## 5.156 first_value_diff_0

DESCRIPTION LINKS AUTOMATON

**Origin** Paparazzi puzzle

**Constraint** first_value_diff_0(VAR, VARIABLES)

**Synonyms** first_value_diff_from_0, first_value_different_from_0.

**Arguments**

| | | |
|---|---|---|
| VAR | : | dvar |
| VARIABLES | : | collection(var−dvar) |

**Restrictions**

$\texttt{VAR} \neq 0$
$|\texttt{VARIABLES}| \geq 1$
required(VARIABLES, var)

**Purpose** VAR is equal to the first non-zero variable of the collection VARIABLES.

**Example**

$(8, \langle 0, 0, 8, 0, 5 \rangle)$
$(4, \langle 4, 0, 8, 0, 5 \rangle)$

**Typical**

$|\texttt{VARIABLES}| > 1$
$\texttt{minval}(\texttt{VARIABLES.var}) < 0 \vee \texttt{maxval}(\texttt{VARIABLES.var}) > 1$
$|\texttt{VARIABLES}| - \texttt{among\_diff\_0}(\texttt{VARIABLES.var}) \geq 1$
$\bigvee \left( \begin{array}{l} |\texttt{VARIABLES}| \leq 4, \\ |\texttt{VARIABLES}| - \texttt{among\_diff\_0}(\texttt{VARIABLES.var}) > 1 \end{array} \right)$

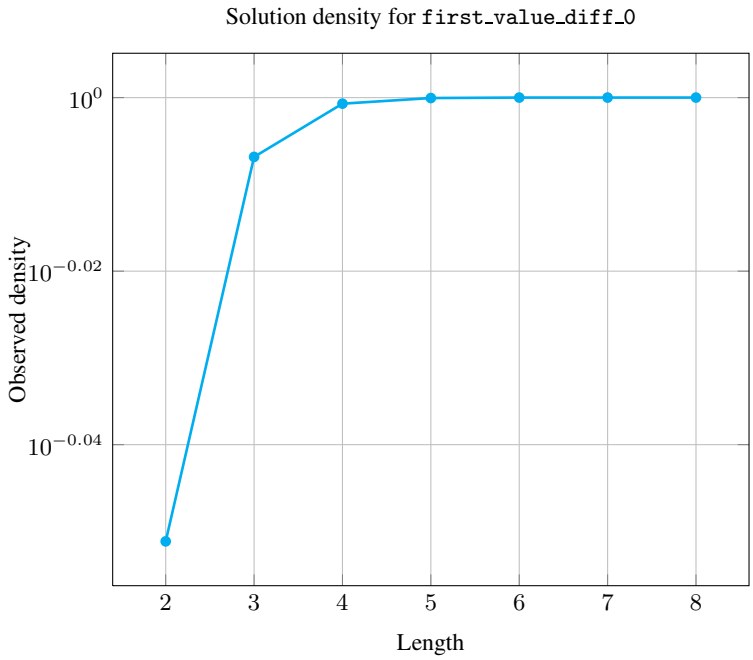
**Arg. properties**

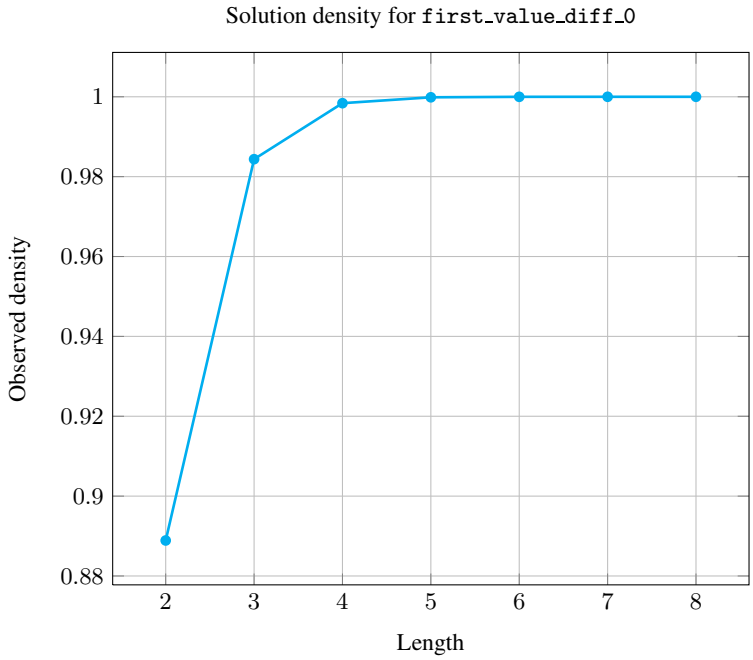
Functional dependency: VAR determined by VARIABLES.

**Counting**

| Length ($n$) | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| Solutions | 8 | 63 | 624 | 7775 | 117648 | 2097151 | 43046720 |

Number of solutions for first_value_diff_0: domains $0..n$

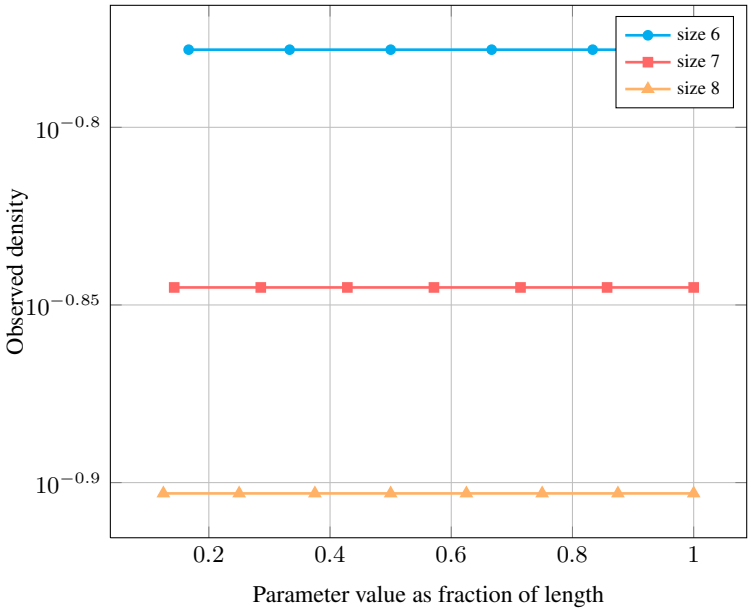

Solution density for first_value_diff_0
Observed density
$10^{0}$
$10^{-0.02}$
$10^{-0.04}$
2
3
4
5
6
7
8
Length

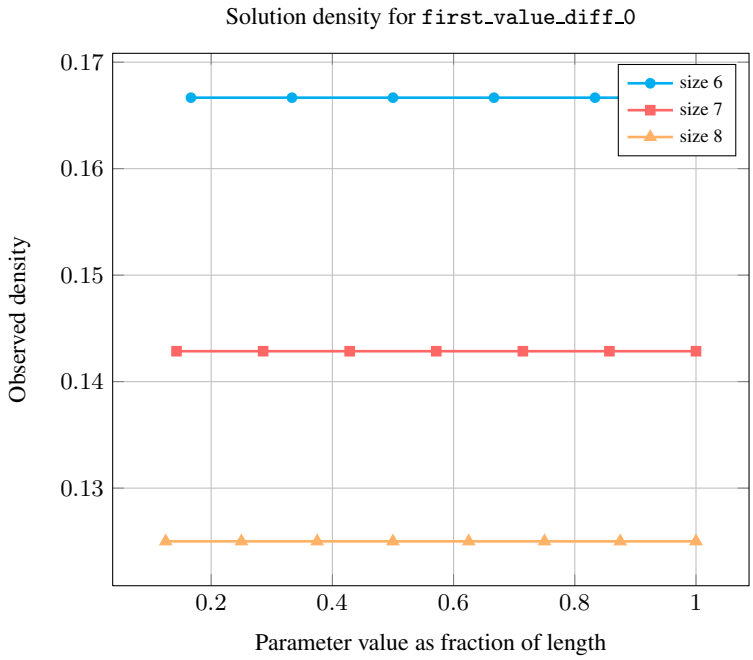

Solution density for first_value_diff_0
Observed density
1
0.98
0.96
0.94
0.92
0.9
0.88
2
3
4
5
6
7
8
Length

| Length ($n$) | | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Total | | 8 | 63 | 624 | 7775 | 117648 | 2097151 | 43046720 |
| Parameter value | 1 | 4 | 21 | 156 | 1555 | 19608 | 299593 | 5380840 |
| | 2 | 4 | 21 | 156 | 1555 | 19608 | 299593 | 5380840 |
| | 3 | - | 21 | 156 | 1555 | 19608 | 299593 | 5380840 |
| | 4 | - | - | 156 | 1555 | 19608 | 299593 | 5380840 |
| | 5 | - | - | - | 1555 | 19608 | 299593 | 5380840 |
| | 6 | - | - | - | - | 19608 | 299593 | 5380840 |
| | 7 | - | - | - | - | - | 299593 | 5380840 |
| | 8 | - | - | - | - | - | - | 5380840 |

Solution count for `first_value_diff_0`: domains $0..n$

Solution density for `first_value_diff_0`






**See also** **implies:** `between_min_max`.

**Keywords** **characteristic of a constraint:** joker value, automaton, automaton with counters.
**modelling:** functional dependency.

**Automaton**

Figure 5.335 depicts an automaton that only accepts all the solutions to the `first_value_diff_0` constraint. This automaton uses a counter in order to record the value of the first non-zero variable $\texttt{VAR}_i$ already encountered. To each variable $\texttt{VAR}_i$ of the collection `VARIABLES` corresponds a 0-1 signature variable $S_i$. The following signature constraint links $\texttt{VAR}_i$ and $S_i$: $\texttt{VAR}_i \neq 0 \Leftrightarrow S_i$.

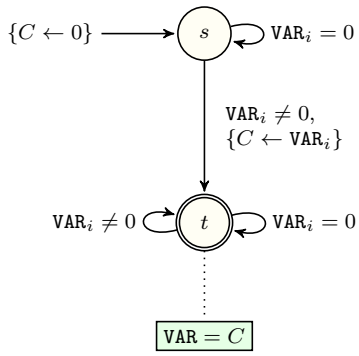



Figure 5.335: Automaton (with one counter) of the `first_value_diff_0` constraint

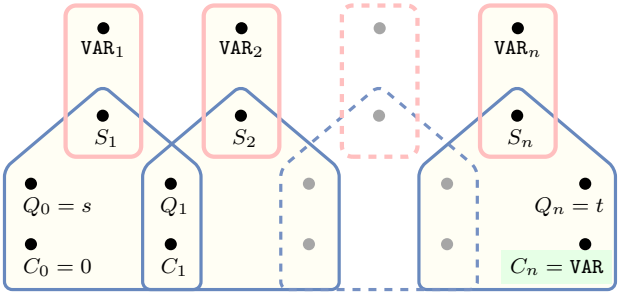



Figure 5.336: Hypergraph of the reformulation corresponding to the automaton (with one counter) of the `first_value_diff_0` constraint