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# Project “Computer Experiments”

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Fallstudien II / Case Studies II

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## Model Input Parameters

Part	Quantity	Symbol	Unit	Distrib.	Mean	Std.
Membrane	Young's modulus	$E_{\text{mem}}$	[GPa]	Lognormal	0.6	0.09
	Poisson's ratio	$\nu_{\text{mem}}$		Uniform	0.4	0.0115
	thickness	$t_{\text{mem}}$	[mm]	Deterministic	1	
	pre-stress	$\sigma_{\text{mem}}$	[MPa]	Lognormal	4	0.8
	surface loading	$f_{\text{mem}}$	[kPa]	Gumbel	0.4	0.12
	rupture stress <sup>1</sup>	$\sigma_{\text{mem, y}}$	[MPa]	Lognormal	11	1.650
Truss	Young's modulus	$E_{\text{tru}}$	[GPa]	Deterministic	205	
	cross sectional area	$A_{\text{tru}}$	[cm <sup>2</sup> ]	Deterministic	25	
Edge cable	Young's modulus	$E_{\text{edg}}$	[GPa]	Deterministic	205	
	diameter	$d_{\text{edg}}$	[mm]	Deterministic	12	
	pre-stress	$\sigma_{\text{edg}}$	[MPa]	Lognormal	353.678	70.735
Support cable	Young's modulus	$E_{\text{sup}}$	[GPa]	Deterministic	205	
	diameter	$d_{\text{sup}}$	[mm]	Deterministic	12	
	pre-stress	$\sigma_{\text{sup}}$	[MPa]	Lognormal	400.834	80.166

<sup>1</sup> No parameter of the structural analysis model.

## Normal Distribution

$X \sim \mathcal{N}(\mu, \sigma^2)$  with probability density function

$$f_X(x) = \frac{1}{\sqrt{2\pi\sigma^2}} \exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right) \mathbf{1}_{(-\infty,\infty)}(x) \text{ where } \mu \in \mathbb{R}, \sigma^2 > 0$$

$$\mathbb{E}(X) = \mu$$

$$\text{Var}(X) = \sigma^2$$

## Uniform Distribution

$X \sim \mathcal{U}(a, b)$  with probability density function

$$f_X(x) = \frac{1}{b-a} \mathbf{1}_{[a,b]}(x) \text{ where } a, b \in \mathbb{R}, a < b$$

$$\text{E}(X) = \frac{1}{2}(a + b)$$

$$\text{Var}(X) = \frac{1}{12}(b - a)^2$$

$$a = \text{E}(X) - \sqrt{3 \cdot \text{Var}(X)}$$

$$b = \text{E}(X) + \sqrt{3 \cdot \text{Var}(X)}$$

## Log-normal Distribution $\ln X \sim \mathcal{N}(\mu/\sigma^2)$

$X \sim \mathcal{LN}(\mu, \sigma^2)$  with probability density function

$$f_X(x) = \frac{1}{\sqrt{2\pi\sigma^2}x} \exp\left(-\frac{(\log(x) - \mu)^2}{2\sigma^2}\right) \mathbf{1}_{(0,\infty)}(x) \text{ where } \mu \in \mathbb{R}, \sigma > 0$$

$$\mathbb{E}(X) = \exp\left(\mu + \frac{1}{2}\sigma^2\right)$$

$$\text{Var}(X) = \exp(2\mu + \sigma^2) (\exp(\sigma^2) - 1)$$

$$\mu = \log\left(\frac{\mathbb{E}(X)^2}{\sqrt{\mathbb{E}(X)^2 + \text{Var}(X)}}\right)$$

$$\sigma^2 = \log\left(1 + \frac{\text{Var}(X)}{\mathbb{E}(X)^2}\right)$$

## Gumbel Distribution

$X \sim \mathcal{G}(\mu, \beta)$  with probability density function

$$f_X(x) = \frac{1}{\beta} \exp(-z - \exp(-z)) \mathbf{1}_{(-\infty, \infty)}(x) \text{ where } z = \frac{x - \mu}{\beta}, \mu \in \mathbb{R}, \beta > 0$$

$E(X) = \mu + \beta\gamma$  where  $\gamma = -\Gamma'(1) \approx 0.5772$  is the Euler-Mascheroni constant

$$\text{Var}(X) = \frac{\pi^2 \beta^2}{6}$$

$$\mu = E(X) - \frac{\sqrt{6 \cdot \text{Var}(X)}\gamma}{\pi}$$

$$\beta = \frac{\sqrt{6 \cdot \text{Var}(X)}}{\pi}$$