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Introduction

In this notebook, we will be conducting a simple analysis on the DVD Rental database with SQL queries in a Jupyter environment.

The main objective of this project is to practice and expose myself to writing SQL queries to query from an actual database.

Problem Statement

How can the DVD rental store optimize its inventory and pricing strategies to meet customer demands, increase revenue, and improve its rental performance while taking into account the popularity and revenue generated by different genres and individual movies?

Approach

1) Load database into PostgreSQL using dvdrental.tar file

2) Connect to database using sqlalchemy & psycopg2

3) Run SQL queries to query from database

4) Visualise outputs of the SQL queries with matplotlib & seaborn

5) Conclusion & Recommendations

Import Libraries

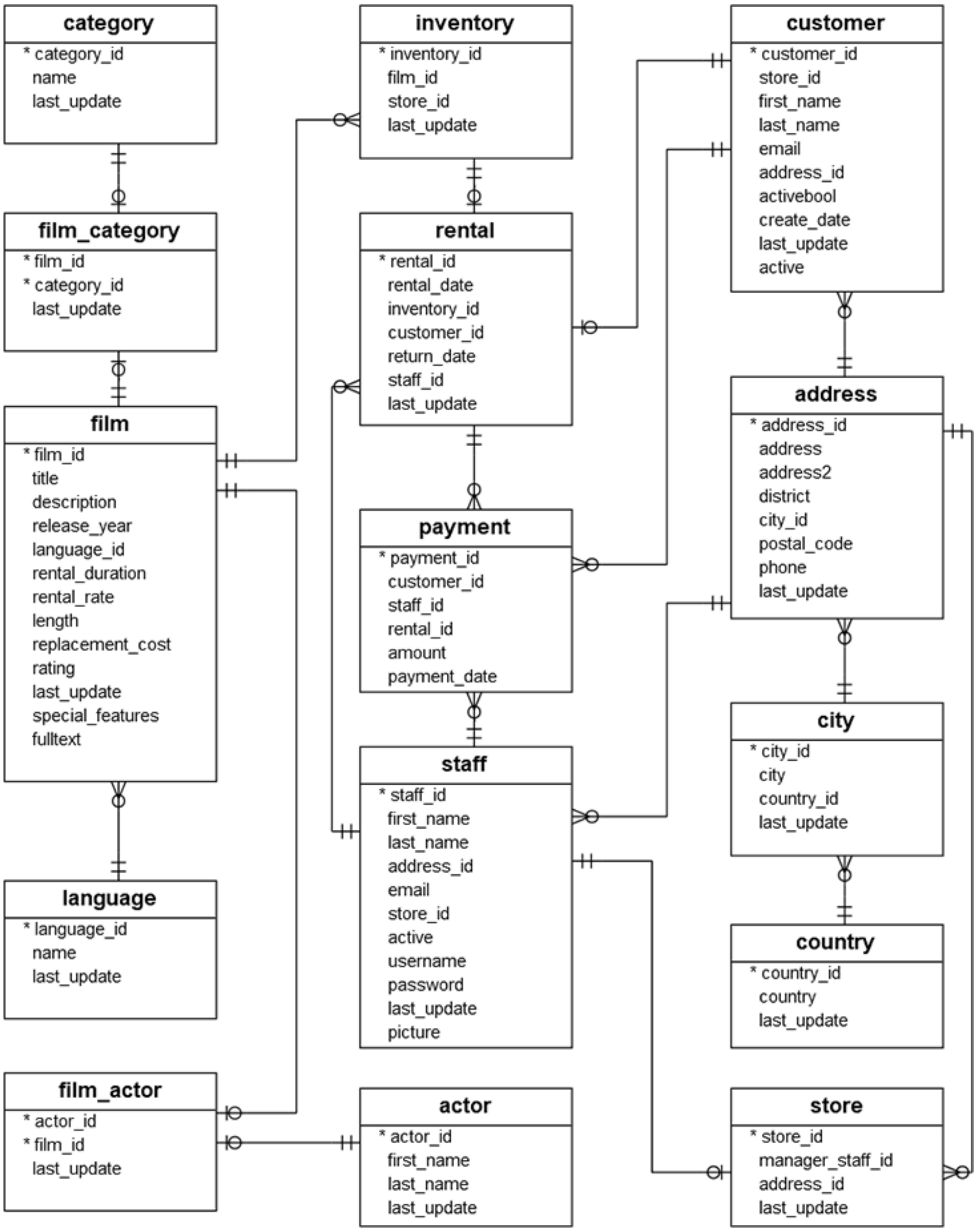
In [1]:
```
from sqlalchemy import create_engine, text
import psycopg2

import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

Connecting to database

In [2]:
```
# database connection string
db_string = ---

# create database engine
engine = create_engine(db_string)
```

In [3]:
```
# connect to the database
connection = engine.connect()
```

Database Schema



Data Analysis

In the analysis, we will be exploring these few pointers.

In [4]:
```
# function to load SQL query into a dataframe immediately
def load_query(query):
    df = pd.read_sql(text(query),connection)
    return df
```

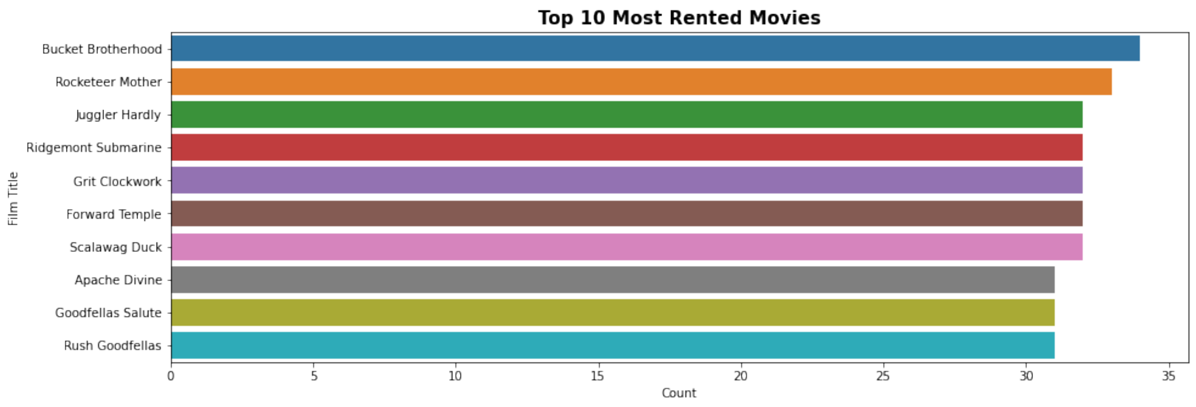
Top 10 Most Popular Movies

In [5]:
```
# Query top 10 most popular movies in the database using number of
top10_most_popularmovies = load_query("""

SELECT title film_title, COUNT(title) count
FROM rental r JOIN inventory i ON r.inventory_id = i.inventory_id
JOIN film f ON i.film_id = f.film_id
GROUP BY title
ORDER BY count DESC
LIMIT 10

 """)

top10_most_popularmovies.head()
```

Out[5]:

	film_title	count
0	Bucket Brotherhood	34
1	Rocketeer Mother	33
2	Juggler Hardly	32
3	Ridgemont Submarine	32
4	Grit Clockwork	32

```
In [6]: plt.figure(figsize=(15,5))
        sns.barplot(data = top10_most_popularmovies, x='count', y='film_tit
        plt.title('Top 10 Most Rented Movies', fontsize=15, fontweight='bol
        plt.ylabel('Film Title')
        plt.xlabel('Count');
```



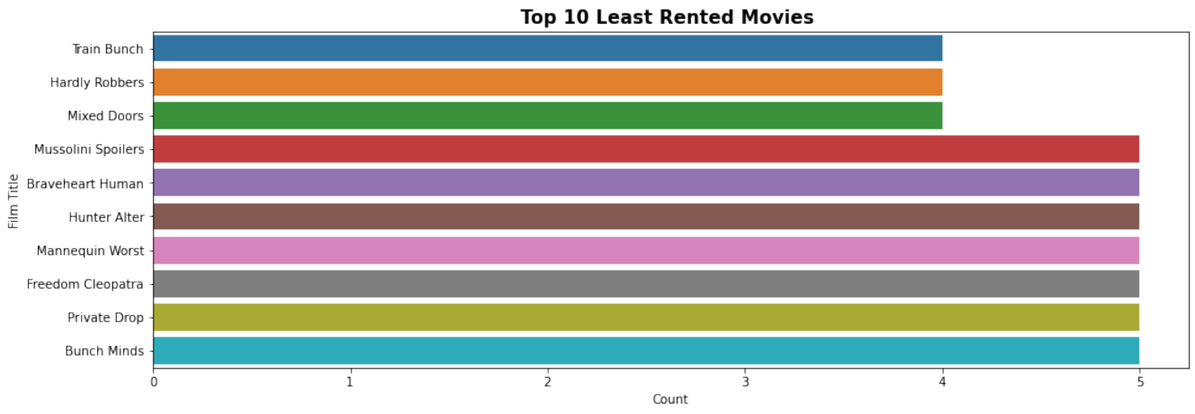
Top 10 Least Popular Movies

```
In [7]: # Query top 10 least popular movies in the database using number of
        top10_least_popularmovies = load_query("""

        SELECT title film_title, COUNT(title) count
        FROM rental r JOIN inventory i ON r.inventory_id = i.inventory_id
        JOIN film f ON i.film_id = f.film_id
        GROUP BY title
        ORDER BY count ASC
        LIMIT 10

         """)

        top10_least_popularmovies.head()
```

Out[7]:

	film_title	count
0	Train Bunch	4
1	Hardly Robbers	4
2	Mixed Doors	4
3	Mussolini Spoilers	5
4	Braveheart Human	5

In [8]:
```
plt.figure(figsize=(15,5))
sns.barplot(data = top10_least_popularmovies, x='count', y='film_ti
plt.title('Top 10 Least Rented Movies ', fontsize=15, fontweight='b
plt.ylabel('Film Title')
plt.xlabel('Count');
```



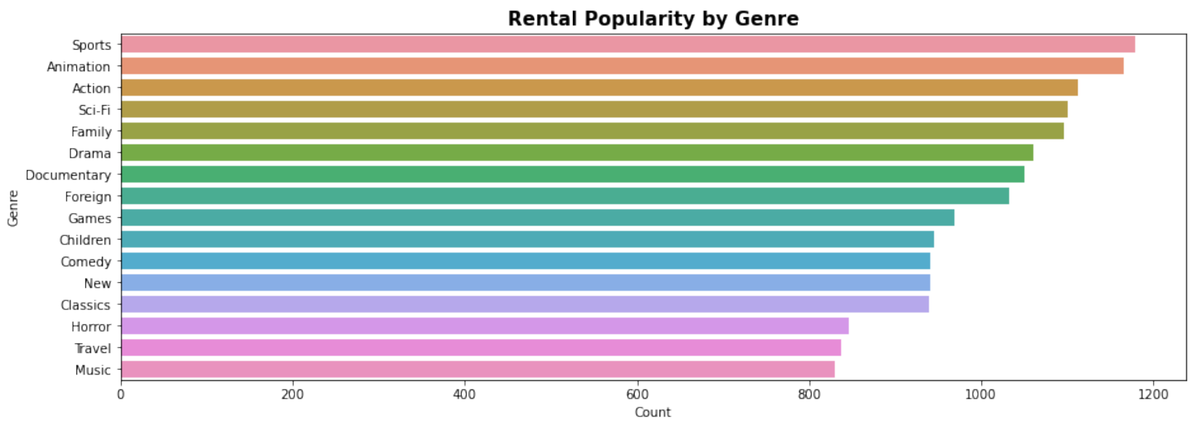
Rental Popularity by Genre

In [9]:
```
# Query popularity of genre with regards to the number of times ren
popularity_genre = load_query("""

SELECT c.name genre, COUNT(rental_id) count
FROM rental r JOIN inventory i ON r.inventory_id = i.inventory_id
JOIN film_category fc ON i.film_id = fc.film_id
JOIN category c ON fc.category_id = c.category_id
GROUP BY genre
ORDER BY count DESC

""")

popularity_genre.head()
```

Out[9]:

	genre	count
0	Sports	1179
1	Animation	1166
2	Action	1112
3	Sci-Fi	1101
4	Family	1096

In [10]:
```
plt.figure(figsize=(15,5))
sns.barplot(data =popularity_genre, x='count', y='genre')
plt.title('Rental Popularity by Genre', fontsize=15, fontweight='bo
plt.ylabel('Genre')
plt.xlabel('Count');
```



Top 3 Most Rented Movies by Genre

In [11]:
```
# Use WITH clause to JOIN tables with necessary information
# Use DENSE_RANK() to rank the COUNT of rental per title PARTITION
# Used DENSE_RANK() to get distinct rankings so there are no multip
# Ordered by count then order by title
# Use WHERE clause to get the top 3 rank

popular_movies_bygenre = load_query("""

WITH temp_table AS (SELECT c.name, f.title, COUNT(f.title) count
FROM rental r JOIN inventory i ON r.inventory_id = i.inventory_id
JOIN film_category fc ON i.film_id = fc.film_id
JOIN category c ON fc.category_id = c.category_id
JOIN film f ON i.film_id = f.film_id
GROUP BY c.name, f.title)

SELECT *
FROM
(SELECT name genre,
title movie_title,
count rent_count,
DENSE_RANK() OVER (PARTITION BY name ORDER BY count DESC, title ASC
FROM temp_table) as x
WHERE x.rank <= 3


""")

popular_movies_bygenre
```

Out[11]:

	genre	movie_title	rent_count	rank
0	Action	Rugrats Shakespeare	30	1
1	Action	Suspects Quills	30	2

2	Action	Handicap Boondock	28	3
3	Animation	Juggler Hardly	32	1
4	Animation	Dogma Family	30	2
5	Animation	Storm Happiness	29	3
6	Children	Robbers Joon	31	1
7	Children	Idols Snatchers	30	2
8	Children	Sweethearts Suspects	29	3
9	Classics	Timberland Sky	31	1
10	Classics	Frost Head	30	2
11	Classics	Gilmore Boiled	28	3
12	Comedy	Zorro Ark	31	1
13	Comedy	Cat Coneheads	30	2
14	Comedy	Closer Bang	28	3
15	Documentary	Wife Turn	31	1
16	Documentary	Virginian Pluto	29	2
17	Documentary	Expendable Stallion	28	3
18	Drama	Hobbit Alien	31	1
19	Drama	Harry Idaho	30	2
20	Drama	Witches Panic	30	3
21	Family	Apache Divine	31	1
22	Family	Network Peak	31	2
23	Family	Rush Goodfellas	31	3
24	Foreign	Rocketeer Mother	33	1
25	Foreign	Shock Cabin	30	2
26	Foreign	Moon Bunch	29	3
27	Games	Forward Temple	32	1
28	Games	Grit Clockwork	32	2
29	Games	Massacre Usual	30	3
30	Horror	Pulp Beverly	30	1
31	Horror	Family Sweet	29	2
32	Horror	Swarm Gold	27	3
33	Music	Scalawag Duck	32	1
34	Music	Boogie Amelie	29	2
35	Music	Confidential Interview	29	3
36	New	Ridgemont Submarine	32	1
37	New	Butterfly Chocolat	30	2

38	New	Fatal Haunted	28	3
39	Sci-Fi	Goodfellas Salute	31	1
40	Sci-Fi	English Bulworth	30	2
41	Sci-Fi	Graffiti Love	30	3
42	Sports	Gleaming Jawbreaker	29	1
43	Sports	Talented Homicide	29	2
44	Sports	Roses Treasure	28	3
45	Travel	Bucket Brotherhood	34	1
46	Travel	Muscle Bright	30	2
47	Travel	Horror Reign	27	3

Revenue Generating Films

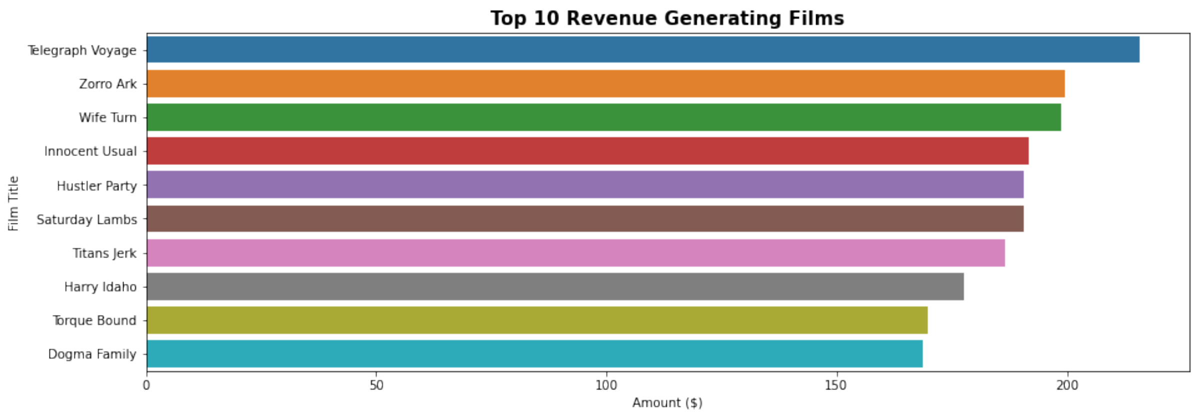
In [12]:

```
# Query the sum of payments grouped by the film title
# LEFT JOIN used to account for all of the rental

revenue_films = load_query("""

SELECT f.title film_title, SUM(p.amount) revenue
FROM rental r JOIN payment p ON r.rental_id = p.rental_id
JOIN inventory i ON r.inventory_id = i.inventory_id
JOIN film f ON i.film_id = f.film_id
GROUP BY f.title, f.film_id
ORDER BY revenue DESC
LIMIT 10

""")

revenue_films.head()
```

Out[12]:

	film_title	revenue
0	Telegraph Voyage	215.75
1	Zorro Ark	199.72
2	Wife Turn	198.73
3	Innocent Usual	191.74
4	Hustler Party	190.78

In [13]:
```
plt.figure(figsize=(15,5))
sns.barplot(data = revenue_films, x='revenue', y='film_title')
plt.title('Top 10 Revenue Generating Films', fontsize=15, fontweigh
plt.ylabel('Film Title')
plt.xlabel('Amount ($)');
```



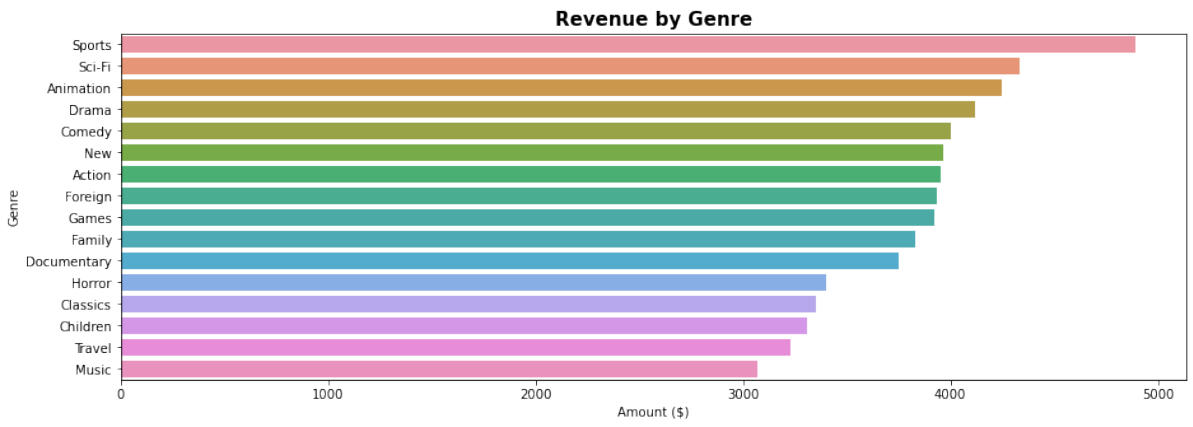
Revenue Generating Genre

In [14]:
```
# Query the sum of payments grouped by the genre
# LEFT JOIN used to account for all of the rental

revenue_genre = load_query("""

SELECT c.name genre, SUM(p.amount) revenue
FROM rental r JOIN payment p ON r.rental_id = p.rental_id
JOIN inventory i ON r.inventory_id = i.inventory_id
JOIN film f ON i.film_id = f.film_id
JOIN film_category fc ON f.film_id = fc.film_id
JOIN category c ON fc.category_id = c.category_id
GROUP BY c.name
ORDER BY revenue DESC

""")

revenue_genre.head()
```

Out[14]:

	genre	revenue
0	Sports	4892.19
1	Sci-Fi	4336.01
2	Animation	4245.31
3	Drama	4118.46
4	Comedy	4002.48

In [15]:
```
plt.figure(figsize=(15,5))
sns.barplot(data = revenue_genre, x='revenue', y='genre')
plt.title('Revenue by Genre', fontsize=15, fontweight='bold')
plt.ylabel('Genre')
plt.xlabel('Amount ($)');
```



Revenue by Month

In [16]:
```
load_query("""

SELECT MIN(payment_date), MAX(payment_date)
FROM payment

""")
```

Out[16]:

	min	max
0	2007-02-14 21:21:59.996577	2007-05-14 13:44:29.996577

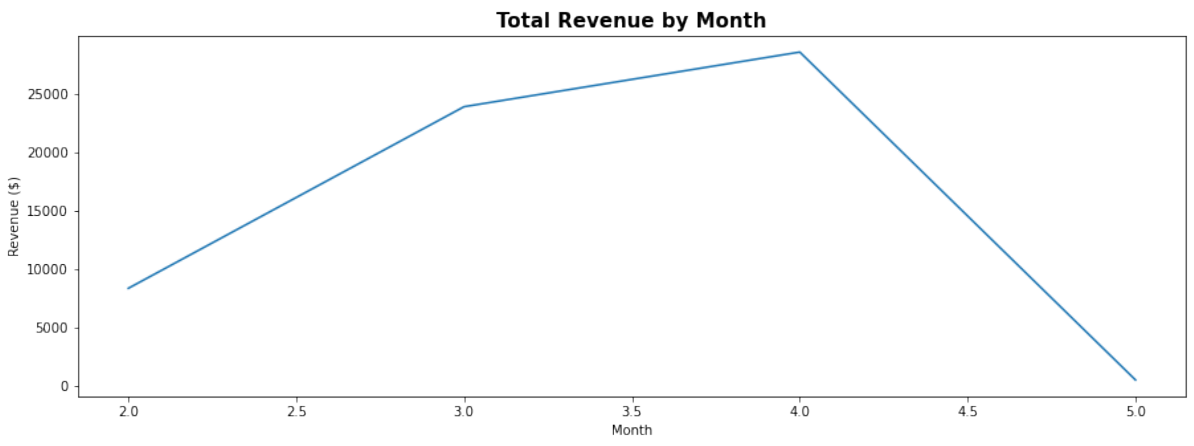
Notice that the payment dates spans from 14/02/2007 to 14/05/2007 only

In [17]:
```
# Query sum of amount grouped by month

revenue_month = load_query("""

SELECT
EXTRACT(MONTH from payment_date) as month, SUM(amount) revenue
FROM payment
GROUP BY month
ORDER BY month

""")

revenue_month.head()
```

Out[17]:

	month	revenue
0	2.0	8351.84
1	3.0	23886.56
2	4.0	28559.46
3	5.0	514.18

In [18]:
```
plt.figure(figsize=(15,5))
sns.lineplot(data=revenue_month, x="month", y="revenue", )
plt.title('Total Revenue by Month', fontsize=15, fontweight='bold')
plt.ylabel('Revenue ($)')
plt.xlabel('Month');
```



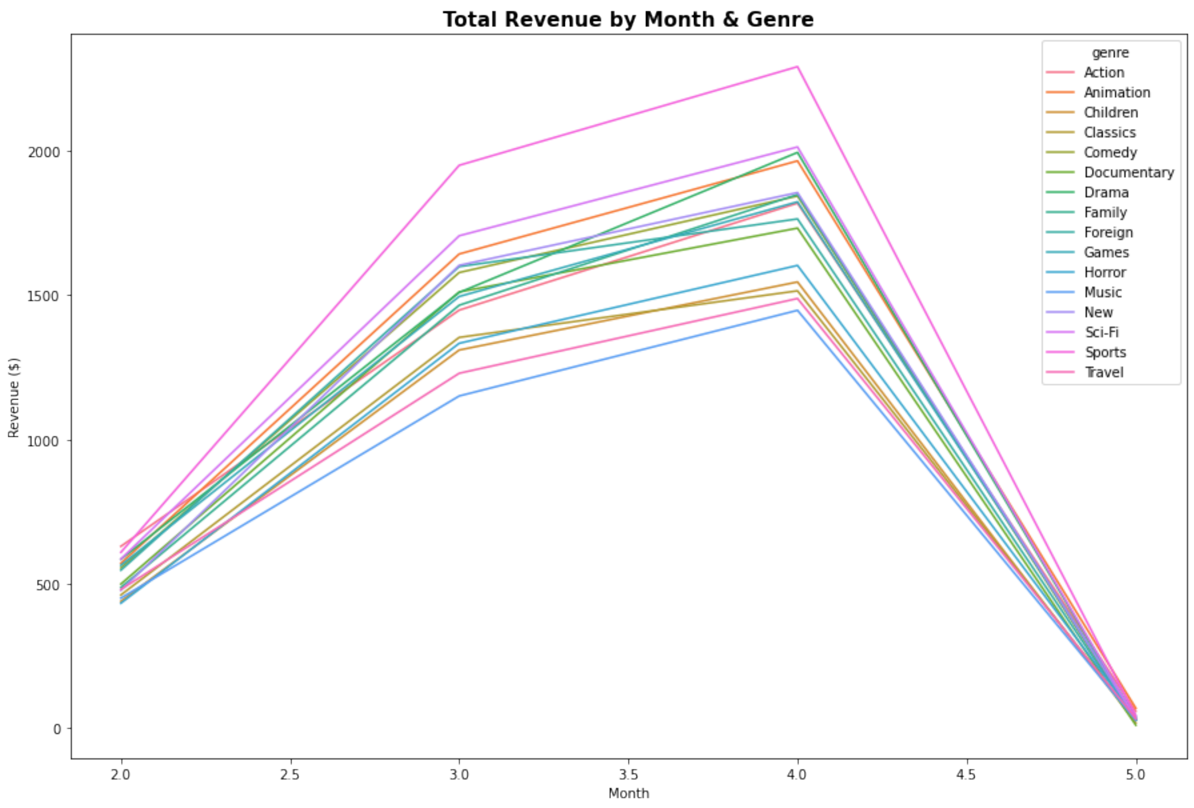
Revenue by Month by Genre

In [19]:
```
revenue_month_genre = load_query("""

SELECT
EXTRACT(MONTH from payment_date) as month,
c.name genre,
SUM(amount) revenue

FROM rental r JOIN payment p ON r.rental_id = p.rental_id
JOIN inventory i ON r.inventory_id = i.inventory_id
JOIN film f ON i.film_id = f.film_id
JOIN film_category fc ON f.film_id = fc.film_id
JOIN category c ON fc.category_id = c.category_id

GROUP BY month, c.name
ORDER BY name, month


""")

revenue_month_genre.head(8)
```

Out[19]:

	month	genre	revenue
0	2.0	Action	628.52
1	3.0	Action	1448.19
2	4.0	Action	1819.33
3	5.0	Action	55.80
4	2.0	Animation	569.53
5	3.0	Animation	1642.95
6	4.0	Animation	1966.08
7	5.0	Animation	66.75

In [20]:
```
plt.figure(figsize=(15,10))
sns.lineplot(data=revenue_month_genre, x="month", y="revenue", hue=
plt.title('Total Revenue by Month & Genre', fontsize=15, fontweight
plt.ylabel('Revenue ($)')
plt.xlabel('Month');
```



Since the number of months available in the database is quite limited, it is difficult to draw any conclusion.

Films with price of rental greater than the rental price of top 3 most rented films

In [21]:
```
# Query the genre and titles of films that has a rental cost greate
# and is not in the top 3

load_query("""

WITH t1 AS
(SELECT c.name, f.title, COUNT(f.title) count, MAX(amount) amount
FROM rental r JOIN inventory i ON r.inventory_id = i.inventory_id
JOIN film_category fc ON i.film_id = fc.film_id
JOIN category c ON fc.category_id = c.category_id
JOIN film f ON i.film_id = f.film_id
JOIN payment p ON p.rental_id = r.rental_id
GROUP BY c.name, f.title),
t2 AS
(SELECT name, title, count, amount, DENSE_RANK() OVER (PARTITION BY
FROM t1)

SELECT name genre, title film_title
FROM t2
WHERE amount > (SELECT MAX(amount) FROM t2 WHERE rank <= 3) AND ran

""")
```

Out[21]:

	genre	film_title
0	Children	Ties Hunger
1	Comedy	Flintstones Happiness
2	Documentary	Midsummer Groundhog
3	Drama	Scorpion Apollo
4	Foreign	Trap Guys
5	New	Sting Personal
6	New	Mine Titans

Conclusion & Recommendations

1) Increasing rental prices for action films

- Top 3 Genres based on rental include Sports, Animation and Action
- Top 3 Genres based on revenue include Sports, Sci-Fi and Animation

Notice that Action ranks 3rd based on the rental while ranking 7th based on the revenue generated. This is where the DVD store can experiment with increasing the rental prices for action films since there is a demand for action films.

2) General price adjustments

- Other than increasing rental prices for action films, the store can also consider **increasing the rental prices for popular films** due to the high demand and **reduce the prices for the less popular films**.
- the DVD rental store can also consider **having promotions for these films to increase the number of rents for less popular films.**
- After identifying the list of film titles that has a rental price greater than the rental price of the top 3 most rented films, the DVD rental store can lower the prices of these films in order to increase the rental count of these films.

3) Meeting customer demands

- Based on the number of rents, the DVD rental store can consider **bringing in more films from the popular genres**.
- Based on the top 3 rented films by genre, the DVD rental store can also consider **bringing in more copies of the top 3 films of every genre.**
- Based on the top 10 rented films, the DVD rental store can **bring in more copies of the popular films.**

By meeting the customer demands, the DVD rental store would be able to optimise the company's inventory and generate more revenue.

The opposite can be inferred for the less popular films & genres.