`unitchg`: A package for unit conversion

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2025 German Stata Conference
March 28th 2025
University of Hamburg

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Aim of presentation

- Introducing `unitchg` and the egen-function `unitchg()`.
- Universal approach to convert units of measurement.
- Main purpose: `unitchg()`—Creation of variables holding converted number.
- `unitchg` is a companion, mostly for documentation.

(Examples below use `unitchg` to show Stata output)

Motivation

- Variables may contain values expressed in units hard to interpret for some
- Milage of Linc. Mark V is 12 $\frac{\text{miles}}{\text{gallon}_{\text{US}}}$. Small or Large?
- Europeans speek $\frac{\text{liter}}{100\ \text{km}}$

```
. unitchg 12, milage(mi/gal_US) to(l/100 km)
12 mile per US gallon is  19.60117608 liter per 100 kilometer
```

- Other examples:
  - flat sizes in ft^2 (instead of m^2).
  - body height in feet and inches (instead of meters and centimeters).
  - areas in acre (instead of hectare, soccer-fields, etc).
  - wages in USD (instead of EUR).
  - etc.

About unit conversion

Absolute scales (e.g. lengths, areas, volumes, etc.): constant rescale factor.

Interval scales (e.g. temperature): additive shift and rescale factor.

Fractions (e.g. speed, milage): rescale factor (nominator, denominator) and inversion.

Currencies rescale factor for date/period.

Unit conversion can be done with a one liner, once you know the rescale factor (or formula). `unitchg` saves you the trouble of looking up.

Simplified syntax

```
. unitchg # , converter(from-unit) [ to(to-unit) ]
. egen newvarname= unitchg(varname) ,
converter(from-unit) [ to(to-unit) ]
```

Basic idea: Take the input and use the converter to change the originating *from-unit* into units of *to-unit*.

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Basic examples with `unitchg`

```
. unitchg 42.195, length(km) to(mi)
42.195 kilometer is  26.21870502 mile
. unitchg 5.11, length(ft) to(cm) decimal(inch)
5.91666666666667 foot is       180.34 centimeter
. unitchg 0.75, volume(l) to(gal_US)
0.75 liter is  .1981290393 US gallon
. unitchg 1, area(ac) to(h)
1 acre is  .4046856422 hectare
. unitchg 55, speed(mi/h) to(km/h)
55 mile per hour is  88.51409703 kilometer per hour
. unitchg 4.50, speed(min/km) to(km/h) decimal(second)
4.833333333333333 minute per kilometer is   12.4137931 kilometer per hour
```

Some entertainment

The scope of `unitchg` is broad . . .

```
. unitchg 42.195, l(km) to(fur)
42.195 kilometer is  209.7500597 furlong
. unitchg 0.75, v(l) to(vodka bottle)
0.75 liter is  1.219570695 vodka bottle (RU)
. unitchg 1, ti(quarantine) to(lunation)
1 quarantine is  1.354527627 lunation
. unitchg 5, s(min/km) to(fur/fortnight)
5 minute per kilometer is  20042.94918 furlong per fortnight
. unitchg 1, ar(ftball_UK) to(ftball_US)
1 UK football field is  1.596622892 US football field
```

German users may be relieved to see that areas can be converted to units of Saarland.[1] The U.S., for example, is as big as 3840 units of Saarland:

```
. unitchg 3809525, area(mi^2) to(saarland)
3809525 mile^2 is  3839.631291 saarland
```

[1] See `https://taz.de/Massstab-Saarland/!5839047/`

Examples with `egen-unitchg`

```
. sysuse auto
(1978 automobile data)
. egen milageEU = unitchg(mpg), mil(mi/gal_US) to(l/100 km)
. egen headroomEU = unitchg(headroom), l(in) to(cm)
. egen trunkEU = unitchg(trunk), v(ft^3) to(l)
. egen weightEU = unitchg(weight), m(lb) to(kg)
. egen lengthEU = unitchg(length), l(in) to(m)
. egen displacementEU = unitchg(displacement), v(in^3) to(cm^3)
. d *EU
```

Variable name	Storage type	Display format	Value label	Variable label
milageEU	float	%9.0g		Mileage (mpg) converted to liter per 100 kilometer
headroomEU	float	%9.0g		Headroom (in.) converted to centimeter
trunkEU	float	%9.0g		Trunk space (cu. ft.) converted to liter
weightEU	float	%9.0g		Weight (lbs.) converted to kilogram
lengthEU	float	%9.0g		Length (in.) converted to meter
displacementEU	float	%9.0g		Displacement (cu. in.) converted to centimeter^3

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Basics

- Conversion by calling the API `frankfurter.dev`[2].
- Source: European Central Bank.
- Stata must be Online.
- Defaults to exchange rate of the current day:

```
. unitchg 45, currency(EUR) to(USD)
45 EUR is       48.546 USD (at 2025-03-27)
```

- Aside: returns might be useful:

```
. return list
macros:
             r(toname) : "USD (at 2025-03-27)"
           r(fromname) : "EUR"
             r(factor) : "1.0788"
                 r(to) : "48.546"
               r(from) : "45"
```

[2] https://frankfurter.dev/

Specification of date

- Exact dates in any DMY format:

```
. unitchg 45, c(EUR) to(USD) date(17/mar/2025)
45 EUR is      49.0635 USD (at 2025-03-17)
. unitchg 45, c(EUR) to(USD) date(19. 3. 2025)
45 EUR is      49.0365 USD (at 2025-03-19)
```

- Yearly averages by stating the year

```
. unitchg 45, c(EUR) to(USD) date(2000)
45 EUR is  41.57680078 USD (average of 2000-01-01..2000-12-31)
. unitchg 45, c(EUR) to(USD) date(2024)
45 EUR is  48.71108171 USD (average of 2024-01-01..2024-12-31)
```

- Averages of any period by stating DMY of start and end.

```
. unitchg 45, c(EUR) to(USD) date(7. April 2000:7.4.2011)
45 EUR is  54.45475258 USD (average of 2000-04-07..2011-04-07)
```

- Missing exact dates refer to first day/last day:

```
. unitchg 45, c(EUR) to(USD) date(2000:7.4.2011)
45 EUR is  54.20918839 USD (average of 2000-01-01..2011-04-07)
. unitchg 45, c(EUR) to(USD) date(7 April 2000:2011)
45 EUR is  54.98774476 USD (average of 2000-04-07..2011-12-31)
```

Contents

`unitchg` documents what we have

- `unitchg` can be extended easily.[3] An alternative syntax documents the available converters and units.

  `unitchg [`*`converter [search-term]`*`]`
- `unitchg`: clickable list of converters.
- `unitchg` *`converter`*: available units for converter
- `unitchg` *`converter search-term`* : list of converters' units matching the search term

[3] `https://gitup.uni-potsdam.de/ukohler/unitchg`

List of converters

```
. unitchg
Available converters are:
  o angles
  o areas
  o currencies
  o datastorages
  o datatransfers
  o lengths
  o masses
  o milages
  o speeds
  o temperatures
  o times
  o volumes
Click on converter, or type unitchg converter-name for a list of available
> units.
```

List of temperatures

```
. unitchg temperatures
```

	1	2
1	C	Celsius
2	De	Delisle
3	F	Fahrenheit
4	K	Kelvin
5	N	Newton
6	Ra	Rankine
7	Re	Réaumur
8	Ro	Rømer

List of ancient Roman masses

```
. unitchg masses Roman
```

	1	2
1	assarion	Biblical Roman assarion
2	denarius	Biblical Roman denarius
3	lepton	Biblical Roman lepton
4	quadrans	Biblical Roman quadrans

Numbers of units

As it stands, there are

- 14 angles
- 130 areas
- 31 currencies
- 40 datastorages
- 100 datatransfers
- 91 lengths
- 61 masses
- $2 \times 158 \times 91 = 28756$ milages
- $2 \times 67 \times 91 = 12194$ speeds
- 8 temperatures
- 67 times
- 158 volumes

Units are from Europe or Northern America, including some ancient ones. Nothing from Asia yet (except some Hindu measures for time).

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About Precision

- Conversion is done in two steps:
  1. Input is converted to a base unit (SI base, if applicable)
  2. Base unit is converted into the to-unit.
- Units are restricted to those re-scalable to the base unit with a factor in float precision (i.e. quantities on earth).
- Standard test: cycling through all available units and test whether the original number (0–1000) is reproduced within float precision.
- Do not overuse: Expressing nano-meters in light-minutes, or terra-liters in teaspoons, etc.
- It is possible though:

```
. unitchg 1, length(nm) to(light-minute)
1 nanometer is  5.55940e-20 light-minute
. unitchg 1, volume(Tl) to(tsp)
1 teraliter is  2.00000e+14 teaspoon
```

GitLab-Site

- Package will be sent to SSC
- Development version can be accessed from GitLab:

```
. net from https://gitup.uni-potsdam.de/ukohler/unitchg/-/raw/main/
. net describe unitchg
```

Contributions welcome.

Acknowledgement

Rescale-factors, or formulas were taken from the following sources:

- Areas, datastorages, datatransfers, lengths, masses, volumes: `https://www.translatorscafe.com/unit-converter/en-US/`
- Angles: `https://www.calculatorsoup.com/calculators/conversions/angle.php`
- Temperatures: `https://en.wikipedia.org/wiki/Conversion_of_scales_of_temperature`
- Times: `https://en.wikipedia.org/wiki/Unit_of_time`
- Hindu units of time: `https://en.wikipedia.org/wiki/Hindu_units_of_time`
- Currencies:`https://api.frankfurter.dev`.

I thank the maintainers, contributors, and developers of all the above web-pages.