

# Gompertz

## Parametrisation

The Gompertz distribution has log survival function

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

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

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

and

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

## 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

**initial** -20

**fixed** FALSE

**prior** normal

**param** -20 0.01

**to.theta** function(x, sc = 0.1) log(x) / sc

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

**status** experimental

**survival** FALSE

**discrete** FALSE

**link** default log neglog

**pdf** gompertz

**doc** gompertz distribution

**hyper**

**theta**

**hyperid** 106101

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## 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