Dark Corners of PostgreSQL Statistics Analyzer

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PGDay.ru 2016

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Statistics: What? Where? Why?

The Flipping Plan Problem

Deep Dive into Code

A Bird Eye's View

Solution?

Statistics: What? Where? Why?

- pg_statistic
- pg_stats
- MCV: =, <, >
- hist: <, >

schemaname	name
tablename	name
attname	name
inherited	boolean
null_frac	real
avg_width	integer
n_distinct	real
most_common_vals	anyarray
most_common_freqs	real[]
histogram_bounds	anyarray
correlation	real
most_common_elems	anyarray
most_common_elem_freqs	real[]
elem_count_histogram	real[]

len(mcv) ≤ statistics_target

Statistics: What? Where? Why?

The Flipping Plan Problem

```
SELECT *
  FROM print_list
  JOIN ...
  JOIN ...
 WHERE status = 'NOT_YET_PRINTED';
```

```
  ->  Index Scan using print_list_status_idx on print_list
(cost=0.27..1138.53 rows=6073 width=56)
(actual time=0.727..0.727 rows=0 loops=1)
```

```
  ->  Seq Scan (OMG!)
```

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```
most_common_vals   | {PRINTED,PREPARED,ERROR}          -- 2+ “ERROR”
most_common_freqs  | {0.996567,0.002853,6.66667e-05}
histogram_bounds   |

most_common_vals   | {PRINTED,PREPARED}                -- 0  “ERROR”
most_common_freqs  | {0.996543,0.003457}
histogram_bounds   |

most_common_vals   | {PRINTED}                         -- 1  “ERROR”
most_common_freqs  | {0.997102}
histogram_bounds   | {PREPARED,ERROR}
```

```
    status      |  count   | sample
(expectation)
----------------+---------+--------
 PRINTED        | 3551367 |  29914
 PREPARED       |   10162 |     85
 ERROR          |     159 |      1 <====== this*
 TO_BE_PREPARED |       2 |      0
```

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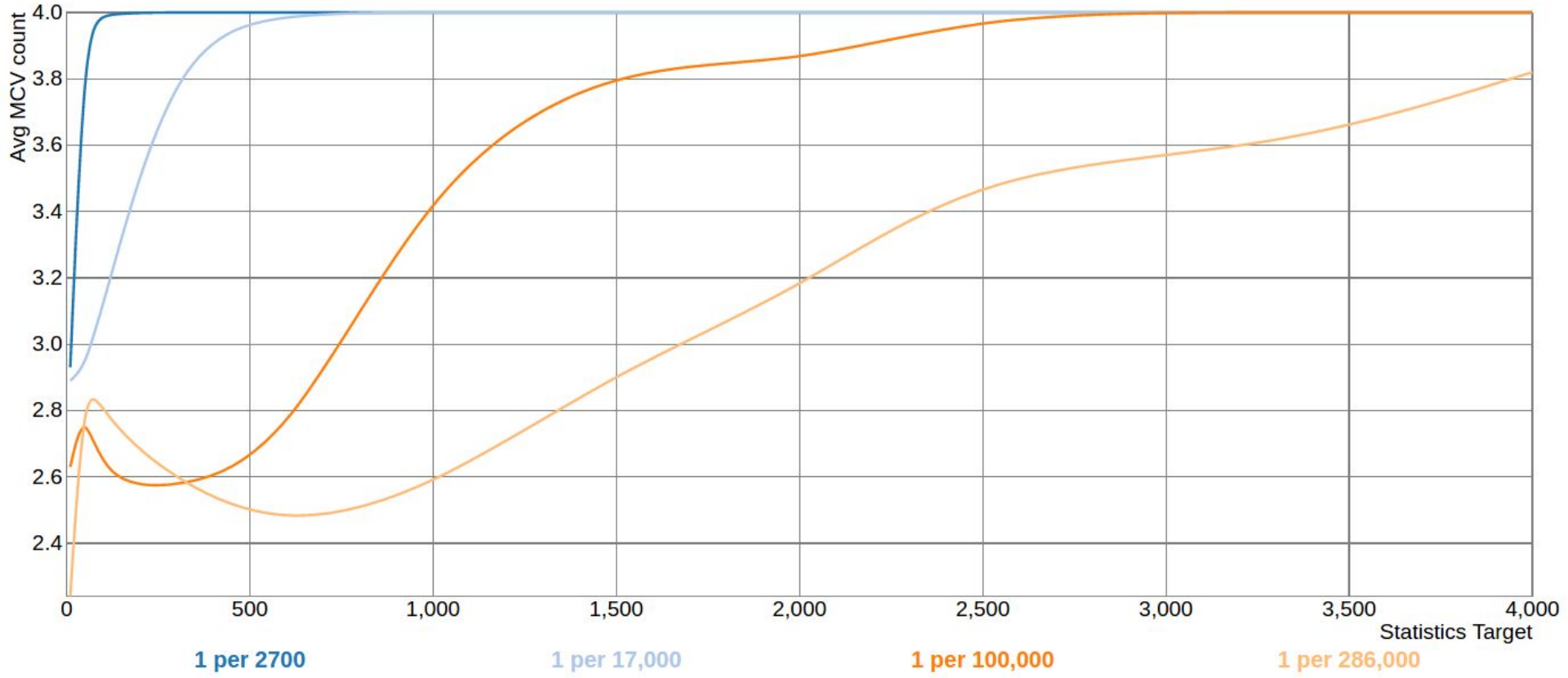

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operator <

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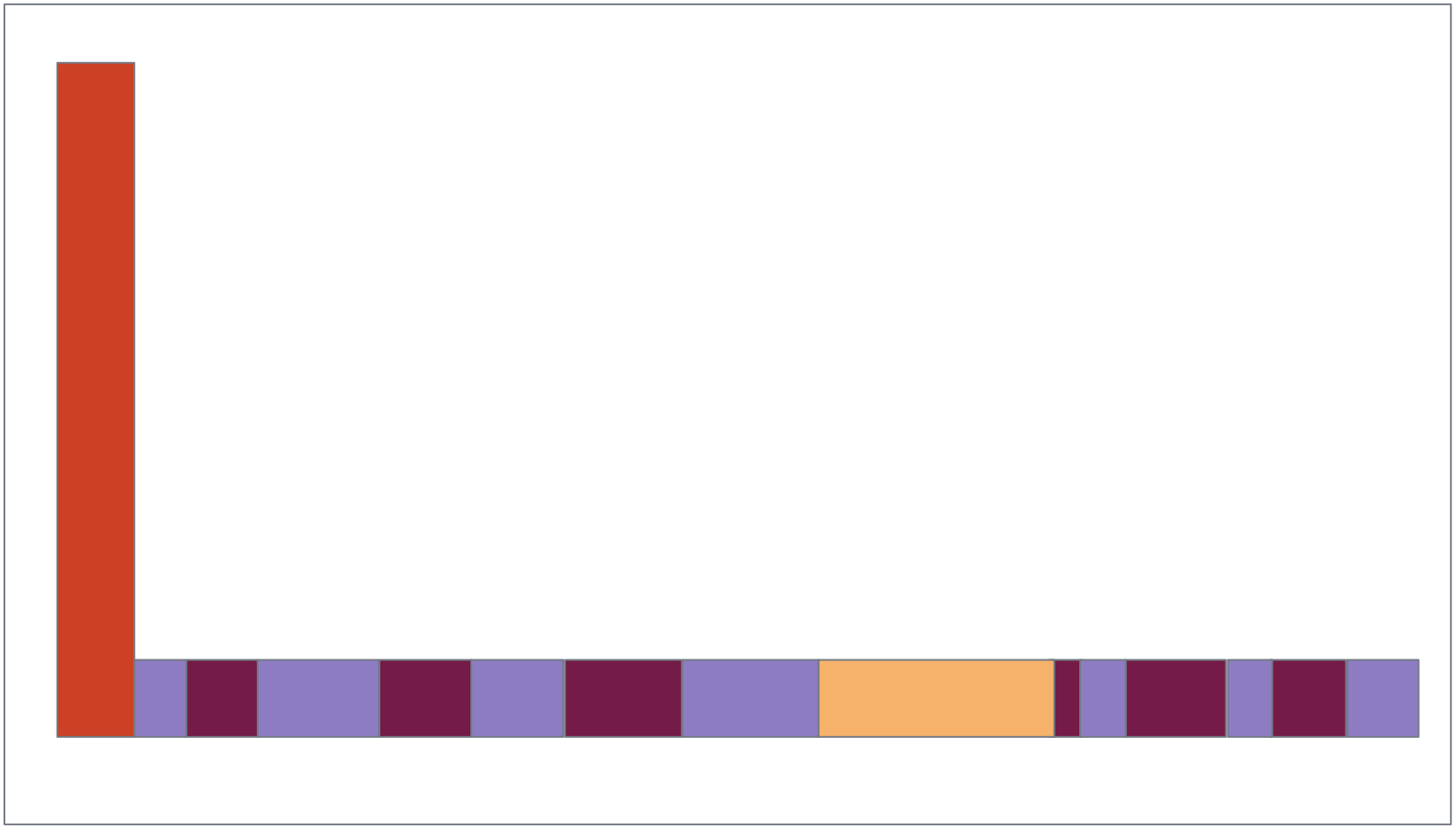

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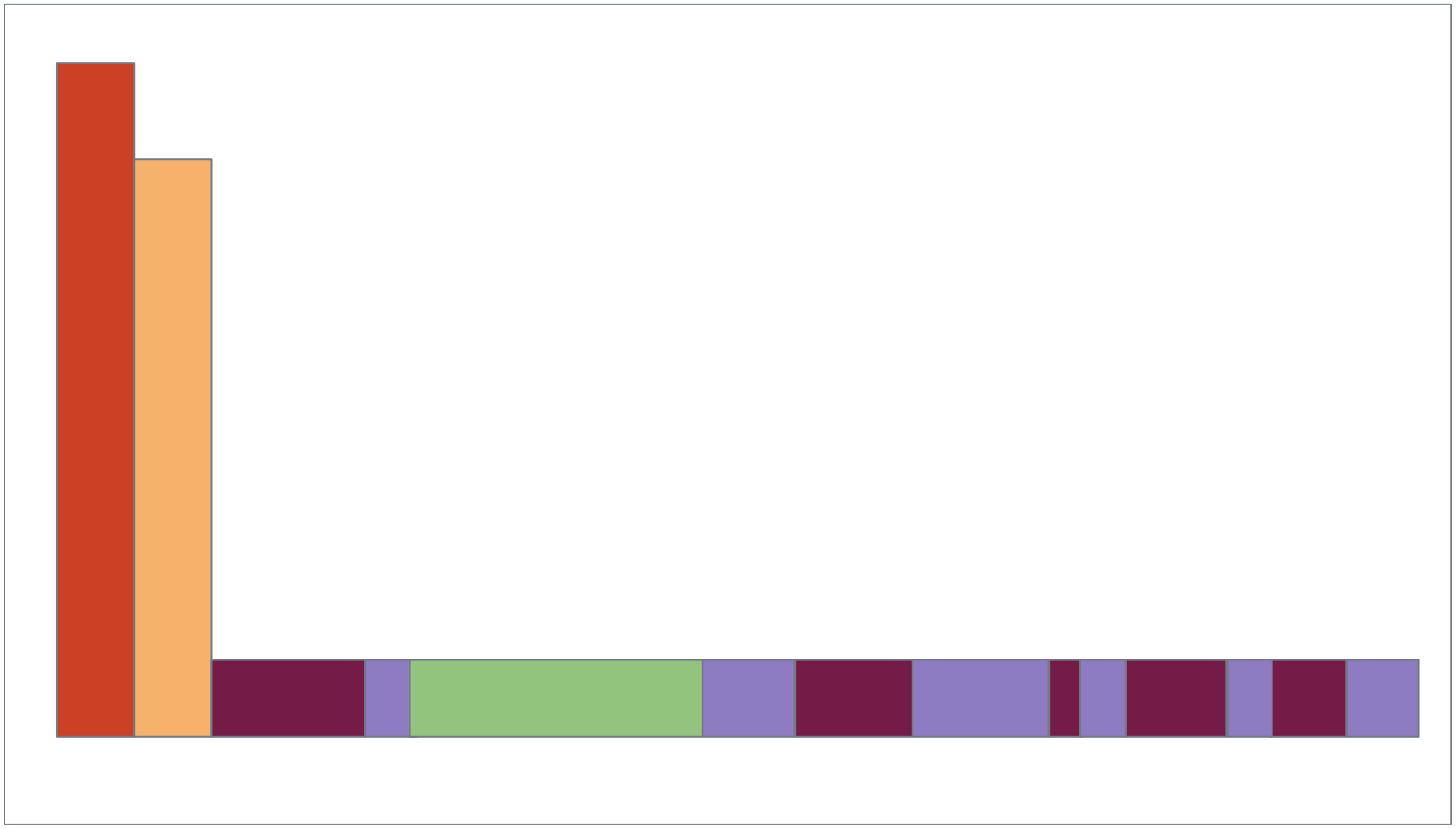

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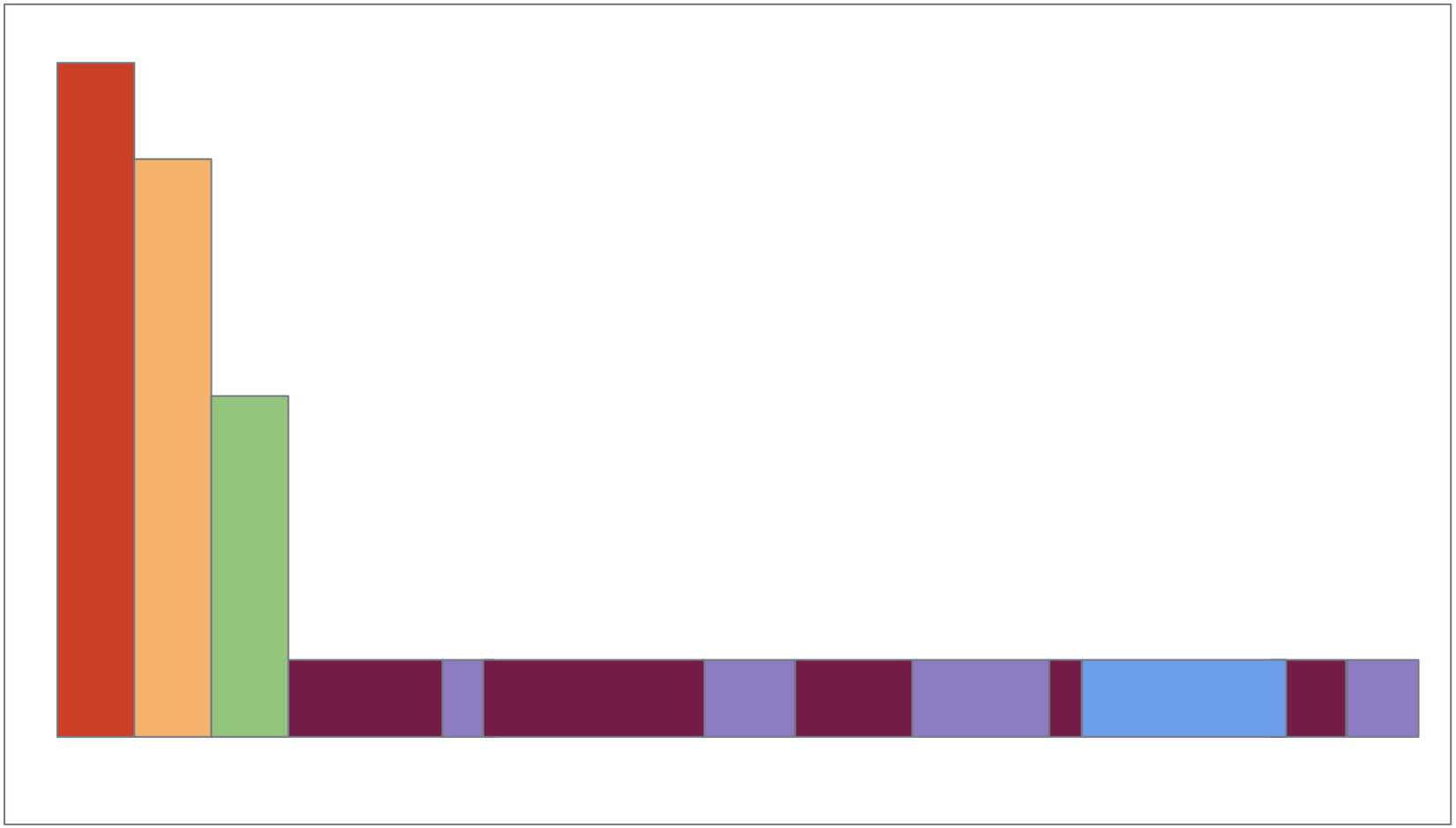

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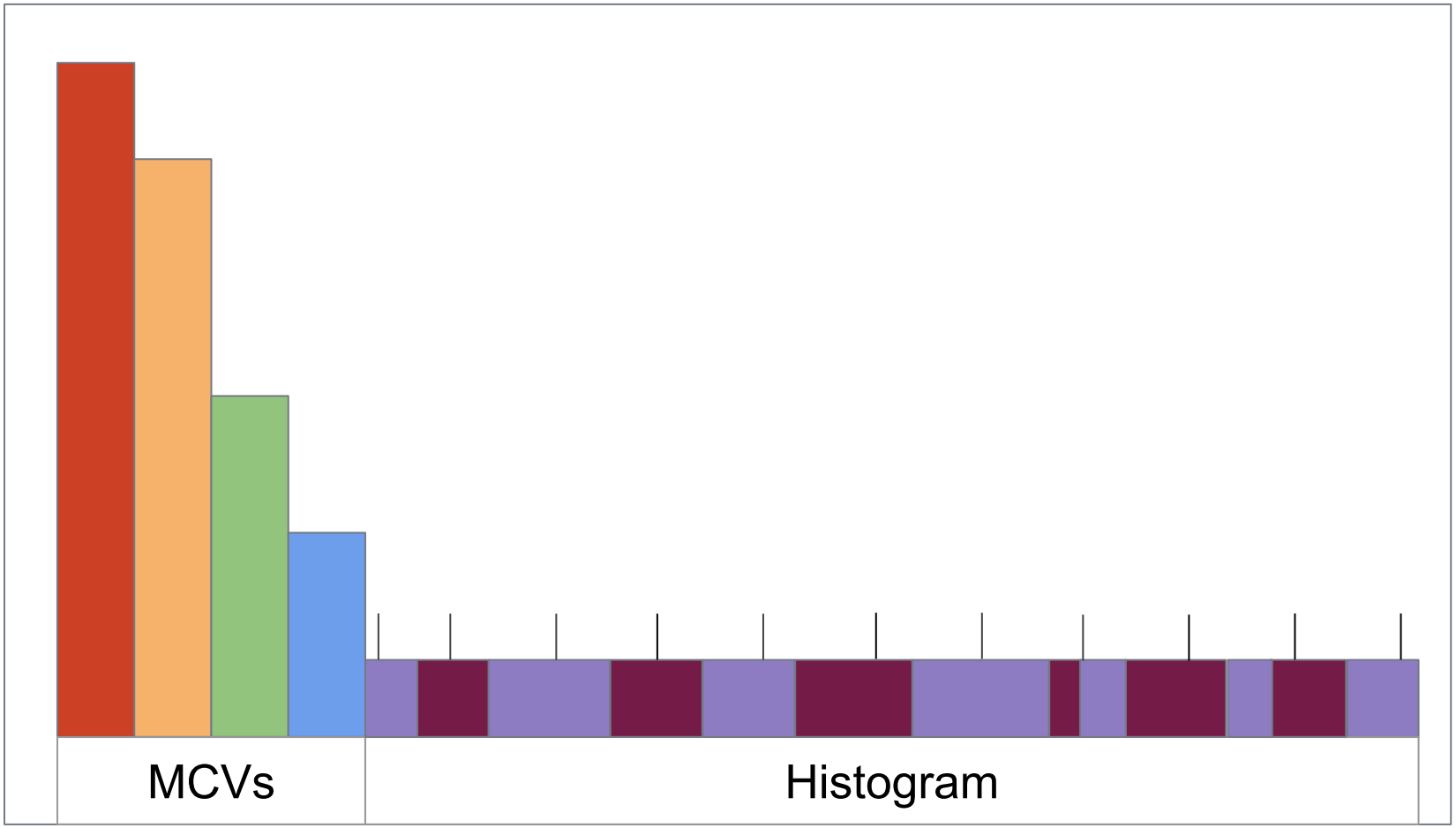

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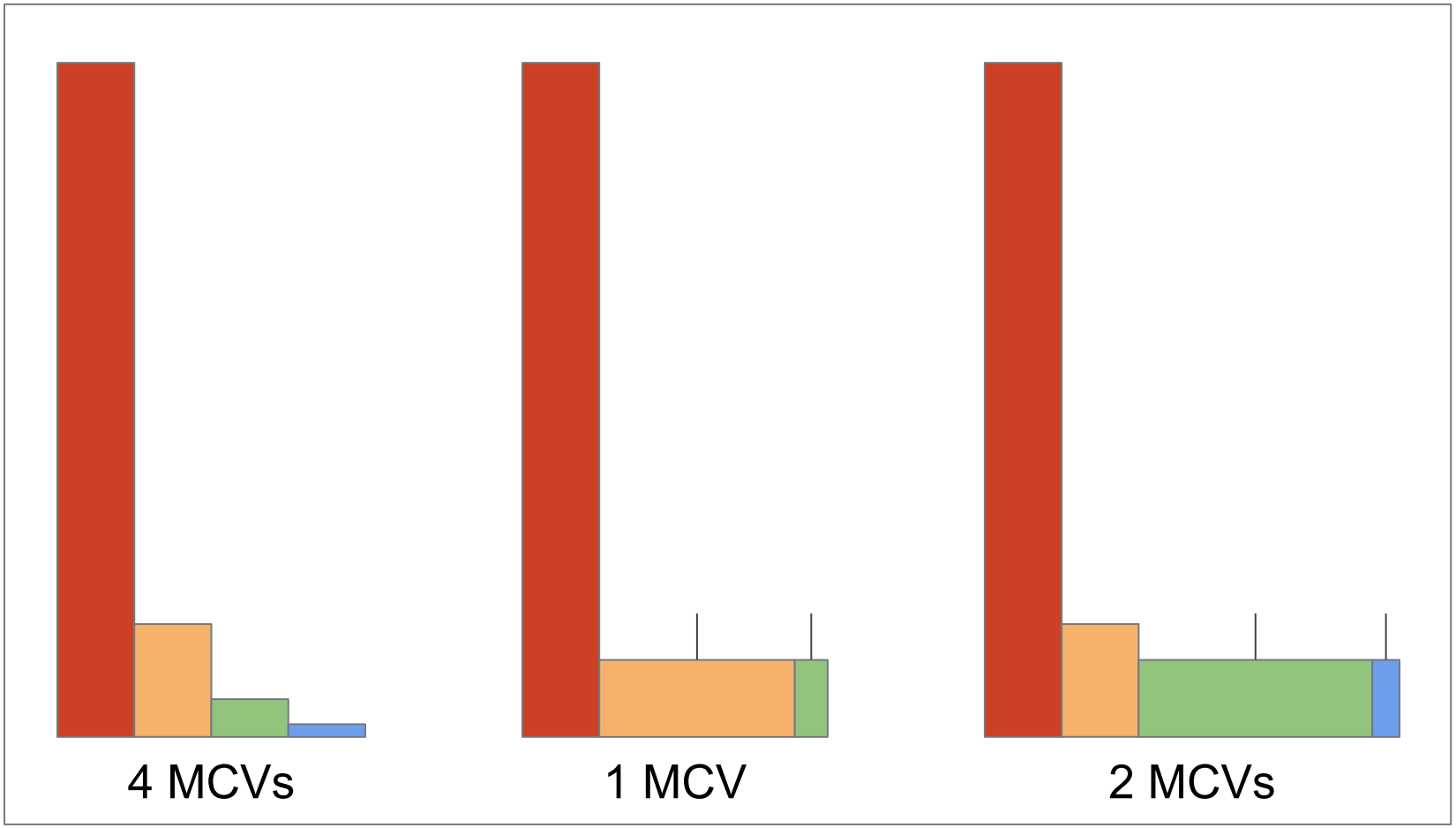

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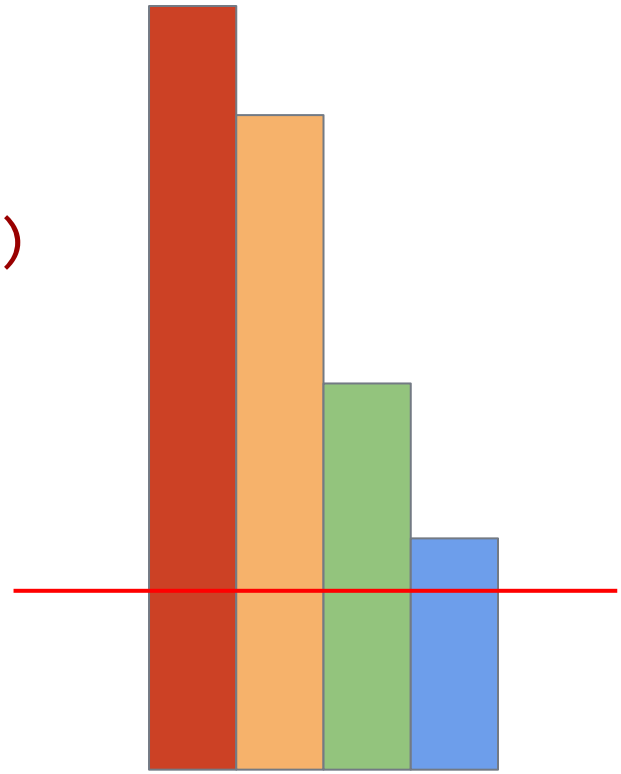
Statistics: What? Where? Why?

The Flipping Plan Problem

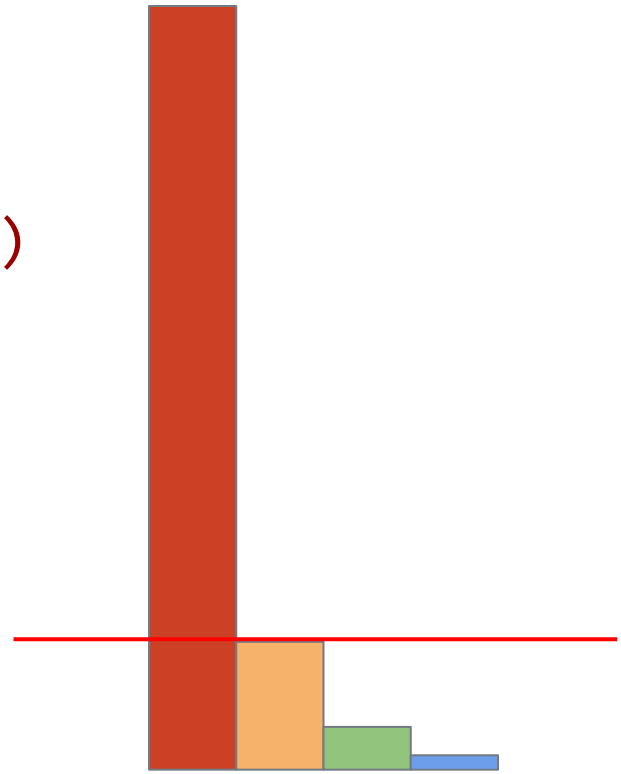
Deep Dive into Code

```
mincount = ...

for (i = 0; i < num_mcv; i++)
{
  if (track[i].count < mincount)
  {
     num_mcv = i;
     break;
  }
}
```

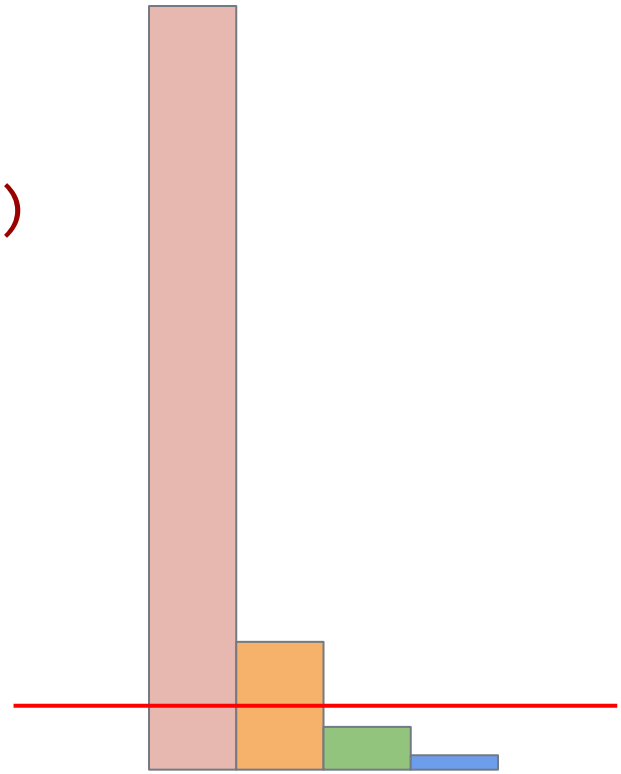


```
mincount = ...
for (i = 0; i < num_mcv; i++)
{
  if (track[i].count < mincount)
  {
     num_mcv = i;
     break;
  }
}
```



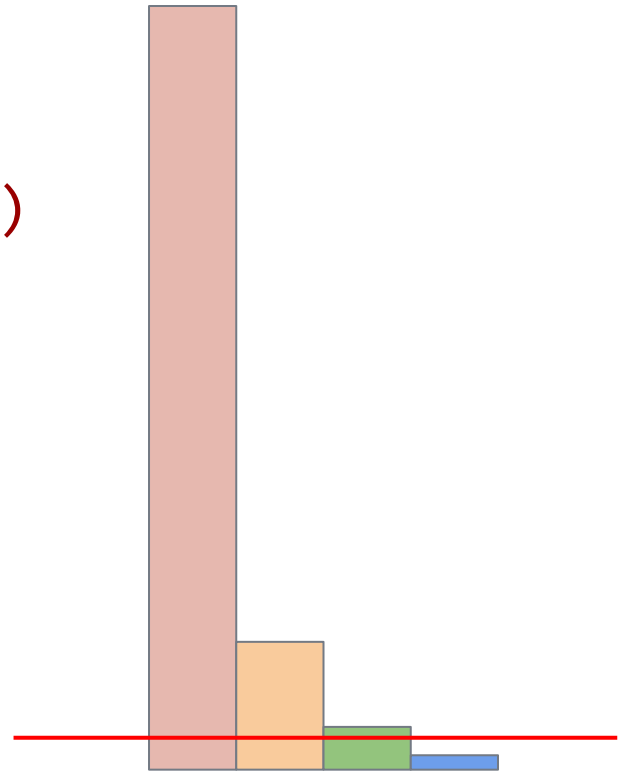
```
for (i = 0; i < num_mcv; i++)
{
  mincount = ...
  if (track[i].count < mincount)
  {
     num_mcv = i;
     break;
  }
}
```

```
// i = 1
```



```
for (i = 0; i < num_mcv; i++)
{
  mincount = ...
  if (track[i].count < mincount)
  {
     num_mcv = i;
     break;
  }
}
```

```
// i = 2
```



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```
WITH stats1 AS (
     SELECT *,
            current_setting('default_statistics_target')::int    AS stats_target,

            array_length(most_common_vals,1)                     AS num_mcv,
            (SELECT SUM(f) FROM UNNEST(most_common_freqs) AS f)  AS mcv_frac,

            array_length(histogram_bounds,1)                     AS num_hist,
            (SELECT COUNT(DISTINCT h)
               FROM UNNEST(histogram_bounds::text::text[]) AS h) AS distinct_hist

       FROM pg_stats
      WHERE schemaname NOT IN ('pg_catalog', 'information_schema')
 ),
 stats2 AS (
     SELECT *,
            distinct_hist::real/num_hist AS hist_ratio
       FROM stats1
 )
```

“Before”

```
most_common_vals   | {101,100}
most_common_freqs  | {0.806367,0.1773}
hist_ratio         | 0.214286
histogram_bounds   | {202,202,202,202,202,202,202,202,202,3001,302,302,302,
                      302,302,302,302,302,302,302,302,3031,3185,502,502,502,
                      502,502}
```

“After”

```
most_common_vals   | {101,100,302,202,502,3001,3059,3029,3031,3140,3041,3095,
                      3100,3102,3192}
most_common_freqs  | {0.803933,0.179,0.00656667,0.00526667,0.00356667,

0.000333333,0.000133333,0.0001,0.0001,0.0001,...}
hist_ratio         | 1
histogram_bounds   | {3007,3011,3027,3056,3067,3073,3084,3087,3088,3106,3107,
                      3118,3134,3163,3204,3225,3247}
```

“Before”

```
  WITH ...
SELECT count(1),
       min(hist_ratio)::real,
       avg(hist_ratio)::real,
       max(hist_ratio)::real,
       stddev(hist_ratio)::real
  FROM stats2
 WHERE histogram_bounds IS NOT NULL;
```

```
count  | 21335
min    | 0.176471
avg    | 0.939104
max    | 1
stddev | 0.14548
```

```
  WITH ...
SELECT count(1),
       min(hist_ratio)::real,
       avg(hist_ratio)::real,
       max(hist_ratio)::real,
       stddev(hist_ratio)::real
  FROM stats2
 WHERE distinct_hist < num_hist;
```

```
count  | 4128
min    | 0.176471
avg    | 0.686448
max    | 0.990099
stddev | 0.172547
```

“After”

```
  WITH ...
SELECT count(1),
       min(hist_ratio)::real,
       avg(hist_ratio)::real,
       max(hist_ratio)::real,
       stddev(hist_ratio)::real
  FROM stats2
 WHERE histogram_bounds IS NOT NULL;
```

```
count  | 18314
min    | 0.448276
avg    | 0.988884
max    | 1
stddev | 0.052899
```

```
  WITH ...
SELECT count(1),
       min(hist_ratio)::real,
       avg(hist_ratio)::real,
       max(hist_ratio)::real,
       stddev(hist_ratio)::real
  FROM stats2
 WHERE distinct_hist < num_hist;
```

```
count  | 1095      (was 4128)
min    | 0.448276  (was 0.176471)
avg    | 0.81408   (was 0.686448)
max    | 0.990099
stddev | 0.119637
```

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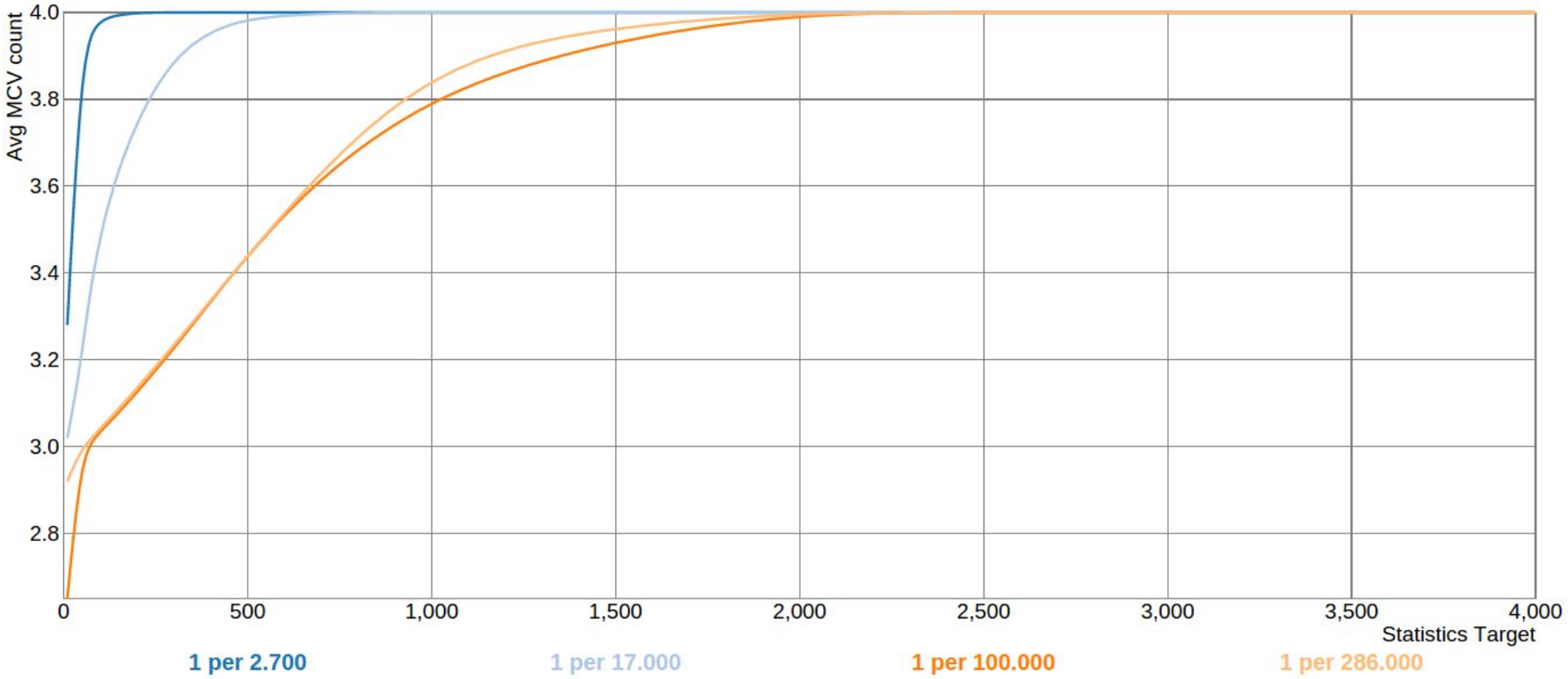

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“Before”

```
  WITH ...
SELECT count(1),
       min(num_mcv)::real,
       avg(num_mcv)::real,
       max(num_mcv)::real,
       stddev(num_mcv)::real
  FROM stats2
 WHERE num_mcv IS NOT NULL;
```

```
count  | 27452
min    | 1
avg    | 32.7115
max    | 100
stddev | 40.6927
```

```
  WITH ...
SELECT count(1),
       min(num_mcv)::real,
       avg(num_mcv)::real,
       max(num_mcv)::real,
       stddev(num_mcv)::real
  FROM stats2
 WHERE num_mcv < 100;
```

```
count  | 20980
min    | 1
avg    | 11.9541
max    | 99
stddev | 18.4132
```

“After”

```
  WITH ...
SELECT count(1),
       min(num_mcv)::real,
       avg(num_mcv)::real,
       max(num_mcv)::real,
       stddev(num_mcv)::real
  FROM stats2
 WHERE num_mcv IS NOT NULL;
```

```
count  | 27527
min    | 1
avg    | 38.4341  (was 32.7115)
max    | 100
stddev | 43.3596
```

```
  WITH ...
SELECT count(1),
       min(num_mcv)::real,
       avg(num_mcv)::real,
       max(num_mcv)::real,
       stddev(num_mcv)::real
  FROM stats2
 WHERE num_mcv < 100;
```

```
count  | 19329
min    | 1
avg    | 12.3222  (was 11.9541)
max    | 99
stddev | 19.6959
```

Statistics: What? Where? Why?

The Flipping Plan Problem

Deep Dive into Code

A Bird Eye's View

Solution?

References

- pgsql-hackers thread (the patch)
- pgsql-performance thread (flipping plan)
- commitfest entry