

# Damped sine - fitting is linear DETLEF. AMBERG @ 611X. DE

fit:  $f(t) = C_1 e^{2t} \cos(2\pi t)$  given  $f(0,1) = 0,335$   
 $f(0,2) = 0,134$   
 $f(0,3) = -0,115$

Difference equation:  $f(t_2) = 2 \sqrt{b} \cos(2\pi \cdot 0,1) \cdot f(t_1) - b f(t_0)$   
 $\frac{f(t_2)}{f(t_0)} = 2 \sqrt{b} \cos(2\pi \cdot 0,1) \frac{f(t_1)}{f(t_0)} - b$

quadratic eqn. in  $x$ :  $f(t_2) = 2x \cdot \cos(2\pi) f(t_1) - x^2 f(t_0)$   
 $\Rightarrow -f(t_0)x^2 + 2\cos(2\pi) f(t_1)x - f(t_2) = 0$

$$\Rightarrow x^2 - \frac{2\cos(0,2\pi) f(t_1)}{f(t_0)} x + \frac{f(t_2)}{f(t_0)} = 0$$

$$\Rightarrow x_{1,2} = \frac{\cos(0,2\pi) f(t_1)}{f(t_0)}$$

$$= 0,274 \pm \sqrt{(0,274)^2 + 0,301}$$

$$= 0,274 \pm \sqrt{0,576}$$

$$= 0,274 \pm 0,613$$

only positive solution:  $x = 0,8872$

Probe:  $-0,119 = 2 \cdot 0,8872 \cos(2\pi \cdot 0,1) \cdot 0,134 - 0,8872^2 \cdot 0,335$   
 $= 0,192 - 0,3405 = -0,118$  close enough  
 $x = \sqrt{b} = e^{1/10} = 0,8872 \Rightarrow \frac{1}{10} = -0,11968$

Bestimmung  $C_1$ :

$$f(t_0) = C_1 e^{2 \cdot 0,1} \cos(2\pi \cdot 0,1)$$

$$\Rightarrow f(t_0) = C_1 \cdot 0,8872 \cdot \cos(2\pi \cdot 0,1)$$

$$\Rightarrow C_1 = 0,5503$$

Probe  $f(t_1) = 0,5503 \cdot e^{2 \cdot 0,1} \cos(2\pi \cdot 0,2) = 0,5503 \cdot 0,7871 \cdot 0,1305 = 0,7338$  close enough  
 $f(t_2) = 0,5503 \cdot e^{-3 \cdot 0,11568} \cos(2\pi \cdot 0,3) = -0,11875$