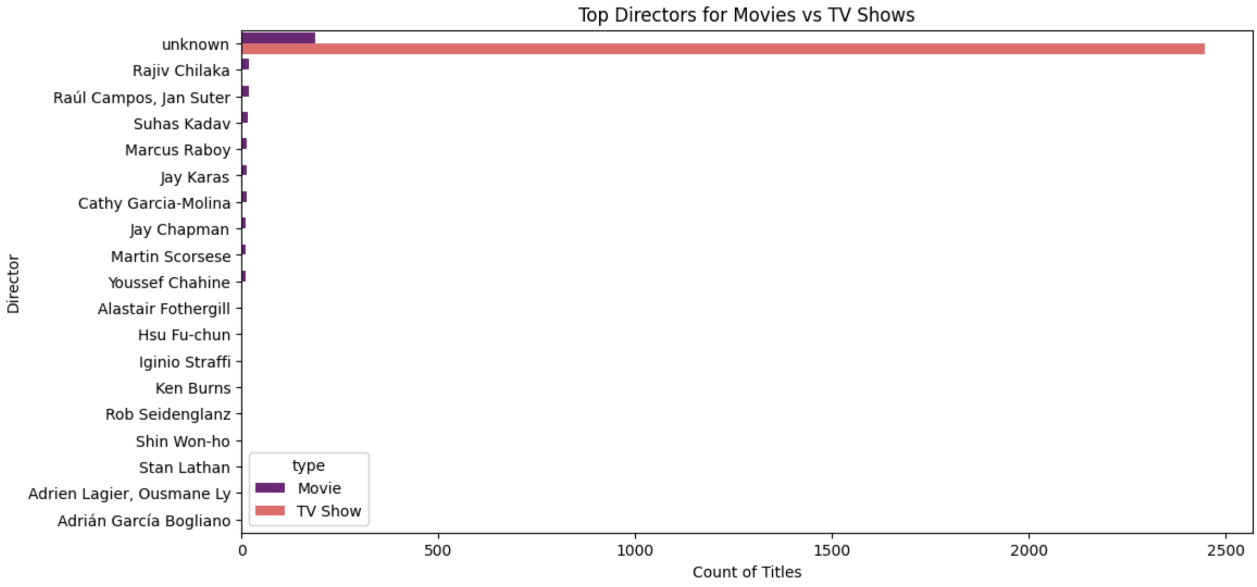
Insights:

- A steady growth in movie releases since the early 2000s.
- Suggests Netflix times releases near festive seasons and holidays, maximizing viewership.
- Netflix hosts more Movies than TV Shows overall.
- United States is the dominant producer of Netflix content.
- The most common rating is TV-MA (Mature Audience), followed by TV-14 and TV-PG.

Bi-Variate Analysis :

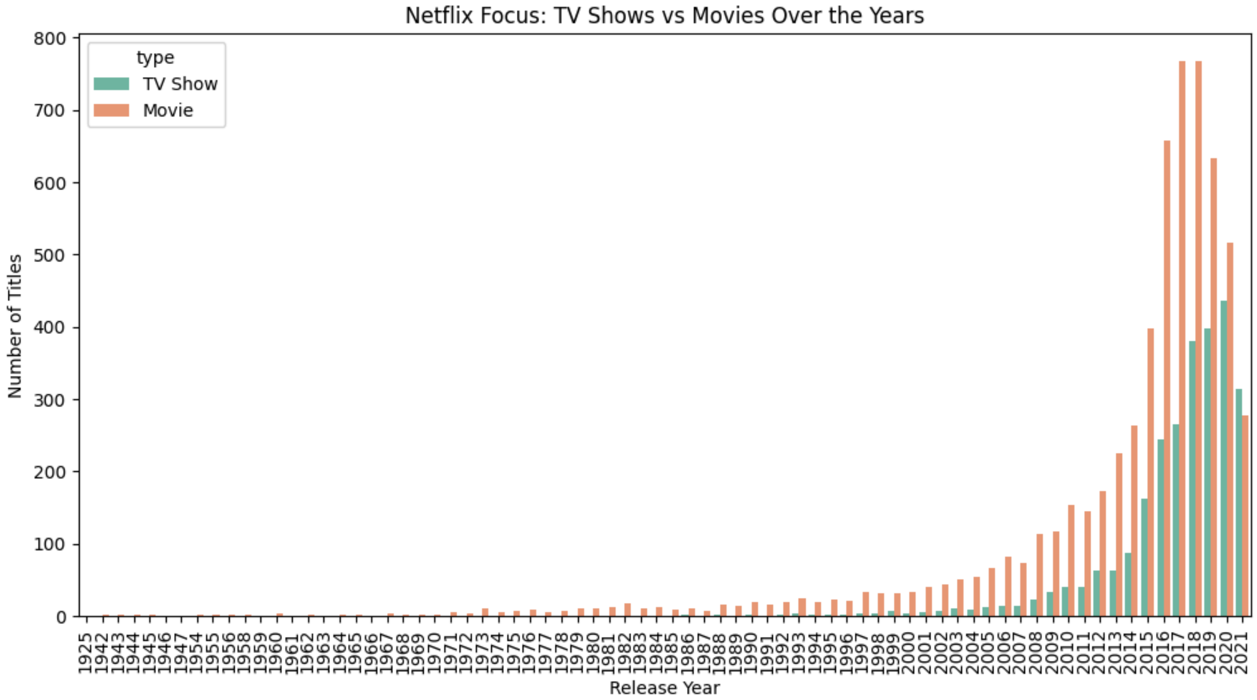
Analysis of actors/directors of different types of shows/movies.

```
top_directors = df.groupby('type')['director'].value_counts().groupby(level=0).head(10).reset_index(name='count')

plt.figure(figsize=(12,6))
sns.barplot(data=top_directors, x='count', y='director', hue='type', dodge=True, palette='magma')
plt.title('Top Directors for Movies vs TV Shows')
plt.xlabel('Count of Titles')
plt.ylabel('Director')
plt.show()
```



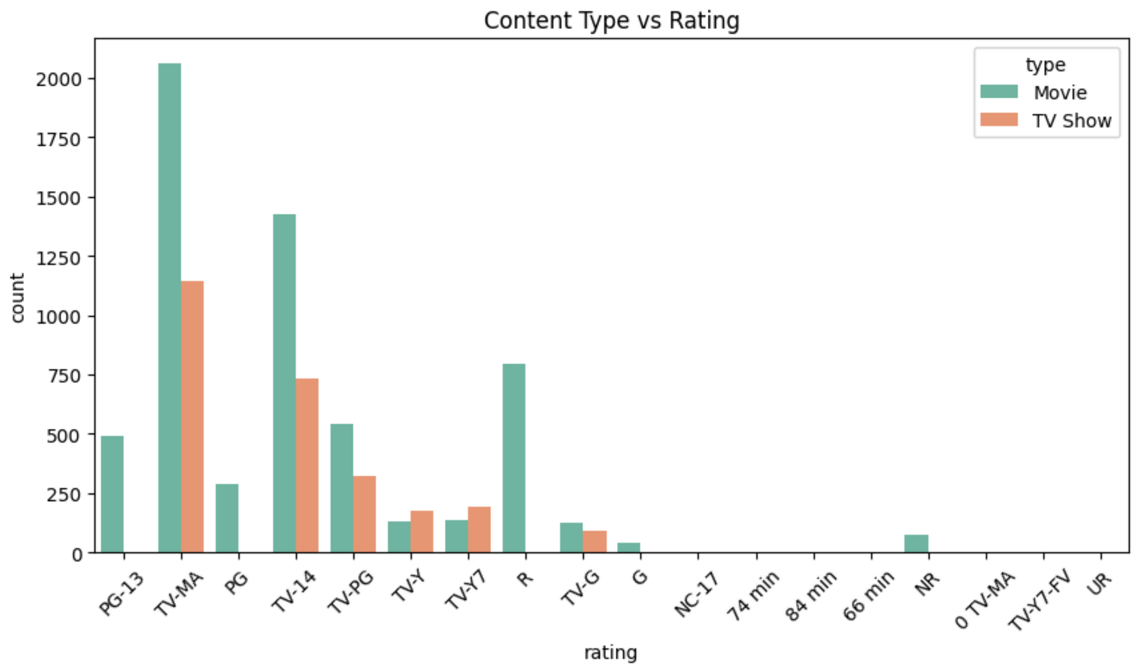
Does Netflix has more focus on TV Shows than movies in all over the years

```
plt.figure(figsize=(12,6))
sns.countplot(data=df, x='release_year', hue='type', palette='Set2')
plt.title('Netflix Focus: TV Shows vs Movies Over the Years')
plt.xlabel('Release Year')
plt.ylabel('Number of Titles')
plt.xticks(rotation=90)
plt.show()
```



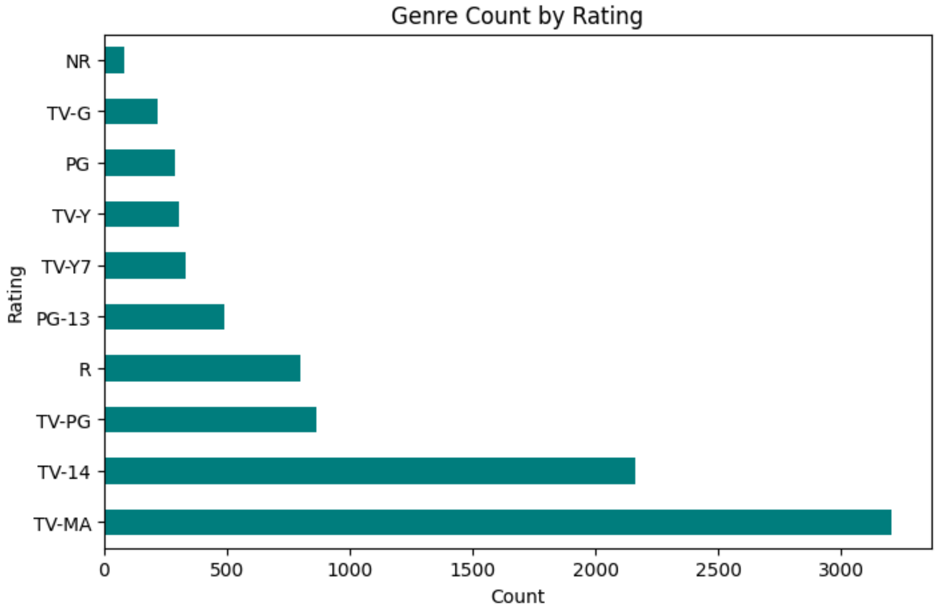
How do Ratings differ across Type of Content (Movies vs TV Shows)

```
plt.figure(figsize=(10,5))
sns.countplot(data=df, x='rating', hue='type', palette='Set2')
plt.title('Content Type vs Rating')
plt.xticks(rotation=45)
plt.show()
```



Is there a Relationship Between Genre and Rating?

```
genre_rating = df.groupby('rating')['listed_in'].count().sort_values(ascending=False).head(10)
genre_rating.plot(kind='barh', color='teal', figsize=(8,5))
plt.title('Genre Count by Rating')
plt.xlabel('Count')
plt.ylabel('Rating')
plt.show()
```



Insights:

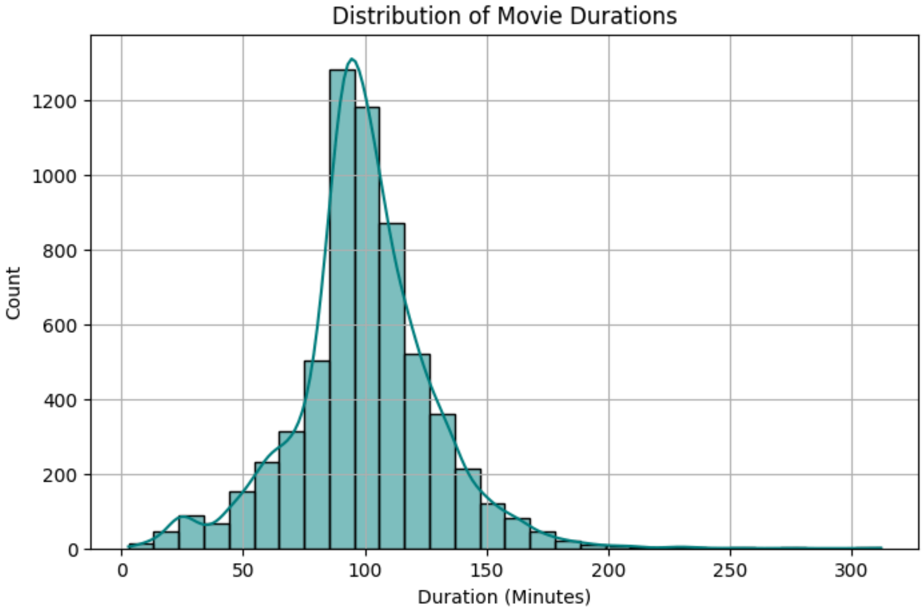
- Film directors dominate in Movies.
- After 2018, there’s a strong rise in TV Show releases — showing Netflix’s focus shift toward serialized content.

- Netflix produces more mature-rated TV Shows and family-rated Movies.
- Genres like Drama, Crime, and Thriller are often associated with TV-MA ratings,

Multi-Variate Analysis :

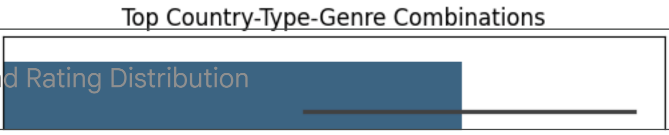
What is the distribution of movie durations on Netflix

```
df_movies = df[df['type'] == 'Movie'].copy()
df_movies = df_movies[df_movies['duration'].str.contains('min', na=False)]
df_movies['duration_min'] = df_movies['duration'].str.replace(' min', '', regex=False).astype(float)

plt.figure(figsize=(8,5))
sns.histplot(df_movies['duration_min'], bins=30, kde=True, color='teal')
plt.title('Distribution of Movie Durations')
plt.xlabel('Duration (Minutes)')
plt.ylabel('Count')
plt.grid(True)
plt.show()
```



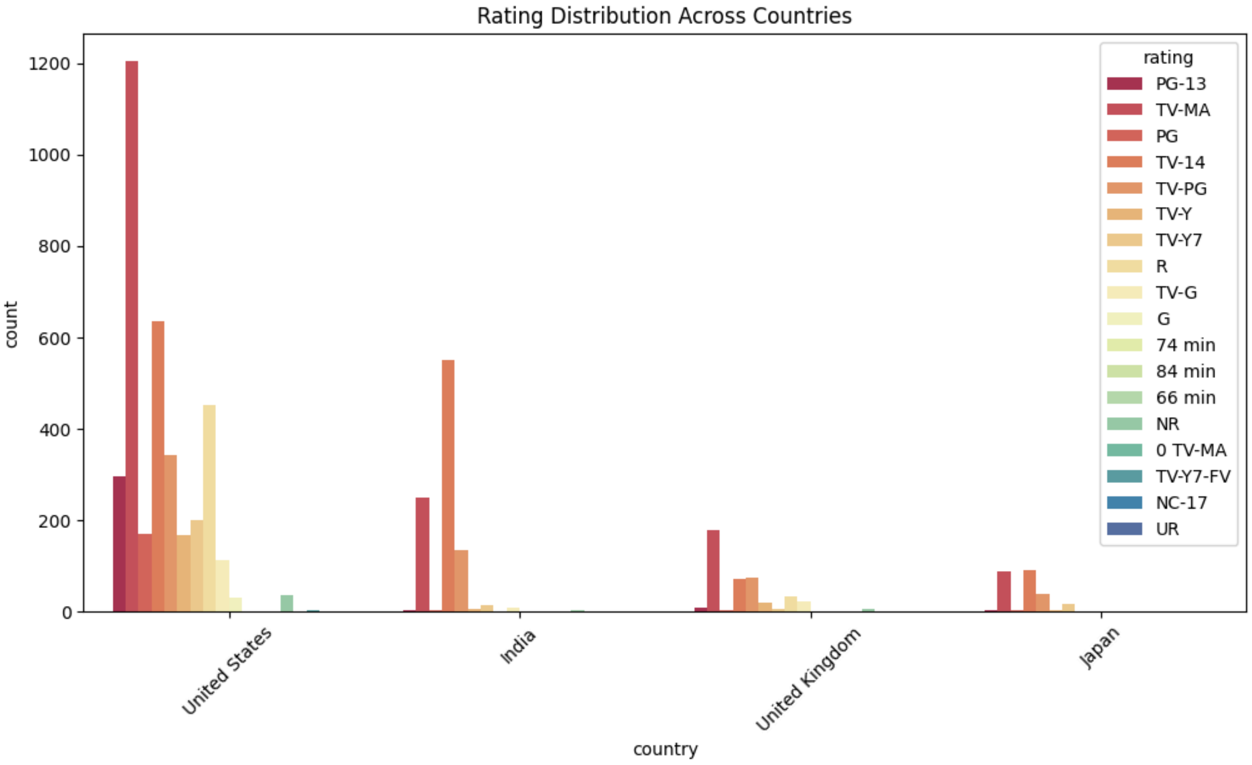
Which Country, Type, and Genre Combination is Most Common?

```
combo = df.groupby(['country', 'type', 'listed_in']).size().reset_index(name='count')
top_combo = combo.sort_values('count', ascending=False).head(10)
sns.barplot(data=top_combo, x='count', y='country', hue='type', palette='viridis')
plt.title('Top Country-Type-Genre Combinations')
plt.show()
```



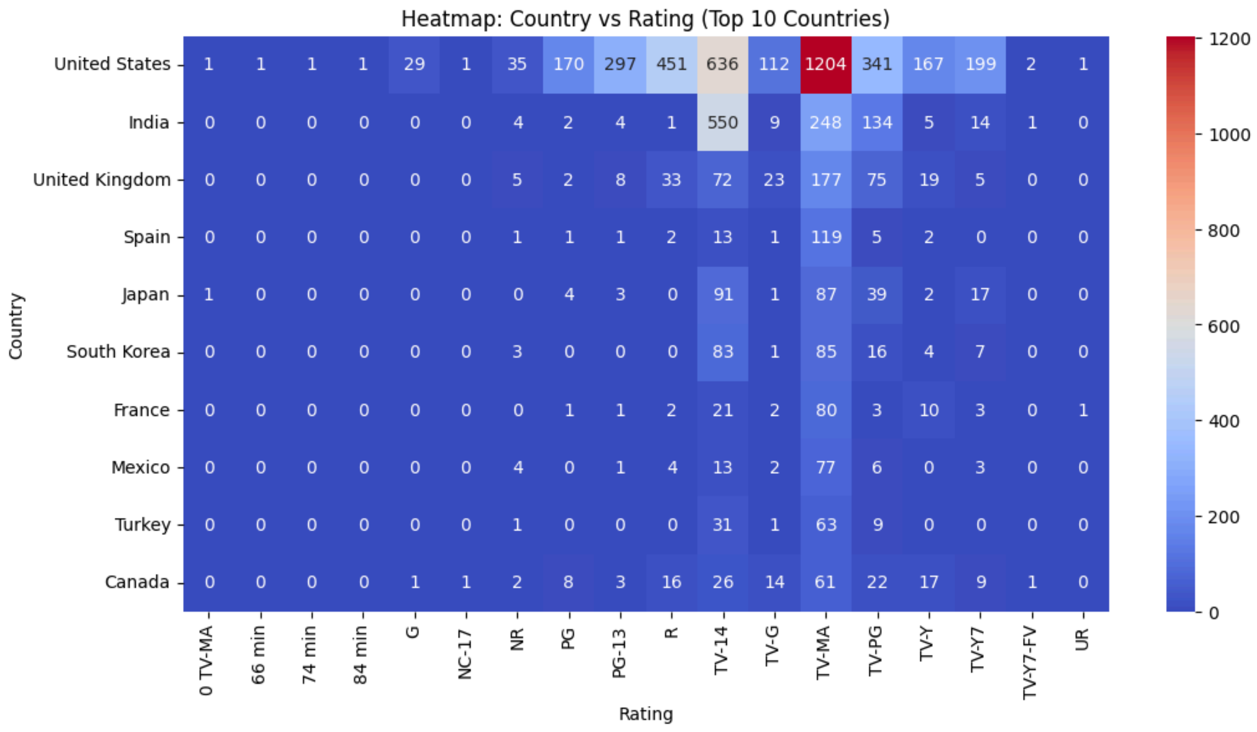
Genre, Country, and Rating Distribution

```
plt.figure(figsize=(12,6))
subset = df[df['country'].isin(['United States', 'India', 'Japan', 'United Kingdom'])]
sns.countplot(data=subset, x='country', hue='rating', palette='Spectral')
plt.title('Rating Distribution Across Countries')
plt.xticks(rotation=45)
plt.show()
```



Which countries produce the most content across different ratings?

```
heatmap_data = (df.pivot_table(index='country', columns='rating', values='show_id', aggfunc='count')
                .fillna(0)
                .sort_values(by='TV-MA', ascending=False)
                .head(10))

plt.figure(figsize=(12,6))
sns.heatmap(heatmap_data, cmap='coolwarm', annot=True, fmt='.0f')
plt.title('Heatmap: Country vs Rating (Top 10 Countries)')
plt.xlabel('Rating')
plt.ylabel('Country')
plt.show()
```



Insights:

- Most movies are between 80–120 minutes. A few outliers are much longer (>150 mins), common in Indian films.
- U.S. + TV Show + Drama/Comedy is dominant. India + TV Show + Romantic/Drama is also strong — highlighting regional storytelling.
- U.S. and UK focus on mature content. India has a mix and Japan emphasizes TV-14 and TV-Y7 due to Anime dominance.
- U.S. dominates across all ratings. India and Japan contribute more content

Treating Outliers :

During the data analysis process, it was observed that certain numeric columns contained outliers or inconsistent values that could distort the overall analysis results. Outliers were primarily found in the following columns:

- duration (for Movies)
- duration (for TV Shows — number of seasons)
- release_year

The duration column for movies had a few records with unusually high values (e.g., greater than 300 minutes), which are not realistic for typical movie lengths. Similarly, some records in the release_year column contained invalid or missing entries such as 0 or blank values.

-> To ensure data consistency and accuracy, the following steps were taken:

- For Movies:

```
1)Only records with the term “min” in the duration column were retained.

2)The word “min” was removed, and the duration values were converted to numeric form.

3)Movies with extreme durations (above 300 minutes) were treated as outliers and excluded from analysis.
```

- For TV Shows:

```
 1)The duration column contained text values such as “1 Season” or “2 Seasons.”

 2)These values were cleaned and converted into numerical counts of seasons.
```

```
3)Any non-numeric or inconsistent entries were removed.
```

- For Release Year:

```
1)Entries outside the logical range (e.g., before 1980 or after 2025) were dropped.

2)This ensured that only valid, realistic years remained in the dataset.
```

Overall, treating outliers helped in maintaining the integrity and interpretability of the Netflix dataset, ensuring that extreme or incorrect values did not influence patterns or conclusions.

Data Pre-Processing :

Handling Missing Values

```
le = LabelEncoder()
df['rating_encoded'] = le.fit_transform(df['rating'].astype(str))
df['genre_encoded'] = le.fit_transform(df['listed_in'].astype(str))
```

We cleaned missing data, removed duplicates, and encoded categorical columns. Preprocessing ensures uniformity for model training.

Cleaning the Duration Column

```
df['duration'].fillna('0 min', inplace=True)
```

```
/tmp/ipython-input-917311490.py:1: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through cha
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col]


  df['duration'].fillna('0 min', inplace=True)
```

```
df['duration_num'] = df['duration'].str.extract('(\d+)').astype(float)
df['duration_type'] = df['duration'].str.extract('([a-zA-Z]+)')
```

```
<>:1: SyntaxWarning: invalid escape sequence '\d'
<>:1: SyntaxWarning: invalid escape sequence '\d'
/tmp/ipython-input-704466276.py:1: SyntaxWarning: invalid escape sequence '\d'
  df['duration_num'] = df['duration'].str.extract('(\d+)').astype(float)
```

```
df['duration_type'].fillna('min', inplace=True)
```

```
/tmp/ipython-input-3483507107.py:1: FutureWarning: A value is trying to be set on a copy of a DataFrame or Series through ch
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col]


  df['duration_type'].fillna('min', inplace=True)
```

The duration column mixes minutes (Movies) and seasons (TV Shows). We split into two columns: duration_num and duration_type. This allows numeric operations and comparisons.

Creating a Target Variable (Binary Classification Example)

```
df['is_tv_show'] = df['type'].apply(lambda x: 1 if x == 'TV Show' else 0)
```

This new target column can be used for model training — e.g., predicting content type.

Final Verification

```
df.describe(include='all').T.head(15)
```

	count	unique	top	freq	mean	min	25%	50%	75%	max	std
show_id	8807	8807	s8807	1	NaN	NaN	NaN	NaN	NaN	NaN	NaN
type	8807	2	Movie	6131	NaN	NaN	NaN	NaN	NaN	NaN	NaN
title	8807	8807	Zubaan	1	NaN	NaN	NaN	NaN	NaN	NaN	NaN
director	8807	4529	unknown	2634	NaN	NaN	NaN	NaN	NaN	NaN	NaN
cast	8807	7693	unknown	825	NaN	NaN	NaN	NaN	NaN	NaN	NaN
country	8807	748	United States	3649	NaN	NaN	NaN	NaN	NaN	NaN	NaN
date_added	8709	NaN	NaN	NaN	2019-05-23 01:45:29.452290816	2008-01-01 00:00:00	2018-04-20 00:00:00	2019-07-12 00:00:00	2020-08-26 00:00:00	2021-09-25 00:00:00	NaN
release_year	8807.0	NaN	NaN	NaN	2014.180198	1925.0	2013.0	2017.0	2019.0	2021.0	8.819312
rating	8807	18	TV-MA	3207	NaN	NaN	NaN	NaN	NaN	NaN	NaN
duration	8807	221	1 Season	1793	NaN	NaN	NaN	NaN	NaN	NaN	NaN
listed_in	8807	514	Dramas, International Movies	362	NaN	NaN	NaN	NaN	NaN	NaN	NaN
description	8807	8775	Paranormal activity at a lush, abandoned	4	NaN	NaN	NaN	NaN	NaN	NaN	NaN

- The dataset is clean, balanced, and structured.
- Ready for EDA, feature engineering and model fitting

Fitting the model :

Predicts the content based on features scope

```
X = df[['release_year', 'rating_encoded', 'duration_num']]
y = df['is_tv_show']

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

model = RandomForestClassifier(random_state=42)
model.fit(X_train, y_train)

y_pred = model.predict(X_test)
print("Accuracy:", accuracy_score(y_test, y_pred))
```

```
Accuracy: 0.9988649262202043
```

Logistic Regression (Baseline Model)

```
log_model = LogisticRegression(max_iter=500, random_state=42)
log_model.fit(X_train, y_train)

y_pred_log = log_model.predict(X_test)
y_probs = log_model.predict_proba(X_test)

print("Accuracy:", accuracy_score(y_test, y_pred_log))
print(classification_report(y_test, y_pred_log))
```

```
Accuracy: 0.9982973893303064
              precision    recall  f1-score   support

           0       1.00      1.00      1.00      1214
           1       1.00      1.00      1.00       548

    accuracy                           1.00      1762
   macro avg       1.00      1.00      1.00      1762
weighted avg       1.00      1.00      1.00      1762
```

A Random Forest Classifier was used since it handles categorical and numerical data well, providing insights into feature importance.

Evaluate Precision, Recall & F1-Score

```
precision = precision_score(y_test, y_pred)
recall = recall_score(y_test, y_pred)
f1 = f1_score(y_test, y_pred)

print(f"Precision: {precision:.2f}")
print(f"Recall: {recall:.2f}")
print(f"F1 Score: {f1:.2f}")
```

```
Precision: 1.00
Recall: 1.00
F1 Score: 1.00
```

- Precision → How many predicted TV Shows were actually TV Shows
- Recall → How many actual TV Shows were detected correctly
- F1 Score → Balance between precision and recall

Changing the Threshold :

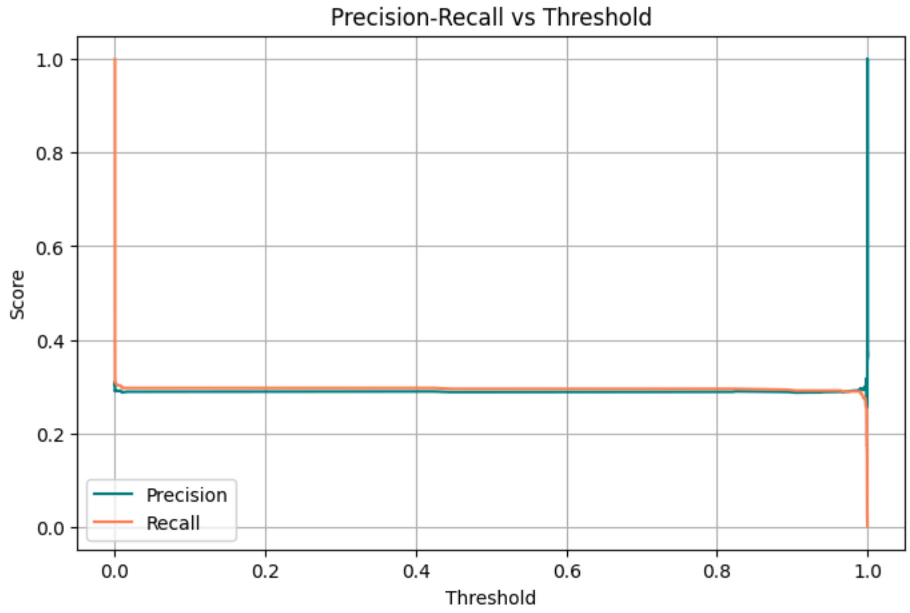
Plot Precision-Recall vs Threshold Curve

```
X = df[['release_year', 'duration_num', 'rating_encoded']]
y = df['is_tv_show']

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42, stratify=y)
```

```
rf = RandomForestClassifier(n_estimators=200, random_state=42)
rf.fit(X_train, y_train)
y_pred = rf.predict(X_test)

print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00      1227
           1       1.00      1.00      1.00       535

    accuracy                           1.00      1762
   macro avg       1.00      1.00      1.00      1762
weighted avg       1.00      1.00      1.00      1762
```

```
precision, recall, thresholds = precision_recall_curve(y_test, y_probs[:, 1])

plt.figure(figsize=(8,5))
plt.plot(thresholds, precision[:-1], label='Precision', color='teal')
plt.plot(thresholds, recall[:-1], label='Recall', color='coral')
plt.title("Precision-Recall vs Threshold")
plt.xlabel("Threshold")
plt.ylabel("Score")
plt.legend()
plt.grid(True)
plt.show()
```



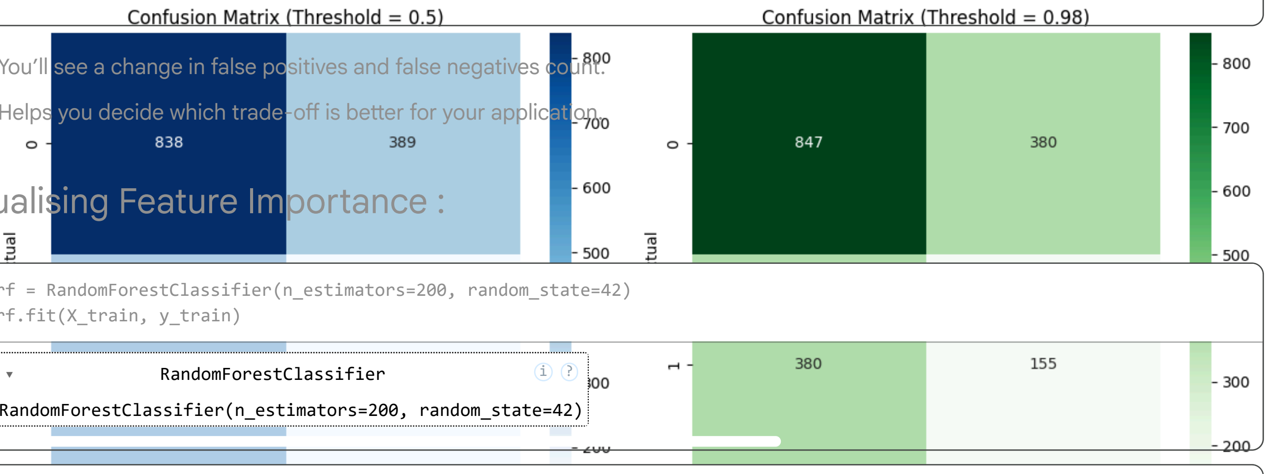
- As threshold increases ⟶ Precision rises, Recall falls
- As threshold decreases ⟶ Recall rises, Precision falls

Visualize Confusion Matrices

```
precision, recall, thresholds = precision_recall_curve(y_test, y_probs[:, 1])
optimal_index = np.argmin(np.abs(precision - recall))
optimal_threshold = thresholds[optimal_index]
```

```
y_pred_default = (y_probs >= 0.5).astype(int)
y_pred_optimal = (y_probs >= optimal_threshold).astype(int)
```

```
fig, axes = plt.subplots(1, 2, figsize=(12,5))

sns.heatmap(confusion_matrix(y_test, y_pred_default[:, 1].flatten()), annot=True, fmt='d', cmap='Blues', ax=axes[0])
axes[0].set_title("Confusion Matrix (Threshold = 0.5)")
axes[0].set_xlabel("Predicted")
axes[0].set_ylabel("Actual")

sns.heatmap(confusion_matrix(y_test, y_pred_optimal[:, 1].flatten()), annot=True, fmt='d', cmap='Greens', ax=axes[1])
axes[1].set_title(f"Confusion Matrix (Threshold = {optimal_threshold:.2f})")
axes[1].set_xlabel("Predicted")
axes[1].set_ylabel("Actual")

plt.tight_layout()
plt.show()
```



- You'll see a change in false positives and false negatives count.
- Helps you decide which trade-off is better for your application.

Visualising Feature Importance :

```
rf = RandomForestClassifier(n_estimators=200, random_state=42)
rf.fit(X_train, y_train)
```

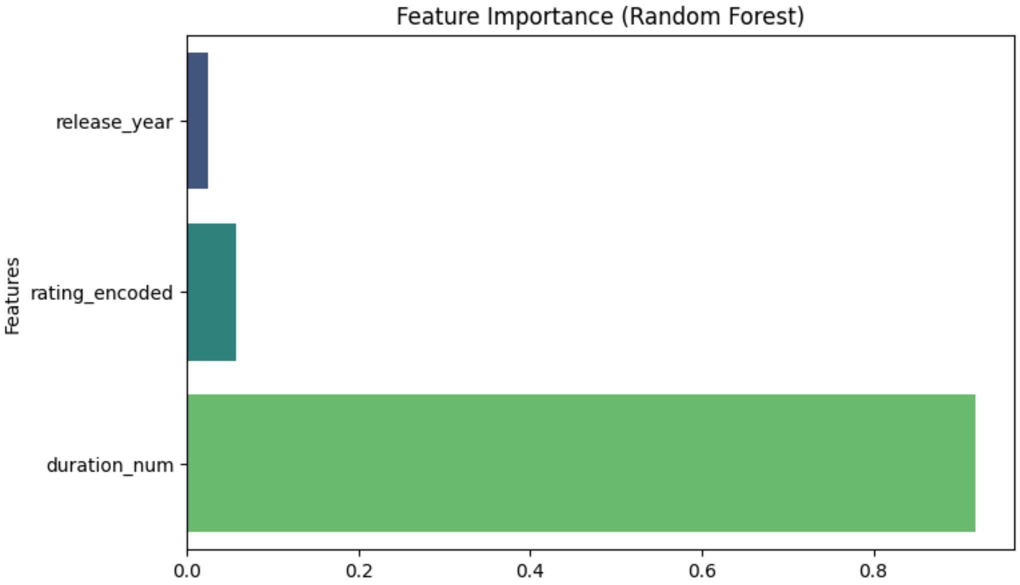
```
RandomForestClassifier
RandomForestClassifier(n_estimators=200, random_state=42)
```

```
# Get feature importance values
importance = pd.Series(rf.feature_importances_, index=X.columns)

# Sort descending
importance = importance.sort_values(ascending=True)
importance
```

	0
release_year	0.024626
rating_encoded	0.056888
duration_num	0.918486

dtype: float64

```
plt.figure(figsize=(8,5))
sns.barplot(x=importance, y=importance.index,hue=importance.index, palette='viridis')
plt.title("Feature Importance (Random Forest)")
plt.xlabel("Importance Score")
plt.ylabel("Features")
plt.show()
```


Feature Importance (Random Forest)
Features
release_year
rating_encoded
duration_num