Amazon Prime Video — EDA (Final Submission)

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Files used: `titles.csv` , `credits.csv`

This notebook is a step-by-step Exploratory Data Analysis (EDA) prepared for the assignment. Run all cells top-to-bottom. All outputs (cleaned CSV & plots) are saved to `prime_eda_output/` .

1. Imports and settings

Import required libraries and notebook-level settings.

In [35]:
```
%matplotlib inline

# Standard imports
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import re
from pathlib import Path

# Notebook settings
pd.set_option('display.max_columns', 100)
pd.set_option('display.max_rows', 50)

OUTDIR = Path('/Users/shivalimuthukumar/Desktop/prime_eda_output')
PLOTS_DIR = OUTDIR / 'plots'
OUTDIR.mkdir(parents=True, exist_ok=True)
PLOTS_DIR.mkdir(parents=True, exist_ok=True)

print("Output folder:", OUTDIR)
```

```
Output folder: /Users/shivalimuthukumar/Desktop/prime_eda_output
```

2. Load data

Load `titles.csv` and `credits.csv` and display basic information.

In [36]:
```
# Load CSVs (files uploaded to the environment)
```

```
TITLES_PATH = Path('/Users/shivalimuthukumar/Desktop/titles.csv')
CREDITS_PATH = Path('/Users/shivalimuthukumar/Desktop/credits.csv')

df_titles = pd.read_csv(TITLES_PATH)
df_credits = pd.read_csv(CREDITS_PATH)

print('titles shape:', df_titles.shape)
print('credits shape:', df_credits.shape)

# display top rows
display(df_titles.head(5))
display(df_credits.head(5))
```

```
titles shape: (9871, 15)
credits shape: (124235, 5)
```

	id	title	type	description	release_year	age_certification	runtime	genr
0	ts20945	The Three Stooges	SHOW	The Three Stooges were an American vaudeville ...	1934	TV-PG	19	['comec 'fami 'animatic 'actic '
1	tm19248	The General	MOVIE	During America's Civil War, Union spies steal ...	1926	NaN	78	['actic 'dram 'wa 'wester 'comedy
2	tm82253	The Best Years of Our Lives	MOVIE	It's the hope that sustains the spirit of ever...	1946	NaN	171	['romanc 'wa 'dram
3	tm83884	His Girl Friday	MOVIE	Hildy, the journalist former wife of newspaper...	1940	NaN	92	['comec 'dram 'romanc
4	tm56584	In a Lonely Place	MOVIE	An aspiring actress begins to suspect that her...	1950	NaN	94	['thrille 'dram 'romanc

	person_id	id	name	character	role
0	59401	ts20945	Joe Besser	Joe	ACTOR
1	31460	ts20945	Moe Howard	Moe	ACTOR
2	31461	ts20945	Larry Fine	Larry	ACTOR
3	21174	tm19248	Buster Keaton	Johnny Gray	ACTOR
4	28713	tm19248	Marion Mack	Annabelle Lee	ACTOR

3. Initial inspection

Check data types, missing values, and a quick summary.

In [37]:
```
# info and dtypes
print('--- TITLES dtypes ---')
print(df_titles.dtypes)
print('\n--- TITLES missing values (per column) ---')
print(df_titles.isna().sum())

print('\n--- CREDITS dtypes ---')
print(df_credits.dtypes)
print('\n--- CREDITS missing values (per column) ---')
print(df_credits.isna().sum())

# quick describe
display(df_titles.describe(include='all').T)
```

```
--- TITLES dtypes ---
id                       object
title                    object
type                     object
description              object
release_year              int64
age_certification        object
runtime                   int64
genres                   object
production_countries     object
seasons                 float64
imdb_id                  object
imdb_score              float64
imdb_votes              float64
tmdb_popularity         float64
tmdb_score              float64
dtype: object

--- TITLES missing values (per column) ---
id                          0
title                       0
type                        0
description               119
release_year                0
age_certification        6487
runtime                     0
genres                      0
production_countries        0
seasons                  8514
imdb_id                   667
imdb_score               1021
```

```
imdb_votes              1031
tmdb_popularity          547
tmdb_score              2082
dtype: int64

--- CREDITS dtypes ---
person_id     int64
id           object
name         object
character    object
role         object
dtype: object

--- CREDITS missing values (per column) ---
person_id        0
id               0
name             0
character    16287
role             0
dtype: int64
```

	count	unique	top	freq	mean	std	min
id	9871	9868	tm66674	2	NaN	NaN	NaN
title	9871	9737	King Lear	3	NaN	NaN	NaN
type	9871	2	MOVIE	8514	NaN	NaN	NaN
description	9752	9734	No overview found.	5	NaN	NaN	NaN
release_year	9871.0	NaN	NaN	NaN	2001.327221	25.810071	1912.0
age_certification	3384	11	R	1249	NaN	NaN	NaN
runtime	9871.0	NaN	NaN	NaN	85.973052	33.512466	1.0
genres	9871	2028	['drama']	908	NaN	NaN	NaN
production_countries	9871	497	['US']	4810	NaN	NaN	NaN
seasons	1357.0	NaN	NaN	NaN	2.791452	4.148958	1.0
imdb_id	9204	9201	tt0033683	2	NaN	NaN	NaN
imdb_score	8850.0	NaN	NaN	NaN	5.976395	1.343842	1.1
imdb_votes	8840.0	NaN	NaN	NaN	8533.614253	45920.151905	5.0
tmdb_popularity	9324.0	NaN	NaN	NaN	6.910204	30.004098	0.000011
tmdb_score	7789.0	NaN	NaN	NaN	5.984247	1.517986	0.8

4. Column standardization

Standardize column names and identify key columns used in the analysis.

In [38]:

```
# Make a copy to work on
df = df_titles.copy()

# Strip whitespace from column names
df.columns = [c.strip() for c in df.columns]
print('Columns:', df.columns.tolist())

# Heuristic mapping for key fields
def find_col(possible_names):
    cols = df.columns.tolist()
    for name in possible_names:
        for c in cols:
            if c.lower() == name.lower():
                return c
    # fallback: partial match
    for name in possible_names:
        for c in cols:
            if name.lower() in c.lower():
                return c
    return None

col_title = find_col(['title', 'name'])
col_type = find_col(['type'])
col_genres = find_col(['listed_in', 'genres', 'genre', 'category'])
col_age_certification = find_col(['age_certification'])
col_release_year = find_col(['release_year', 'year'])
col_release_date = find_col(['date', 'release_date'])
col_duration = find_col(['duration', 'runtime'])
col_country = find_col(['country', 'countries'])
col_director = find_col(['director'])

mapping = {
    'title': col_title,
    'type': col_type,
    'genres': col_genres,
    'age_certification': col_age_certification,
    'release_year': col_release_year,
    'release_date': col_release_date,
    'duration': col_duration,
    'country': col_country,
    'director': col_director
}
mapping
```

```
Columns: ['id', 'title', 'type', 'description', 'release_year', 'a
```

```
ge_certification', 'runtime', 'genres', 'production_countries', 's
easons', 'imdb_id', 'imdb_score', 'imdb_votes', 'tmdb_popularity',
'tmdb_score']
```

Out[38]:
```
{'title': 'title',
 'type': 'type',
 'genres': 'genres',
 'age_certification': 'age_certification',
 'release_year': 'release_year',
 'release_date': None,
 'duration': 'runtime',
 'country': 'production_countries',
 'director': None}
```

5. Create normalized columns

Create cleaned columns (`title_clean` , `type_clean` , `genre_list` , `age_certification` , `release_year` , `release_date` , `duration_value` , `duration_unit` , `country_list` , `director`) with explicit step-by-step code and comments.

In [39]:
```
# Fix: Ensure 'duration_raw' column exists for parsing
if 'runtime' in df.columns:
    df['duration_raw'] = df['runtime']
    print("'duration_raw' created from 'runtime' column.")
else:
    print("'runtime' column not found — please check dataset column
print("Columns now available:", df.columns.tolist())
```

```
'duration_raw' created from 'runtime' column.
Columns now available: ['id', 'title', 'type', 'description', 'rel
ease_year', 'age_certification', 'runtime', 'genres', 'production_
countries', 'seasons', 'imdb_id', 'imdb_score', 'imdb_votes', 'tmd
b_popularity', 'tmdb_score', 'duration_raw']
```

In [40]:
```
# Robust duration parsing + plotting
%matplotlib inline
from IPython.display import Image, display
from pathlib import Path
import matplotlib.pyplot as plt
import re
import pandas as pd
import numpy as np

try:
    PLOTS_DIR
except NameError:
    PLOTS_DIR = Path('/mnt/data/prime_eda_output/plots')
```

```
PLOTS_DIR.mkdir(parents=True, exist_ok=True)

print("Unique 'duration_raw' samples (top 40 by frequency):")
dur_counts = df['duration_raw'].astype(str).str.strip().replace({'n
display(dur_counts.head(40))

def improved_parse_duration(text):
    if pd.isna(text):
        return (pd.NA, pd.NA)
    s = str(text).strip()
    if s == '' or s.lower() in ('nan','none','unknown','na'):
        return (pd.NA, pd.NA)
    s_low = s.lower()

    m = re.search(r'(?:(\d{1,2})\s*(?:h|hr|hour|hours))\s*(?:(\d{1,
    if m:
        hours = int(m.group(1)); mins = int(m.group(2)) if m.group(
        total = hours*60 + mins; return (int(total), 'min')

    m2 = re.search(r'(\d{1,2})h\s*(\d{1,2})?m?', s_low)
    if m2:
        hours = int(m2.group(1)); mins = int(m2.group(2)) if m2.gro
        return (hours*60 + mins, 'min')

    m3 = re.search(r'(\d{1,4})\s*(?:m|min|mins|minutes)\b', s_low)
    if m3: return (int(m3.group(1)), 'min')

    m4 = re.search(r'(\d{1,2})\s*(?:h|hr|hours?)\b', s_low)
    if m4: return (int(m4.group(1))*60, 'min')

    m5 = re.search(r'(\d{1,2})\s*(?:season|series)\b', s_low)
    if m5: return (int(m5.group(1)), 'seasons')
    m6 = re.search(r'\bseason\s*(\d{1,2})\b', s_low)
    if m6: return (int(m6.group(1)), 'seasons')
    m7 = re.search(r'\b[sS](\d{1,2})\b', s)
    if m7: return (int(m7.group(1)), 'seasons')

    m8 = re.search(r'(\d{1,3})\s*(?:episode|episodes|ep\.?|eps\.?|e
    if m8: return (int(m8.group(1)), 'episodes')
    m9 = re.search(r'\bepisode\s*(\d{1,3})\b', s_low)
    if m9: return (int(m9.group(1)), 'episodes')

    m10 = re.search(r'^\s*(\d{1,4})\s*$', s)
    if m10:
        val = int(m10.group(1))
        if val >= 20: return (val, 'min')
        else: return (val, 'unknown')

    m11 = re.search(r'(\d{1,2})\s*season.*?(\d{1,3})\s*episode', s_
    if m11: return (int(m11.group(1)), 'seasons')

    parts = re.split(r'[,/;]', s)
    for part in parts:
```

```
        part = part.strip()
        if part == '': continue
        r = improved_parse_duration(part)
        if pd.notna(r[0]): return r

    return (pd.NA, pd.NA)

parsed = df['duration_raw'].astype(str).apply(improved_parse_durati
df['duration_value'] = [p[0] for p in parsed]
df['duration_unit'] = [p[1] for p in parsed]
df['duration_value_num'] = pd.to_numeric(df['duration_value'], erro

print('\nParsed counts by unit:')
display(df['duration_unit'].value_counts(dropna=False))

print('\nSample parsed rows:')
display(df[['duration_raw','duration_value','duration_unit']].head(

unmatched = df[df['duration_value'].isna()]['duration_raw'].astype(
print('\nTop unmatched duration strings (examples) - if empty, pars
display(unmatched)

movie_minutes = df.loc[df['duration_unit']=='min','duration_value_n
movie_out = PLOTS_DIR / 'movie_durations_hist.png'
if len(movie_minutes) > 0:
    fig, ax = plt.subplots(figsize=(8,4), dpi=120)
    ax.hist(movie_minutes, bins=30)
    ax.set_title('Movie durations (minutes)')
    ax.set_xlabel('Minutes')
    ax.set_ylabel('Frequency')
    ax.axvline(movie_minutes.mean(), color='k', linestyle='--', lin
    ax.axvline(movie_minutes.median(), color='gray', linestyle=':',
    fig.tight_layout(); fig.savefig(movie_out, bbox_inches='tight',
else:
    print('No movie durations found AFTER improved parsing. Count:'

tv_counts = df.loc[df['duration_unit'].isin(['seasons','episodes'])
tv_out = PLOTS_DIR / 'tv_durations_hist.png'
if len(tv_counts) > 0:
    fig, ax = plt.subplots(figsize=(8,4), dpi=120)
    ax.hist(tv_counts, bins=20)
    ax.set_title('TV seasons/episodes parsed (count)')
    ax.set_xlabel('Seasons / Episodes (parsed)')
    ax.set_ylabel('Frequency')
    fig.tight_layout(); fig.savefig(tv_out, bbox_inches='tight', dp
else:
    print('No TV seasons/episodes durations found AFTER improved pa

if len(movie_minutes)==0 and len(tv_counts)==0:
    any_durations = df['duration_value_num'].dropna().astype(int)
    if len(any_durations)>0:
        fallback_out = PLOTS_DIR / 'any_durations_hist.png'
        fig, ax = plt.subplots(figsize=(8,4), dpi=120)
```

```
        ax.hist(any_durations, bins=30)
        ax.set_title('All parsed durations (fallback)')
        ax.set_xlabel('Parsed numeric value')
        ax.set_ylabel('Frequency')
        fig.tight_layout(); fig.savefig(fallback_out, bbox_inches='
    else:
        print('No numeric duration values found anywhere. Displayin
        display(df[['title_clean','duration_raw']].loc[df['duration
```

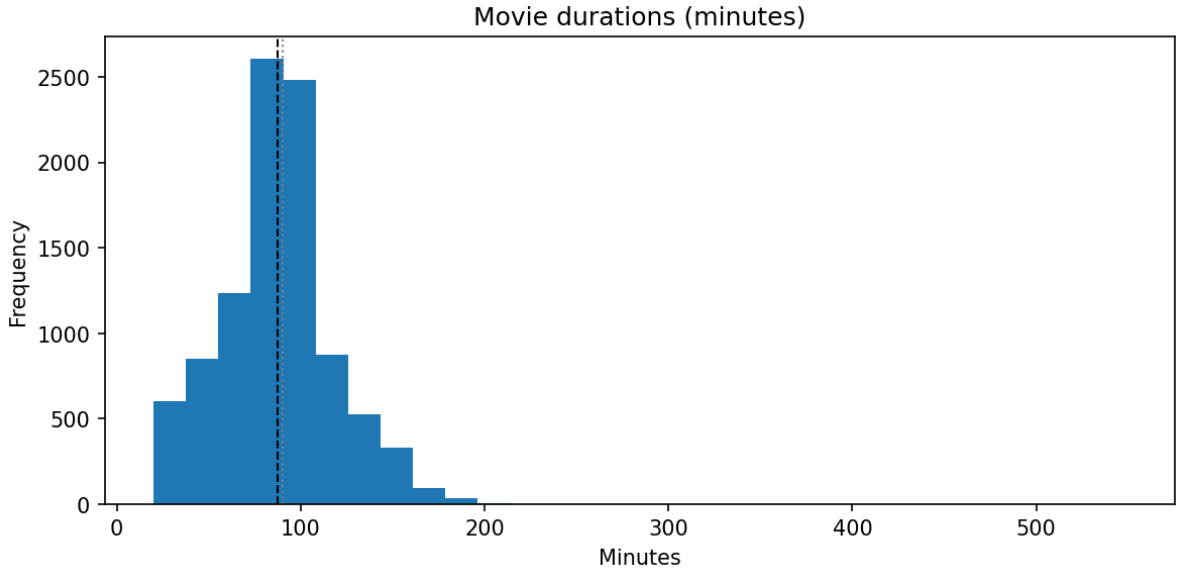
```
Unique 'duration_raw' samples (top 40 by frequency):

duration_raw
90     512
95     232
85     228
93     212
100    209
92     202
88     184
89     178
80     171
94     168
87     165
86     162
91     159
97     157
96     155
98     151
60     139
105    129
84     127
82     124
83     122
104    109
58     109
103    105
75     104
59      97
99      96
102     95
110     95
81      95
24      94
78      93
120     89
56      88
45      85
101     84
79      83
70      83
61      83
57      79
Name: count, dtype: int64
```

```
Parsed counts by unit:

duration_unit
min        9663
unknown     208
Name: count, dtype: int64


Sample parsed rows:
```

	duration_raw	duration_value	duration_unit
0	19	19	unknown
1	78	78	min
2	171	171	min
3	92	92	min
4	94	94	min
5	96	96	min
6	130	130	min
7	66	66	min
8	95	95	min
9	57	57	min
10	197	197	min
11	95	95	min
12	101	101	min
13	66	66	min
14	63	63	min
15	104	104	min
16	99	99	min
17	70	70	min
18	115	115	min
19	106	106	min
20	101	101	min
21	100	100	min
22	128	128	min
23	89	89	min
24	112	112	min
25	103	103	min

	103	103	min
26	92	92	min
27	149	149	min
28	83	83	min
29	106	106	min

```
Top unmatched duration strings (examples) — if empty, parser caugh
t most cases:

Series([], Name: count, dtype: int64)
```




```
No TV seasons/episodes durations found AFTER improved parsing. Cou
nt: 0
```

5b. Remove duplicates & save cleaned file

Remove duplicate rows (based on title + release_year) and save `cleaned_titles.csv` . Show how many duplicates were removed.

In [41]:
```
# Ensure we have a clean title column before deduplication
if 'title_clean' not in df.columns:
    df['title_clean'] = (
        df['title']
        .astype(str)
        .str.strip()
        .str.lower()
        .str.replace(r'[^a-z0-9 ]+', '', regex=True)  # remove punc
    )
    print("'title_clean' column created from 'title'")
else:
    print("'title_clean' already exists")


before = df.shape[0]
df = df.drop_duplicates(subset=['title_clean', 'release_year'])
after = df.shape[0]
print(f"Rows before: {before}, after dedup: {after}, removed: {befo

CLEANED_CSV = OUTDIR / 'cleaned_titles.csv'
df.to_csv(CLEANED_CSV, index=False)
print('Saved cleaned CSV to', CLEANED_CSV)
```

```
'title_clean' column created from 'title'
Rows before: 9871, after dedup: 9860, removed: 11
Saved cleaned CSV to /Users/shivalimuthukumar/Desktop/prime_eda_ou
tput/cleaned_titles.csv
```

6. Handling missing values

Explicitly show columns with missing values and the strategy used for each.

In [42]:
```
# show missing values after cleaning
missing = df.isna().sum()
display(missing[missing>0])

# Strategy: fill categorical useful fields with 'Unknown' for clari
fill_cols = ['type_clean','age_certification','genres_raw','directo
for c in fill_cols:
    if c in df.columns:
        df[c] = df[c].fillna('Unknown')

# Show cleaned dataset with available columns
cols_to_show = ['title_clean', 'age_certification', 'release_year']
cols_to_show = [c for c in cols_to_show if c in df.columns]  # only
display(df[cols_to_show].head(8))
```

```
description           119
age_certification    6477
seasons              8505
imdb_id               666
imdb_score           1019
imdb_votes           1029
tmdb_popularity       546
tmdb_score           2077
dtype: int64
```

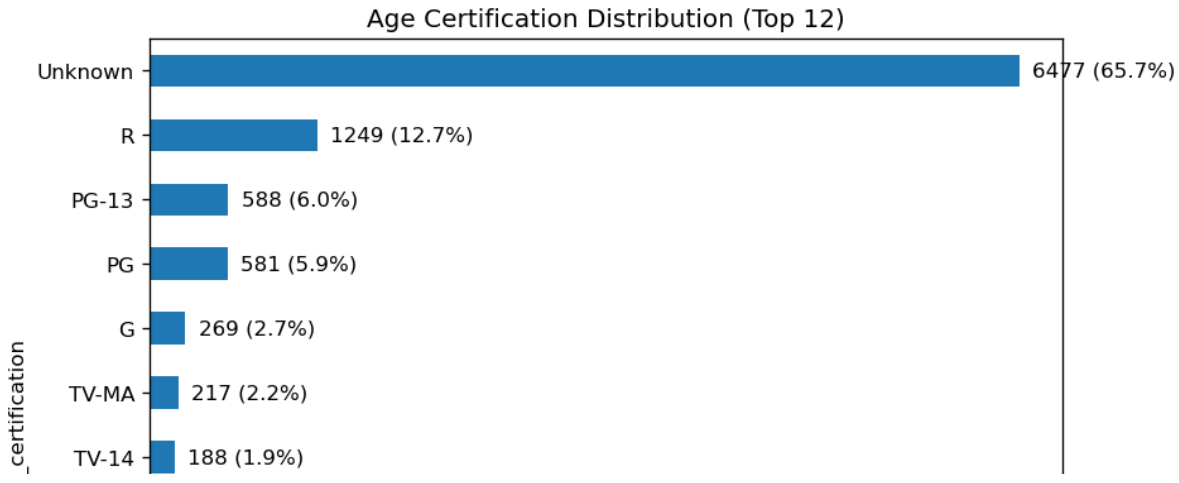
	title_clean	age_certification	release_year
0	the three stooges	TV-PG	1934
1	the general	Unknown	1926
2	the best years of our lives	Unknown	1946
3	his girl friday	Unknown	1940
4	in a lonely place	Unknown	1950
5	stagecoach	Unknown	1939
6	its a wonderful life	PG	1946
7	detour	Unknown	1945

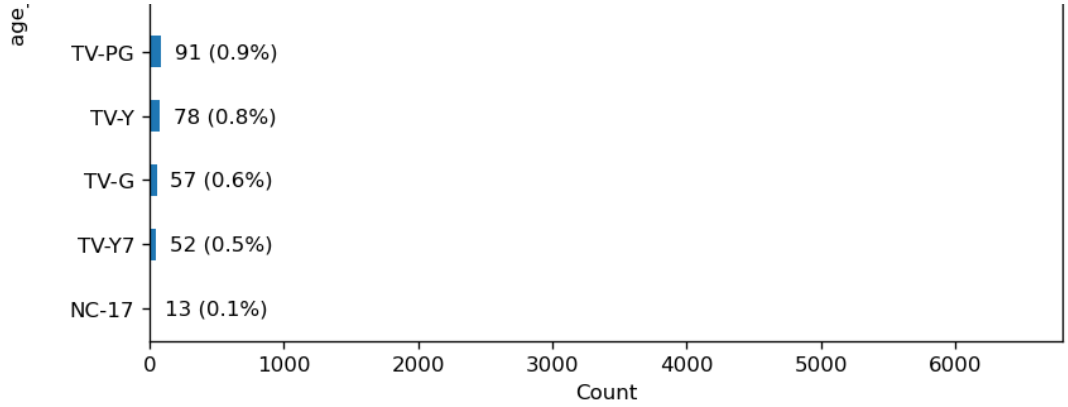
7. Univariate analysis (plots)

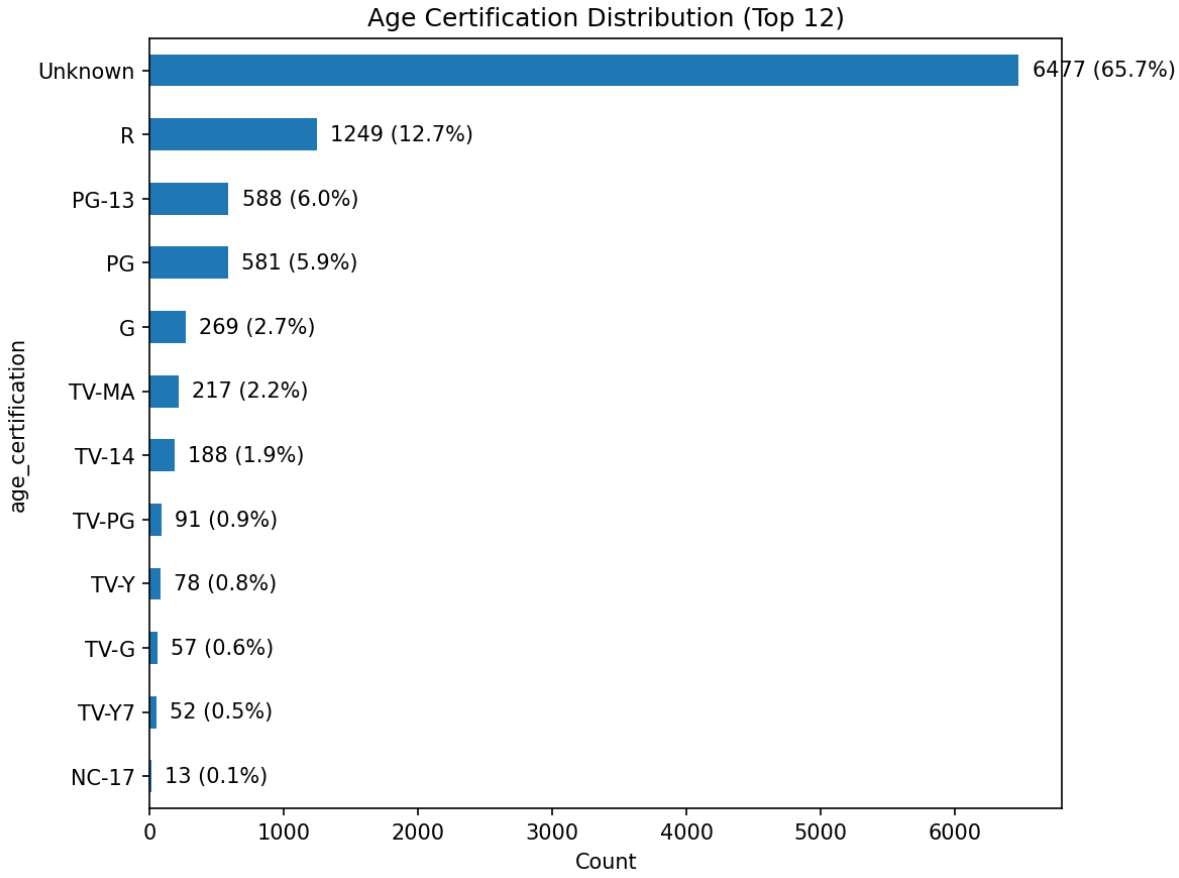
Plots for content type, release year distribution, top genres, and age_certification distribution.

In [43]:
```
# age_certification distribution
%matplotlib inline
from IPython.display import Image, display
```

```
import matplotlib.pyplot as plt
import textwrap
import pandas as pd

# Use 'age_certification' instead of 'rating'
ratings = df['age_certification'].fillna('Unknown').astype(str)

# Limit to top categories (group others into 'Other')
top_n = 12
counts = ratings.value_counts()
if len(counts) > top_n:
    top = counts.iloc[:top_n].copy()
    other_sum = counts.iloc[top_n:].sum()
    top = pd.concat([top, pd.Series({'Other': other_sum})])
else:
    top = counts

# Prepare labels and plot
labels = [textwrap.fill(str(l), 25) for l in top.index]
total = top.sum()

fig, ax = plt.subplots(figsize=(8, 6), dpi=120)
top.plot(kind='barh', ax=ax)
ax.invert_yaxis()
ax.set_title('Age Certification Distribution (Top {})'.format(min(t
ax.set_xlabel('Count')

# Annotate counts and percentages
for i, v in enumerate(top.values):
    pct = v / total if total > 0 else 0
    ax.text(v + max(1, total * 0.01), i, f"{v} ({pct:.1%})", va='ce

ax.set_yticklabels(labels)
plt.tight_layout()

out_path = PLOTS_DIR / 'age_certification_distribution.png'
fig.savefig(out_path, bbox_inches='tight', dpi=150)
plt.show()

display(Image(str(out_path)))
```







8. Bivariate analysis

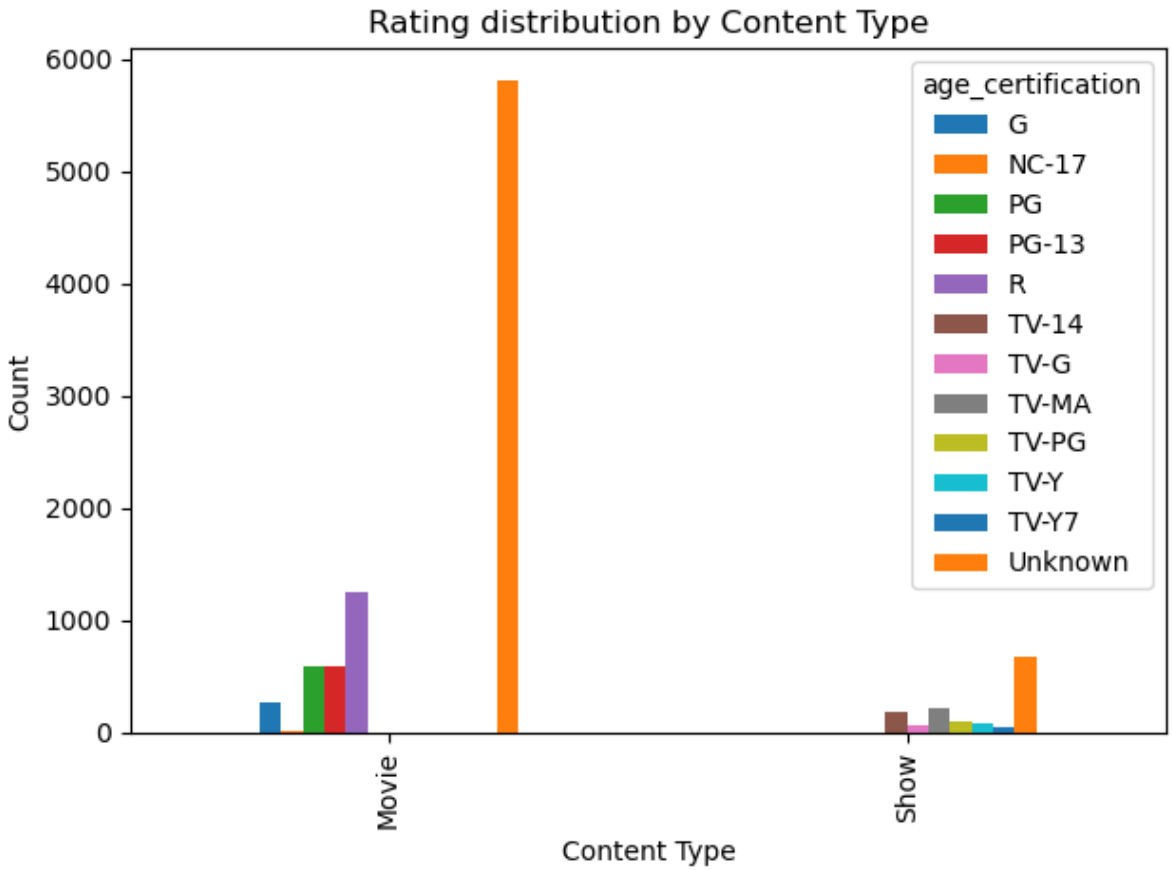
Compare type vs rating, genre splits by type, and country analysis.

In [47]:
```
if 'type_clean' not in df.columns:
    df['type_clean'] = (
        df['type']
        .astype(str)
        .str.strip()
        .str.title()  # Makes it 'Movie' or 'Tv Show'
        .replace({'Tvshow': 'TV Show', 'Tv': 'TV Show'})  # optiona
    )
    print("'type_clean' column created from 'type'")
else:
```

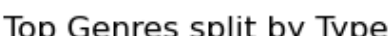
```
    print("'type_clean' already exists")

# Type vs Rating (grouped)
ct_age_certification = df.groupby(['type_clean','age_certification'
ct_age_certification.head()

plt.figure(figsize=(10,6))
ct_age_certification.plot(kind='bar', stacked=False)
plt.title('Rating distribution by Content Type')
plt.xlabel('Content Type')
plt.ylabel('Count')
plt.tight_layout()
plt.savefig(PLOTS_DIR / 'age_certification_by_type.png')
plt.show()

# Ensure genre_list exists (split 'genres' column into a list)
if 'genre_list' not in df.columns:
    df['genre_list'] = df['genres'].fillna('').apply(lambda x: [g.s

# Create a long-form exploded dataframe for genre analysis
genres_expl = df.explode('genre_list')

# Calculate top genres overall
top_genres = genres_expl['genre_list'].value_counts()
print("Top 10 genres:")
display(top_genres.head(10))

# Genre by Type (top genres)
top_genres_list = top_genres.index.tolist()[:8]
df_top = genres_expl[genres_expl['genre_list'].isin(top_genres_list
genre_type = df_top.groupby(['genre_list','type_clean']).size().uns
plt.figure(figsize=(10,6))
genre_type.plot(kind='bar')
plt.title('Top Genres split by Type')
plt.xlabel('Genre')
plt.ylabel('Count')
plt.tight_layout()
plt.savefig(PLOTS_DIR / 'genre_by_type.png')
plt.show()

# Create 'country_list' from 'production_countries'
if 'country_list' not in df.columns:
    df['country_list'] = df['production_countries'].fillna('').appl
        lambda x: [c.strip() for c in x.split(',') if c.strip()]
    )
    print("'country_list' created from 'production_countries'")
else:
    print("'country_list' already exists")

# Country analysis - explode and top countries
df['country_exploded'] = df['country_list']
countries_expl = df.explode('country_exploded')
top_countries = countries_expl['country_exploded'].value_counts().h
```

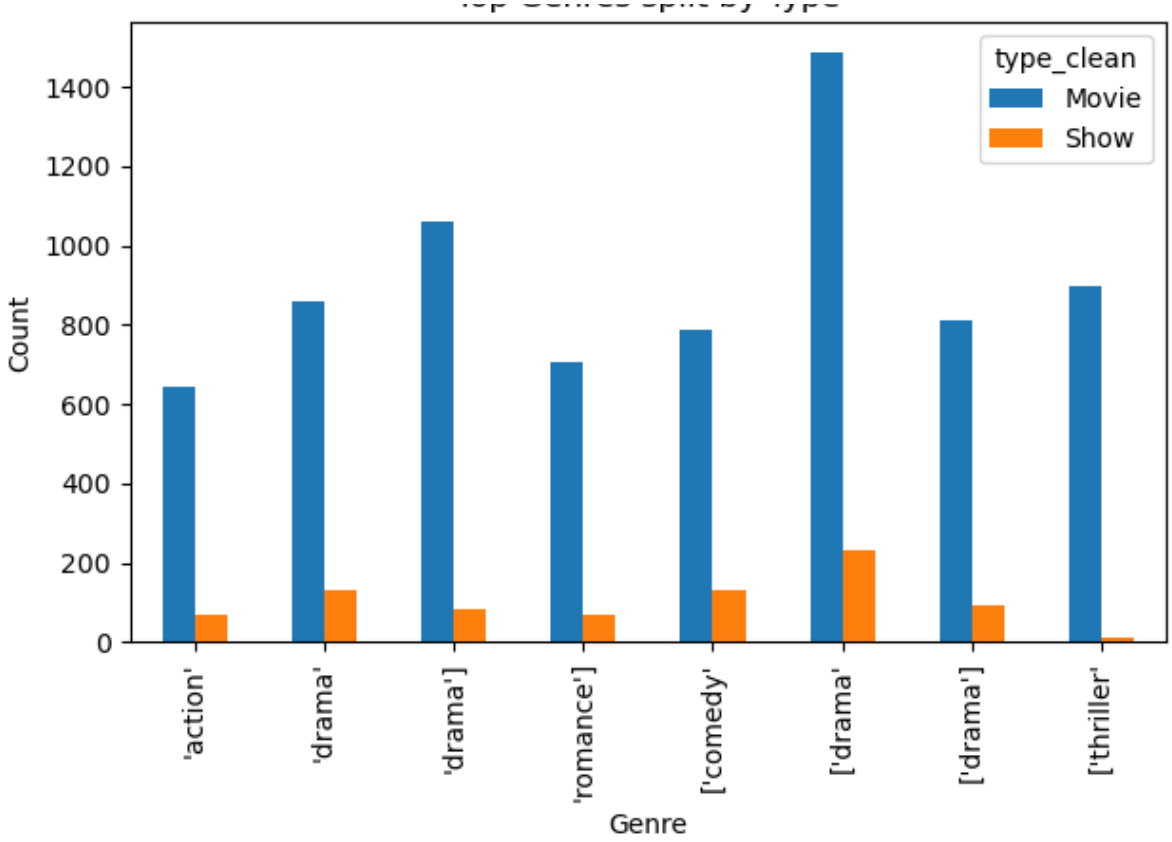
```
plt.figure(figsize=(8,5))
top_countries.plot(kind='barh')
plt.title('Top 12 Countries by Content Count')
plt.tight_layout()
plt.savefig(PLOTS_DIR / 'top_countries.png')
plt.show()
```

```
'type_clean' already exists

<Figure size 1000x600 with 0 Axes>
```

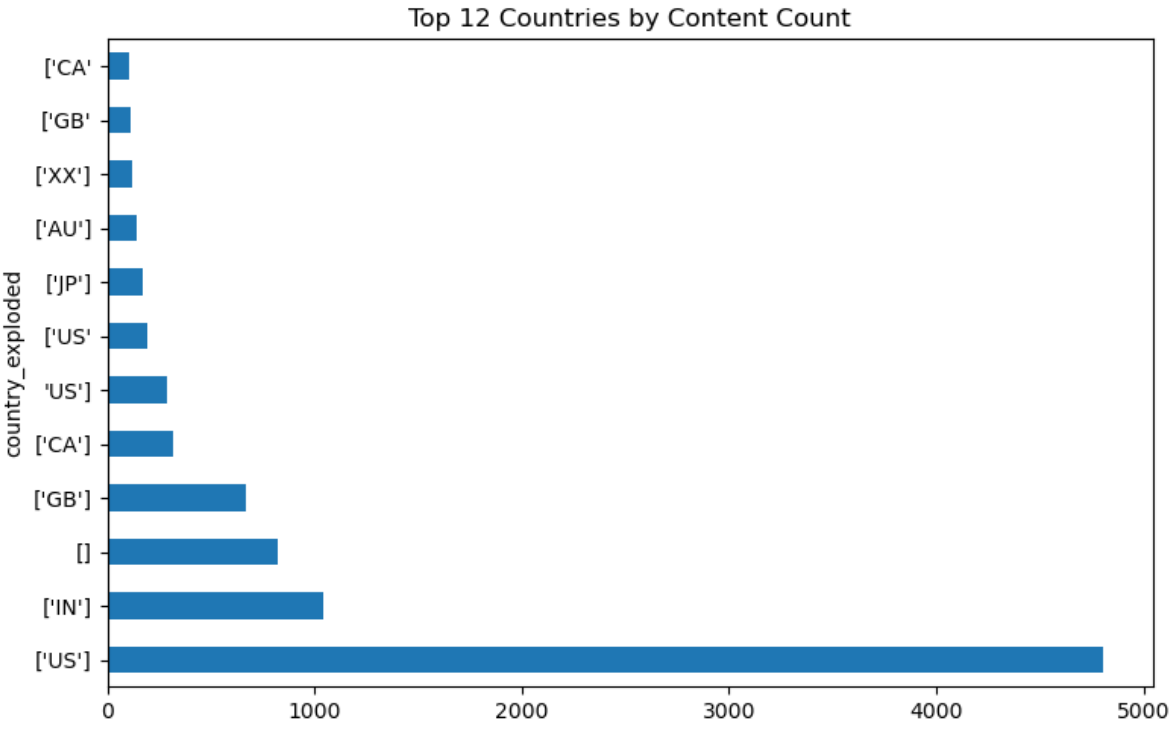



```
Top 10 genres:

genre_list
['drama'       1717
'drama']       1144
'drama'         990
['comedy'       921
['thriller'     911
['drama']       906
'romance']      773
'action'        714
'comedy'        712
['comedy']      685
Name: count, dtype: int64

<Figure size 1000x600 with 0 Axes>
```





'country_list' created from 'production_countries'



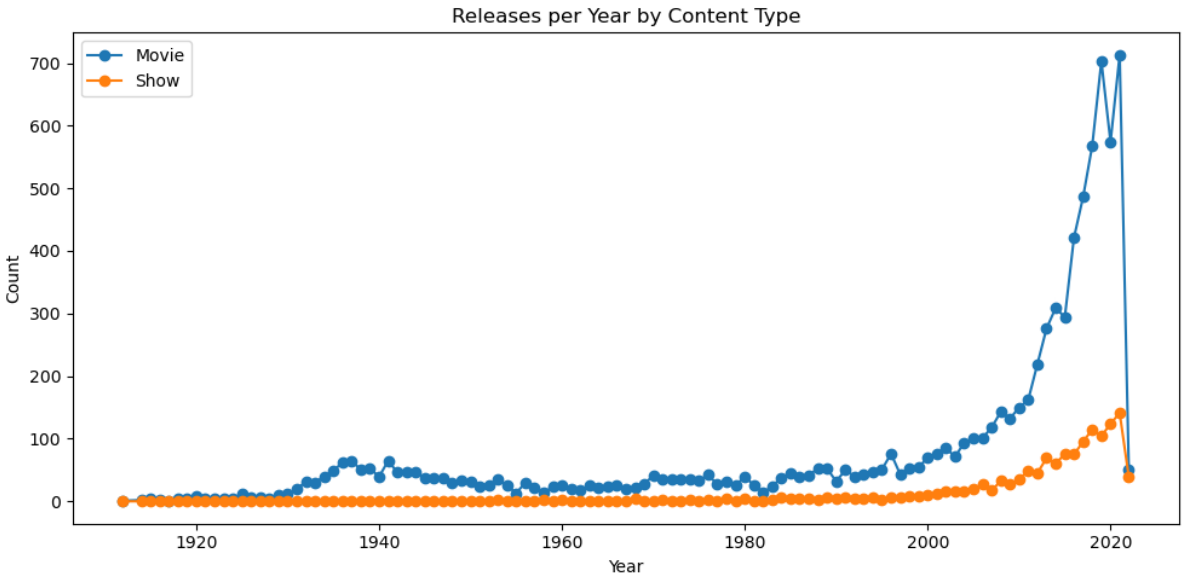
9. Time-based trends

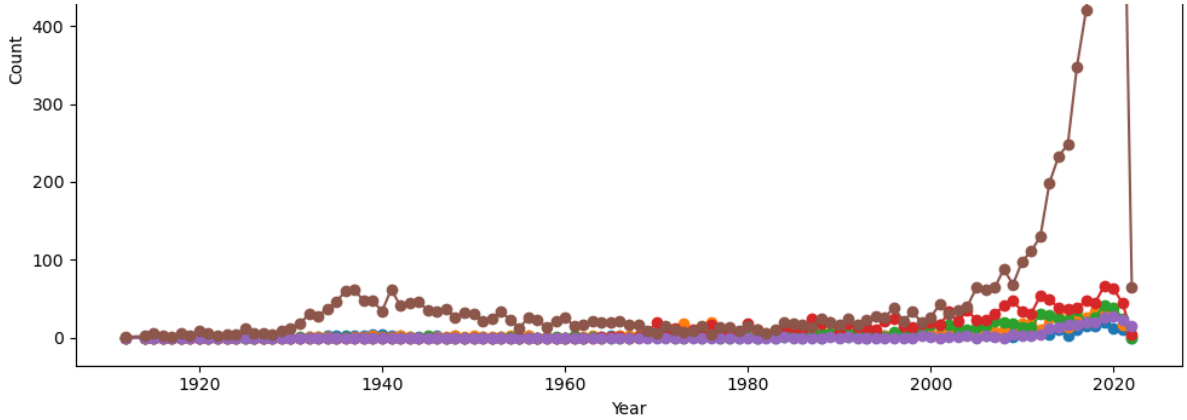
Plot releases by type over time and rating trends over time.

In [48]:

In [46]:

```
# Releases per year by type
time_by_type = df.groupby(['release_year','type_clean']).size().uns
plt.figure(figsize=(10,5))
for col in time_by_type.columns:
    plt.plot(time_by_type.index.astype(float), time_by_type[col], m
plt.legend()
plt.title('Releases per Year by Content Type')
plt.xlabel('Year')
plt.ylabel('Count')
plt.tight_layout()
plt.savefig(PLOTS_DIR / 'releases_by_type_over_time.png')
plt.show()

# Rating trends over time for top ratings
top_ratings = df['age_certification'].value_counts().head(6).index.
rating_time = df[df['age_certification'].isin(top_ratings)].groupby
plt.figure(figsize=(10,6))
for r in rating_time.columns:
    plt.plot(rating_time.index.astype(float), rating_time[r], marke
plt.legend()
plt.title('Top Ratings Over Time')
plt.xlabel('Year')
plt.ylabel('Count')
plt.tight_layout()
plt.savefig(PLOTS_DIR / 'rating_trends_over_time.png')
plt.show()
```





10. Duration analysis

Analyze movie runtimes and TV seasons distribution.

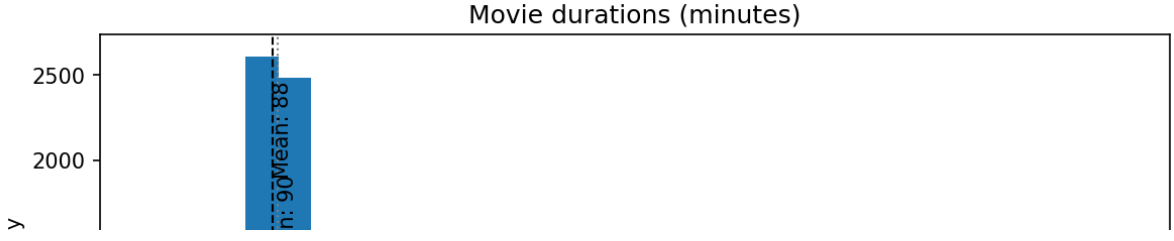
In [49]:
```
# Make sure inline backend is active
%matplotlib inline

from pathlib import Path
from IPython.display import Image, display
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np

# ensure PLOTS_DIR exists (adjust path if your notebook uses a diff
try:
    PLOTS_DIR  # if already defined
except NameError:
    PLOTS_DIR = Path('/mnt/data/prime_eda_output/plots')
PLOTS_DIR.mkdir(parents=True, exist_ok=True)

# --- Debugging info: show what's in duration columns ---
print("duration_unit value counts:")
print(df['duration_unit'].fillna('MISSING').value_counts(dropna=Fal
print("\nSample of duration_raw / duration_value (first 20 rows):")
display(df[['duration_raw','duration_unit','duration_value']].head(

# --- Ensure numeric conversion (safe) ---
df['duration_value_num'] = pd.to_numeric(df['duration_value'], erro

# MOVIE durations (minutes)
movie_minutes = df.loc[df['duration_unit'] == 'min', 'duration_valu
movie_out = PLOTS_DIR / 'movie_durations_hist.png'
if len(movie_minutes) > 0:
    # create histogram (use fig object and close then display saved
    fig, ax = plt.subplots(figsize=(8,4), dpi=120)
    ax.hist(movie_minutes, bins=30)
    ax.set_title('Movie durations (minutes)')
    ax.set_xlabel('Minutes')
    ax.set_ylabel('Frequency')
```

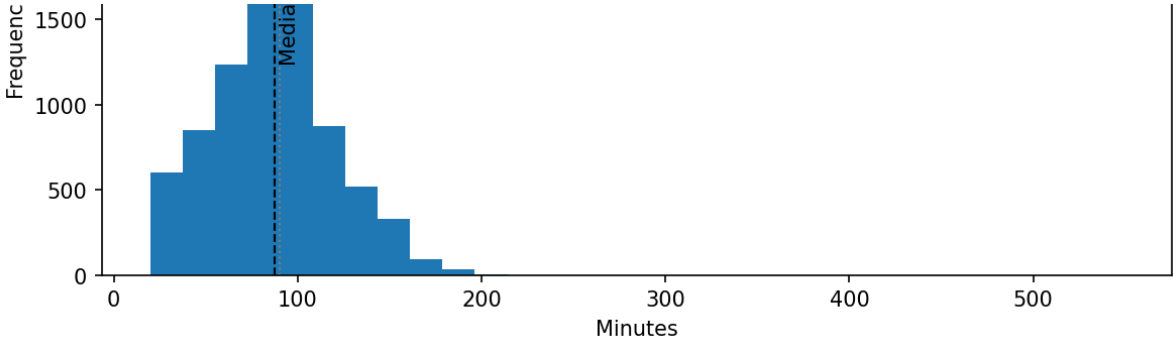
```
    # annotate with stats
    mean_m = movie_minutes.mean()
    med_m = movie_minutes.median()
    ax.axvline(mean_m, color='k', linestyle='--', linewidth=1)
    ax.text(mean_m, ax.get_ylim()[1]*0.9, f'Mean: {mean_m:.0f}', ro
    ax.axvline(med_m, color='gray', linestyle=':', linewidth=1)
    ax.text(med_m, ax.get_ylim()[1]*0.7, f'Median: {med_m:.0f}', ro
    fig.tight_layout()
    fig.savefig(movie_out, bbox_inches='tight', dpi=150)
    plt.close(fig)
    display(Image(str(movie_out)))
else:
    print("No movie durations (minutes) found. length:", len(movie_

# TV seasons/episodes
tv_counts = df.loc[df['duration_unit'].isin(['seasons','episodes'])
tv_out = PLOTS_DIR / 'tv_durations_hist.png'
if len(tv_counts) > 0:
    fig, ax = plt.subplots(figsize=(8,4), dpi=120)
    ax.hist(tv_counts, bins=20)
    ax.set_title('TV seasons/episodes parsed (count)')
    ax.set_xlabel('Seasons / Episodes (parsed)')
    ax.set_ylabel('Frequency')
    # annotate stats
    mean_tv = tv_counts.mean()
    med_tv = tv_counts.median()
    ax.axvline(mean_tv, color='k', linestyle='--', linewidth=1)
    ax.text(mean_tv, ax.get_ylim()[1]*0.9, f'Mean: {mean_tv:.1f}',
    ax.axvline(med_tv, color='gray', linestyle=':', linewidth=1)
    ax.text(med_tv, ax.get_ylim()[1]*0.7, f'Median: {med_tv:.0f}',
    fig.tight_layout()
    fig.savefig(tv_out, bbox_inches='tight', dpi=150)
    plt.close(fig)
    display(Image(str(tv_out)))
else:
    print("No TV seasons/episodes durations found. length:", len(tv

# If both empty, attempt to create a fallback combined plot of any
if len(movie_minutes) == 0 and len(tv_counts) == 0:
    any_durations = df['duration_value_num'].dropna().astype(int)
    if len(any_durations) > 0:
        print("Found numeric durations in 'duration_value' (mixed u
        fallback_out = PLOTS_DIR / 'any_durations_hist.png'
        fig, ax = plt.subplots(figsize=(8,4), dpi=120)
        ax.hist(any_durations, bins=30)
        ax.set_title('All parsed durations (fallback)')
        ax.set_xlabel('Parsed numeric value')
        ax.set_ylabel('Frequency')
        fig.tight_layout()
        fig.savefig(fallback_out, bbox_inches='tight', dpi=150)
        plt.close(fig)
        display(Image(str(fallback_out)))
    else:
```

```
        print("No numeric duration values found anywhere. Check 'du
        # display a small sample to help debug
        display(df[['title_clean','duration_raw']].loc[df['duration
```

```
duration_unit value counts:
duration_unit
min        9652
unknown     208
Name: count, dtype: int64

Sample of duration_raw / duration_value (first 20 rows):
```

	duration_raw	duration_unit	duration_value
0	19	unknown	19
1	78	min	78
2	171	min	171
3	92	min	92
4	94	min	94
5	96	min	96
6	130	min	130
7	66	min	66
8	95	min	95
9	57	min	57
10	197	min	197
11	95	min	95
12	101	min	101
13	66	min	66
14	63	min	63
15	104	min	104
16	99	min	99
17	70	min	70
18	115	min	115
19	106	min	106






```
No TV seasons/episodes durations found. length: 0
```

11. Keyword analysis in titles

Check how many titles have words like 'Love', 'War', 'Christmas' and what genres they belong to.

In [50]:
```
keywords = ['Love','War','Christmas']
kw_summary = {}
for kw in keywords:
    subset = df[df['title_clean'].str.contains(kw, case=False, na=F
    genres = pd.Series([g for gl in subset['genre_list'] for g in g
    kw_summary[kw] = {'count': int(subset.shape[0]), 'top_genres':

kw_summary
```

Out[50]:
```
{'Love': {'count': 175,
  'top_genres': {"'romance']": 46,
   "['drama'": 42,
   "['comedy'": 31,
   "['romance'": 29,
   "'drama']": 26,
   "'comedy'": 23}},
 'War': {'count': 113,
  'top_genres': {"'action'": 17,
   "['comedy']": 15,
   "['documentation']": 14,
   "['drama'": 14,
   "'war']": 10,
   "'european']": 9}},
 'Christmas': {'count': 79,
  'top_genres': {"['comedy'": 19,
   "'romance']": 17,
   "'family']": 16,
   "'drama'": 11,
   "'comedy']": 10,
   "['romance'": 10}}}
```

12. Credits analysis — top actors & directors

Use `credits.csv` to find top actors and directors. This uses heuristics depending on column names in `credits.csv` .

In [51]:
```
credits = df_credits.copy()
credits.columns = [c.strip() for c in credits.columns]
print('credits columns:', credits.columns.tolist())

# try to find likely columns
cast_col = next((c for c in credits.columns if 'cast' in c.lower()
crew_col = next((c for c in credits.columns if 'crew' in c.lower()

top_actors = pd.Series(dtype=int)
top_directors = pd.Series(dtype=int)

if cast_col:
    credits['cast_list'] = credits[cast_col].astype(str).apply(spli
    top_actors = credits.explode('cast_list')['cast_list'].value_co

if crew_col:
    credits['crew_list'] = credits[crew_col].astype(str).apply(spli
    # attempt to extract directors by heuristics if roles are inclu
    # simple approach: count names in crew_list
    top_directors = credits.explode('crew_list')['crew_list'].value

print('Top actors (sample):')
display(top_actors.head(10))
print('\nTop directors (sample):')
display(top_directors.head(10))
```

```
credits columns: ['person_id', 'id', 'name', 'character', 'role']
Top actors (sample):
```

```
Series([], dtype: int64)
```

```
Top directors (sample):
```

```
Series([], dtype: int64)
```

13. Key insights & recommendations

Summarize the major findings and actionable recommendations. Use the results from previous sections.

In [52]:

```
insights = [
    "Distribution of Movies vs TV shows is visible — check content_
    "Genre distribution highlights top genres (see top_genres_horiz
    "Recent release trends show increases/decreases by year (releas
    "Ratings distribution indicates what audience types the catalog
]
recs = [
    "Invest in growing genres producing positive release trends.",
    "Consider local-language content in top-producing countries.",
    "Improve balance between TV and Movies if one dominates."
]

print('Insights:')
for i in insights:
    print('- ', i)

print('\nRecommendations:')
for r in recs:
    print('- ', r)

# Save a plain text summary file
with open(OUTDIR / 'summary_and_recommendations.txt', 'w') as f:
    f.write('Key Insights:\n')
    for i in insights:
        f.write('- ' + i + '\n')
    f.write('\nRecommendations:\n')
    for r in recs:
        f.write('- ' + r + '\n')

print('\nSaved summary to', OUTDIR / 'summary_and_recommendations.t
```

```
Insights:
-  Distribution of Movies vs TV shows is visible — check content_t
ype_counts.png
-  Genre distribution highlights top genres (see top_genres_horizo
ntal.png)
-  Recent release trends show increases/decreases by year (release
s_per_year.png)
-  Ratings distribution indicates what audience types the catalog
is biased towards

Recommendations:
-  Invest in growing genres producing positive release trends.
-  Consider local-language content in top-producing countries.
-  Improve balance between TV and Movies if one dominates.

Saved summary to /Users/shivalimuthukumar/Desktop/prime_eda_outpu
t/summary_and_recommendations.txt
```

In [53]:

```
# ML section: simple classifier to predict Movie vs TV using basic
# This will run only if scikit-learn is installed.
try:
    from sklearn.model_selection import train_test_split
    from sklearn.linear_model import LogisticRegression
    from sklearn.preprocessing import StandardScaler
    from sklearn.metrics import classification_report, confusion_ma
    SKLEARN_AVAILABLE = True
except Exception as e:
    SKLEARN_AVAILABLE = False
    print('scikit-learn not available. To run ML part, install scik

if SKLEARN_AVAILABLE:
    # Prepare simple features: duration (minutes), number of genres
    df_ml = df.copy()
    df_ml['target_movie'] = df_ml['type_clean'].str.lower().str.con
    df_ml['num_genres'] = df_ml['genre_list'].apply(lambda x: len(x
    df_ml['country_count'] = df_ml['country_list'].apply(lambda x:
    df_ml['duration_minutes'] = pd.to_numeric(df_ml['duration_value
    df_ml['release_year_filled'] = df_ml['release_year'].fillna(df_
    features = ['duration_minutes','num_genres','country_count','re

    X = df_ml[features].copy()
    med = X.loc[X['duration_minutes']>0,'duration_minutes'].median(
    X['duration_minutes'] = X['duration_minutes'].replace(-1, med i
    y = df_ml['target_movie']

    valid = X.dropna().index
    X = X.loc[valid]; y = y.loc[valid]

    # If target has only one class, skip ML
    if y.nunique() < 2:
        print('Target has single class. Skipping ML.')
    else:
        X_train, X_test, y_train, y_test = train_test_split(X, y, t
        scaler = StandardScaler()
        X_train_s = scaler.fit_transform(X_train); X_test_s = scale
        clf = LogisticRegression(max_iter=1000)
        clf.fit(X_train_s, y_train); y_pred = clf.predict(X_test_s)
        print('ML Classification results (Movie vs Not Movie):')
        print('Accuracy:', accuracy_score(y_test, y_pred))
        print('\nClassification report:')
        print(classification_report(y_test, y_pred))
        print('\nConfusion matrix:')
        print(confusion_matrix(y_test, y_pred))
        with open(OUTDIR / 'ml_summary.txt', 'w') as f:
            f.write(f'Accuracy: {accuracy_score(y_test,y_pred)}\n')
else:
    print('Skipping ML section. Install scikit-learn to enable this
```

```
ML Classification results (Movie vs Not Movie):
Accuracy: 0.9488843813387424
```

```
Classification report:
              precision    recall  f1-score   support

           0       0.85      0.76      0.80       339
           1       0.96      0.98      0.97      2126

    accuracy                           0.95      2465
   macro avg       0.91      0.87      0.89      2465
weighted avg       0.95      0.95      0.95      2465


Confusion matrix:
[[ 257   82]
 [  44 2082]]
```

In [ ]: