

3.

(a) How many players have an unknown birthdate?

```
EXPLAIN SELECT COUNT(playerID)
FROM Master
WHERE birthYear = '' or birthMonth = '' or birthDay = '';
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	Master	NULL	ALL	NULL	NULL	NULL	NULL	18491	27.10	Using where

ADD Primary key:

```
mysql> show indexes in Master;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Master | 0 | PRIMARY | 1 | playerID | A | 18961 | NULL | NULL | BTREE | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.01 sec)
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	Master	NULL	ALL	NULL	NULL	NULL	NULL	18961	27.10	Using where

ADD INDEX:

```
mysql> show indexes in Master;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Master | 1 | birthYear | 1 | birthYear | A | 167 | NULL | NULL | YES | BTREE | | YES | NULL |
| Master | 1 | birthMonth | 1 | birthMonth | A | 13 | NULL | NULL | YES | BTREE | | YES | NULL |
| Master | 1 | birthDay | 1 | birthDay | A | 32 | NULL | NULL | YES | BTREE | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.00 sec)
```

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	SIMPLE	Master	NULL	index_merge	birthYear,birthMonth,birthDay	birthYear,birthMonth,birthDay	5,5,5	NULL	883	100.00	Using union(birthYear,birthMonth,birthDay); Using where

Thus, we can see the approximated number of rows to scan when adding index is much lower than that of only primary and without any indexes.

(b) How many people are in the Hall of Fame? What fraction of each category of person are in the Hall Of Fame? Are more people in the Hall Of Fame alive or dead? Does this vary by category?

How many people are in the Hall of Fame?

Without primary key:

```
mysql> source /Users/mengtianao/Documents/ece656/MengTianao/A2/Q3/baseball.sql;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | partitions | type | possible_keys | key | key_len | ref | rows | filtered | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | SIMPLE | HallOffFame | NULL | ALL | NULL | NULL | NULL | NULL | 4136 | 100.00 | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

With primary key only:

```
mysql> show indexes in halloffame;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| HALLOFFAME | 0 | PRIMARY | 1 | playerID | A | 1260 | NULL | NULL | BTREE | | | YES | NULL |
| HALLOFFAME | 0 | PRIMARY | 2 | yearid | A | 4024 | NULL | NULL | BTREE | | | YES | NULL |
| HALLOFFAME | 0 | PRIMARY | 3 | votedBy | A | 4156 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.01 sec)
```

```
mysql> source /Users/mengtianao/Documents/ece656/MengTianao/A2/Q3/baseball.sql;
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | partitions | type | possible_keys | key | key_len | ref | rows | filtered | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | SIMPLE | HallOffFame | NULL | index | PRIMARY | PRIMARY | 1538 | NULL | 4156 | 100.00 | Using index |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

With Foreign key and primary key:

```
Database changed
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| HallOffFame | 0 | PRIMARY | 1 | playerID | A | 1260 | NULL | NULL | BTREE | | | YES | NULL |
| HallOffFame | 0 | PRIMARY | 2 | yearid | A | 4024 | NULL | NULL | BTREE | | | YES | NULL |
| HallOffFame | 0 | PRIMARY | 3 | votedBy | A | 4156 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | partitions | type | possible_keys | key | key_len | ref | rows | filtered | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | SIMPLE | HallOffFame | NULL | index | PRIMARY | PRIMARY | 2048 | NULL | 4156 | 100.00 | Using index |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set, 1 warning (0.00 sec)
```

Add indexes:

```
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| HALLOFFAME | 1 | PLAYERID | 1 | playerID | A | 0 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | partitions | type | possible_keys | key | key_len | ref | rows | filtered | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | SIMPLE | HallOffFame | NULL | range | PLAYERID | PLAYERID | 767 | NULL | 1261 | 100.00 | Using index for group-by (scanning) |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set, 1 warning (0.00 sec)
```

What fraction of each category of person are in the Hall Of Fame? Are more people in the Hall Of Fame alive or dead? Does this vary by category?

Without primary key and foreign key:

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	PRIMARY	<derived2>	NULL	ALL	NULL	NULL	NULL	NULL	4136	100.00	Using where
1	PRIMARY	<derived5>	NULL	ref	<auto_key0>	<auto_key0>	768	t1.category	10	100.00	NULL
1	PRIMARY	<derived4>	NULL	ref	<auto_key0>	<auto_key0>	768	t1.category	1382	100.00	NULL
5	DERIVED	Master	NULL	ALL	NULL	NULL	NULL	NULL	18962	0.10	Using where; Using temporary; Using filesort
5	DERIVED	Halloffame	NULL	ALL	NULL	NULL	NULL	NULL	4136	100.00	Using where; Using join buffer (hash join)
4	DERIVED	Halloffame	NULL	ALL	NULL	NULL	NULL	NULL	4136	100.00	Using temporary; Using filesort
4	DERIVED	Master	NULL	ALL	NULL	NULL	NULL	NULL	18962	7.29	Using where; Using join buffer (hash join)
2	DERIVED	Halloffame	NULL	ALL	NULL	NULL	NULL	NULL	4136	100.00	Using filesort
3	SUBQUERY	Halloffame	NULL	ALL	NULL	NULL	NULL	NULL	4136	100.00	NULL

9 rows in set, 1 warning (0.01 sec)

Only with primary key:

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	PRIMARY	<derived5>	NULL	ALL	NULL	NULL	NULL	NULL	62	100.00	Using where
1	PRIMARY	<derived4>	NULL	ref	<auto_key0>	<auto_key0>	768	t3.category	38	100.00	NULL
1	PRIMARY	<derived2>	NULL	ref	<auto_key0>	<auto_key0>	768	t3.category	41	100.00	NULL
5	DERIVED	Master	NULL	ALL	PRIMARY	PRIMARY	NULL	NULL	18921	0.10	Using where; Using temporary; Using filesort
5	DERIVED	Halloffame	NULL	ref	PRIMARY	PRIMARY	767	baseball.Master.playerID	3	100.00	NULL
4	DERIVED	Halloffame	NULL	ALL	PRIMARY	NULL	NULL	NULL	4156	100.00	Using filesort
4	DERIVED	Master	NULL	eq_ref	PRIMARY	PRIMARY	767	baseball.Halloffame.playerID	1	72.90	Using where
2	DERIVED	Halloffame	NULL	ALL	NULL	NULL	NULL	NULL	4156	100.00	Using filesort
3	SUBQUERY	Halloffame	NULL	index	PRIMARY	PRIMARY	1538	NULL	4156	100.00	Using index

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
HALLOFFAME	0	PRIMARY	1	playerID	A	1268		NULL	NULL	BTREE			YES	NULL
HALLOFFAME	0	PRIMARY	2	yearid	A	4024		NULL	NULL	BTREE			YES	NULL
HALLOFFAME	0	PRIMARY	3	votedBy	A	4156		NULL	NULL	BTREE			YES	NULL

3 rows in set (0.00 sec)

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
MASTER	0	PRIMARY	1	playerID	A	18961		NULL	NULL	BTREE			YES	NULL

With primary key and foreign key:

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
HallofFame	0	PRIMARY	1	playerID	A	1260	NULL	NULL	BTREE				YES	NULL
HallofFame	0	PRIMARY	2	yearid	A	4024	NULL	NULL	BTREE				YES	NULL
HallofFame	0	PRIMARY	3	votedBy	A	4156	NULL	NULL	BTREE				YES	NULL
3 rows in set (0.00 sec)														
Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Master	0	PRIMARY	1	playerID	A	18582	NULL	NULL	BTREE				YES	NULL
1 row in set (0.00 sec)														
id	select_type	table	partitions	type	possible_keys	key	key_len	ref		rows	filtered	Extra		
1	PRIMARY	<derived5>	NULL	ALL	NULL	NULL	NULL	NULL		61	100.00	NULL		
1	PRIMARY	<derived4>	NULL	ALL	NULL	NULL	NULL	NULL		3829	10.00	Using where; Using join buffer (hash join)		
1	PRIMARY	<derived2>	NULL	ALL	NULL	NULL	NULL	NULL		4156	10.00	Using where; Using join buffer (hash join)		
5	DERIVED	Master	NULL	ALL	PRIMARY	PRIMARY	NULL	NULL		18582	0.10	Using where; Using temporary; Using filesort		
5	DERIVED	HallofFame	NULL	ref	PRIMARY	PRIMARY	1822	baseball_pkfk.Master.playerID		3	100.00	NULL		
4	DERIVED	HallofFame	NULL	ALL	PRIMARY	NULL	NULL	NULL		4156	100.00	Using filesort		
4	DERIVED	Master	NULL	eq_ref	PRIMARY	PRIMARY	1822	baseball_pkfk.HallofFame.playerID		1	72.90	Using where		
2	DERIVED	HallofFame	NULL	ALL	NULL	NULL	NULL	NULL		4156	100.00	Using filesort		
3	SUBQUERY	HallofFame	NULL	index	PRIMARY	PRIMARY	2848	NULL		4156	100.00	Using index		

Add index on category:

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
HALLOFFAME	1	CATEGORY	1	category	A	4	NULL	NULL	YES	BTREE			YES	NULL
1 row in set (0.00 sec)														
id	select_type	table	partitions	type	possible_keys	key	key_len	ref		rows	filtered	Extra		
1	PRIMARY	<derived4>	NULL	ALL	NULL	NULL	NULL	NULL		413	100.00	Using where		
1	PRIMARY	<derived2>	NULL	ref	<auto_key0>	<auto_key0>	768	t2.category		10	100.00	NULL		
1	PRIMARY	<derived5>	NULL	ref	<auto_key0>	<auto_key0>	768	t2.category		10	100.00	NULL		
5	DERIVED	Master	NULL	ALL	NULL	NULL	NULL	NULL		1	100.00	Using where; Using temporary; Using filesort		
5	DERIVED	HallofFame	NULL	ALL	CATEGORY	NULL	NULL	NULL		4136	10.00	Using where; Using join buffer (hash join)		
4	DERIVED	Master	NULL	ALL	NULL	NULL	NULL	NULL		1	100.00	Using where; Using temporary; Using filesort		
4	DERIVED	HallofFame	NULL	ALL	CATEGORY	NULL	NULL	NULL		4136	10.00	Using where; Using join buffer (hash join)		
2	DERIVED	HallofFame	NULL	index	CATEGORY	CATEGORY	768	NULL		4136	100.00	NULL		
3	SUBQUERY	HallofFame	NULL	ALL	NULL	NULL	NULL	NULL		4136	100.00	NULL		

(c) What are the names and total pay (individually) of the three people with the three largest total salaries? What category are these people (Players? Managers? Other?)? What are the top three by category?

What are the names and total pay (individually) of the three people with the three largest total salaries?

Without any index:

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	PRIMARY	Master	NULL	ALL	NULL	NULL	NULL	NULL	1	100.00	Using temporary; Using filesort
1	PRIMARY	<derived2>	NULL	ref	<auto_key0>	<auto_key0>	768	baseball.Master.playerID	261	100.00	NULL
2	DERIVED	Salaries	NULL	ALL	NULL	NULL	NULL	NULL	26112	100.00	Using temporary

With pk:

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Salaries	0	PRIMARY	1	yearID	A	31	NULL	NULL	NULL	BTREE			YES	NULL
Salaries	0	PRIMARY	2	teamID	A	920	NULL	NULL	NULL	BTREE			YES	NULL
Salaries	0	PRIMARY	3	playerID	A	26648	NULL	NULL	NULL	BTREE			YES	NULL

3 rows in set (0.01 sec)

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
MASTER	0	PRIMARY	1	playerID	A	18961	NULL	NULL	NULL	BTREE			YES	NULL

1 row in set (0.00 sec)

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	PRIMARY	<derived2>	NULL	ALL	NULL	NULL	NULL	NULL	26648	100.00	Using filesort
1	PRIMARY	Master	NULL	eq_ref	PRIMARY	PRIMARY	767	t1.playerID	1	100.00	NULL
2	DERIVED	Salaries	NULL	ALL	PRIMARY	NULL	NULL	NULL	26648	100.00	Using temporary

With pk and fk:

```
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Salaries | 0 | PRIMARY | 1 | teamID | A | 43 | NULL | NULL | BTREE | | | YES | NULL |
| Salaries | 0 | PRIMARY | 2 | yearID | A | 936 | NULL | NULL | BTREE | | | YES | NULL |
| Salaries | 0 | PRIMARY | 3 | playerID | A | 28571 | NULL | NULL | BTREE | | | YES | NULL |
| Salaries | 1 | playerID | 1 | playerID | A | 5224 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
4 rows in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Master | 0 | PRIMARY | 1 | playerID | A | 18582 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | partitions | type | possible_keys | key | key_len | ref | rows | filtered | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | <derived2> | NULL | ALL | NULL | NULL | NULL | 28571 | 100.00 | Using filesort | |
| 1 | PRIMARY | Master | NULL | eq_ref | PRIMARY | PRIMARY | 1022 | t1.playerID | 1 | 100.00 | NULL |
| 2 | DERIVED | Salaries | NULL | index | PRIMARY,playerID | playerID | 1022 | NULL | 28571 | 100.00 | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

What category are these people (Players? Managers? Other?)? What are the top three by category?

Players Only:

Without any index:

```
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | partitions | type | possible_keys | key | key_len | ref | rows | filtered | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | Master | NULL | ALL | NULL | NULL | NULL | NULL | 1 | 100.00 | Using temporary; Using filesort |
| 1 | PRIMARY | <derived2> | NULL | ref | <auto_key0> | <auto_key0> | 767 | baseball.Master.playerID | 26 | 100.00 | NULL |
| 2 | DERIVED | <subquery3> | NULL | ALL | NULL | NULL | NULL | NULL | NULL | 100.00 | Using temporary |
| 2 | DERIVED | Salaries | NULL | ALL | NULL | NULL | NULL | NULL | 26112 | 10.00 | Using where; Using join buffer (hash join) |
| 3 | MATERIALIZED | Master | NULL | ALL | NULL | NULL | NULL | NULL | 1 | 100.00 | NULL |
| 4 | SUBQUERY | Managers | NULL | ALL | NULL | NULL | NULL | NULL | 3436 | 100.00 | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
```

With pk:

```

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Salaries | 0 | PRIMARY | 1 | yearID | A | 31 | NULL | NULL | BTREE | | | YES | NULL |
| Salaries | 0 | PRIMARY | 2 | teamID | A | 920 | NULL | NULL | BTREE | | | YES | NULL |
| Salaries | 0 | PRIMARY | 3 | playerID | A | 26648 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Managers | 0 | PRIMARY | 1 | playerID | A | 698 | NULL | NULL | BTREE | | | YES | NULL |
| Managers | 0 | PRIMARY | 2 | yearID | A | 3385 | NULL | NULL | BTREE | | | YES | NULL |
| Managers | 0 | PRIMARY | 3 | inseason | A | 3436 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| MASTER | 0 | PRIMARY | 1 | playerID | A | 18961 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | partitions | type | possible_keys | key | key_len | ref | rows | filtered | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | <derived2> | NULL | ALL | NULL | NULL | NULL | NULL | 26637 | 100.00 | Using filesort |
| 1 | PRIMARY | Master | NULL | eq_ref | PRIMARY | PRIMARY | 767 | t1.playerID | 1 | 100.00 | NULL |
| 2 | DERIVED | Salaries | NULL | ALL | PRIMARY | NULL | NULL | NULL | 26637 | 100.00 | Using temporary |
| 2 | DERIVED | Master | NULL | eq_ref | PRIMARY | PRIMARY | 767 | baseball.Salaries.playerID | 1 | 100.00 | Using index |
| 2 | DERIVED | <subquery4> | NULL | eq_ref | <auto_distinct_key> | <auto_distinct_key> | 768 | baseball.Salaries.playerID | 1 | 100.00 | Using where; Not exists |
| 4 | MATERIALIZED | Managers | NULL | index | PRIMARY | PRIMARY | 775 | NULL | 3436 | 100.00 | Using index |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+

```

With pk and fk:

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Database changed
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Salaries | 0 | PRIMARY | 1 | teamID | A | 43 | NULL | NULL | BTREE | | | YES | NULL |
| Salaries | 0 | PRIMARY | 2 | yearID | A | 936 | NULL | NULL | BTREE | | | YES | NULL |
| Salaries | 0 | PRIMARY | 3 | playerID | A | 28571 | NULL | NULL | BTREE | | | YES | NULL |
| Salaries | 1 | playerID | 1 | playerID | A | 5224 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
4 rows in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Managers | 0 | PRIMARY | 1 | playerID | A | 698 | NULL | NULL | BTREE | | | YES | NULL |
| Managers | 0 | PRIMARY | 2 | yearID | A | 3385 | NULL | NULL | BTREE | | | YES | NULL |
| Managers | 0 | PRIMARY | 3 | inseason | A | 3436 | NULL | NULL | BTREE | | | YES | NULL |
| Managers | 1 | yearID | 1 | yearID | A | 146 | NULL | NULL | BTREE | | | YES | NULL |
| Managers | 1 | yearID | 2 | lgID | A | 276 | NULL | NULL | BTREE | | | YES | NULL |
| Managers | 1 | yearID | 3 | teamID | A | 2835 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
6 rows in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Master | 0 | PRIMARY | 1 | playerID | A | 18582 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | partitions | type | possible_keys | key | key_len | ref | rows | filtered | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | <derived2> | NULL | ALL | NULL | NULL | NULL | NULL | 18582 | 100.00 | Using filesort |
| 1 | PRIMARY | Master | NULL | eq_ref | PRIMARY | PRIMARY | 1022 | t1.playerID | 1 | 100.00 | NULL |
| 2 | DERIVED | Master | NULL | index | PRIMARY | PRIMARY | 1022 | NULL | 18582 | 100.00 | Using index; Using temporary |
| 2 | DERIVED | Salaries | NULL | ref | PRIMARY,playerID | playerID | 1022 | baseball_pkfk.Master.playerID | 1 | 100.00 | NULL |
| 2 | DERIVED | <subquery4> | NULL | eq_ref | <auto_distinct_key> | <auto_distinct_key> | 1023 | baseball_pkfk.Master.playerID | 1 | 100.00 | Using where; Not exists |
| 4 | MATERIALIZED | Managers | NULL | index | PRIMARY | yearID | 2050 | NULL | 3436 | 100.00 | Using index |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+

```

With index:

```

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Salaries | 1 | PLAYERID | 1 | playerID | A | 5155 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Managers | 1 | PLAYERID | 1 | playerID | A | 698 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Master | 1 | PLAYERID | 1 | playerID | A | 0 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | partitions | type | possible_keys | key | key_len | ref | rows | filtered | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | Master | NULL | ALL | PLAYERID | NULL | NULL | NULL | 1 | 100.00 | Using temporary; Using filesort |
| 1 | PRIMARY | <derived2> | NULL | ref | <auto_key0> | <auto_key0> | 767 | baseball.Master.playerID | 2 | 100.00 | NULL |
| 2 | DERIVED | Master | NULL | index | PLAYERID | PLAYERID | 767 | NULL | 1 | 100.00 | Using index; Using temporary; LooseScan |
| 2 | DERIVED | Salaries | NULL | ref | PLAYERID | PLAYERID | 767 | baseball.Master.playerID | 5 | 100.00 | NULL |
| 2 | DERIVED | <subquery4> | NULL | eq_ref | <auto_distinct_key> | <auto_distinct_key> | 768 | baseball.Master.playerID | 1 | 100.00 | Using where; Not exists |
| 4 | MATERIALIZED | Managers | NULL | index | PLAYERID | PLAYERID | 767 | NULL | 1 | 100.00 | Using index |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+

```

Managers Only:

Without any index:

```

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | partitions | type | possible_keys | key | key_len | ref | rows | filtered | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | Master | NULL | ALL | NULL | NULL | NULL | NULL | 1 | 100.00 | Using temporary; Using filesort |
| 1 | PRIMARY | <derived2> | NULL | ref | <auto_key0> | <auto_key0> | 767 | baseball.Master.playerID | 26 | 100.00 | NULL |
| 2 | DERIVED | <subquery3> | NULL | ALL | NULL | NULL | NULL | NULL | NULL | 100.00 | Using temporary |
| 2 | DERIVED | Salaries | NULL | ALL | NULL | NULL | NULL | NULL | 26784 | 10.00 | Using where; Using join buffer (hash join) |
| 3 | MATERIALIZED | Managers | NULL | ALL | NULL | NULL | NULL | NULL | 1 | 100.00 | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+

```

With pk:

```

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Salaries | 0 | PRIMARY | 1 | yearID | A | 31 | NULL | NULL | BTREE | | | YES | NULL |
| Salaries | 0 | PRIMARY | 2 | teamID | A | 928 | NULL | NULL | BTREE | | | YES | NULL |
| Salaries | 0 | PRIMARY | 3 | playerID | A | 26648 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Managers | 0 | PRIMARY | 1 | playerID | A | 698 | NULL | NULL | BTREE | | | YES | NULL |
| Managers | 0 | PRIMARY | 2 | yearID | A | 3385 | NULL | NULL | BTREE | | | YES | NULL |
| Managers | 0 | PRIMARY | 3 | inseason | A | 3436 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
3 rows in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| MASTER | 0 | PRIMARY | 1 | playerID | A | 18961 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | partitions | type | possible_keys | key | key_len | ref | rows | filtered | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | <derived2> | NULL | ALL | NULL | NULL | NULL | NULL | 26648 | 100.00 | Using filesort |
| 1 | PRIMARY | Master | NULL | eq_ref | PRIMARY | PRIMARY | 767 | t1.playerID | 1 | 100.00 | NULL |
| 2 | DERIVED | Salaries | NULL | ALL | PRIMARY | NULL | NULL | NULL | 26648 | 100.00 | Using temporary |
| 2 | DERIVED | <subquery3> | NULL | eq_ref | <auto_distinct_key> | <auto_distinct_key> | 767 | baseball.Salaries.playerID | 1 | 100.00 | NULL |
| 3 | MATERIALIZED | Managers | NULL | index | PRIMARY | PRIMARY | 775 | NULL | 3436 | 100.00 | Using index |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+

```

With pk and fk:

```

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Salaries | 1 | playerID | 1 | playerID | A | 5224 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Managers | 0 | PRIMARY | 1 | playerID | A | 698 | NULL | NULL | BTREE | | | YES | NULL | |
| Managers | 0 | PRIMARY | 2 | yearID | A | 3385 | NULL | NULL | BTREE | | | YES | NULL |
| Managers | 0 | PRIMARY | 3 | inseason | A | 3436 | NULL | NULL | BTREE | | | YES | NULL |
| Managers | 1 | yearID | 1 | yearID | A | 146 | NULL | NULL | BTREE | | | YES | NULL |
| Managers | 1 | yearID | 2 | lgID | A | 276 | NULL | NULL | YES | BTREE | | | YES | NULL |
| Managers | 1 | yearID | 3 | teamID | A | 2835 | NULL | NULL | YES | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
6 rows in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Master | 0 | PRIMARY | 1 | playerID | A | 18582 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | partitions | type | possible_keys | key | key_len | ref | rows | filtered | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | <derived2> | NULL | ALL | NULL | NULL | NULL | NULL | 2 | 100.00 | Using filesort |
| 1 | PRIMARY | Master | NULL | eq_ref | PRIMARY | PRIMARY | 1022 | t1.playerID | 1 | 100.00 | NULL |
| 2 | DERIVED | <subquery3> | NULL | ALL | NULL | NULL | NULL | NULL | 100.00 | Using temporary |
| 2 | DERIVED | Salaries | NULL | ref | playerID | playerID | 1022 | <subquery3>.playerID | 1 | 100.00 | NULL |
| 3 | MATERIALIZED | Managers | NULL | index | PRIMARY | yearID | 2050 | NULL | 3436 | 100.00 | Using index |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+

```

With index:

```

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Salaries | 1 | PLAYERID | 1 | playerID | A | 5155 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Managers | 1 | PLAYERID | 1 | playerID | A | 698 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Table | Non_unique | Key_name | Seq_in_index | Column_name | Collation | Cardinality | Sub_part | Packed | Null | Index_type | Comment | Index_comment | Visible | Expression |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| Master | 1 | PLAYERID | 1 | playerID | A | 0 | NULL | NULL | BTREE | | | YES | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| id | select_type | table | partitions | type | possible_keys | key | key_len | ref | rows | filtered | Extra |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
| 1 | PRIMARY | Master | NULL | ALL | PLAYERID | NULL | NULL | NULL | 1 | 100.00 | Using temporary; Using filesort |
| 1 | PRIMARY | <derived2> | NULL | ref | <auto_key0> | <auto_key0> | 767 | baseball.Master.playerID | 2 | 100.00 | NULL |
| 2 | DERIVED | Managers | NULL | index | PLAYERID | PLAYERID | 767 | NULL | 1 | 100.00 | Using index; Using temporary; LooseScan |
| 2 | DERIVED | Salaries | NULL | ref | PLAYERID | PLAYERID | 767 | baseball.Managers.playerID | 5 | 100.00 | NULL |
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+

```

Other:

Without any index:

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	PRIMARY	Master	NULL	ALL	NULL	NULL	NULL	NULL	1	100.00	Using temporary; Using filesort
1	PRIMARY	<derived2>	NULL	ref	<auto_key0>	<auto_key0>	767	baseball.Master.playerID	267	100.00	NULL
2	DERIVED	Salaries	NULL	ALL	NULL	NULL	NULL	NULL	26784	100.00	Using temporary
2	DERIVED	<subquery3>	NULL	eq_ref	<auto_distinct_key>	<auto_distinct_key>	768	baseball.Salaries.playerID	1	100.00	Using where; Not exists
2	DERIVED	<subquery4>	NULL	eq_ref	<auto_distinct_key>	<auto_distinct_key>	768	baseball.Salaries.playerID	1	100.00	Using where; Not exists
3	MATERIALIZED	Managers	NULL	ALL	NULL	NULL	NULL	NULL	1	100.00	NULL
4	MATERIALIZED	Master	NULL	ALL	NULL	NULL	NULL	NULL	1	100.00	NULL

With pk:

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Salaries	0	PRIMARY	1	yearID	A	31	NULL	NULL	BTREE				YES	NULL
Salaries	0	PRIMARY	2	teamID	A	920	NULL	NULL	BTREE				YES	NULL
Salaries	0	PRIMARY	3	playerID	A	26648	NULL	NULL	BTREE				YES	NULL
3 rows in set (0.00 sec)														
Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Managers	0	PRIMARY	1	playerID	A	698	NULL	NULL	BTREE				YES	NULL
Managers	0	PRIMARY	2	yearID	A	3385	NULL	NULL	BTREE				YES	NULL
Managers	0	PRIMARY	3	inseason	A	3436	NULL	NULL	BTREE				YES	NULL
3 rows in set (0.00 sec)														
Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
MASTER	0	PRIMARY	1	playerID	A	18961	NULL	NULL	BTREE				YES	NULL
1 row in set (0.00 sec)														
id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra			
1	PRIMARY	<derived2>	NULL	ALL	NULL	NULL	NULL	NULL	26660	100.00	Using filesort			
1	PRIMARY	Master	NULL	eq_ref	PRIMARY	PRIMARY	767	t1.playerID	1	100.00	NULL			
2	DERIVED	Salaries	NULL	ALL	PRIMARY	NULL	NULL	NULL	26660	100.00	Using temporary			
2	DERIVED	<subquery3>	NULL	eq_ref	<auto_distinct_key>	<auto_distinct_key>	768	baseball.Salaries.playerID	1	100.00	Using where; Not exists			
2	DERIVED	<subquery4>	NULL	eq_ref	<auto_distinct_key>	<auto_distinct_key>	768	baseball.Salaries.playerID	1	100.00	Using where; Not exists			
3	MATERIALIZED	Managers	NULL	index	PRIMARY	PRIMARY	775	NULL	3436	100.00	Using index			
4	MATERIALIZED	Master	NULL	index	PRIMARY	PRIMARY	767	NULL	18872	100.00	Using index			

With pk and fk:

Table	Non_Unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Salaries	1	playerID	1	playerID	A	5224	NULL	NULL	BTREE				YES	NULL
1 row in set (0.01 sec)														
Table	Non_Unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Managers	0	PRIMARY	1	playerID	A	698	NULL	NULL	BTREE				YES	NULL
Managers	0	PRIMARY	2	yearID	A	3385	NULL	NULL	BTREE				YES	NULL
Managers	0	PRIMARY	3	inseason	A	3436	NULL	NULL	BTREE				YES	NULL
Managers	1	yearID	1	yearID	A	146	NULL	NULL	BTREE				YES	NULL
Managers	1	yearID	2	lgID	A	276	NULL	NULL	YES	BTREE			YES	NULL
Managers	1	yearID	3	teamID	A	2835	NULL	NULL	YES	BTREE			YES	NULL
6 rows in set (0.00 sec)														
Table	Non_Unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Master	0	PRIMARY	1	playerID	A	18582	NULL	NULL	BTREE				YES	NULL
1 row in set (0.00 sec)														
id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra			
1	PRIMARY	<derived2>	NULL	ALL	NULL	NULL	NULL	NULL	26780	100.00	Using filesort			
1	PRIMARY	Master	NULL	eq_ref	PRIMARY	PRIMARY	1022	t1.playerID	1	100.00	NULL			
2	DERIVED	Salaries	NULL	ALL	playerID	NULL	NULL	NULL	26780	100.00	Using temporary			
2	DERIVED	<subquery3>	NULL	eq_ref	<auto_distinct_key>	<auto_distinct_key>	1023	baseball_pkf.Salaries.playerID	1	100.00	Using where; Not exists			
2	DERIVED	<subquery4>	NULL	eq_ref	<auto_distinct_key>	<auto_distinct_key>	1023	baseball_pkf.Salaries.playerID	1	100.00	Using where; Not exists			
3	MATERIALIZED	Managers	NULL	index	PRIMARY	yearID	2850	NULL	3436	100.00	Using index			
4	MATERIALIZED	Master	NULL	index	PRIMARY	PRIMARY	1022	NULL	18582	100.00	Using index			



With index:

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Salaries	1	PLAYERID	1	playerID	A	5155	NULL	NULL	BTREE				YES	NULL
1 row in set (0.01 sec)														
Managers	1	PLAYERID	1	playerID	A	698	NULL	NULL	BTREE				YES	NULL
1 row in set (0.00 sec)														
Master	1	PLAYERID	1	playerID	A	0	NULL	NULL	BTREE				YES	NULL
1 row in set (0.00 sec)														
id select_type table partitions type possible_keys key key_len ref rows filtered Extra														
1	PRIMARY	Master	NULL	ALL	PLAYERID	NULL	NULL	NULL	1	100.00	Using temporary; Using filesort			
1	PRIMARY	<derived2>	NULL	ref	<auto_key0>	<auto_key0>	767	baseball.Master.playerID	267	100.00	NULL			
2	DERIVED	Salaries	NULL	ALL	PLAYERID	NULL	NULL	NULL	26784	100.00	Using temporary			
2	DERIVED	<subquery3>	NULL	eq_ref	<auto_distinct_key>	<auto_distinct_key>	768	baseball.Salaries.playerID	1	100.00	Using where; Not exists			
2	DERIVED	<subquery4>	NULL	eq_ref	<auto_distinct_key>	<auto_distinct_key>	768	baseball.Salaries.playerID	1	100.00	Using where; Not exists			
3	MATERIALIZED	Managers	NULL	index	PLAYERID	PLAYERID	767	NULL		1	100.00	Using index		
4	MATERIALIZED	Master	NULL	index	PLAYERID	PLAYERID	767	NULL		1	100.00	Using index		

(d) What is the average number of Home Runs a player has?

Without any index:

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	PRIMARY	<derived2>	NULL	ALL	NULL	NULL	NULL	NULL	102125	100.00	NULL
2	DERIVED	Batting	NULL	ALL	NULL	NULL	NULL	NULL	102125	100.00	Using temporary

With pk:

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Batting	0	PRIMARY	1	playerID	A	20287	NULL	NULL	BTREE				YES	NULL
Batting	0	PRIMARY	2	yearID	A	94489	NULL	NULL	BTREE				YES	NULL
Batting	0	PRIMARY	3	stint	A	102351	NULL	NULL	BTREE				YES	NULL
3 rows in set (0.00 sec)														
id select_type table partitions type possible_keys key key_len ref rows filtered Extra														
1	PRIMARY	<derived2>	NULL	ALL	NULL	NULL	NULL	NULL	102351	100.00	NULL			
2	DERIVED	Batting	NULL	index	PRIMARY	PRIMARY	775	NULL	102351	100.00	NULL			

With pk and fk:

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Batting	0	PRIMARY	1	playerID	A	21261	NULL	NULL	BTREE				YES	NULL
Batting	0	PRIMARY	2	yearID	A	102176	NULL	NULL	BTREE				YES	NULL
Batting	0	PRIMARY	3	stint	A	102176	NULL	NULL	BTREE				YES	NULL
Batting	1	yearID	1	yearID	A	147	NULL	NULL	BTREE				YES	NULL
Batting	1	yearID	2	lgID	A	317	NULL	NULL	YES	BTREE			YES	NULL
Batting	1	yearID	3	teamID	A	2625	NULL	NULL	YES	BTREE			YES	NULL
6 rows in set (0.00 sec)														
id select_type table partitions type possible_keys key key_len ref rows filtered Extra														
1	PRIMARY	<derived2>	NULL	ALL	NULL	NULL	NULL	NULL	102176	100.00	NULL			
2	DERIVED	Batting	NULL	index	PRIMARY,yearID	PRIMARY	1030	NULL	102176	100.00	NULL			
2 rows in set, 1 warning (0.00 sec)														

With index:

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Batting	1	PLAYERID	1	playerID	A	0	NULL	NULL	BTREE				YES	NULL
1 row in set (0.00 sec)														
id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra			
1	PRIMARY	<derived2>	NULL	ALL	NULL	NULL	NULL	NULL	2	100.00	NULL			
2	DERIVED	Batting	NULL	index	PLAYERID	PLAYERID	767	NULL	1	100.00	NULL			
2 rows in set, 1 warning (0.00 sec)														

(e) If we only count players who got at least 1 Home Run, what is the average number of HomeRuns a player has?

Without any index:

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra		
1	PRIMARY	<derived2>	NULL	ALL	NULL	NULL	NULL	NULL	102273	100.00	NULL		
2	DERIVED	Batting	NULL	ALL	NULL	NULL	NULL	NULL	102273	100.00	Using temporary		
2 rows in set, 1 warning (0.00 sec)													

With pk:

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Batting	0	PRIMARY	1	playerID	A	20287	NULL	NULL	BTREE				YES	NULL
Batting	0	PRIMARY	2	yearID	A	94489	NULL	NULL	BTREE				YES	NULL
Batting	0	PRIMARY	3	stint	A	102351	NULL	NULL	BTREE				YES	NULL
3 rows in set (0.00 sec)														
id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra			
1	PRIMARY	<derived2>	NULL	ALL	NULL	NULL	NULL	NULL	102421	100.00	NULL			
2	DERIVED	Batting	NULL	index	PRIMARY	PRIMARY	775	NULL	102421	100.00	NULL			
2 rows in set, 1 warning (0.00 sec)														

With pk and fk:

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Batting	0	PRIMARY	1	playerID	A	21261	NULL	NULL	BTREE				YES	NULL
Batting	0	PRIMARY	2	yearID	A	102176	NULL	NULL	BTREE				YES	NULL
Batting	0	PRIMARY	3	stint	A	102176	NULL	NULL	BTREE				YES	NULL
Batting	1	yearID	1	yearID	A	147	NULL	NULL	BTREE				YES	NULL
Batting	1	yearID	2	lgID	A	317	NULL	NULL	YES	BTREE			YES	NULL
Batting	1	yearID	3	teamID	A	2625	NULL	NULL	YES	BTREE			YES	NULL
6 rows in set (0.00 sec)														
id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra			
1	PRIMARY	<derived2>	NULL	ALL	NULL	NULL	NULL	NULL	102176	100.00	NULL			
2	DERIVED	Batting	NULL	index	PRIMARY,yearID	PRIMARY	1030	NULL	102176	100.00	NULL			
2 rows in set, 1 warning (0.00 sec)														

With index:

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Batting	1	PLAYERID	1	playerID	A	0	NULL	NULL	BTREE				YES	NULL
1 row in set (0.00 sec)														
id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra			
1	PRIMARY	<derived2>	NULL	ALL	NULL	NULL	NULL	NULL	2	100.00	NULL			
2	DERIVED	Batting	NULL	index	PLAYERID	PLAYERID	767	NULL	1	100.00	NULL			
2 rows in set, 1 warning (0.00 sec)														

(f) If we define a player as a good batter if they have more than the average number of HomeRuns, and a player is a good Pitcher if they have more than the average number of ShutOut games, then how many players are both good batters and good pitchers?

Without any index:

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	PRIMARY	<derived7>	NULL	ALL	NULL	NULL	NULL	NULL	44649	33.33	Using where
1	PRIMARY	<derived3>	NULL	ref	<auto_key1>	<auto_key1>	767	t4.playerID	10	33.33	Using where
8	SUBQUERY	<derived9>	NULL	ALL	NULL	NULL	NULL	NULL	44649	100.00	NULL
9	DERIVED	Pitching	NULL	ALL	NULL	NULL	NULL	NULL	44649	100.00	Using temporary
7	DERIVED	Pitching	NULL	ALL	NULL	NULL	NULL	NULL	44649	100.00	Using temporary
4	SUBQUERY	<derived5>	NULL	ALL	NULL	NULL	NULL	NULL	102273	100.00	NULL
5	DERIVED	Batting	NULL	ALL	NULL	NULL	NULL	NULL	102273	100.00	Using temporary
3	DERIVED	Batting	NULL	ALL	NULL	NULL	NULL	NULL	102273	100.00	Using temporary

With pk:

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Batting	0	PRIMARY	1	playerID	A	20287	NULL	NULL	BTREE				YES	NULL
Batting	0	PRIMARY	2	yearID	A	94489	NULL	NULL	BTREE				YES	NULL
Batting	0	PRIMARY	3	stint	A	102381	NULL	NULL	BTREE				YES	NULL
3 rows in set (0.00 sec)														
Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Pitching	0	PRIMARY	1	playerID	A	8694	NULL	NULL	BTREE				YES	NULL
Pitching	0	PRIMARY	2	yearID	A	41081	NULL	NULL	BTREE				YES	NULL
Pitching	0	PRIMARY	3	stint	A	44668	NULL	NULL	BTREE				YES	NULL
3 rows in set (0.00 sec)														
id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra			
1	PRIMARY	<derived7>	NULL	ALL	NULL	NULL	NULL	44649	33.33	Using where				
1	PRIMARY	<derived3>	NULL	ref	<auto_key1>	<auto_key1>	767	t4.playerID	10	33.33	Using where			
9	SUBQUERY	<derived9>	NULL	ALL	NULL	NULL	NULL	44649	100.00	NULL				
9	DERIVED	Pitching	NULL	index	PRIMARY	PRIMARY	775	NULL	44649	100.00	NULL			
7	DERIVED	Pitching	NULL	index	PRIMARY	PRIMARY	775	NULL	44689	100.00	NULL			
4	SUBQUERY	<derived5>	NULL	ALL	NULL	NULL	NULL	102246	100.00	NULL				
5	DERIVED	Batting	NULL	index	PRIMARY	PRIMARY	775	NULL	102246	100.00	NULL			
3	DERIVED	Batting	NULL	index	PRIMARY	PRIMARY	775	NULL	102246	100.00	NULL			

With pk and fk:

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Batting	0	PRIMARY	1	playerID	A	22621	NULL	NULL	BTREE				YES	NULL
Batting	0	PRIMARY	2	yearID	A	182176	NULL	NULL	BTREE				YES	NULL
Batting	0	PRIMARY	3	stint	A	182176	NULL	NULL	BTREE				YES	NULL
Batting	1	yearID	1	yearID	A	147	NULL	BTREE				YES	NULL	
Batting	1	yearID	2	lgID	A	317	NULL	NULL	YES	BTREE			YES	NULL
Batting	1	yearID	3	teamID	A	2625	NULL	NULL	YES	BTREE			YES	NULL
6 rows in set (0.00 sec)														
Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Pitching	0	PRIMARY	1	playerID	A	8184	NULL	NULL	BTREE				YES	NULL
Pitching	0	PRIMARY	2	yearID	A	44456	NULL	NULL	BTREE				YES	NULL
Pitching	0	PRIMARY	3	stint	A	47436	NULL	NULL	BTREE				YES	NULL
Pitching	1	yearID	1	yearID	A	152	NULL	NULL	BTREE				YES	NULL
Pitching	1	yearID	2	lgID	A	349	NULL	NULL	YES	BTREE			YES	NULL
Pitching	1	yearID	3	teamID	A	2818	NULL	NULL	YES	BTREE			YES	NULL
6 rows in set (0.00 sec)														
id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra			
1	PRIMARY	<derived7>	NULL	ALL	NULL	NULL	NULL	47436	33.33	Using where				
1	PRIMARY	<derived3>	NULL	ALL	NULL	NULL	NULL	102176	3.33	Using where; Using join buffer (hash join)				
8	SUBQUERY	<derived9>	NULL	ALL	NULL	NULL	NULL	47436	100.00	NULL				
9	DERIVED	Pitching	NULL	index	PRIMARY	yearID	PRIMARY	1030	NULL	47436	100.00	NULL		
7	DERIVED	Pitching	NULL	index	PRIMARY	yearID	PRIMARY	1030	NULL	47436	100.00	NULL		
4	SUBQUERY	<derived5>	NULL	ALL	NULL	NULL	NULL	102176	100.00	NULL				
8	DERIVED	Batting	NULL	index	PRIMARY	yearID	PRIMARY	1030	NULL	102176	100.00	NULL		
3	DERIVED	Batting	NULL	index	PRIMARY	yearID	PRIMARY	1030	NULL	102176	100.00	NULL		

With index:

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Batting	1	HR	1	HR	A	38	NULL	NULL	YES	BTREE			YES	NULL
1 row in set (0.00 sec)														
Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Pitching	1	SHO	1	SHO	A	0	NULL	NULL	YES	BTREE			YES	NULL
1 row in set (0.00 sec)														
id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra			
1	PRIMARY	<derived7>	NULL	ALL	NULL	NULL	NULL	1022	33.33	Using where				
1	PRIMARY	<derived3>	NULL	ref	<auto_key0>	<auto_key0>	767	t4.playerID	2	100.00	NULL			
8	SUBQUERY	<derived9>	NULL	ALL	NULL	NULL	NULL	1022	1	100.00	Using temporary			
9	DERIVED	Pitching	NULL	ALL	NULL	NULL	NULL	1022	1	100.00	Using temporary			
7	DERIVED	Pitching	NULL	ALL	NULL	NULL	NULL	1022	1	100.00	Using temporary			
4	SUBQUERY	<derived5>	NULL	ALL	NULL	NULL	NULL	102199	100.00	NULL				
5	DERIVED	Batting	NULL	ALL	NULL	NULL	NULL	102199	100.00	Using temporary				
3	DERIVED	Batting	NULL	ALL	NULL	NULL	NULL	102199	100.00	Using temporary				

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Batting	1	PLAYERID	1	playerID	A	0		NULL	NULL	BTREE			YES	NULL

1 row in set (0.00 sec)

Table	Non_unique	Key_name	Seq_in_index	Column_name	Collation	Cardinality	Sub_part	Packed	Null	Index_type	Comment	Index_comment	Visible	Expression
Pitching	1	PLAYERID	1	playerID	A	0		NULL	NULL	BTREE			YES	NULL

1 row in set (0.00 sec)

id	select_type	table	partitions	type	possible_keys	key	key_len	ref	rows	filtered	Extra
1	PRIMARY	<derived7>	NULL	ALL	NULL	NULL	NULL	NULL	2	50.00	Using where
2	PTMARY	<derived43>	NULL	ref	<auto_key0>	<auto_key0>	767	t4.playerID	1022	33.33	Using where; Using index
8	SUBQUERY	<derived9>	NULL	ALL	NULL	NULL	NULL	NULL	2	100.00	NULL
9	DERIVED	Pitching	NULL	index	PLAYERID	PLAYERID	767	NULL	1	100.00	NULL
7	DERIVED	Pitching	NULL	index	PLAYERID	PLAYERID	767	NULL	1	100.00	NULL
4	SUBQUERY	<derived5>	NULL	ALL	NULL	NULL	NULL	NULL	102199	100.00	NULL
5	DERIVED	Batting	NULL	index	PLAYERID	PLAYERID	767	NULL	102199	100.00	NULL
3	DERIVED	Batting	NULL	index	PLAYERID	PLAYERID	767	NULL	102199	100.00	NULL

8 rows in set, 1 warning (0.00 sec)