

VarTable

VarTable is a package to make variation table, in a simple way
This package is build on top of [fletcher](#)
(version: 0.1.0)

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1 - Introduction

This package is designed to simplify the creation of variation tables for functions. To do this, it gives you a typst function, whose parameters are described in detail in this documentation.

A word of warning: it's quite normal that during the array creation process, The elements, such as the lines between the various elements, aren't created as they should be. For example, the line between the labels and the rest, which doesn't go all the way to the end.

If you encounter any bugs, please report them on my [GitHub](#).

2 - tabvar function

2.1 - general description

tabvar

Render a variation table and sign table of your functions

Parameters

```
tabvar(  
  init: dictionary,  
  domain: array,  
  arrow: string,  
  stroke: lenght color gradient,  
  stroke-arrow: lenght color gradient,  
  lign-0: bool,  
  content: array  
)
```

init dictionary

initialitation of the table

- in “variable”, is an content wich contain the table’s variable (like x or t)
- in “label”, you have to put array of 2 arguments that contain in first position the lign’s label and in second position, if the lign is a variation table or a sign table with this following keys : “Variation” and “Sign”

Example: for a variation table of a function f , you should write:

```
init: (  
  variable: $x$,  
  label: (  
    ([sign of $f$], "Sign"), //<- the first lign is a sign table  
    ([variation of $f$], "Variation") //<- the second lign is a variation table  
  )  
)
```

Default: (

```
  "variable": [],  
  "label": [],  
)
```

domain array

values taken by the variable

for example if your funtion changes sign or reaches a max/min for $x \in \{0, 1, 2, 3\}$

you should write this :

```
domain: ($0$, $1$, $2$, $3$)
```

Default: ()

arrow string

Optional

the style of the arrow

you can use all different kinds of “string” arrow of the fletcher package, so I invite you to read the [fletcher documentation](#)

Default: "->"

stroke lenght or color or gradient

Optional

the table's color and thickness

Caution : this stroke can take only lenght, color or gradient types but none of the others

Default: 1pt + black

stroke-arrow lenght or color or gradient

Optional

the arrow's color and thickness

Caution : this stroke can take only lenght, color or gradient types but none of the others

Default: 0.6pt + black

lign-0 bool

Optional

if you want 0 on lign between the sign

Default: false

content array

the content of the table

see below for more details

Default: (,)

2.2 - The content parameter

The content parameter must be an array with one element per line (per label)

Each element is itself an array with one element per column, with a different format for either sign or variation rows

2.2.1 - Sign rows format

Should contain as much element as the domain less one (one per interval) + one optional end bar style element

Each element is in either of these form (can be mixed on a same line):

() – Empty : extend previous cell

body – Simple body such as $+$ or $-$

(body, bar style) – to specify an optional style for the previous bar, with one of "|" (simple bar),

"||" (double bar) or "0" (bar with a zero)

NB: the sign-0 parameter change the default bar style from "|"

the optional last element is "||"

2.2.1.1 - A classical sign array

A sign array must be just contain content like $+$ or $-$, but if you want put anything else, you can.

Example :

A normal sign table :

```
#tabvar(  
  init: (  
    variable:  $t$ ,  
    label: ([sign], "Sign"),  
  ),  
  domain: ( $2$ ,  $4$ ,  $6$ ,  $8$ ),  
  content: ( $+$ ,  $-$ ,  $+$ ),  
)
```

t	2	4	6	8
sign	+	−	+	

but if you want, you can do that :

```
#tabvar(  
  init: (  
    variable:  $t$ ,  
    label: ([sign], "Sign"),  
  ),  
  domain: ( $2$ ,  $4$ ,  $6$ ,  $8$ ),  
  content: (  
    (  
      "hello world",  
       $-$ ,  
       $\frac{3}{2}$   
    ),  
  ),  
)
```

t	2	4	6	8
sign	hello world	−	$\frac{3}{2}$	

But I'm not really sure about the utility of that

(note: on the second example the table is squeezed with the scale function)

2.2.1.2 - Custom separation bar

For all signs except the first, instead of putting the sign directly, you can put a couple, whose first component defines the type of bar just before it.

And there are 3 different types of bar:

- with the "|" key, you make a simple bar
- with the "0" key, you make a bar with a 0 on the center
- with the "||" key, you make a double bar, like for the undefined values

Example :

```
#tabvar(  
  init: (  
    variable: $t$,  
    label: ([sign], "Sign"),  
  ),  
  domain: ($2$, $4$, $6$, $8$),  
  content: (  
    (  
      $+$,  
      ("|", $-$),  
      ("0", $-$),  
      ("||", $+$)  
    ),  
  ),  
)
```

t	2	4	6	8	10
sign	+	−	0	−	+

Note : The lign-0 parameter is to default lines to "0" type or "|" type

If you want a double lign at the start, you could, as we have just seen, with the "||" type on the very first sign and at the end, you could add this element || at the end of sign array

Example :

```
#tabvar(  
  lign-0: true,  
  init: (  
    variable: $t$,  
    label: ([sign], "Sign"),  
  ),  
  domain: ($2$, $4$, $6$, $8$),  
  content: (  
    (  
      ("||", $+$),  
      $-$,  
      "||"  
    ),  
  ),  
)
```

t	2	4	6
sign	+	0	−

2.2.1.3 - Same sign for more than one value of the variable

For this, it is pretty easy, instead of putting the sign directly, you can put a empty couple

Example :

```
#tabvar(  
  lign-0: true,  
  init: (  
    variable: $t$,  
    label: ([sign], "Sign"),  
  ),  
  domain: ($2$, $4$, $6$, $8$),  
  content: (  
    (  
      $+$,  
      (),  
      $-$  
    ),  
  ),  
)
```

t	2	4	6	8
sign		+	0	-

2.2.2 - Variation table

Should contain as much element as the domain

Each element is in either of these forms :

() to extend previous arrow

(position,body) with position being one of top, center or bottom

(pos1, pos2,"||",body1,body2) to put in 2 value separated by an undefined (double bar)

(pos,"||",body) short for (pos,pos,"||",body,body) (see previous format)

2.2.2.1 - A classical variation array

An variation array must be contain couple with in first position, the position; and in second position, whatever you want as long as it's of the content type.

The position can be: top, center or bottom, but no other type of alignment

Example :

```
#tabvar(  
  lign-0: true,  
  init: (  
    variable: $t$,  
    label: ([variation], "Variation"),  
  ),  
  domain: ($2$, $4$, $6$, $8$),  
  content: (  
    (  
      (top, $3$),  
      (bottom, $0$),  
      (center, $1$),  
      (top, $4$),  
    ),  
  ),  
)
```

t	2	4	6	8
variation	3		1	4

2.2.2.2 - Undefined values

If your function have certain values undefined like $f(x) = \frac{1}{x}$ for $x = 0$, you certainly want to put a double ligh to mean it undefine, and you can!

★ For each values of domain except the start and the end.

The array of one value should look like (pos1, pos2, "||", content1, content2)

where:

- pos1 and 2 is top, center, bottom and pos1 is for the placement of content1 similary for pos2
- "||" is to precise the value is undefine
- content1 and 2 is type of content and content1 one is for before the double bar and content2 for after

Example:

```
#tabvar(
  init: (
    variable: $t$,
    label: ([variation], "Variation"),),
),
domain: ($2$, $4$, $6$, $8$),
content: (
  (
    (top, $3$),
    (bottom, top, "||", $0$, $2$),
    (bottom, $1$),
  ),
),
)
```

t	2	4	6
variation	3 ↘ 0	2 ↘ 1	

If pos1 and pos2 is same, you can just fill in one instead of two,

In the same way if content1 and content2 is same, you can also enter just one

Example:

Instead of (top, top, "||" , \$0\$, \$0\$) you can use (top, "||" , \$0\$)

```
#tabvar(
  init: (
    variable: $t$,
    label: ([variation], "Variation"),),
),
domain: ($2$, $4$, $6$, $8$),
content: (
  (
    (top, $3$),
    (bottom, "||", $0$, $1$),
    (top, center, "||", $2$),
    (top, "||", $3$),
    (bottom, $1$),
  ),
),
)
```

t	2	4	6	8	9
variation	<div>3 ↘ 0</div>	<div>2 ↗ 1</div>	<div>3 ↗ 2</div>	<div>3 ↘ 1</div>	

★ For the first and the end values

It a basic array but with "||" this parameter at the array's center

For example (top, "||", \$3\$)

```
#tabvar(
  init: (
    variable: $t$,
    label: ([[variation], "Variation"]),
  ),
  domain: ($2$, $4$, $6$, $8$),
  content: (
    (
      (top, "||", $3$),
      (bottom, $1$),
      (top, "||", $2$),
    ),
  ),
)
```

t	2	4	6
variation	3		2

2.2.2.3 - Skip a value

When you want to use several functions in the same table, you will probably want to skip some values, to do this, as with sign arrays, you create an empty array

Example :

```
#tabvar(
  init: (
    variable: $t$,
    label: ([[variation], "Variation"]),
  ),
  domain: ($2$, $4$, $6$, $8$),
  content: (
    (
      (top, "||", $3$),
      (),
      (bottom, $2$),
    ),
  ),
)
```

t	2	4	6
variation	3		2

3 - More complex examples

There is a little bundle of what you can do

3.1 - Γ function on $[0; +\infty]$

Where it takes a minimum on $[0; +\infty[$ for $x = \alpha$

Code:

```
#tabvar(
  init: (
    variable:  $t$ ,
    label: (
      ([sign of  $\Gamma$ ], "Sign"),
      ([variation of  $\Gamma$ ], "Variation"),
    ),
  ),
  domain: ( $0$ ,  $\alpha$ ,  $+\infty$ ),
  content: (
    ( $-$ ,  $+$ ),
    (
      (top, " $||$ ",  $+\infty$ ),
      (bottom,  $\Gamma(\alpha)$ ),
      (top,  $+\infty$ ),
    ),
  ),
)
```

Result:

t	0	α	$+\infty$
sign of Γ	-		+
variation of Γ	$+\infty \searrow \Gamma(\alpha) \nearrow +\infty$		

3.2 - A Rational function

Take $f(x) = \frac{4x^2+12x+29}{4(x^2+3x+2)}$

So we have $f'(x) = \frac{-2x-3}{16(x^2+3x+2)^2}$

And finally, we get:

Code:

```
#tabvar(
  init: (
    variable: $t$,
    label: (
      ([sign of $f'$], "Sign"),
      ([variation of $f$], "Variation"),
    ),
  ),
  domain: ($ -\infty $, $ -2 $, $ -3 / 2 $, $ -1 $, $ +\infty $),
  content: (
    ($+$, ("||", $+$), $-$, ("||", $-$)),
    (
      (bottom, $1$),
      (top, bottom, "||", $+\infty$, $-\infty$),
      (top, $-20$),
      (bottom, top, "||", $-\infty$, $+\infty$),
      (bottom, $1$),
    ),
  ),
)
```

Result:

t	$-\infty$	-2	$-\frac{3}{2}$	-1	$+\infty$
sign of f'	+		+	-	-
variation of f	$1 \nearrow +\infty$		$-\infty \nearrow -20 \searrow -\infty$		$+\infty \searrow 1$

3.3 Hyperbolic function

Code:

```
#tabvar(
  arrow: "|-harpoon",
  stroke-arrow: gradient.linear(..color.map.rainbow),
  init: (
    variable: $t$,
    label: (
      ([sign of $cosh$, "Sign"),
      ([variation of $cosh$, "Variation"),
      ([sign of $sinh$ and $tanh$, "Sign"),
      ([variation of $sinh$, "Variation"),
      ([variation of $tanh$, "Variation"),
    ),
  ),
  domain: ($ -\infty $, $ 0 $, $ +\infty $),
  content: (
    ($-$, $+$),
    (
      (top, $+\infty$),
      (bottom, $1$),
      (top, $+\infty$),
    ),
    ($+$, $()$),
    (
      (bottom, $-\infty$),
      (),
      (top, $+\infty$),
    ),
    (
      (bottom, $1$),
      (),
      (top, $-1$),
    ),
  ),
),
)
```

Result:

t	$-\infty$	0	$+\infty$
sign of cosh	$-$		$+$
variation of cosh	$+\infty$	1	$+\infty$
sign of sinh and tanh		$+$	
variation of sinh	$-\infty$		$+\infty$
variation of tanh	1		-1

3.3 A weird table for a simple polynom function

Take $g(t) = t^2 - t^3$

So, we have $g'(t) = 2t - 3t^2$

And has local extrema for $x = 0$ and $x = \frac{2}{3}$

Code:

```
#tabvar(
  lign-0: true,
  stroke: 5pt + red,
  arrow: "X-*-<>",
  stroke-arrow: purple + 1.4pt,
  init: (
    variable: $t$,
    label: (
      ([sign of $g'$], "Sign"),
      ([variation of $g$], "Variation"),
    ),
  ),
  domain: ($ -\infty $, $ 0 $, $ 2 / 3 $, $ +\infty $),
  content: (
    ($-$, ("|", $+$), $-$),
    (
      (top, $+\infty$),
      (bottom, $0$),
      (center, $ 4 / 27 $),
      (bottom, $-\infty$),
    ),
  ),
),
)
```

Result:

t	$-\infty$	0	$\frac{2}{3}$	$+\infty$
sign of g'	$-$	$+$	0	$-$
variation of g				