

CARDINALITY ESTIMATION PART (2)



AMR ELHELW

```
EXPLAIN SELECT count(*) FROM employee;
```

QUERY PLAN

```
Aggregate  (cost=94.50..94.51 rows=1 width=8)  
  -> Seq Scan on employee  (cost=0.00..82.00 rows=5000 width=0)  
(2 rows)
```

```
EXPLAIN SELECT count(*) FROM employee GROUP BY dept_id;
```

QUERY PLAN

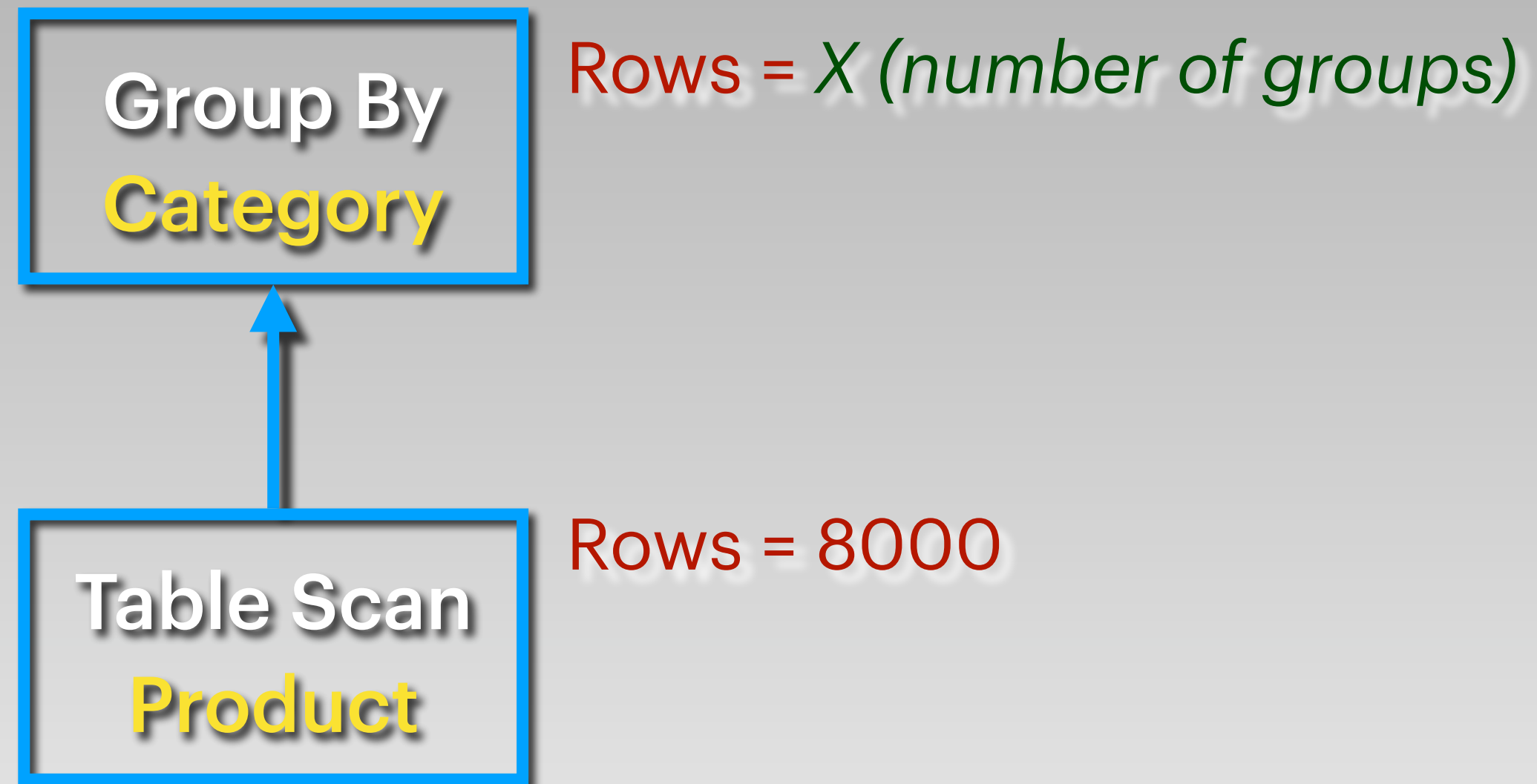
```
HashAggregate (cost=107.00..107.20 rows=20 width=12)
```

```
  Group Key: dept_id
```

```
    -> Seq Scan on employee (cost=0.00..82.00 rows=5000 width=4)
```

```
(3 rows)
```

```
SELECT count(*) FROM product GROUP BY category;
```



X = no. of distinct values in category


```
SELECT count(*) FROM product GROUP BY category, supplier;
```

Rows in 'product' table = 500

No. of distinct values in 'category' column = 10

No. of distinct values in 'supplier' column = 20

Assuming
Independence

No. of groups = $10 * 20 = 200$

```
... GROUP BY col1, col2, ..., coln;
```

$rows_{in}$: input cardinality

$dv(col_i)$ = no. of distinct values in 'col_i'

$rows_{out} = \min(rows_{in}, dv(col_1) * dv(col_2) * ... * dv(col_n))$

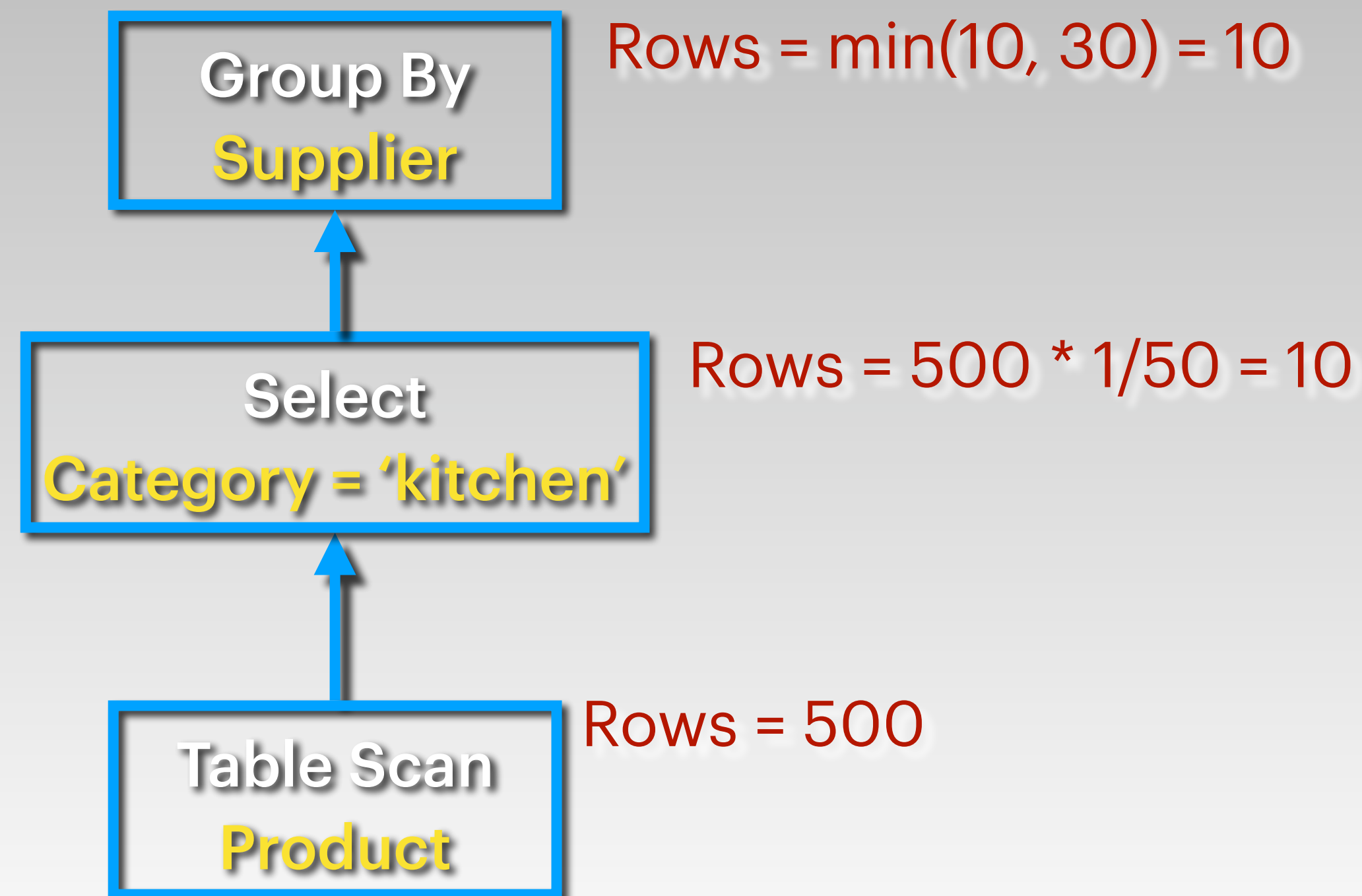
Assuming Independence

```
SELECT count(*) FROM product WHERE category = 'kitchen' GROUP BY supplier;
```

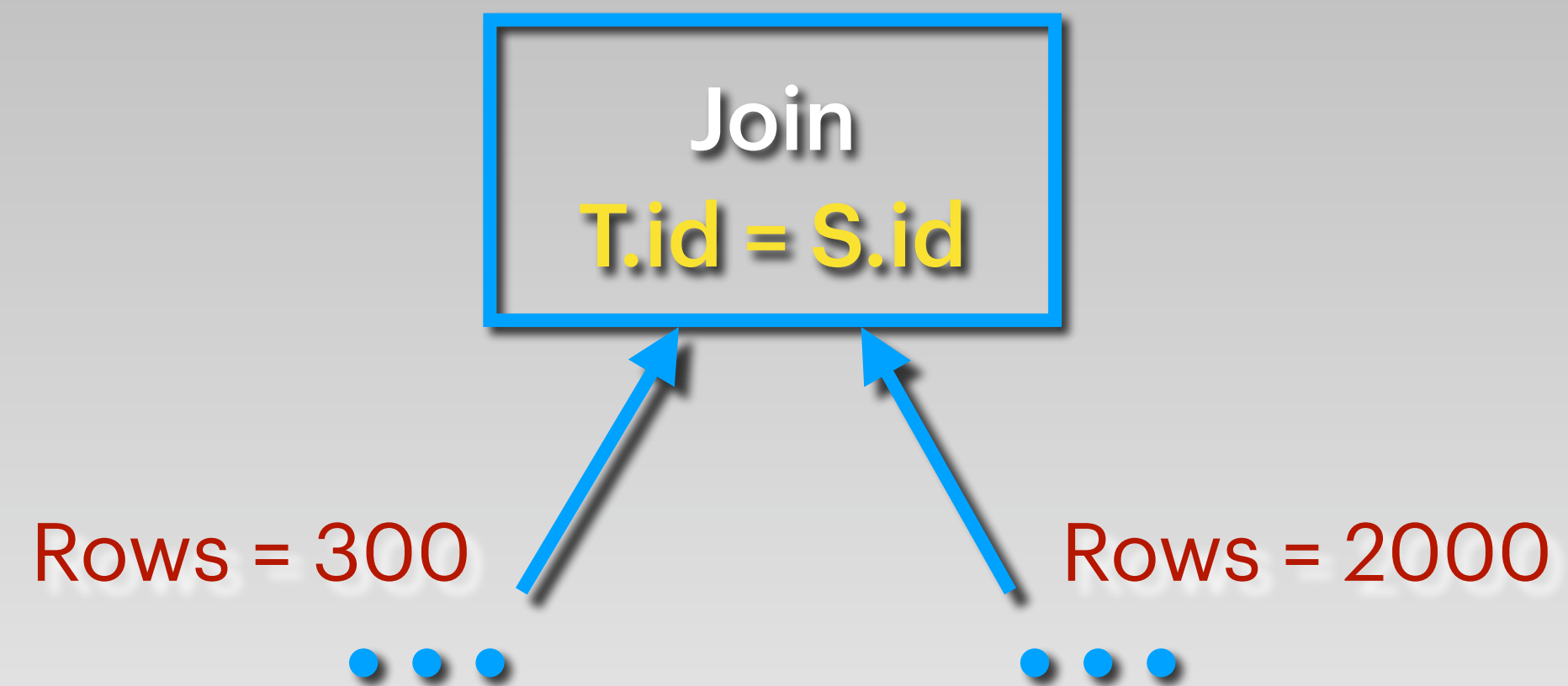
Rows in 'product' table = 500

No. of distinct values in 'category' column = 50

No. of distinct values in 'supplier' column = 30



Rows = ??



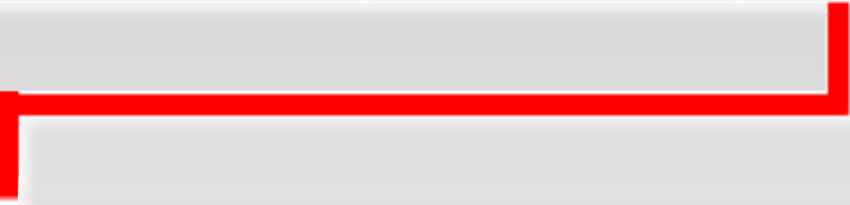
Special Case: PK-FK join

```
SELECT ename, dname FROM employee e JOIN department d ON e.deptno = d.deptno;
```

Employee table

Empno (PK)	Ename	job	Mgr	hiredate	sal	comm	Deptno (FK)
7369	SMITH	CLERK	7902	17-DEC-80	800		20
7499	ALLEN	SALESMAN	7698	20-FEB-81	1600	300	30
7521	WARD	SALESMAN	7698	22-FEB-81	1250	500	30
7566	JONES	MANAGER	7839	02-APR-81	2975		20
7654	BLAKE	MANAGER	7839	01-MAY-81	2850		30

Department table



Deptno (PK)	dname	loc
10	ACCOUNTING	NEW YORK
20	RESEARCH	DALLAS
30	SALES	CHICAGO

```
EXPLAIN SELECT e.name, d.name FROM employee e JOIN dept d ON e.dept_id = d.id;
```

QUERY PLAN

```
Hash Join (cost=1.45..152.20 rows=5000 width=17)
```

```
Hash Cond: (e.dept_id = d.id)
```

```
-> Seq Scan on employee e (cost=0.00..82.00 rows=5000 width=21)
```

```
-> Hash (cost=1.20..1.20 rows=20 width=4)
```

```
    -> Seq Scan on dept d (cost=0.00..1.20 rows=20 width=4)
```

```
(5 rows)
```

General Case

```
SELECT ... FROM S JOIN T ON S.a = T.b;
```

S			T		
	a			b	
	
	5			5	
	5			5	
	...			5	
				...	

No. of output rows with (a = b = 5) = 2 * 3

- rows_S = no. of rows in table S = 200
- rows_T = no. of rows in table T = 1000
- dv_a = no. of distinct values in S.a = 20
- dv_b = no. of distinct values in T.b = 25

Assuming Uniformity

For a given value:
No. of rows in S with that value = rows_S/dv_a = 10
No. of rows in T with that value = rows_T/dv_b = 40
No. of output rows with that value = rows_S/dv_a * rows_T/dv_b = 400

Assuming Inclusion

No. of distinct values in output = min(dv_a, dv_b) = 20

No. of output rows = min(dv_a, dv_b) * rows_S/dv_a * rows_T/dv_b
= rows_S * rows_T / max(dv_a, dv_b)
= 8000

```
SELECT ... FROM S JOIN T ON S.a = T.b;
```

$rows_S$ = no. of rows in table S = 200

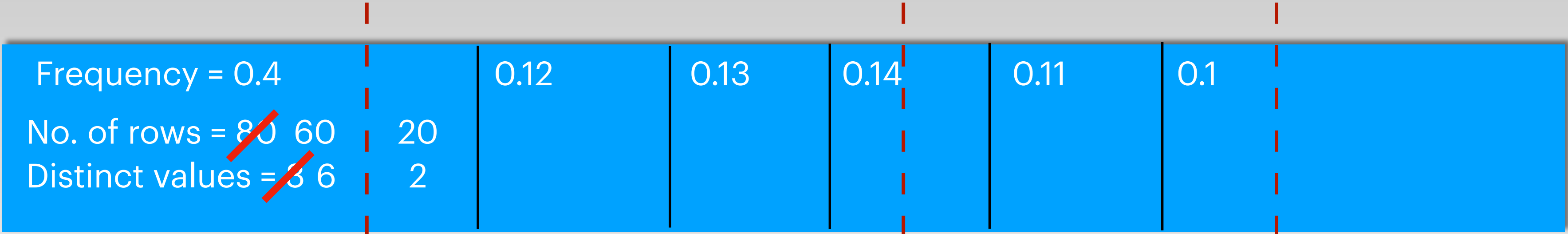
$rows_T$ = no. of rows in table T = 1000

dv_a = no. of distinct values in $S.a$ = 20

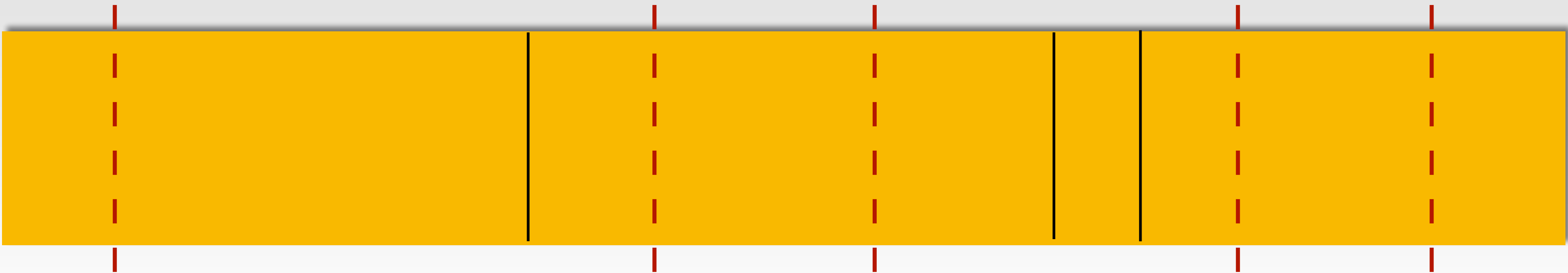
dv_b = no. of distinct values in $T.b$ = 25

No. of output rows = $rows_S * rows_T / \max(dv_a, dv_b)$

Histogram for $S.a$



Histogram for $T.b$



```
EXPLAIN ANALYZE SELECT e.name, d.name FROM employee e JOIN dept d ON e.dept_id = d.id JOIN location l ON d.loc_id = l.id
WHERE city = 'London';
```

QUERY PLAN

```
Hash Join (cost=2.54..123.29 rows=2000 width=17) (actual time=0.102..1.329 rows=1264 loops=1)
  Hash Cond: (e.dept_id = d.id)
    -> Seq Scan on employee e (cost=0.00..82.00 rows=5000 width=21) (actual time=0.014..0.462 rows=5000 loops=1)
    -> Hash (cost=2.44..2.44 rows=8 width=4) (actual time=0.047..0.049 rows=5 loops=1)
      Buckets: 1024 Batches: 1 Memory Usage: 9kB
      -> Hash Join (cost=1.09..2.44 rows=8 width=4) (actual time=0.039..0.045 rows=5 loops=1)
        Hash Cond: (d.loc_id = l.id)
          -> Seq Scan on dept d (cost=0.00..1.20 rows=20 width=8) (actual time=0.005..0.007 rows=20 loops=1)
          -> Hash (cost=1.06..1.06 rows=2 width=4) (actual time=0.020..0.021 rows=2 loops=1)
            Buckets: 1024 Batches: 1 Memory Usage: 9kB
            -> Seq Scan on location l (cost=0.00..1.06 rows=2 width=4) (actual time=0.012..0.013 rows=2 loops=1)
              Filter: ((city)::text = 'London'::text)
              Rows Removed by Filter: 3
```

```
Planning Time: 0.400 ms
Execution Time: 1.442 ms
(15 rows)
```