# Gompertz

## Parametrisation

The Gompertz distribution has log survial function

$$\log S(y) = -\frac{\mu}{\alpha} \left( \exp(\alpha y) - 1 \right)$$

for response $y \geq 0$, $\mu > 0$ and $\alpha > 0$. The cummulative distribution function and the density then follows as

$$F(y) = 1 - \exp\left[ -\frac{\mu}{\alpha} \left( \exp(\alpha y) - 1 \right) \right]$$

and

$$f(y) = \mu \exp\left[ \alpha y - \frac{\mu}{\alpha} \left( \exp(\alpha y) - 1 \right) \right].$$

## Link-function

The parameter $\mu$ is linked to the linear predictor $\eta$ as:

$$\mu = \exp(\eta)$$

## Hyperparameters

The shape parameter $\alpha$ is represented as

$$\alpha = \exp(S\theta)$$

and the prior is defined on $\theta$. The constant $S$ currently set to 0.1 to avoid numerical instabilities in the optimization, since small changes of $\alpha$ can make a huge difference.

## Specification

- `family="gompertz"` for regression models and `family="gompertz.surv"` for survival models.

- Required arguments: $y$ (to be given in a format by using `inla.surv()` for survival models )

## Hyperparameter spesification and default values

**doc** `gompertz distribution`

**hyper**

    **theta**

        **hyperid** `105101`
        **name** `shape`
        **short.name** `alpha`
        **output.name.intern** `alpha_intern for Gompertz`
        **output.name** `alpha parameter for Gompertz`
        **initial** `-1`
        **fixed** `FALSE`
        **prior** `normal`
        **param** `0 1`
        **to.theta** `function(x, sc = 0.1) log(x) / sc`

**from.theta** `function(x, sc = 0.1) exp(sc * x)`

**survival** `FALSE`

**discrete** `FALSE`

**link** `default log neglog`

**pdf** `gompertz`

**doc** `gompertz distribution`

**hyper**

    **theta1**

        **hyperid** `106101`
        **name** `shape`
        **short.name** `alpha`
        **output.name.intern** `alpha_intern for Gompertz-surv`
        **output.name** `alpha parameter for Gompertz-surv`
        **initial** `-10`
        **fixed** `FALSE`
        **prior** `normal`
        **param** `0 1`
        **to.theta** `function(x, sc = 0.1) log(x) / sc`
        **from.theta** `function(x, sc = 0.1) exp(sc * x)`

    **theta2**

        **hyperid** `106102`
        **name** `beta1`
        **short.name** `beta1`
        **output.name** `beta1 for Gompertz-Cure`
        **output.name.intern** `beta1 for Gompertz-Cure`
        **initial** `-5`
        **fixed** `FALSE`
        **prior** `normal`
        **param** `-4 100`
        **to.theta** `function(x) x`
        **from.theta** `function(x) x`

    **theta3**

        **hyperid** `106103`
        **name** `beta2`
        **short.name** `beta2`
        **output.name** `beta2 for Gompertz-Cure`
        **output.name.intern** `beta2 for Gompertz-Cure`
        **initial** `0`
        **fixed** `FALSE`
        **prior** `normal`
        **param** `0 100`

**to.theta** `function(x) x`

**from.theta** `function(x) x`

**theta4**

    **hyperid** `106104`

    **name** `beta3`

    **short.name** `beta3`

    **output.name** `beta3 for Gompertz-Cure`

    **output.name.intern** `beta3 for Gompertz-Cure`

    **initial** `0`

    **fixed** `FALSE`

    **prior** `normal`

    **param** `0 100`

    **to.theta** `function(x) x`

    **from.theta** `function(x) x`

**theta5**

    **hyperid** `106105`

    **name** `beta4`

    **short.name** `beta4`

    **output.name** `beta4 for Gompertz-Cure`

    **output.name.intern** `beta4 for Gompertz-Cure`

    **initial** `0`

    **fixed** `FALSE`

    **prior** `normal`

    **param** `0 100`

    **to.theta** `function(x) x`

    **from.theta** `function(x) x`

**theta6**

    **hyperid** `106106`

    **name** `beta5`

    **short.name** `beta5`

    **output.name** `beta5 for Gompertz-Cure`

    **output.name.intern** `beta5 for Gompertz-Cure`

    **initial** `0`

    **fixed** `FALSE`

    **prior** `normal`

    **param** `0 100`

    **to.theta** `function(x) x`

    **from.theta** `function(x) x`

**theta7**

    **hyperid** `106107`

    **name** `beta6`

    **short.name** `beta6`

    **output.name** `beta6 for Gompertz-Cure`

    **output.name.intern** `beta6 for Gompertz-Cure`

**initial** 0

**fixed** FALSE

**prior** normal

**param** 0 100

**to.theta** function(x) x

**from.theta** function(x) x

**theta8**

    **hyperid** 106108

    **name** beta7

    **short.name** beta7

    **output.name** beta7 for Gompertz-Cure

    **output.name.intern** beta7 for Gompertz-Cure

    **initial** 0

    **fixed** FALSE

    **prior** normal

    **param** 0 100

    **to.theta** function(x) x

    **from.theta** function(x) x

**theta9**

    **hyperid** 106109

    **name** beta8

    **short.name** beta8

    **output.name** beta8 for Gompertz-Cure

    **output.name.intern** beta8 for Gompertz-Cure

    **initial** 0

    **fixed** FALSE

    **prior** normal

    **param** 0 100

    **to.theta** function(x) x

    **from.theta** function(x) x

**theta10**

    **hyperid** 106110

    **name** beta9

    **short.name** beta9

    **output.name** beta9 for Gompertz-Cure

    **output.name.intern** beta9 for Gompertz-Cure

    **initial** 0

    **fixed** FALSE

    **prior** normal

    **param** 0 100

    **to.theta** function(x) x

    **from.theta** function(x) x

**theta11**

    **hyperid** 106111

> **name** beta10
>
> **short.name** beta10
>
> **output.name** beta10 for Gompertz-Cure
>
> **output.name.intern** beta10 for Gompertz-Cure
>
> **initial** 0
>
> **fixed** FALSE
>
> **prior** normal
>
> **param** 0 100
>
> **to.theta** function(x) x
>
> **from.theta** function(x) x

**survival** TRUE

**discrete** FALSE

**link** default log neglog

**pdf** gompertz

## Example

In the following example we estimate the parameters in a simulated case

```
library(flexsurv)
library(INLA)


n <- 1000
alpha <- 1.0
intercept <- 1.1
beta <- 1.2
x <- rnorm(n, sd = 0.2)
eta <- intercept + beta*x
mu <- exp(eta)
event <- rep(1,n)
y <- rgompertz(n, rate = mu, shape = alpha)

r <- inla(y ~ 1 + x,
          family ="gompertz", data=data.frame(y, x))
r.surv <- inla(inla.surv(y, event) ~ 1 + x,
               family ="gompertzsurv", data=data.frame(y, event, x))

## should be 'small'
print(r$mlik - r.surv$mlik)
```

## Notes