Øving 4 - Akustikk og feilforplanting:

Oppgave 1)

$$\alpha_{absorbant} = \frac{24V\ln 10}{cS_{absorbant}}\left(\frac{1}{T_{60,med}} - \frac{1}{T_{60,uten}}\right)$$

a)

$$\sigma_\alpha^2 \approx \sigma_{T_{60,med}}^2\left(\frac{\partial\alpha}{\partial T_{60,med}}\right)^2 + \sigma_{T_{60,uten}}^2\left(\frac{\partial\alpha}{\partial T_{60,uten}}\right)^2$$

$$\frac{\partial\alpha}{\partial T_{60,med}} = \frac{-24V\ln(10)}{cS_{absorbant}} \cdot \left(\frac{1}{T_{60,med}^2}\right)$$

$$\frac{\partial\alpha}{\partial T_{60,uten}} = \frac{24V\ln(10)}{cS_{absorbant}} \cdot \left(\frac{1}{T_{60,uten}^2}\right)$$

$$\underline{\underline{\sigma_\alpha^2 = \left(\frac{24v\ln(10)}{cS_{absorbant}}\right)^2\left(\frac{\sigma_{T_{60,uten}}^2}{T_{60,uten}^4} + \frac{\sigma_{T_{60,med}}^2}{T_{60,med}^4}\right)}}$$

b)

Kode:

```
import numpy as np
import matplotlib.pyplot as plt
#1.1
#Find the mean value and standard deviation of the data set
dataMed= np.loadtxt('Øvinger/Øving 4 /T60Med.txt', delimiter=',')
dataUten = np.loadtxt('Øvinger/Øving 4 /T60Uten.txt', delimiter=',')

V = 240
S_absorbent = 10
c = 343.4



estimteStandardDeviationMed = np.sqrt(1/(len(dataMed)-1) * np.sum((dataMed - dataMed.mean())**2))
print("Estimated standard deviation of dataMed: ", np.round(estimteStandardDeviationMed, 4))
estimateStandardDeviationUten = np.sqrt(1/(len(dataUten)-1) * np.sum((dataUten - dataUten.mean())**2))
print("Estimated standard deviation of dataUten: ", np.round(estimateStandardDeviationUten, 4))

alpha = (24*V*np.log(10) / (c*S_absorbent)) * (1/dataMed - 1/dataUten)
alphaMean = np.mean(alpha)

estimateStandardDeviationAlpha = ((24 * V * np.log(10)) / (c * S_absorbent))**2 * (((estimateStandardDeviationUten**2) / dataUten.mean()**4) + (
print("Estimated standard deviation of alpha: ", np.round(estimateStandardDeviationAlpha, 4))
```

Resultat:

```
r/Øving 4 /oppgave1.py"
Estimated standard deviation of dataMed:  0.3244
Estimated standard deviation of dataUten:  0.1792
Estimated standard deviation of alpha:  0.0118
```

c)

Using:

$$CI = \bar{x} + t_p \frac{s}{\sqrt{n}}$$

Kode

```
#1.2
#Need to calculate a confidence interval for the alpha value

#From the web
t = 2.365

UpperalphaConfidenceInterval = alphaMean + t * estimateStandardDeviationAlpha/np.sqrt(len(alpha))
LoweralphaConfidenceInterval = alphaMean - t * estimateStandardDeviationAlpha/np.sqrt(len(alpha))

print("The confidence interval for alpha is: ", np.round(LoweralphaConfidenceInterval, 4), " to ", np.round(UpperalphaConfidenceInterval, 4))
```

Result:

```
Estimated standard deviation of alpha:  0.0118
The confidence interval for alpha is:  0.1622  to  0.1819
```

Task 2)

$y = kx$, n målinger av x og y.

↑ avstand ↑ tid fra klapp

$$S(k) = \sum_{i=1}^{n} (y_i - kx_i)^2$$

$$\frac{dS(k)}{dk} = 0 = \sum_{i=1}^{n} -2x_i(y_i - kx_i) = -2\sum_{i=1}^{n} x_i(y_i - kx_i)$$

$$\sum_{i=1}^{n} x_i y_i = \sum_{i=1}^{n} k x_i^2$$

$$\boxed{k = \frac{\sum_{i=1}^{n} x_i y_i}{\sum_{i=1}^{n} x_i^2}}$$

Task 3)

Korrigering av avstand! $d = y - x$

antar!

$$x = x_{scan} + \xi \quad , \quad \xi \sim N(0, \sigma_x)$$

$$y = y_{scan} + \eta \quad , \quad \eta \sim N(0, \sigma_x)$$

a)

$$\mu_d = \mu_y - \mu_x = y_{scan} + \eta - (x_{scan} + \xi)$$

$$= d_{scan} + (\eta - \xi)$$

Siden $\eta = \xi$ så får vi:

$$\underline{\underline{\mu_d = d_{scan}}}$$

b)

$$\sigma_d^2 = \sigma_x^2 \left(\frac{\partial d}{\partial x}\right)^2 + \sigma_y^2 \left(\frac{\partial d}{\partial y}\right)^2$$

$$= \eta^2 (-1) + \xi^2 (1)^2$$

$$= \eta^2 + \xi^2 = 2\sigma_x^2$$

$$\underline{\underline{\sigma_d = \sqrt{2}\, \sigma_x^2}}$$

c)

$$d = \sqrt{(y_{scan} - x_{scan} + \sigma_x)^2}$$

$$d = \sqrt{(y-x)^2}$$

$$\sigma_d^2 = \sigma_x^2 \left(\frac{\partial d}{\partial x}\right)^2 + \sigma_x^2 \left(\frac{\partial d}{\partial y}\right)^2$$

$$= \sigma_x^2 \left(\frac{2(y_{scan} - x_{scan} + \sigma_x)}{2\sqrt{(y_{scan} - x_{scan} + \sigma_x)^2}}\right)^2 + \sigma_y^2 \left(\frac{2(y_{scan} - x_{scan} + \sigma_x)}{2(y_{scan} - x_{scan} + \sigma_x)}\right)^2$$

$$= 2\sigma_x^2$$

$$\underline{\underline{\sigma_d = \sqrt{2}\,\sigma_x}}$$

d)

$$d^2 = (y_i - x_i)^2 = (y_{scan} - x_{scan} + \sigma_x)^2$$

$$d^2 = (y_{scan} - x_{scan})^2 + n^2 + 2(y_{scan} - x_{scan})n$$

$$\mu_d^2 = \mu(y_{scan} - x_{scan})^2 + \mu(n^2) + \mu(2n(y_{scan} - x_{scan}))$$

$$\mu_d^2 = (y_{scan} - x_{scan})^2 + \mu n^2 + 2(y_{scan} - x_{scan})\mu n$$

Hvor $\eta = N(0, \sqrt{2}\sigma_x)$

$\mu(\eta) = 0$

$Var(\eta) = 2\sigma_x^2$

$$\underline{\underline{\mu_d^2 = (y_{Jcm} - x_{Jcm})^2 + 2\sigma_x^2}}$$