TØ 4. Laboratory Exercise 1

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In this session we will use Python to analysis data gathered in the laboratory. First we will start by using Python to calculate statistics of pipette measurements and afterwards we will use Python calculate and plot the standard curve for absorption measurements.

1 Pipette measurements

In the laboratory, you carried out a pipetting exercise in which you had to measure the same volume three times in order to assess your precision (Exercise 1, protocol step 12).

In this session we will stary by using Python to calculate the mean and standard deviation of these results.

1.1 Exercise: A function for the mean

The mean of three numbers x_1, x_2, x_3 can be written as

$$m(x_1, x_2, x_3) = \frac{x_1 + x_2 + x_3}{3}$$

In the cell below finish implementing the function `mean_func` for calculating the mean

```
def mean_func(x1, x2, x3):
  result = _______
  return result

# Its always a good idea to experiment
# Consider what the result of the below should be
test = mean_func(1, 2, 3)
print(test)
```

1.2 Exercise: Calculating the mean and standard deviation

In the cell below the two functions `mean_func` and `std_func` are available.

Start by setting the variables `x1`, `x2`, `x3` equal to your measurements, then use the two functions to calculate the mean and the standard deviation.

```
# Define your measurements
x1 = _______
x2 = _______
x3 = _______

# Calculate the mean and standard deviation
mean_value = mean_func(_____, _____, _____)
std_value = _______ # Use std_func
```

If you want to try writing a more general function for calculating the mean see the extra exercises.

1.3 Exercise: Analyzing the standard deviation

What does the standard deviation tell you about your precision?

If the standard deviation is high, what could this be due to in your pipetting?

2 Adsorption measurements

In the laboratory you made adsorption measurements, now you will use Python to make a standard curve from these measurements. Start by uploading your measurements

```
//| echo: false
viewof xlsx_file = Inputs.file({
  label: "Upload Excel file",
  accept: ".xlsx",
  required: false
})

xlsx_name = xlsx_file ? xlsx_file.name : null
xlsx_bytes = xlsx_file
  ? Array.from(new Uint8Array(await xlsx_file.arrayBuffer()))
  : null
```

This loads the data as a `pd.DataFrame` which will be touched on later and used extensively in other courses.

The next cell calculates the mean and the standard deviation across the replicates

```
mean = df[["m1", "m2", "m3"]].mean(axis=1)
std = df[["m1", "m2", "m3"]].mean(axis=1)

pd.DataFrame({"conc": df["conc"], "mean": mean, "std": std})
```

And now we can plot it the standard curve

```
# Create the plotting window
fig, ax = plt.subplots()

# Plot mean with std errorbars.
```

```
ax.errorbar(df['conc'], mean, yerr=std,
  label="Mean ± SD", fmt="o-", capsize=5)

# Plot customization
ax.set_xlabel("Concentration (µM)")
ax.set_ylabel("Absorption (A400)")
ax.set_title("Average adsorption vs concentration")
ax.legend()

# Display the plot
plt.show()
```

2.1 Exercise: Interpretation

How can you tell whether you have made your dilutions and carried out your absorbance measurements with high accuracy? What can a standard curve be used for?