EasyReg Transformations

1 Parameters

EasyReg transformation	# z	
= *Actual function*		
Linear combination	≥ 1	
$= b(1)z_1 + b(2)z_2 + ...$		
Multiplicative combination	≥ 1	(1)
$= z_1^{b(1)} z_2^{b(2)} z_3^{b(3)} ......$		

Note
(1) This transformation is only valid if the z_i's are positive

2 Transformations related to the normal distribution

EasyReg transformation	# z	
= *Actual function*		
Normal: density of N(0,1)	≥ 1	
$= f(z) = \exp\left(-z^2/2\right)/\sqrt{2\pi} = \text{Normal}(z)$		
Probit: c.d.f. of N(0,1)	≥ 1	(1)
$= F(z) = \int_{-\infty}^{z} f(x)dx = \text{Probit}(z)$		
NormalIntegral(a,b)	2	(2)
$= \int_{-\infty}^{\infty} F(a + b.x)f(x)dx$		
NormalIntegralUp(a,b,c)	3	(2)
$= \int_{c}^{\infty} F(a + b.x)f(x)dx$		
NormalIntegralDown(a,b,c)	3	(2)
$= \int_{-\infty}^{c} F(a + b.x)f(x)dx$		

Notes:
(1) The Probit function does not have a closed form, and is therefore computed numerically.
(2) These integrals are computed numerically. They become only visible if the exact number of variables (# **z**) is selected.

The following integrals can be computed indirectly via the **Normal(z)** and **Probit(z)** transformations

$$\begin{aligned}
\int_{-\infty}^{c} f(a+b.x)f(x)dx &= f\left(a/\sqrt{b^2+1}\right)/\sqrt{b^2+1} \\
&\quad \times F\left(c\sqrt{b^2+1}+ab/\sqrt{b^2+1}\right) \\
\int_{c}^{\infty} f(a+b.x)f(x)dx &= f\left(a/\sqrt{b^2+1}\right)/\sqrt{b^2+1} \\
&\quad \times\left[1-F\left(c\sqrt{b^2+1}+ab/\sqrt{b^2+1}\right)\right] \\
\int_{-\infty}^{\infty} f(a+b.x)f(x)dx &= f\left(a/\sqrt{b^2+1}\right)/\sqrt{b^2+1}
\end{aligned}$$

3 Other integrals

EasyReg transformation = *Actual function*	**# z**	
IntegralUp((a[1+x+d.b.(x+c)^r+(1-d)b.x^r]^(-a-1)dx)(a,b,c,d,r)	5	(1)
$= \int_0^\infty a\left[1+x+d.b\,(x+c)^r+(1-d)bx^r\right]^{-a-1} dx$ $a>0,\ b\geq 0,\ c\geq 0,\ d\geq 0,\ r\geq 0,$		
Integral(a[b+x+c(q^r-x^r)]^(-a-1).dx|p<x<q)(a,b,c,p,q,r)	6	
$= \int_p^q a\left[b+x+c\,(q^r-x^r)\right]^{-a-1} dx,$ $a>0,\ b\geq 0,\ p\geq 0,\ q\geq p,\ r\geq 0,\ c>-\left(\frac{b+p}{q^r-p^r}\right)\ if\ r>0.$		
Integral(exp[-c.exp(d.(ln(1/x))^e)(ln(1/x))^f]dx|a<x<b)(a,b,c,d,e,f)	6	(1)
$= \int_a^b \exp\left[-c\exp\left(d.\left(\ln\left(1/x\right)\right)^e\right)\left(\ln\left(1/x\right)\right)^f\right] dx$ $0\leq a<b\leq 1,\ d>0,\ e>0.$		
Integral(exp[-c.(ln(1/x))^d]dx|a<x<b)(a,b,c,d)	4	(1)
$= \int_a^b \exp\left[-c.\left(\ln\left(1/x\right)\right)^d\right] dx,\ 0\leq a<b\leq 1,\ d>0.$		

Note
(1) These integrals may occur in multiple duration models. They are computed numerically. These transformations become only visible if the exact number of variables (# **z**) involved is selected.

4 Other transformations

EasyReg transformation	**# z**	
= *Actual function*		
EXP(z)	≥ 1	
$= \exp(z) = e^z$		
(EXP(z)-1)/z	≥ 1	
$= (\exp(z) - 1)/z = \sum_{k=1}^{\infty} \left(z^{k-1}/k!\right)$		
Logit: 1/(1+EXP(-z))	≥ 1	
$= 1/(1 + \exp(-z)) = \text{Logit}(z)$		
LOG(z)	≥ 1	(1)
$= \ln(z)$ (= *natural logarithm*), $z > 0$		
LOG(z+1)/z	≥ 1	
$= \ln(z+1)/z = \sum_{k=1}^{\infty}(-z)^{k-1}/k,\ z > -1$		
SIN(z)	≥ 1	
$= \sin(z)$		
SIN(z)/z	≥ 1	(2)
$= \sin(z)/z = \sum_{k=0}^{\infty}(-1)^k z^{2k+1}/(2k+1)!$		
COS(z)	≥ 1	
$= \cos(z)$		
(COS(z)-1)/(z^2)	≥ 1	(2)
$= (\cos(z) - 1)/z^2 = \sum_{k=1}^{\infty}(-1)^k z^{2k-2}/(2k)!$		
TAN(z)	≥ 1	
$= \sin(z)/\cos(z)$ (= *tangents*)		
ATN(z)	≥ 1	(3)
$= \text{TAN}^{-1}(z) = \int_0^z \left(1 + x^2\right)^{-1} dx$ (= *arctangents*).		
ABS(z)	≥ 1	
$= \|z\|$ (= *absolute value*).		
Negative: -z	≥ 1	
$= -z$		
LogGamma(z)	≥ 1	
$= \ln(\Gamma(z)),\ z > 0,$ *were* $\Gamma(z) = \int_0^{\infty} x^{z-1}\exp(-x)dx$ (= *gamma function*)		
FixedPoint(a,b,c)	3	(4)
= Solution of $z^a = b.z + c,\ z > 0,\ a > 0$		

EasyReg transformation	**# z**	
= *Actual function*		
z^2	≥ 1	
$= z^2$		
SQR(z)	≥ 1	
$= \sqrt{z},\ z > 0$		
Reciprocal: 1/z	≥ 1	
$= 1/z,\ z \neq 0$		
Dummy z>0	≥ 1	
$= 1$ if $z > 0,\ = 0$ if $z \leq 0$		
Dummy z=0	≥ 1	
$= 1$ if $z = 0,\ = 0$ if $z \neq 0$		
Dummy z<0	≥ 1	
$= 1$ if $z < 0,\ = 0$ if $z \geq 0$		
Dummy z>c, with c a constant	≥ 1	(5)
$= 1$ if $z > c,\ = 0$ if $z \leq c$		
Dummy z=c, with c a constant	≥ 1	(5)
$= 1$ if $z = c,\ = 0$ if $z \neq c$		
Dummy z<c, with c a constant	≥ 1	(5)
$= 1$ if $z < c,\ = 0$ if $z \geq c$		
c*z, with c a constant	≥ 1	(5)
$= c.z$		
z^c, with c a constant	≥ 1	(5)
$= z^c,\ z > 0$		
Add up	≥ 2	
$= z_1 + z_2 + z_3 + ...$		
Subtract	2	
$= z_1 - z_2$		
Ratio	2	
$= z_1/z_2,\ z_2 \neq 0$		
Multiply	≥ 2	
$= z_1.z_2.z_3......$		
Minimum	≥ 2	
$= \min(z_1, z_2, z_3, ...)$		
Maximum	≥ 2	
$= \max(z_1, z_2, z_3, ...)$		

EasyReg transformation	# z	
Sample sum	1	(6)
Sample mean	1	(6)

Notes
(1) Logarithm with base 10, $\log^{10}(z)$, can be computed as $\ln(z)/\ln(10)$.
(2) These functions are computed via their series expansion for z close to zero.
(3) Note that $\text{ATN}(\infty) = \pi/2$, $\text{ATN}(-\infty) = -\pi/2$, $\text{ATN}(1) = \pi/4$. Moreover, note that

$$\frac{\text{ATN}(z) + 2.\text{ATN}(1)}{4.\text{ATN}(1)} = \frac{\text{ATN}(z) + \pi/2}{\pi} = \int_{-\infty}^{z} \frac{1}{\pi\left(1 + x^2\right)} dx$$

is the distribution function of the standard Cauchy distribution. The latter is equal to the t distribution with 1 degree of freedom.
(4) This transformation was used in Bierens, H. J. (2007), "Econometric Analysis of Linearized Singular Dynamic Stochastic General Equilibrium Models", *Journal of Econometrics* 236, 595-627.
(5) EasyReg will ask for the value of the constant c.
(6) This transformation only applies to cross-section data. Missing values will be skipped.

5 Conditional execution statements

EasyReg allows you to execute transformations conditional on the value of a dummy variable. These conditional execution statements are:

If z = 0 then next = 0
If z = 0 then next = 1
If z = 1 then next = 0
If z = 1 then next = 1

where **z** is a previously declared dummy variable. The effect of these statements is that the next transformation will be skipped, and instead the new variable involved gets either the value 1 or 0. These statements are used in the code as, for example, Z(34)=If Z(12) = 0 then next = 1. Then Z(35)=1 if Z(12) = 0, regardless how Z(35) is specified. The variable Z(34) should not be used in any following transformation (It actually gets the value of Z(12)).