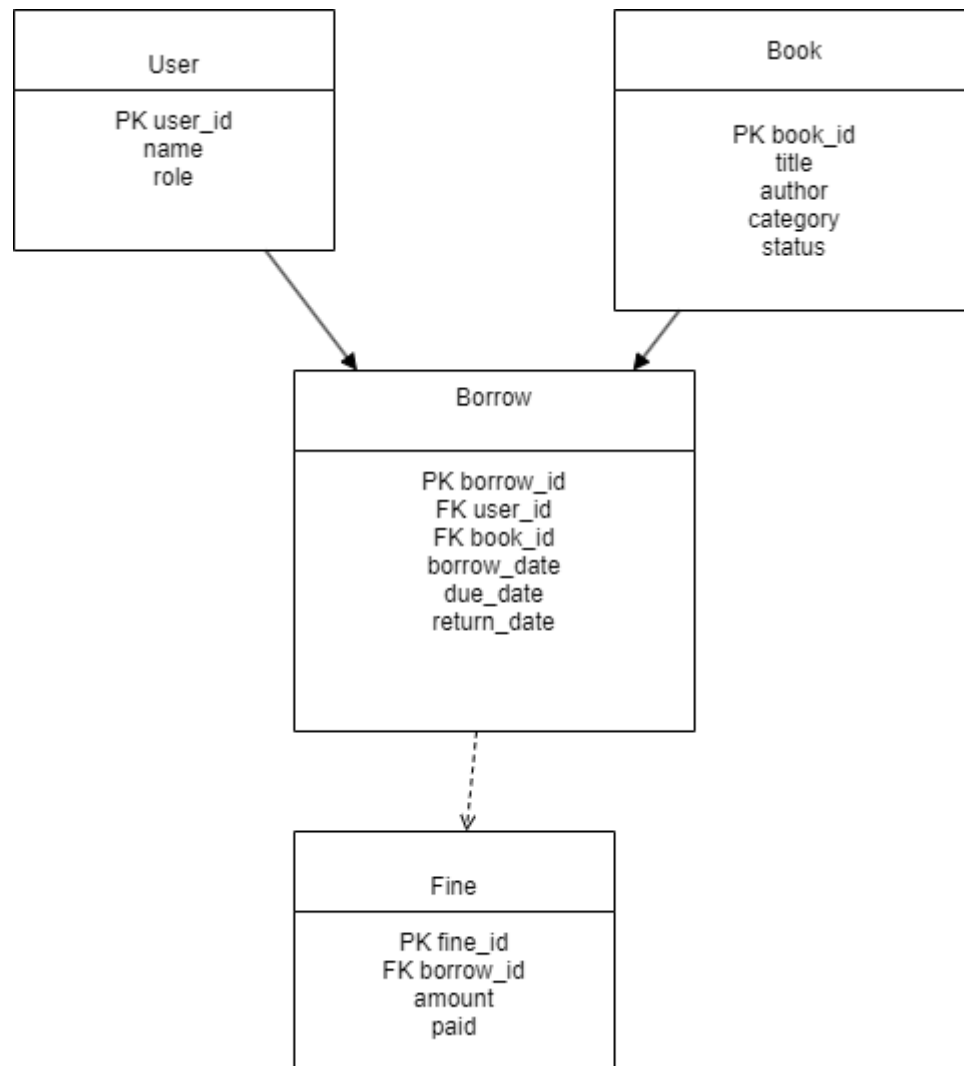


## 一、系統功能構想

借書、還書、逾期產生罰金、圖書查詢、借閱統計查詢

## 二、ER 圖



## 三、正規化

### (1) User 表格

未正規化 (UNF)：包含使用者的姓名、身分與借書資料。

1NF：將重複借書行為分離，只保留單一使用者基本屬性 (user\_id, name, role)。

2NF：user\_id 為主鍵，每個非主鍵欄位 (name, role) 都完整依賴於 user\_id，無部分依賴。

3NF：屬性間無遞移依賴 (例如 role 並不依賴 name)，符合 3NF。

## (2) Book 表格

1NF：每本書一筆紀錄，所有欄位值皆為原子值 (不可再分)。

2NF：主鍵為 book\_id，其餘欄位 (title, author, category, status) 都完全依賴 book\_id。

3NF：沒有欄位彼此依賴 (如 category 與 title 無依賴關係)，符合 3NF。

## (3) Borrow 表格

1NF：每一次借書紀錄一筆，不含重複群組。

2NF：主鍵為 borrow\_id，其餘欄位 (user\_id, book\_id, borrow\_date, due\_date, return\_date) 完全依賴主鍵。

3NF：return\_date 與 due\_date 為獨立欄位，不依賴其他非主鍵欄位，符合 3NF。

## (4) Fine 表格

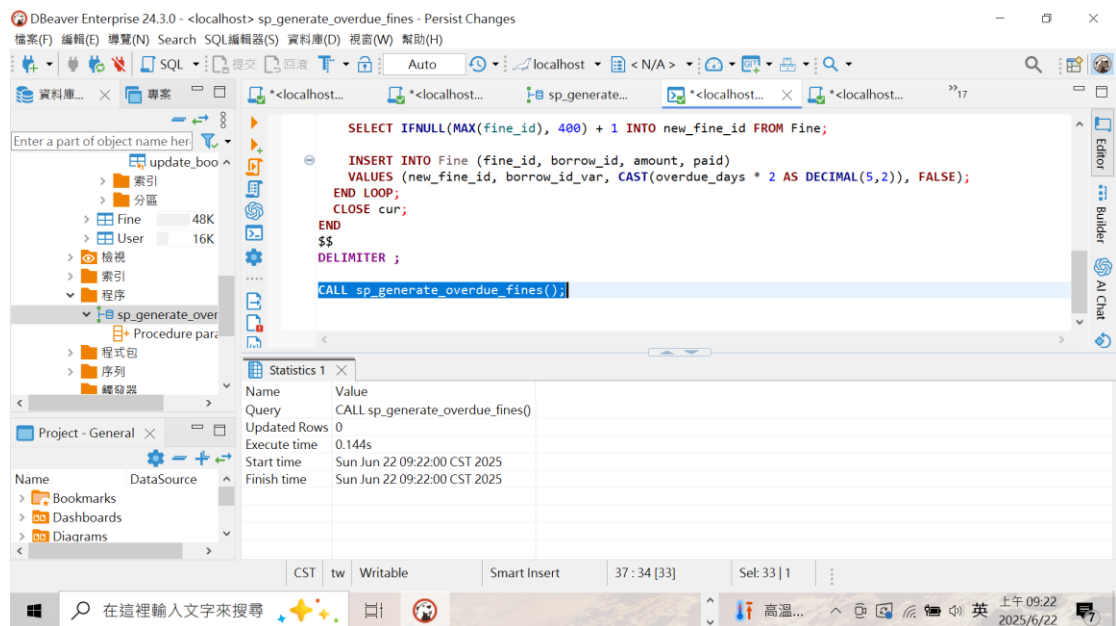
1NF：每筆罰金記錄一筆資料，無重複結構。

2NF：fine\_id 為主鍵，所有欄位都依賴 fine\_id。

3NF：amount 與 paid 皆不依賴其他非主鍵欄位，符合 3NF。

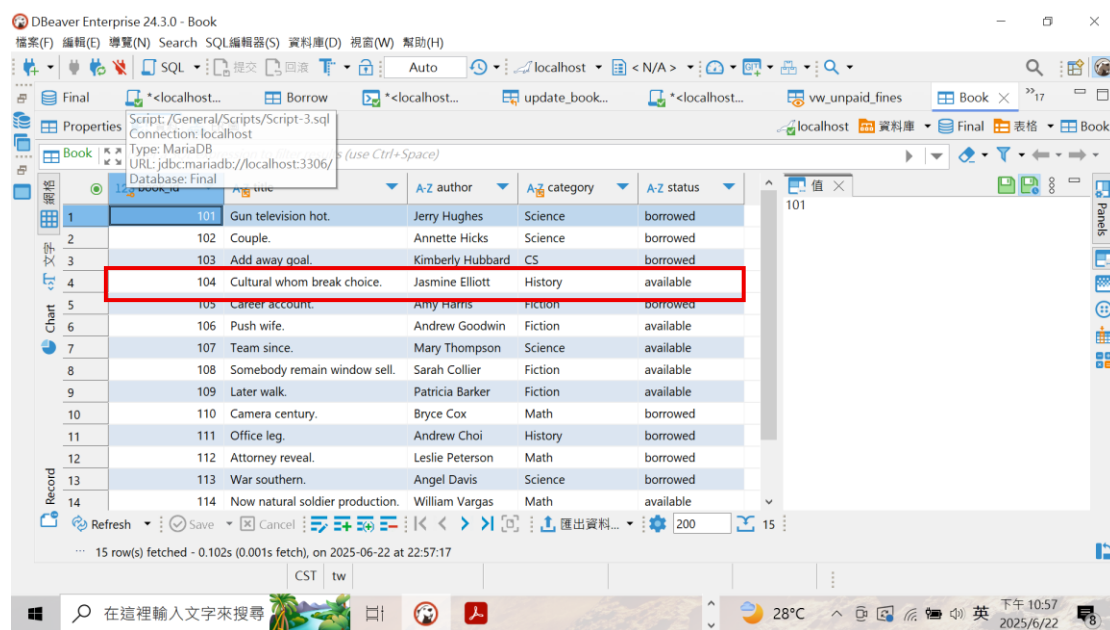
## 四、 建立 Stored Procedure-逾期自動產生罰金

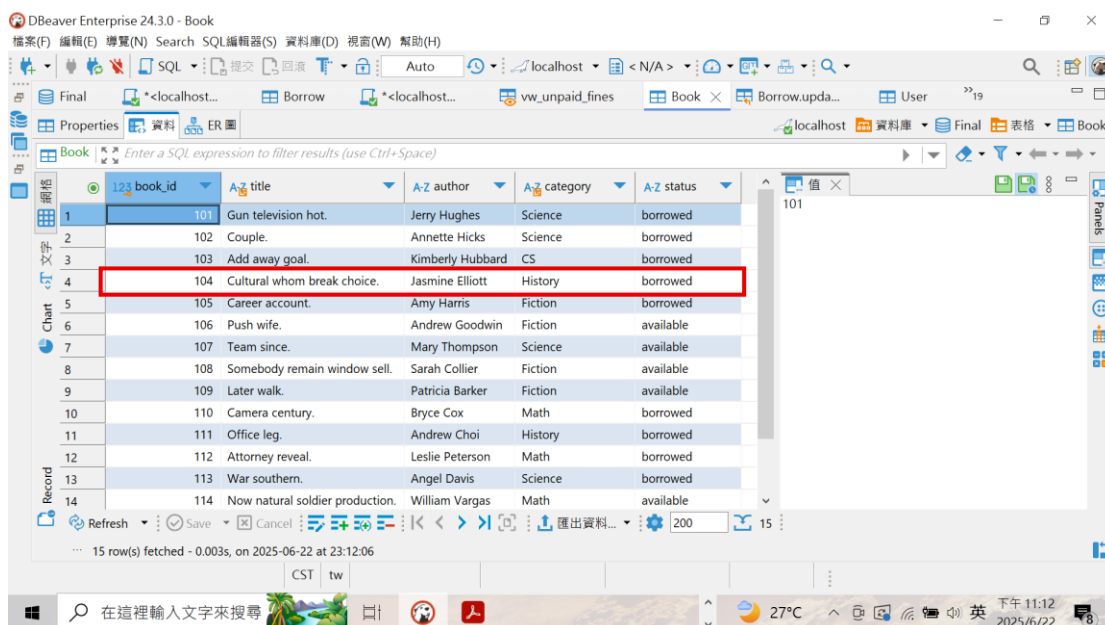
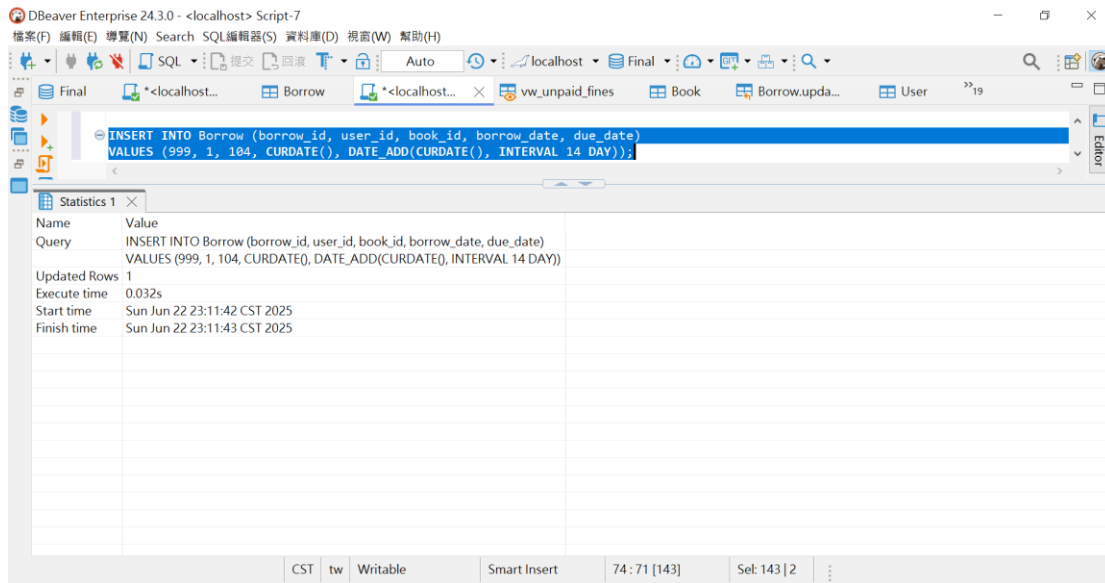
相關 SQL 貼在 Final.sql 裡，測試確認可以呼叫



## 五、 建立 Trigger-借書時自動將書籍狀態設為 "borrowed"

建立 Trigger 的相關 SQL 在 Final.sql 裡，以下測試 Trigger 是否正確執行





## 六、 功能查詢清單

### (1) 可借圖書查詢

*SELECT \* FROM Book WHERE status = 'available';*

DBeaver Enterprise 24.3.0 - <localhost> Script-7

SQL: `SELECT * FROM Book WHERE status = 'ava'`

	book_id	title	author	category	status
1	104	Cultural whom break choice.	Jasmine Elliott	History	available
2	106	Push wife.	Andrew Goodwin	Fiction	available
3	107	Team since.	Mary Thompson	Science	available
4	108	Somebody remain window sell.	Sarah Collier	Fiction	available
5	109	Later walk.	Patricia Barker	Fiction	available
6	114	Now natural soldier production.	William Vargas	Math	available
7	115	Already from.	Steven Alexander	Math	available

## (2) 查詢所有未歸還書籍的借閱紀錄

```

SELECT
    b.borrow_id,
    u.name AS user_name,
    bk.title AS book_title,
    b.borrow_date,
    b.due_date
FROM Borrow b
JOIN User u ON b.user_id = u.user_id
JOIN Book bk ON b.book_id = bk.book_id
WHERE b.return_date IS NULL;

```

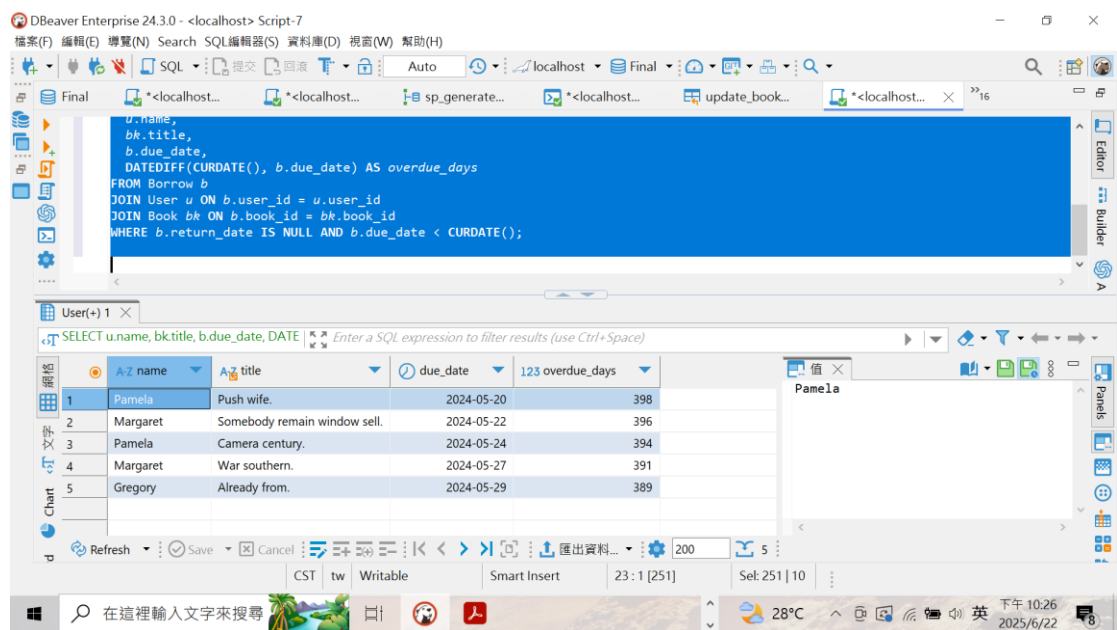
DBeaver Enterprise 24.3.0 - <localhost> Script-7

SQL: `SELECT b.borrow_id, u.name AS user_name, bk.title AS book_title, b.borrow_date, b.due_date FROM Borrow b JOIN User u ON b.user_id = u.user_id JOIN Book bk ON b.book_id = bk.book_id WHERE b.return_date IS NULL;`

	borrow_id	user_name	book_title	borrow_date	due_date
1	201	Margaret	Gun television hot.	2025-06-21	2025-07-05
2	306	Pamela	Push wife.	2024-05-06	2024-05-20
3	308	Margaret	Somebody remain window	2024-05-08	2024-05-22
4	310	Pamela	Camera century.	2024-05-10	2024-05-24
5	313	Margaret	War southern.	2024-05-13	2024-05-27
6	315	Gregory	Already from.	2024-05-15	2024-05-29

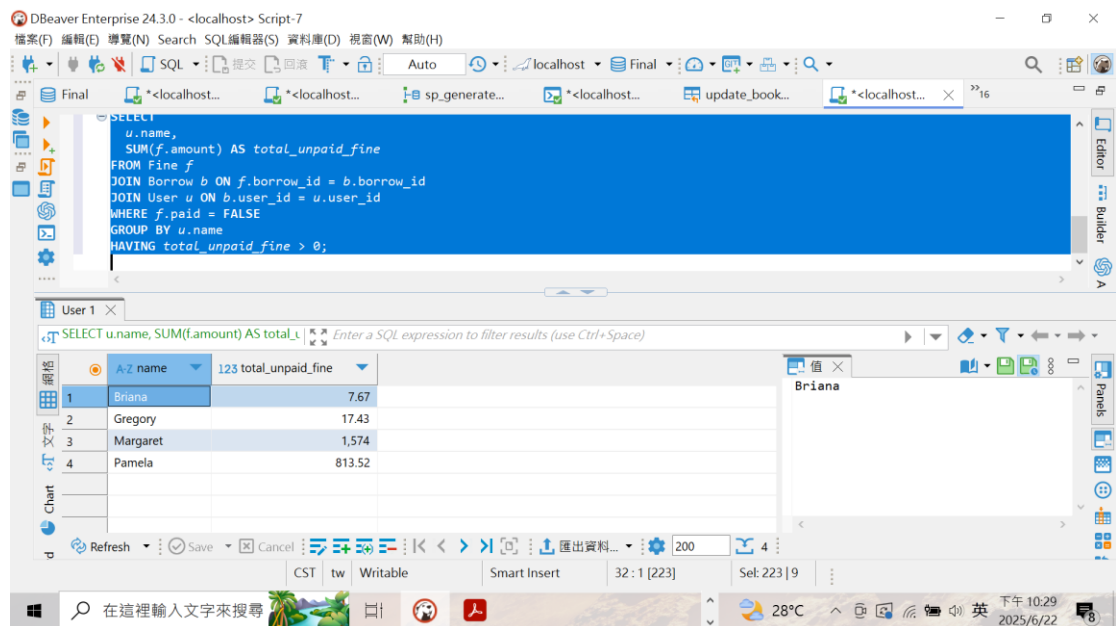
(3) 查詢逾期未還書的使用者名單 (含逾期天數)

```
SELECT
    u.name,
    bk.title,
    b.due_date,
    DATEDIFF(CURDATE(), b.due_date) AS overdue_days
FROM Borrow b
JOIN User u ON b.user_id = u.user_id
JOIN Book bk ON b.book_id = bk.book_id
WHERE b.return_date IS NULL AND b.due_date < CURDATE();
```



(4) 查詢每位使用者目前應繳總罰金 (未繳者)

```
SELECT
    u.name,
    SUM(f.amount) AS total_unpaid_fine
FROM Fine f
JOIN Borrow b ON f.borrow_id = b.borrow_id
JOIN User u ON b.user_id = u.user_id
WHERE f.paid = FALSE
GROUP BY u.name
HAVING total_unpaid_fine > 0;
```



##### (5) 顯示每本書被借的次數(熱門書籍統計)

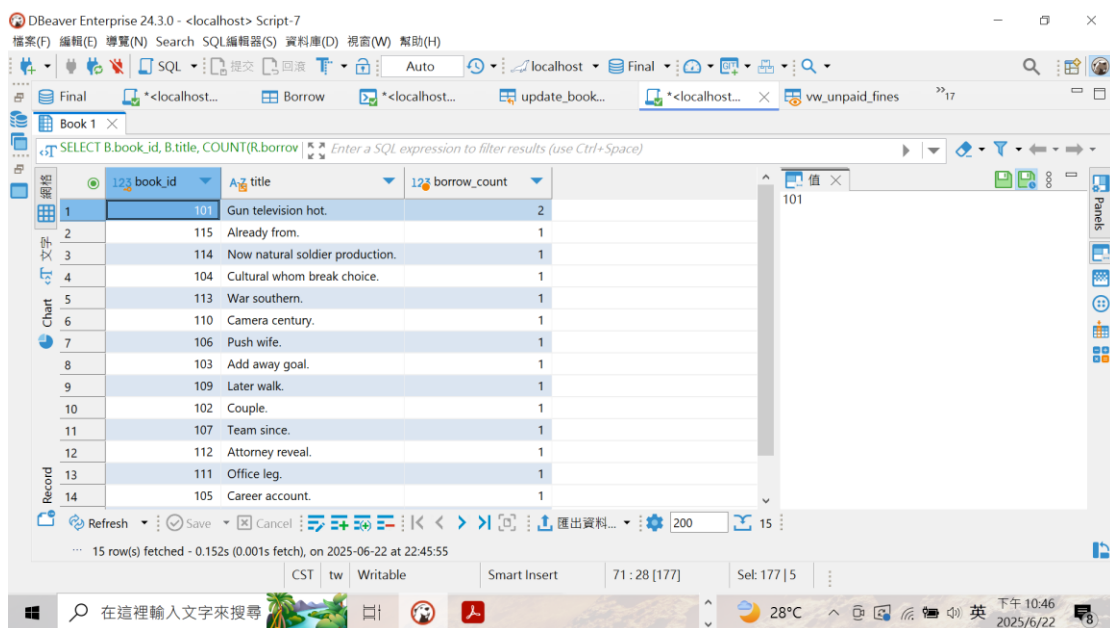
*SELECT B.book\_id, B.title, COUNT(R.borrow\_id) AS borrow\_count*

*FROM Book B*

*LEFT JOIN Borrow R ON B.book\_id = R.book\_id*

*GROUP BY B.book\_id, B.title*

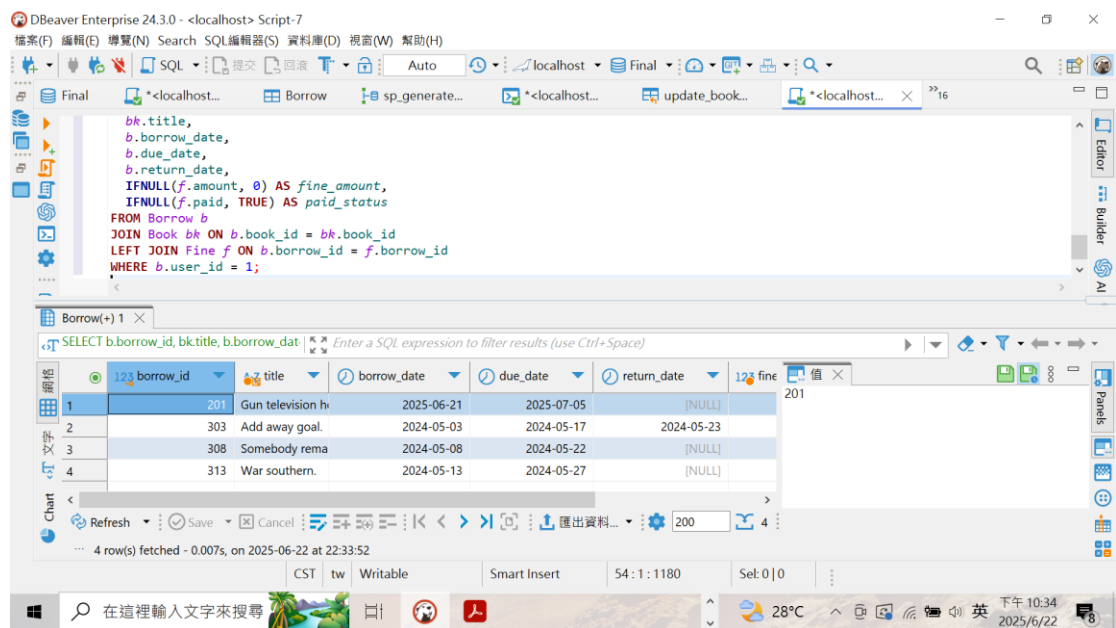
*ORDER BY borrow\_count DESC;*



## (6) 查詢某使用者借閱與還書紀錄（帶上罰金）

- 查詢 user\_id 為 1 的使用者借閱與還書紀錄

```
SELECT
    b.borrow_id,
    bk.title,
    b.borrow_date,
    b.due_date,
    b.return_date,
    IFNULL(f.amount, 0) AS fine_amount,
    IFNULL(f.paid, TRUE) AS paid_status
FROM Borrow b
JOIN Book bk ON b.book_id = bk.book_id
LEFT JOIN Fine f ON b.borrow_id = f.borrow_id
WHERE b.user_id = 1;
```



## (7) 建立 View：逾期未繳罰金明細

```
CREATE OR REPLACE VIEW vw_unpaid_fines AS
SELECT
    u.name AS user_name,
    bk.title AS book_title,
    f.amount,
    f.paid
FROM Fine f
```

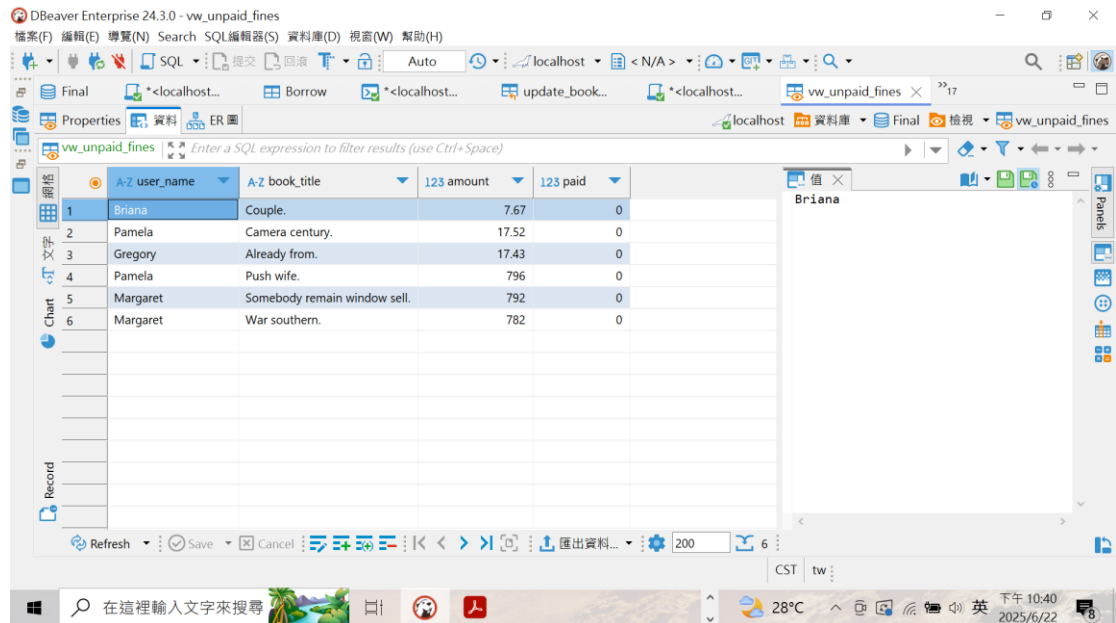


*JOIN Borrow b ON f.borrow\_id = b.borrow\_id*

*JOIN User u ON b.user\_id = u.user\_id*

*JOIN Book bk ON b.book\_id = bk.book\_id*

*WHERE f.paid = FALSE;*



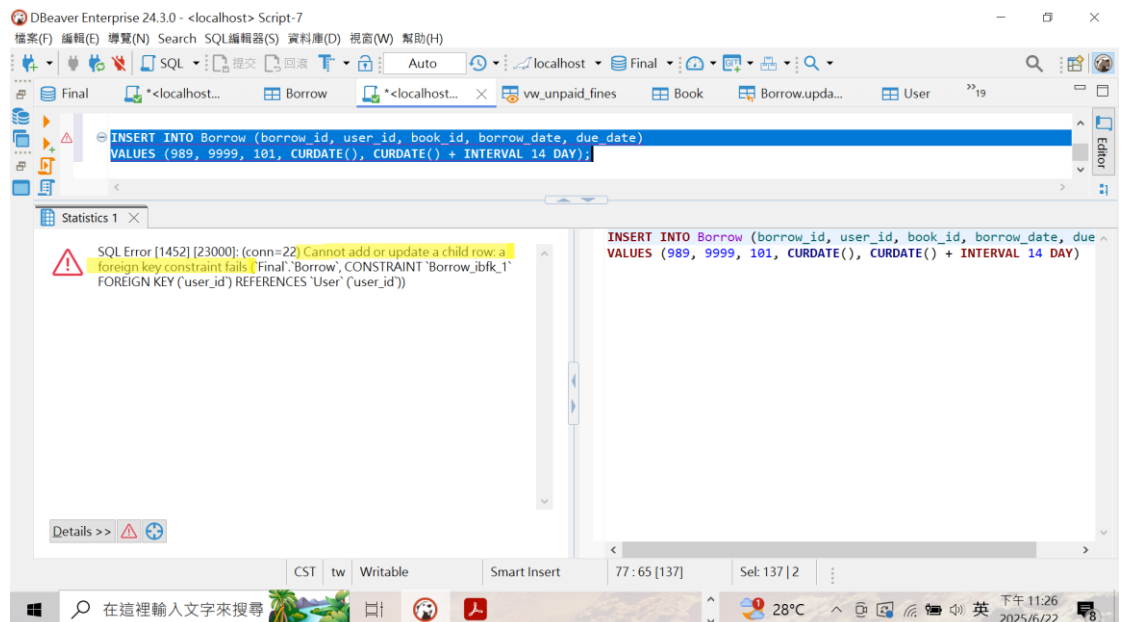
The screenshot shows the DBeaver Enterprise 24.3.0 interface. The main window displays a table view for the query 'vw\_unpaid\_fines'. The table has five columns: 'A-Z user\_name', 'A-Z book\_title', '123 amount', '123 paid', and an empty column. The data is as follows:

	A-Z user_name	A-Z book_title	123 amount	123 paid	
1	Briana	Couple.	7.67	0	
2	Pamela	Camera century.	17.52	0	
3	Gregory	Already from.	17.43	0	
4	Pamela	Push wife.	796	0	
5	Margaret	Somebody remain window sell.	792	0	
6	Margaret	War southern.	782	0	

The interface also shows a toolbar with various icons, a sidebar with 'Properties', 'Data', and 'ER' tabs, and a status bar at the bottom indicating the current table and query.

## 七、資料一致性測試：外鍵約束與限制條件

插入不存在 user\_id 的借書紀錄，測試外鍵是否成功



The screenshot shows the DBeaver Enterprise 24.3.0 interface with an SQL editor. The editor contains the following SQL statement:

```
INSERT INTO Borrow (borrow_id, user_id, book_id, borrow_date, due_date)
VALUES (989, 9999, 101, CURDATE(), CURDATE() + INTERVAL 14 DAY);
```

The SQL editor shows an error message in the 'Statistics' tab:

```
SQL Error [1452] [23000]: (conn=22) Cannot add or update a child row: a
foreign key constraint fails 'Final'.Borrow, CONSTRAINT 'Borrow_ibfk_1'
FOREIGN KEY (user_id) REFERENCES 'User' (user_id)
```

The error message indicates that the foreign key constraint 'Borrow\_ibfk\_1' is violated because the user\_id 9999 does not exist in the User table.

## 八、交易處理測試：確保操作一致性

DBeaver Enterprise 24.3.0 - Book

檔案(F) 編輯(E) 專案(N) Search SQL編輯器(S) 資料庫(D) 視窗(W) 幫助(H)

Auto localhost N/A

Final \*localhost... Borrow \*localhost... vw\_unpaid\_fines Book Borrow.upda... User >>19

Properties 資料 ER圖 localhost 資料庫 Final 表格 Book

Book Enter a SQL expression to filter results (use Ctrl+Space)

	book_id	title	author	category	status
1	101	Gun television hot.	Jerry Hughes	Science	borrowed
2	102	Couple.	Annette Hicks	Science	borrowed
3	103	Add away goal.	Kimberly Hubbard	CS	borrowed
4	104	Cultural whom break choice.	Jasmine Elliott	History	borrowed
5	105	Career account.	Amy Harris	Fiction	borrowed
6	106	Push wife.	Andrew Goodwin	Fiction	available
7	107	Team since.	Mary Thompson	Science	available
8	108	Somebody remain window sell.	Sarah Collier	Fiction	available
9	109	Later walk.	Patricia Barker	Fiction	available
10	110	Camera century.	Bryce Cox	Math	borrowed
11	111	Office leg.	Andrew Choi	History	borrowed
12	112	Attorney reveal.	Leslie Peterson	Math	borrowed
13	113	War southern.	Angel Davis	Science	borrowed
14	114	Now natural soldier production.	William Vargas	Math	available

Refresh Save Cancel 匯出資料... 200 15

15 row(s) fetched - 0.003s, on 2025-06-22 at 23:12:06

CST tw

在這裡輸入文字來搜尋 28°C 下午 11:33 2025/6/22

DBeaver Enterprise 24.3.0 - <localhost> Script-7

檔案(F) 編輯(E) 專案(N) Search SQL編輯器(S) 資料庫(D) 視窗(W) 幫助(H)

Auto localhost Final Borrow \*localhost... vw\_unpaid\_fines Borrow.upda... User Book >>19

```
INSERT INTO Borrow (borrow_id, user_id, book_id, borrow_date, due_date)
VALUES (999, 1, 104, CURDATE(), DATE_ADD(CURDATE(), INTERVAL 14 DAY));

INSERT INTO Borrow (borrow_id, user_id, book_id, borrow_date, due_date)
VALUES (989, 9999, 101, CURDATE(), CURDATE() + INTERVAL 14 DAY);

START TRANSACTION;
UPDATE Book SET status = 'borrowed' WHERE book_id = 106;
commit;
ROLLBACK;
```

Statistics 1

Name	Value
Query	ROLLBACK
Updated Rows	0
Execute time	0.004s
Start time	Sun Jun 22 23:41:05 CST 2025
Finish time	Sun Jun 22 23:41:05 CST 2025

CST tw Writable Smart Insert 82:10 [9] Set: 9 | 1

在這裡輸入文字來搜尋 28°C 下午 11:42 2025/6/22

DBeaver Enterprise 24.3.0 - Book

檔案(F) 編輯(E) 導覽(N) Search SQL編輯器(S) 資料庫(D) 視窗(W) 幫助(H)

Auto localhost < N/A > localhost 資料庫 Final 表格 Book

Enter a SQL expression to filter results (use Ctrl+Space)

	book_id	title	author	category	status
1	101	Gun television hot.	Jerry Hughes	Science	borrowed
2	102	Couple.	Annette Hicks	Science	borrowed
3	103	Add away goal.	Kimberly Hubbard	CS	borrowed
4	104	Cultural whom break choice.	Jasmine Elliott	History	borrowed
5	105	Career account.	Amy Harris	Fiction	borrowed
6	106	Push wife.	Andrew Goodwin	Fiction	available
7	107	Team since.	Mary Thompson	Science	available
8	108	Somebody remain window sell.	Sarah Collier	Fiction	available
9	109	Later walk.	Patricia Barker	Fiction	available
10	110	Camera century.	Bryce Cox	Math	borrowed
11	111	Office leg.	Andrew Choi	History	borrowed
12	112	Attorney reveal.	Leslie Peterson	Math	borrowed
13	113	War southern.	Angel Davis	Science	borrowed
14	114	Now natural soldier production.	William Vargas	Math	available

Refresh Save Cancel 匯出資料... 200 15

15 row(s) fetched - 0.002s, on 2025-06-22 at 23:41:16

CST tw

28°C 下午 11:41 2025/6/22