**Original query**

-> Limit: 50 row(s) (actual time=89139..89139 rows=50 loops=1)

-> Sort: avg\_rating\_amazon DESC (actual time=89139..89139 rows=50 loops=1)

-> Table scan on <temporary> (cost=2.5..2.5 rows=0) (actual time=89139..89139 rows=538 loops=1)

-> Temporary table (cost=0..0 rows=0) (actual time=89139..89139 rows=538 loops=1)

-> Window aggregate: rank() OVER (PARTITION BY pb.genre ORDER BY `avg(perfect\_books.total\_ratings)` desc ) (actual time=89136..89138 rows=538 loops=1)

-> Filter: (`count(distinct amazon\_books.title)` >= 2) (actual time=89136..89137 rows=538 loops=1)

-> Sort: pb.genre, `avg(perfect\_books.total\_ratings)` DESC (actual time=89136..89137 rows=2922 loops=1)

-> Stream results (actual time=89069..89127 rows=2922 loops=1)

-> Group aggregate: count(distinct amazon\_books.title), avg(perfect\_books.total\_ratings), avg(tmp\_field), count(distinct amazon\_books.title), avg(amazon\_books.rating), avg(perfect\_books.rating) (actual time=89069..89121 rows=2922 loops=1)

-> Sort: pb.genre, pb.author (actual time=89069..89075 rows=10950 loops=1)

-> Stream results (cost=10666 rows=675) (actual time=38.2..89000 rows=10950 loops=1)

-> Filter: ((pb.title = ab.title) and (pb.author = ab.author)) (cost=10666 rows=675) (actual time=29.6..175 rows=10950 loops=1)

-> Inner hash join (<hash>(pb.title)=<hash>(ab.title)), (<hash>(pb.author)=<hash>(ab.author)) (cost=10666 rows=675) (actual time=29.6..147 rows=10950 loops=1)

-> Filter: (ab.price is not null) (cost=1.96 rows=68.7) (actual time=0.0327..20.7 rows=7928 loops=1)

-> Table scan on ab (cost=1.96 rows=7630) (actual time=0.0313..18.1 rows=7928 loops=1)

-> Hash

-> Filter: ((pb.rating >= 4) and (pb.total\_ratings > 100)) (cost=1039 rows=1092) (actual time=0.0834..19.9 rows=7342 loops=1)

-> Table scan on pb (cost=1039 rows=9827) (actual time=0.0774..17.5 rows=10000 loops=1)

-> Select #2 (subquery in projection; dependent)

-> Aggregate: count(0) (cost=386 rows=1) (actual time=8.09..8.09 rows=1 loops=10950)

-> Filter: ((apb.author = pb.author) and (apb.rating > 4.5)) (cost=370 rows=164) (actual time=6.66..8.08 rows=1.34 loops=10950)

-> Table scan on apb (cost=370 rows=4932) (actual time=0.0125..6.9 rows=4846 loops=10950)

- Загальний час виконання: 89 139 мс

- Кількість викликів підзапиту: 10 950

- Тимчасові таблиці: так

- Тип доступу: повне сканування

- Індекси не використовуються

**Step 1 refactor**

-> Limit: 50 row(s) (actual time=319..319 rows=50 loops=1)

-> Sort: avg\_rating\_amazon DESC (actual time=319..319 rows=50 loops=1)

-> Table scan on <temporary> (cost=2.5..2.5 rows=0) (actual time=318..318 rows=538 loops=1)

-> Temporary table (cost=0..0 rows=0) (actual time=318..318 rows=538 loops=1)

-> Window aggregate: rank() OVER (PARTITION BY b.genre ORDER BY `avg(perfect\_books.total\_ratings)` desc ) (actual time=314..318 rows=538 loops=1)

-> Filter: (`count(distinct amazon\_books.title)` >= 2) (actual time=314..315 rows=538 loops=1)

-> Sort: b.genre, `avg(perfect\_books.total\_ratings)` DESC (actual time=314..315 rows=2922 loops=1)

-> Stream results (actual time=239..304 rows=2922 loops=1)

-> Group aggregate: count(distinct amazon\_books.title), avg(perfect\_books.total\_ratings), avg(price), count(distinct amazon\_books.title), avg(amazon\_books.amazon\_rating), avg(perfect\_books.perfect\_rating), max(tmp\_field) (actual time=239..298 rows=2922 loops=1)

-> Sort: b.genre, b.author (actual time=239..246 rows=10950 loops=1)

-> Stream results (cost=198421 rows=0) (actual time=53.5..205 rows=10950 loops=1)

-> Nested loop left join (cost=198421 rows=0) (actual time=53.4..175 rows=10950 loops=1)

-> Filter: ((pb.title = ab.title) and (pb.author = ab.author)) (cost=10666 rows=675) (actual time=30.8..116 rows=10950 loops=1)

-> Inner hash join (<hash>(pb.title)=<hash>(ab.title)), (<hash>(pb.author)=<hash>(ab.author)) (cost=10666 rows=675) (actual time=30.8..96.7 rows=10950 loops=1)

-> Filter: (ab.price is not null) (cost=1.96 rows=68.7) (actual time=0.0269..17.8 rows=7928 loops=1)

-> Table scan on ab (cost=1.96 rows=7630) (actual time=0.0256..16.7 rows=7928 loops=1)

-> Hash

-> Filter: ((pb.rating >= 4) and (pb.total\_ratings > 100)) (cost=1039 rows=1092) (actual time=0.0836..20.9 rows=7342 loops=1)

-> Table scan on pb (cost=1039 rows=9827) (actual time=0.0781..18.2 rows=10000 loops=1)

-> Index lookup on ps using <auto\_key0> (author=pb.author) (cost=0.25..2.5 rows=10) (actual time=0.0049..0.00503 rows=0.23 loops=10950)

-> Materialize CTE popular\_stats (cost=0..0 rows=0) (actual time=22.7..22.7 rows=2267 loops=1)

-> Table scan on <temporary> (actual time=17..17.6 rows=2267 loops=1)

-> Aggregate using temporary table (actual time=17..17 rows=2267 loops=1)

-> Filter: (amazon\_popular\_books.rating > 4.5) (cost=517 rows=1644) (actual time=0.015..8.64 rows=3745 loops=1)

-> Table scan on amazon\_popular\_books (cost=517 rows=4932) (actual time=0.014..7.9 rows=4846 loops=1)

- Загальний час виконання: 319 мс

- Кількість викликів підзапиту: 1 (використовується CTE один раз)

- Тимчасові таблиці: так

- Тип доступу: повне сканування

- Індекси не використовуються

**Step 3 indexing**

-> Limit: 50 row(s) (actual time=1392..1392 rows=50 loops=1)

-> Sort: avg\_rating\_amazon DESC (actual time=1392..1392 rows=50 loops=1)

-> Table scan on <temporary> (cost=2.5..2.5 rows=0) (actual time=1391..1391 rows=538 loops=1)

-> Temporary table (cost=0..0 rows=0) (actual time=1391..1391 rows=538 loops=1)

-> Window aggregate: rank() OVER (PARTITION BY b.genre ORDER BY `avg(perfect\_books.total\_ratings)` desc ) (actual time=1388..1390 rows=538 loops=1)

-> Filter: (`count(distinct amazon\_books.title)` >= 2) (actual time=1388..1389 rows=538 loops=1)

-> Sort: b.genre, `avg(perfect\_books.total\_ratings)` DESC (actual time=1388..1389 rows=2922 loops=1)

-> Stream results (actual time=1322..1379 rows=2922 loops=1)

-> Group aggregate: count(distinct amazon\_books.title), avg(perfect\_books.total\_ratings), avg(perfect\_books.perfect\_rating), avg(amazon\_books.amazon\_rating), avg(price), count(distinct amazon\_books.title), max(tmp\_field) (actual time=1322..1374 rows=2922 loops=1)

-> Sort: b.genre, b.author (actual time=1322..1328 rows=10950 loops=1)

-> Stream results (cost=94173 rows=871322) (actual time=19.4..1283 rows=10950 loops=1)

-> Nested loop left join (cost=94173 rows=871322) (actual time=19.4..1246 rows=10950 loops=1)

-> Nested loop inner join (cost=5713 rows=530) (actual time=0.173..1181 rows=10950 loops=1)

-> Filter: ((ab.price is not null) and (ab.author is not null)) (cost=819 rows=6867) (actual time=0.0766..19.2 rows=7928 loops=1)

-> Table scan on ab (cost=819 rows=7630) (actual time=0.0741..17 rows=7928 loops=1)

-> Filter: ((pb.rating >= 4) and (pb.total\_ratings > 100) and (pb.title = ab.title)) (cost=0.509 rows=0.0772) (actual time=0.065..0.146 rows=1.38 loops=7928)

-> Index lookup on pb using idx\_perfect\_author\_genre (author=ab.author), with index condition: (pb.author = ab.author) (cost=0.509 rows=2.04) (actual time=0.00872..0.132 rows=29.6 loops=7928)

-> Index lookup on ps using <auto\_key0> (author=pb.author) (cost=846..849 rows=10) (actual time=0.00531..0.00544 rows=0.23 loops=10950)

-> Materialize CTE popular\_stats (cost=846..846 rows=1644) (actual time=19.2..19.2 rows=2267 loops=1)

-> Group aggregate: count(0) (cost=682 rows=1644) (actual time=0.0355..11.2 rows=2267 loops=1)

-> Filter: (amazon\_popular\_books.rating > 4.5) (cost=517 rows=1644) (actual time=0.0227..8.74 rows=3745 loops=1)

-> Covering index scan on amazon\_popular\_books using idx\_popular\_authot\_rating (cost=517 rows=4932) (actual time=0.0215..7.95 rows=4846 loops=1)

- Загальний час виконання: 1392 мс

- Кількість викликів підзапиту: 1 (використовується CTE один раз)

- Тимчасові таблиці: так

- Тип доступу: індекси

- Індекси використані: idx\_perfect\_author\_genre, idx\_popular\_author\_rating

**Step 3 Joins**

-> Limit: 50 row(s) (actual time=1329..1329 rows=50 loops=1)

-> Sort: avg\_rating\_amazon DESC (actual time=1329..1329 rows=50 loops=1)

-> Table scan on <temporary> (cost=2.5..2.5 rows=0) (actual time=1328..1329 rows=538 loops=1)

-> Temporary table (cost=0..0 rows=0) (actual time=1328..1328 rows=538 loops=1)

-> Window aggregate: rank() OVER (PARTITION BY b.genre ORDER BY `avg(perfect\_books.total\_ratings)` desc ) (actual time=1326..1328 rows=538 loops=1)

-> Filter: (`count(distinct amazon\_books.title)` >= 2) (actual time=1326..1327 rows=538 loops=1)

-> Sort: b.genre, `avg(perfect\_books.total\_ratings)` DESC (actual time=1326..1327 rows=2922 loops=1)

-> Stream results (actual time=1263..1318 rows=2922 loops=1)

-> Group aggregate: count(distinct amazon\_books.title), avg(perfect\_books.total\_ratings), avg(perfect\_books.perfect\_rating), avg(amazon\_books.amazon\_rating), avg(price), count(distinct amazon\_books.title), max(tmp\_field) (actual time=1263..1313 rows=2922 loops=1)

-> Sort: b.genre, b.author (actual time=1263..1269 rows=10950 loops=1)

-> Stream results (cost=94173 rows=871322) (actual time=15.8..1231 rows=10950 loops=1)

-> Nested loop left join (cost=94173 rows=871322) (actual time=15.8..1196 rows=10950 loops=1)

-> Nested loop inner join (cost=5713 rows=530) (actual time=0.108..1136 rows=10950 loops=1)

-> Filter: ((ab.price is not null) and (ab.author is not null)) (cost=819 rows=6867) (actual time=0.0606..19.2 rows=7928 loops=1)

-> Table scan on ab (cost=819 rows=7630) (actual time=0.0588..17.3 rows=7928 loops=1)

-> Filter: ((pb.rating >= 4) and (pb.total\_ratings > 100) and (pb.title = ab.title)) (cost=0.509 rows=0.0772) (actual time=0.0624..0.14 rows=1.38 loops=7928)

-> Index lookup on pb using idx\_perfect\_author\_genre (author=ab.author), with index condition: (pb.author = ab.author) (cost=0.509 rows=2.04) (actual time=0.00756..0.127 rows=29.6 loops=7928)

-> Index lookup on ps using <auto\_key0> (author=pb.author) (cost=846..849 rows=10) (actual time=0.00482..0.00495 rows=0.23 loops=10950)

-> Materialize CTE popular\_stats (cost=846..846 rows=1644) (actual time=15.6..15.6 rows=2267 loops=1)

-> Group aggregate: count(0) (cost=682 rows=1644) (actual time=0.0281..10 rows=2267 loops=1)

-> Filter: (amazon\_popular\_books.rating > 4.5) (cost=517 rows=1644) (actual time=0.0148..7.74 rows=3745 loops=1)

-> Covering index scan on amazon\_popular\_books using idx\_popular\_authot\_rating (cost=517 rows=4932) (actual time=0.0141..7 rows=4846 loops=1)

- Загальний час виконання: 1329 мс

- Кількість викликів підзапиту: 1 (використовується CTE один раз)

- Тимчасові таблиці: так

- Тип доступу: індекси

- Індекси використані: idx\_perfect\_author\_genre, idx\_popular\_author\_rating

**Step 4 index hints**

-> Limit: 50 row(s) (actual time=373..373 rows=50 loops=1)

-> Sort: avg\_rating\_amazon DESC (actual time=373..373 rows=50 loops=1)

-> Table scan on <temporary> (cost=2.5..2.5 rows=0) (actual time=372..372 rows=538 loops=1)

-> Temporary table (cost=0..0 rows=0) (actual time=372..372 rows=538 loops=1)

-> Window aggregate: rank() OVER (PARTITION BY b.genre ORDER BY `avg(perfect\_books.total\_ratings)` desc ) (actual time=369..371 rows=538 loops=1)

-> Filter: (`count(distinct amazon\_books.title)` >= 2) (actual time=369..370 rows=538 loops=1)

-> Sort: b.genre, `avg(perfect\_books.total\_ratings)` DESC (actual time=369..370 rows=2922 loops=1)

-> Stream results (actual time=304..360 rows=2922 loops=1)

-> Group aggregate: count(distinct amazon\_books.title), avg(perfect\_books.total\_ratings), avg(perfect\_books.perfect\_rating), avg(amazon\_books.amazon\_rating), avg(price), count(distinct amazon\_books.title), max(tmp\_field) (actual time=304..354 rows=2922 loops=1)

-> Sort: b.genre, b.author (actual time=304..309 rows=10950 loops=1)

-> Stream results (cost=749768 rows=7.35e+6) (actual time=17.1..274 rows=10950 loops=1)

-> Nested loop left join (cost=749768 rows=7.35e+6) (actual time=17.1..243 rows=10950 loops=1)

-> Nested loop inner join (cost=3949 rows=4469) (actual time=0.188..189 rows=10950 loops=1)

-> Filter: ((pb.total\_ratings > 100) and (pb.title is not null) and (pb.author is not null)) (cost=2211 rows=3725) (actual time=0.118..37.3 rows=7342 loops=1)

-> Index range scan on pb using idx\_perfect\_rating over (4 <= rating), with index condition: (pb.rating >= 4) (cost=2211 rows=4913) (actual time=0.114..34.4 rows=9250 loops=1)

-> Filter: ((pb.title = ab.title) and (pb.author = ab.author) and (ab.price is not null)) (cost=0.333 rows=1.2) (actual time=0.0134..0.0202 rows=1.49 loops=7342)

-> Index lookup on ab using idx\_amazon\_books\_title\_author (title=pb.title, author=pb.author) (cost=0.333 rows=1.33) (actual time=0.0119..0.0173 rows=1.5 loops=7342)

-> Index lookup on ps using <auto\_key0> (author=pb.author) (cost=2055..2058 rows=10) (actual time=0.00446..0.00458 rows=0.23 loops=10950)

-> Materialize CTE popular\_stats (cost=2055..2055 rows=1644) (actual time=16.9..16.9 rows=2267 loops=1)

-> Group aggregate: count(0) (cost=1891 rows=1644) (actual time=0.029..10.1 rows=2267 loops=1)

-> Filter: (amazon\_popular\_books.rating > 4.5) (cost=1726 rows=1644) (actual time=0.0165..7.77 rows=3745 loops=1)

-> Covering index scan on amazon\_popular\_books using idx\_popular\_authot\_rating (cost=1726 rows=4932) (actual time=0.0155..7.06 rows=4846 loops=1)

- Загальний час виконання: 373 мс

- Кількість викликів підзапиту: 1 (використовується CTE один раз)

- Тимчасові таблиці: так

- Тип доступу: індекси

- Індекси використані: idx\_perfect\_ rating, idx\_popular\_author\_rating, idx\_amazon\_books\_title\_author