xint-regression

Classic regressions, with xint.

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https://github.com/cpierquet/latex-packages/tree/main/xint-regression

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```
\def\LISTEX{1,2,3,4,5,6}
\def\LISTEY{8.74,8.80,9.52,10.42,11.83,14.62}

\xintEXPreg[Alt]{\LISTEX}{\LISTEY}              %raw results
$a \approx \exprega$ and $b \approx \expregb$

\xintEXPreg[Alt,round=2]{\LISTEX}{\LISTEY}     %rounded results
$a \approx \exprega$ and $b \approx \expregb$\\

So $y \approx \mathrm{e}^{\exprega x+\expregb}$.
```

$a \approx 0.1014398394374648$ and $b \approx 7.343111895430519$
$a \approx 0.1$ and $b \approx 7.34$

So $y \approx \mathrm{e}^{0.1x+7.34}$.

```
\def\LISTEXX{0,50,100,140}
\def\LISTEYY{275,290,315,350}

\xintEXPOFFreg[offset=250]{\LISTEXX}{\LISTEYY}              %raw results
$a \approx \expregoffa$ and $b \approx \expregoffb$

\xintEXPOFFreg[offset=250,round=2/1]{\LISTEXX}{\LISTEYY}   %rounded results
$a \approx \expregoffa$ and $b \approx \expregoffb$\\

So $y \approx 250+\expregoffb e^{\expregoffa x}$
```

$a \approx 0.009866939273663047$ and $b \approx 24.69189584551776$
$a \approx 0.01$ and $b \approx 24.7$

So $y \approx 250 + 24.7e^{0.01x}$

Contents

1 Introduction

1.1 Global usage

This package offers xint-based commands for working with classical regressions:

- linear regression $ax + b$;
- quadratic regression $ax^2 + bx + c$;
- cubic regression $ax^3 + bx^2 + cx + d$;
- power regression ax^b;
- exponential regression ab^x or e^{ax+b} or be^{ax} or $C + be^{ax}$ (with *fixed* C);
- logarithmic regression $a + b\ln(x)$;
- hyperbolic regression $a + \dfrac{b}{x}$;
- logistic regression $\dfrac{L}{1 + ae^{-bx}}$ (with *fixed* L).

For each type of regression, results (including the coefficient of correlation/determination r or r^2) can be stored in macros, either raw or with rounding (with individuals `[optional keys]`).
For example, if `[coeffa=xxA]`, the macro that will contain the value of coefficient `a` will be `\xxA`.

▶ If the lists differ in size, operations are applied only to the elements within the range of the shorter list.

1.2 Packages used

This package uses `simplekv`, `xintexpr`, `listofitems` and `xstring`.

```
%loading
\usepackage{xint-regression}
```

1.3 Warnings

The precision of the (determination) results seems to be good, which should normally guarantee satisfactory calculations and plots.
Nevertheless, it is advisable to be cautious about the results obtained and those expected.

2 The commands

2.1 Linear regression (xintLINreg or xintlinreg)

The equation is $\boxed{ax+b}$.

```
\xintLINreg[coeffa=...,coeffa=...,coeffr=...,coeffrr=...,round=...]{xlist}{ylist}
```

By default, `coeffa=linrega`; `coeffb=linregb` and `round` is empty.
By default, `coeffr=linregr`; `coeffrr=linregrr` and `round` is empty.
`round=...` can be given within `round=global` or `round=a/b`.

```
\def\LLX{83,71,64,69,69,64,68,59,81,91,57,65,58,62}%
\def\LLY{183,168,171,178,176,172,165,158,183,182,163,175,164,175}%
```

```
%default output
\xintLINreg{\LLX}{\LLY}%
$a \approx \linrega$ and $b \approx \linregb$ \\
$r \approx \linregr$ and $r^2 \approx \linregrr$
```

$a \approx 0.6232992732637560$ and $b \approx 129.5720998852522$
$r \approx 0.7883190802607096$ and $r^2 \approx 0.6214469723030911$

```
%personal macros + global rounding
\xintLINreg[coeffa=LINa,coeffb=LINb,round=2]{\LLX}{\LLY}%
$a \approx \LINa$ and $b \approx \LINb$
```

$a \approx 0.62$ and $b \approx 129.57$

```
%personal macros + individual rounding
\xintLINreg[coeffa=LINEARa,coeffb=LINEARb,round=2/0]{\LLX}{\LLY}%
$a \approx \LINEARa$ and $b \approx \LINEARb$
```

$a \approx 0.62$ and $b \approx 130$

2.2 Quadratic regression (xintQUADreg or xintquadreg)

The equation is $\boxed{ax^2+bx+c}$.

```
\xintQUADreg[coeffa=...,coeffb=...,coeffc=...,coeffrr=...,round=...]{xlist}{ylist}
```

By default, `coeffa=quadrega`; `coeffb=quadregb`, `coeffc=quadrega` and `round` is empty.
By default, `coeffrr=quadregrr` is not rounded.
`round=...` can be given within `round=global` or `round=a/b/...`.

```
\def\LLX{1,2,3,4,5,6,7,8,9,10}%
\def\LLY{3.1,9.8,20.5,35.2,54.1,77.3,103.8,135.0,169.5,208.2}%
```

```
%default output
\xintQUADreg{\LLX}{\LLY}%
$a \approx \quadrega$; $b \approx \quadregb$ and $c \approx \quadregc$

$r^2 \approx \quadregrr$
```

$a \approx 2.001136363636364$; $b \approx 0.8075$ and $c \approx 0.1649999999999900$
$r^2 \approx 0.9999939809721882$

```
%personal macros + global rounding
\xintQUADreg[coeffa=QUADa,coeffb=QUADb,coeffc=QUADc,round=2]{\LLX}{\LLY}%
$a \approx \QUADa$; $b \approx \QUADb$ and $c \approx \QUADc$
```

$a \approx 2$; $b \approx 0.81$ and $c \approx 0.16$

```
%personal macros + individual rounding
\xintQUADreg[coeffa=QUADRAa,coeffb=QUADRAb,coeffc=QUADRAc,round=4/3/2]{\LLX}{\LLY}%
$a \approx \QUADRAa$; $b \approx \QUADRAb$ and $c \approx \QUADRAc$
```

$a \approx 2.0011$; $b \approx 0.808$ and $c \approx 0.16$

2.3 Cubic regression (xintCUBreg or xintcubreg)

The equation for cubic is $\boxed{ax^3 + bx^2 + cx + d}$.

```
\xintCUBreg[coeffa=...,coeffb=...,coeffc=...,coeffd=...,coeffrr=...,round=...]%
  {xlist}
  {ylist}
```

By default, `coeffa=cubrega`; `coeffb=cubregb`; `coeffc=cubregc` and `coeffd=cubregd`.
By default, `coeffrr=cubregrr` is not rounded.

```
\def\LLX{1,2,3,4,5,6,7,8}%
\def\LLY{2.1,7.9,22.3,49.8,95.2,163.4,259.1,387.5}%
```

```
%individual roudings
\xintCUBreg[round=5/3/2/1]{\LLX}{\LLY}%
$a \approx \cubrega$; $b \approx \cubregb$; $c \approx \cubregc$ and $d \approx
↪  \cubregd$

$r^2 \approx \cubregrr$
```

$a \approx 0.80278$; $b \approx -0.646$; $c \approx 2.27$ and $d \approx -0.4$
$r^2 \approx 0.9999997712168544$

2.4 Hyperbolic regression (xintHYPreg or xinthypreg)

The equation for hyperbolic is $\boxed{a + \dfrac{b}{x}}$.

```
\xintHYPreg[coeffa=...,coeffb=...,coeffrr=...,round=...]{xlist}{ylist}
```

By default, `coeffa=hyprega` and `coeffb=hypregb`.
By default, `coeffrr=hypregrr` is not rounded.

```
\def\LLX{1,2,4,5,8,10,20}%
\def\LLY{12.1,7.4,4.3,3.8,2.7,2.3,1.7}%
```

```
%global roudings
\xintHYPreg[round=2]{\LLX}{\LLY}%
$a \approx \hyprega$ and $b \approx \hypregb$

$r^2 \approx \hypregrr$
```

$a \approx 1.41$ and $b \approx 10.97$
$r^2 \approx 0.9937448366855222$

2.5 Logarithmic regression (xintLOGreg or xintlogreg)

The equation for logarithmic is $\boxed{a + b\,\log(x)}$.

```
\xintLOGreg[coeffa=...,coeffb=...,coeffrr=...,round=...]{xlist}{ylist}
```

By default, `coeffa=logrega` and `coeffb=logregb`.
By default, `coeffrr=logregrr` is not rounded.

```
\def\LLX{1,2,5,10,20,50,100}%
\def\LLY{2.1,3.5,5.7,7.2,8.8,10.9,12.3}%
```

```
%individual roudings
\xintLOGreg[round=1/4]{\LLX}{\LLY}%
$a \approx \logrega$ and $b \approx \logregb$

$r^2 \approx \logregrr$
```

$a \approx 2.1$ and $b \approx 2.2421$
$r^2 \approx 0.9996652825626824$

2.6 Power regression (xintPOWreg or xintpowreg)

The equation for power is $\boxed{a \times x^b}$.

```
\xintPOWreg[coeffa=...,coeffb=...,coeffrr=...,round=...]{xlist}{ylist}
```

By default, `coeffa=powrega` and `coeffb=powregb`.
By default, `coeffrr=powregrr` is not rounded.

```
\def\LLX{1,2,3,4,5,6,7,8}%
\def\LLY{2.1,5.9,10.8,17.2,25.1,34.1,44.8,57.2}%
```

```
%default output
\xintPOWreg{\LLX}{\LLY}%
$a \approx \powrega$ and $b \approx \powregb$

$r^2 \approx \powregrr$
```

$a \approx 1.992167504779745$ and $b \approx 1.586903977563563$
$r^2 \approx 0.9952391364059793$

2.7 Exponential regression

Available regressions are:

- $\boxed{a \times b^x}$ (`xintEXPABreg` or `xintexpabreg`);
- $\boxed{e^{ax+b}}$ (`xintEXPreg` or `xintexpreg`);
- $\boxed{b\,e^{ax}}$ (`xintEXPreg` or `xintexpreg` with `[Alt]` key);
- $\boxed{C + b\,e^{ax}}$ with *fixed* C (`xintEXPOFFreg` or `xintexpoffreg`).

```
%a*b^x
\xintEXPABreg[coeffa=...,coeffb=...,coeffrr=...,round=...]{xlist}{ylist}
```

By default, `coeffa=expabrega` and `coeffb=expabregb`.
By default, `coeffrr=expabregrr` is not rounded.

```
%e^(ax+b)
\xintEXPreg[coeffa=...,coeffb=...,coeffrr=...,round=...]{xlist}{ylist}
```

By default, `coeffa=exprega` and `coeffb=expregb`.
By default, `coeffrr=expregrr` is not rounded.

```
%b*e^(ax)
\xintEXPreg[Alt,coeffa=...,coeffb=...,coeffrr=...,round=...]{xlist}{ylist}
```

By default, `coeffa=exprega` and `coeffb=expregb`.
By default, `coeffrr=expregrr` is not rounded.

```
%C+b*e^(ax)
\xintEXPOFFreg[offset=C,coeffa=...,coeffb=...,coeffrr=...,round=...]{xlist}{ylist}
```

By default, `coeffa=expregoffa` and `coeffb=expregoffb`.
By default, `coeffrr=expregoffrr` is not rounded.

```
\def\LLX{1,2,3,4,5,6,7,8}%
\def\LLY{2.1,5.9,10.8,17.2,25.1,34.1,44.8,57.2}%
```

```
%a*b^x
\xintEXPABreg{\LLX}{\LLY}
$a \approx \expabrega$ and $b \approx \expabregb$ and $r^2 \approx \expabregrr$

%e^(ax+b)
\xintEXPreg{\LLX}{\LLY}
$a \approx \exprega$ and $b \approx \expregb$  and $r^2 \approx \expregrr$

%b*e^(ax)
\xintEXPreg[Alt]{\LLX}{\LLY}
$a \approx \exprega$ and $b \approx \expregb$  and $r^2 \approx \expregrr$
```

$a \approx 2.237834559013336$ and $b \approx 1.555219588869324$ and $r^2 \approx 0.8314479752218906$
$a \approx 0.4416167503683003$ and $b \approx 0.8055086835707150$ and $r^2 \approx 0.8314479752218902$
$a \approx 0.4416167503683003$ and $b \approx 2.237834559013334$ and $r^2 \approx 0.8314479752218900$

```
%C+b*e^(ax)
\def\LLX{0,50,100,140}%
\def\LLY{275,290,315,350}%
\xintEXPOFFreg[offset=250]{\LLX}{\LLY}
$a \approx \expregoffa$ and $b \approx \expregoffb$ and $r^2 \approx \expregoffrr$
```

$a \approx 0.009866939273663047$ and $b \approx 24.69189584551776$ and $r^2 \approx 0.9985249882535183$

2.8 Logistic regression (xintLOGISTreg or xintlogistreg)

The equation for logistic is $\boxed{\dfrac{L}{1+a\times e^{-bx}}}$ with *fixed* L, given by *asmyptote*.

```
\xintLOGISTreg[asymptote=...,coeffa=...,coeffb=...,coeffL=...,coeffrr=...,round=...]%
  {xlist}
  {ylist}
```

By default, `coeffa=logista`, `coeffb=logistb`, and `coeffL=logistL`.
By default, `asymptote=10` (user **must** provide the asymptote value).
By default, `coeffrr=logistrr` is not rounded.

```
\def\LLX{0,1,2,3,4,5,6}%
\def\LLY{1,2,4.5,7,8.5,9.2,9.6}%
```

```
%default output with asymptote L=10
\def\LLX{0,1,2,3,4,5,6}%
\def\LLY{1,2,4.5,7,8.5,9.2,9.6}%

\xintLOGISTreg[asymptote=10]{\LLX}{\LLY}%
$L = \logistL$, $a \approx \logista$ and $b \approx \logistb$

$r^2 \approx \logistrr$
```

$L = 10$, $a \approx 8.367734411460100$ and $b \approx 0.9185139202457474$
$r^2 \approx 0.9940997390842095$

3 Integration with other packages

3.1 Number formatting

It is possible to format the results, according to locale rules, for example with sinuitx.

With `[locale=FR]`:

```
%a*b^x
\xintEXPABreg[round=1/3]{\LLX}{\LLY}%
So we obtain $y \approx \num{\expabrega} \times e^{\num{\expabregb}\times x}$
```

So we obtain $y \approx 1{,}5 \times e^{1{,}454 \times x}$

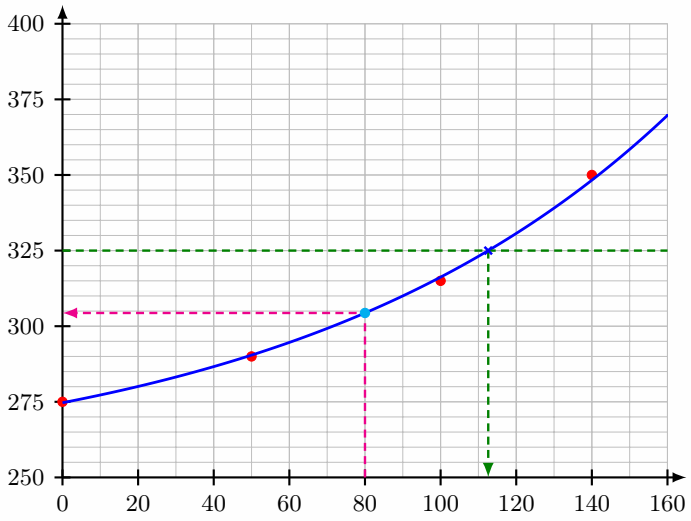
3.2 Plotting

It is also possible to integrate the package's commands into a plotting environment, such as tikz or pgfplots.

For example, with tkz-grapheur package:

```
\def\LISTEXX{0,50,100,140}%
\def\LISTEYY{275,290,315,350}%

\begin{GraphiqueTikz}
  [x=0.05cm,y=0.04cm,Xmin=0,Xmax=160,Xgrille=20,Xgrilles=10,
  Origy=250,Ymin=250,Ymax=400,Ygrille=25,Ygrilles=5]
  %window
  \TracerAxesGrilles[Elargir=2.5mm,Police=\footnotesize]{auto}{auto}
  %points
  \TracerNuage[Style=o,CouleurNuage=red]{\LISTEXX}{\LISTEYY}
  %regression expoffset C+b*epx(ax)
  \xintEXPOFFreg[offset=250]{\LISTEXX}{\LISTEYY}
  \DefinirCourbe[Nom=ajust,Couleur=blue,Trace]
    <ajust>
    {250+\expregoffb*exp(\expregoffa*x)}
  %constructions
  \PlacerImages[Couleurs=cyan/magenta,Traits]{ajust}{80}
  \PlacerAntecedents[Style=x,Couleurs=blue/green!50!black,Traits]{ajust}{325}
\end{GraphiqueTikz}
```



4 History

0.1.3: logistic regression + r^2 for other regressions
0.1.2: r and r^2 for linreg + new names (tks to quark67 for suggestion)
0.1.1: Bugfix
0.1.0: Initial version