

SQL Aggregation Functions, GROUP BY & HAVING

Practice Workbook — Library Management System

Beginner Level | Read every explanation carefully before writing any query

Before You Start — Read This First

Everything in this workbook is based on the Library Management System database you already created and filled with data. Before you write any query, take a moment to remind yourself of the tables and what they contain:

Table	What it stores
Library	LibraryID, Name, Location, ContactNumber, EstablishedYear
Book	BookID, ISBN, Title, Genre, Price, IsAvailable, ShelfLocation, LibraryID
Member	MemberID, FullName, Email, PhoneNumber, MembershipStartDate
Staff	StaffID, FullName, Position, ContactNumber, LibraryID
Loan	LoanID, MemberID, BookID, LoanDate, DueDate, ReturnDate, Status
Payment	PaymentID, LoanID, PaymentDate, Amount, PaymentMethod
Review	ReviewID, BookID, MemberID, Rating, Comments, ReviewDate

Tip: If you are ever unsure which columns a table has, run `SELECT * FROM TableName;` first to see all the data.

Section 1 — Aggregation Functions

What Is an Aggregation Function?

A normal SELECT query returns one row for every row in the table. An aggregation function is different — it reads many rows and returns a single summary number. Think of it like this: instead of listing every book, you ask "how many books are there in total?" and get back one number.

SQL has five main aggregation functions:

Function	What it does
COUNT(*)	Counts every row in the table, including rows where some columns are NULL
COUNT(column)	Counts only the rows where that specific column is NOT NULL — skips NULLs automatically
SUM(column)	Adds up all the numbers in a numeric column
AVG(column)	Divides the total by the count to give the average
MIN(column)	Finds the single smallest value in a column
MAX(column)	Finds the single largest value in a column

Syntax — One Aggregation, Whole Table

When you use an aggregation function without GROUP BY, it looks at every row and gives you one result row back.

```
SELECT COUNT(*) AS TotalRows
FROM   TableName;

-- The AS keyword gives the result column a readable name (alias)
-- Always use an alias with aggregation functions
```

Example: SELECT COUNT(*) AS TotalStaff FROM Staff; — counts all staff members

Section 1 Tasks

Note: Every task in this section returns exactly ONE row. You do not need GROUP BY yet.

Task 1.1: Count the total number of books in the Book table.

Columns to use: No specific column needed — use COUNT(*)

Expected result: 1 row — a single number

Write your query here:

```
SELECT COUNT(*) AS  
TotalBooks  
FROM book
```

Task 1.2: Count how many members are registered in the system.

Table: Member

Write your query here:

```
SELECT COUNT(*) AS  
TotalMembers  
FROM Member;
```

Task 1.3: Find the total sum of all book prices combined.

Column to sum: Price in the Book table

Function to use: SUM

Write your query here:

```
SELECT SUM(Price) AS  
TotalBookPrice  
FROM Book;
```

Task 1.4: Calculate the average price of all books.

Function to use: AVG

Expected result: 1 row — one decimal number

Write your query here:

```
SELECT AVG(Price) AS  
AverageBookPrice  
FROM book
```

Task 1.5: Find the cheapest book price AND the most expensive book price — both in the same single query.

Functions to use: MIN and MAX together

Expected result: 1 row — two columns side by side

Hint: You can write multiple aggregation functions in one SELECT: `SELECT MIN(col) AS ..., MAX(col) AS ...`

Write your query here:

```
SELECT  
    MIN(Price) AS CheapestBook,  
    MAX(Price) AS  
    MostExpensiveBook  
  
FROM book
```

Task 1.6: Count how many loans currently have Status = 'Overdue'.

Hint: Add a WHERE clause to filter only the rows where Status = 'Overdue', then count them

Note: WHERE still works with COUNT — filter first, then count

Write your query here:

```
SELECT COUNT(*) AS  
OverdueLoans  
FROM Loan  
  
WHERE Status
```

Task 1.7: Find the highest rating ever given in the Review table.

Column to use: Rating

Expected result: Should be 5

Write your query here:

```
SELECT MAX(Rating) AS  
HighestRating  
  
FROM review
```

Task 1.8: Find the lowest rating ever given in the Review table.

Write your query here:

```
SELECT MIN(Rating) AS  
LowestRating  
  
FROM review
```

Task 1.9: Calculate the total amount of all fines collected — the sum of every payment ever made.

Table: Payment

Column: Amount

Write your query here:

```
SELECT SUM(Amount) AS  
TotalFinesCollected  
  
FROM
```

Task 1.10: Count how many loans have already been returned (meaning ReturnDate is NOT NULL).

Key concept: COUNT(column) skips NULL values. If you write COUNT(ReturnDate), rows where ReturnDate is NULL will not be counted

Hint: Do not use WHERE here — use COUNT(ReturnDate) directly and let it skip the NULLs for you

Write your query here:

```
SELECT COUNT(ReturnDate) AS  
ReturnedLoans
```

Section 2 — GROUP BY

What Is GROUP BY?

So far, aggregation functions have looked at the entire table and returned one number. GROUP BY lets you break the table into groups and get one number per group.

Without GROUP BY: "How many books are there in total?" → one row, one number

With GROUP BY Genre: "How many books are there in each genre?" → one row per genre

The database first separates the rows into groups based on the column you give GROUP BY, then runs the aggregation function inside each group.

Syntax

```
SELECT    column_to_group_by,    AGG_FUNCTION(another_column) AS alias  
FROM      TableName  
GROUP BY column_to_group_by;
```

Golden Rule: Every column you put in SELECT that is NOT inside an aggregation function MUST also appear in GROUP BY. If you forget this, SQL will give you an error.

Worked Example — Step by Step

Question: "How many books belong to each genre?"

Step 1: Decide what your groups are → Genre

Step 2: Decide what you want to calculate per group → COUNT(*)

Step 3: Put the group column in both SELECT and GROUP BY

```
SELECT    Genre,    COUNT(*) AS BookCount
FROM      Book
GROUP BY  Genre;
```

```
-- Result: one row per genre, showing how many books are in each
```

Part 2-A — Simple GROUP BY Tasks

Task 2.1: Count how many books belong to each Genre.

Expected result: Four rows — one for Fiction, Non-fiction, Reference, Children

Columns in SELECT: Genre and COUNT()*

Write your query here:

```
SELECT Genre, COUNT(*) AS
BookCount
FROM Book
```

Task 2.2: Count how many staff members work in each Library. Group by LibraryID.

Table: Staff

Expected result: One row per library — showing the LibraryID and the staff count

Write your query here:

```
SELECT LibraryID, COUNT(*) AS
StaffCount
FROM Staff
```

Task 2.3: Count how many loans exist for each loan Status (Issued, Returned, Overdue).

Table: Loan

Expected result: Three rows — one per status

Write your query here:

```
SELECT Status, COUNT(*) AS  
  LoanCount  
FROM Loan
```

Task 2.4: Calculate the average book price for each Genre.

Function to use: AVG(Price)

Expected result: One row per genre showing average price

Write your query here:

```
SELECT Genre, AVG(Price) AS  
  AveragePrice  
FROM Book
```

Task 2.5: Find the total price (SUM) of all books in each Genre.

Write your query here:

```
SELECT Genre, SUM(Price) AS  
  TotalGenrePrice  
FROM Book
```

Task 2.6: Find the most expensive book price (MAX) within each Genre.

Write your query here:

```
SELECT Genre, MAX(Price) AS  
MostExpensiveBook  
FROM Book
```

Task 2.7: Count how many reviews each rating value has received.

Table: Review

Group by: Rating

Expected result: One row per rating value (1, 2, 3, 4, 5) — showing how many times each was given

Write your query here:

```
SELECT Rating, COUNT(*) AS  
RatingCount  
FROM Review
```

Task 2.8: Count how many books each Library owns. Group by LibraryID.

Table: Book

Expected result: One row per library

Write your query here:

```
SELECT LibraryID, COUNT(*) AS  
BookCount  
FROM Book  
GROUP BY LibraryID;
```

Task 2.9: Count how many loans each Member has made. Group by MemberID.

Table: Loan

Expected result: One row per member who has at least one loan

Write your query here:

```
SELECT MemberID, COUNT(*) AS  
LoanCount  
FROM Loan
```

Task 2.10: Find the cheapest book (MIN Price) in each Genre.

Write your query here:

```
SELECT Genre, MIN(Price) AS  
CheapestBook  
FROM Book
```

Part 2-B — GROUP BY with ORDER BY

You can sort the results of a GROUP BY query using ORDER BY. You can even order by the aggregated column using its alias.

```
SELECT    Genre,    COUNT(*) AS BookCount  
FROM      Book  
GROUP BY Genre  
ORDER BY BookCount DESC;    -- most books first
```

Task 2.11: Count books per Genre, ordered from the genre with the most books down to the fewest.

Hint: Add ORDER BY after GROUP BY and reference your alias

Write your query here:

```
SELECT Genre, COUNT(*) AS  
BookCount  
FROM Book  
GROUP BY Genre
```

Task 2.12: Show the average price per Genre, ordered from cheapest average to most expensive.

Write your query here:

```
SELECT Genre, AVG(Price) AS  
AveragePrice  
FROM Book  
GROUP BY Genre
```

Task 2.13: Count loans per Status and order the results alphabetically by Status name.

Write your query here:

```
SELECT Status, COUNT(*) AS  
LoanCount  
FROM Loan  
GROUP BY Status
```

Task 2.14: Show the total payment amount collected per PaymentMethod, ordered from the highest total to the lowest.

Table: Payment

Write your query here:

```
SELECT PaymentMethod, SUM(Amount) AS  
TotalCollected  
FROM Payment  
GROUP BY PaymentMethod
```

Task 2.15: Count how many reviews each book has received (group by BookID), ordered so the most-reviewed book appears first.

Table: Review

Write your query here:

```
SELECT BookID, COUNT(*) AS  
ReviewCount  
FROM Review  
GROUP BY BookID
```

Section 3 — HAVING

What Is HAVING?

After GROUP BY creates groups and calculates aggregation values, you sometimes want to keep only certain groups — for example, only genres that have more than 3 books, or only members who have borrowed more than 1 book.

This is what HAVING is for. It filters groups after they have been created, in the same way WHERE filters individual rows before grouping.

Clause	When it runs / what it filters
WHERE	Runs BEFORE grouping — filters individual rows — CANNOT use aggregation functions like COUNT or SUM here
HAVING	Runs AFTER grouping — filters whole groups — CAN and MUST use aggregation functions here

The Most Important Rule

Wrong — this will cause an error: WHERE COUNT(*) > 3

Right — this is correct: HAVING COUNT(*) > 3

Syntax

```

SELECT    column,    AGG_FUNCTION(col) AS alias
FROM      TableName
GROUP BY column
HAVING   AGG_FUNCTION(col) condition;

-- Example:
SELECT    Genre,    COUNT(*) AS BookCount
FROM      Book
GROUP BY Genre
HAVING   COUNT(*) > 3;    -- only show genres with more than 3 books

```

Part 3-A — Simple HAVING Tasks

Task 3.1: Show only the genres that have MORE THAN 3 books.

Hint: GROUP BY Genre, then HAVING COUNT() > 3*

Write your query here:

```

SELECT Genre, COUNT(*) AS
BookCount
FROM Book
GROUP BY Genre

```

Task 3.2: Show only the libraries that have AT LEAST 2 staff members.

Table: Staff — group by LibraryID

Write your query here:

```

SELECT LibraryID, COUNT(*) AS
StaffCount
FROM Staff
GROUP BY LibraryID
HAVING COUNT(*) >= 2;

```

Task 3.3: Show only the members (by MemberID) who have borrowed MORE THAN 1 book.

Table: Loan — group by MemberID

Write your query here:

```
SELECT MemberID, COUNT(*) AS  
LoanCount  
FROM Loan  
GROUP BY MemberID
```

Task 3.4: Show only the genres where the average book price is MORE THAN 30.

Hint: HAVING AVG(Price) > 30

Write your query here:

```
SELECT Genre, AVG(Price) AS  
AveragePrice  
FROM Book  
GROUP BY Genre
```

Task 3.5: Find books (by BookID) that have received AT LEAST 2 reviews.

Table: Review — group by BookID

Write your query here:

```
SELECT BookID, COUNT(*) AS  
ReviewCount  
FROM Review  
GROUP BY BookID
```

Task 3.6: Show genres where the total sum of all book prices is MORE THAN 50.

Hint: HAVING SUM(Price) > 50

Write your query here:

```
SELECT Genre, SUM(Price) AS  
TotalPrice  
FROM Book  
GROUP BY Genre
```

Task 3.7: Find payment methods where the total collected amount is MORE THAN 15.

Table: Payment — group by PaymentMethod

Write your query here:

```
SELECT PaymentMethod, SUM(Amount) AS  
TotalCollected  
FROM Payment  
GROUP BY PaymentMethod
```

Task 3.8: Show loan statuses that appear MORE THAN 3 times in the Loan table.

Write your query here:

```
SELECT Status, COUNT(*) AS  
StatusCount  
FROM Loan  
GROUP BY Status
```

Task 3.9: Show members (by MemberID) who have written AT LEAST 2 reviews.

Table: Review — group by MemberID

Write your query here:

```
SELECT MemberID, COUNT(*) AS  
ReviewCount  
FROM Review  
GROUP BY MemberID
```

Task 3.10: Find libraries (by LibraryID) that own MORE THAN 2 books.

Table: Book — group by LibraryID

Write your query here:

```
SELECT LibraryID, COUNT(*) AS  
BookCount  
FROM Book  
GROUP BY LibraryID
```

Part 3-B — WHERE and HAVING Together

You can use WHERE and HAVING in the same query. Remember: WHERE runs first and removes individual rows, then GROUP BY creates groups from what is left, then HAVING filters those groups.

```
SELECT    Genre,    COUNT(*) AS AvailableCount  
FROM      Book  
WHERE     IsAvailable = 1          -- Step 1: keep only available books  
GROUP BY Genre                    -- Step 2: group what is left  
HAVING    COUNT(*) > 1;           -- Step 3: keep only groups with more  
than 1
```

Task 3.11: Count available books per genre (available means IsAvailable = 1). Show only genres that have more than 1 available book.

Structure: WHERE filters rows → GROUP BY groups → HAVING filters groups

Write your query here:

```
SELECT Genre, COUNT(*) AS  
AvailableCount  
FROM Book  
WHERE IsAvailable = 1  
GROUP BY Genre
```

Task 3.12: Among Fiction and Children books only, show genres where the average price is above 15.

Hint: Use WHERE Genre IN ('Fiction', 'Children') then GROUP BY then HAVING AVG(Price) > 15

Write your query here:

```
SELECT Genre, AVG(Price) AS
AveragePrice
FROM Book
WHERE Genre IN ('Fiction', 'Children')
GROUP BY Genre
```

Task 3.13: Among Overdue and Issued loans only, count per member and show members with more than 1 active loan.

Hint: WHERE Status IN ('Overdue', 'Issued')

Write your query here:

```
SELECT MemberID, COUNT(*) AS
ActiveLoans
FROM Loan
WHERE Status IN ('Overdue', 'Issued')
GROUP BY MemberID
```

Task 3.14: Look only at reviews with Rating >= 3. Group by book and show books that have at least 2 good reviews.

Write your query here:

```
SELECT BookID, COUNT(*) AS
GoodReviews
FROM Review
WHERE Rating >= 3
GROUP BY BookID
```

Task 3.15: Find genres that have more than 1 book priced below 20.

Hint: WHERE Price < 20 first, then group, then HAVING

Write your query here:

```
SELECT Genre, COUNT(*) AS
CheapBooks
FROM Book
WHERE Price < 20
GROUP BY Genre
```

Section 4 — Aggregation with JOIN

Combining Aggregation and JOIN

So far all your aggregation tasks used a single table. In real life, the column you want to group by is often in a different table from the column you want to count or sum. The solution is to JOIN the tables first, then use GROUP BY.

The pattern is always the same:

```
-- 1. JOIN the tables to get the columns you need in one place  
-- 2. GROUP BY the column you want to group on  
-- 3. Apply the aggregation function  
  
SELECT      T1.ColumnName,    AGG(T2.ColumnName) AS alias  
FROM        Table1 T1  
JOIN        Table2 T2  ON  T1.ID = T2.ID  
GROUP BY  T1.ColumnName;
```

Important: When you GROUP BY a column that came from a JOIN, always include the primary key of that table in GROUP BY alongside the display column — for example GROUP BY LIB.LibraryID, LIB.Name. This avoids ambiguity.

Part 4-A — Aggregation + JOIN Tasks

Task 4.1: Show each library name alongside the number of books it owns.

Tables needed: Library and Book

Join condition: Library.LibraryID = Book.LibraryID

Hint: JOIN first, then GROUP BY LIB.LibraryID, LIB.Name, then COUNT(B.BookID)

Write your query here:

Task 4.2: Show each member's full name alongside their total number of loans.

Tables needed: Member and Loan

Join condition: Member.MemberID = Loan.MemberID

Write your query here:

Task 4.3: Show each book's title alongside the number of times it has been borrowed.

Tables needed: Book and Loan

Join condition: Book.BookID = Loan.BookID

Write your query here:

Task 4.4: Show each book's title alongside its average review rating.

Tables needed: Book and Review

Function: AVG(R.Rating)

Hint: Cast the rating for a cleaner decimal: AVG(CAST(R.Rating AS DECIMAL(3,2)))

Write your query here:

Task 4.5: Show each library name alongside the total value (SUM of Price) of all the books it owns.

Tables needed: Library and Book

Write your query here:

Task 4.6: Show each library name alongside the number of staff who work there.

Tables needed: Library and Staff

Write your query here:

Task 4.7: Show each member's full name alongside the total fine amount they have paid.

Tables needed: Member, Loan, and Payment — three tables

Hint: JOIN Member to Loan, then JOIN Loan to Payment, then GROUP BY member, then SUM(P.Amount)

Write your query here:

Task 4.8: Show each genre and the number of DISTINCT members who have borrowed books in that genre.

Tables needed: Book and Loan

Hint: COUNT(DISTINCT L.MemberID) — this avoids counting the same member twice if they borrowed multiple books in the same genre

Write your query here:

Task 4.9: Show each book's title, how many times it was borrowed, and its average rating — all in one query.

Tables needed: Book, Loan, and Review

Hint: Use LEFT JOIN so that books with no loans and books with no reviews still appear in the result

Two aggregations: COUNT(DISTINCT L.LoanID) for borrows, AVG(CAST(R.Rating AS DECIMAL(3,2))) for rating

Write your query here:

Task 4.10: Show each genre with three pieces of information: total number of books, number of available books, and average price.

Table: Book only — no JOIN needed for this one

Hint for available count: Use a CASE expression inside SUM: SUM(CASE WHEN IsAvailable = 1 THEN 1 ELSE 0 END)

Write your query here:

Part 4-B — Aggregation + JOIN + HAVING

Now add HAVING on top of your JOIN queries to filter the groups.

Task 4.11: Show only the library names that own MORE THAN 2 books.

Tables: Library and Book

Write your query here:

Task 4.12: Show only the members' full names who have borrowed MORE THAN 1 book.

Tables: Member and Loan

Write your query here:

Task 4.13: Show only the book titles that have an average rating ABOVE 4.

Tables: Book and Review

Write your query here:

Task 4.14: Show only the genres where more than 3 loans have been made in total.

Tables: Book and Loan

Write your query here:

Task 4.15: Show only the libraries where the total fines collected from their books are MORE THAN 10.

Tables: Library, Book, Loan, and Payment — four tables

Hint: Join all four in a chain: Library → Book → Loan → Payment

Write your query here:

Section 5 — Putting It All Together

SQL Execution Order

SQL does not run your clauses in the order you write them. Understanding the real execution order will help you avoid errors and reason about your queries correctly.

Order	Clause — what it does
1st	FROM — load all rows from the table(s)
2nd	JOIN — combine tables
3rd	WHERE — filter individual rows (before grouping)
4th	GROUP BY — group the remaining rows
5th	HAVING — filter whole groups (after grouping)
6th	SELECT — calculate the output columns and aliases
7th	ORDER BY — sort the final results

These five challenge tasks require you to use all the clauses together in the correct order. Read each task carefully before you write anything.

Task 5.1: Count available books (WHERE IsAvailable = 1) per genre. Show only genres with more than 1 available book. Order the results from most available books to fewest.

Clauses needed: FROM → WHERE → GROUP BY → HAVING → ORDER BY

Write your query here:

Task 5.2: For each library, show the library name and the total number of loans ever made from its books. Show only libraries that have had more than 2 loans. Order by loan count from highest to lowest.

Tables: Library, Book, Loan

Clauses needed: FROM → JOIN → JOIN → GROUP BY → HAVING → ORDER BY

Write your query here:

Task 5.3: Show each member's name and how many overdue loans they have (Status = 'Overdue'). Show only members who have at least 1 overdue loan. Order alphabetically by name.

Tables: Member and Loan

Hint: WHERE filters to Overdue rows first, then you group and count

Write your query here:

Task 5.4: For each book, show the title, total number of borrows, and average review rating. Show only books that have been borrowed at least once AND have an average rating above 3. Order by average rating from highest to lowest.

Tables: Book, Loan, Review

Hint: Use LEFT JOIN so books with no reviews still appear — then HAVING filters them out

Two conditions in HAVING: HAVING COUNT(...) ≥ 1 AND AVG(...) > 3

Write your query here:

Task 5.5: For each genre, show the total number of books, the average price, and the cheapest price. Show only genres where the average price is between 15 and 50. Order by average price from lowest to highest.

Hint: HAVING AVG(Price) BETWEEN 15 AND 50

Write your query here:

Task 5.6 — Challenge: Build a complete library summary report. For each library show: library name, city (Location), total number of books, total number of staff, total number of loans ever made, and total fines collected. Show only libraries that have had at least one loan. Order by total loans from highest to lowest.

Tables needed: Library, Book, Staff, Loan, Payment — five tables

Hint: Use LEFT JOIN for all joins so libraries with missing data still appear

Hint: Use COUNT(DISTINCT ...) for books, staff, and loans to avoid inflated counts from multiple joins

Note: This is the hardest query in the workbook — think through each join carefully before writing

Write your query here:

Evaluation Criteria

Section / Criteria	Points
Section 1 — Aggregation Functions (10 tasks)	15 pts
Section 2 — GROUP BY (15 tasks)	20 pts
Section 3 — HAVING (15 tasks)	25 pts
Section 4 — Aggregation with JOIN (15 tasks)	25 pts
Section 5 — Full challenge queries (6 tasks)	10 pts
Code quality — comments, aliases, formatting	5 pts
TOTAL	100 pts

Submission Guidelines

- 1. SQL Script (.sql file):** One file with all your queries, organised by section. Add a comment above every query explaining in plain words what it does.
- 2. Screenshots:** At least one screenshot per section showing the query and its result.
- 3. Reflection (half a page):** Explain the difference between WHERE and HAVING in your own words, using one example of each from your own work today.

Quick Reference Card

```
-- COUNT all rows (including NULLs)
SELECT COUNT(*) AS alias FROM table;

-- COUNT non-NULL values only
SELECT COUNT(column) AS alias FROM table;

-- SUM, AVG, MIN, MAX
SELECT SUM(col), AVG(col), MIN(col), MAX(col) FROM table;

-- GROUP BY - one result row per group
SELECT col, COUNT(*) AS alias FROM table GROUP BY col;

-- HAVING - filter groups (never use WHERE for this)
SELECT col, COUNT(*) AS alias FROM table GROUP BY col HAVING COUNT(*) > 5;
```

```
-- Full correct order
SELECT    col, AGG(col2) AS alias
FROM      table
JOIN      other ON ...
WHERE     condition_on_individual_rows
GROUP BY col
HAVING    condition_on_groups
ORDER BY alias DESC;
```