Error Analysis

Background

The objective of this experiment is to conduct a statistical analysis of the error associated with different methods of measuring the volume of liquids. Aliquots of distilled water in will be measured several different ways: using beakers, graduated cylinders, volumetric glass pipets, and mechanical pipets. The mass of each sample will be measured using an analytical balance and the density of each sample will be calculated. You will then conduct a statistical analysis of the error associated with the different methods used in the experiment, and compare your data to the class data. The class data will be entered into a spreadsheet available on the assignment page on Canvas.

Part 1: Measuring Volume with a Beaker

Use a 25 mL beaker to measure 15 mL of distilled water. Use a balance to measure the mass of this 15 mL sample of water. Calculate the density of the water. Pour the water out, and repeat 4 more times. Calculate the mean and standard deviation for the density of the water. Put your mean on assignment page in Canvas in the table entitled "Part 1: Beakers".

Part 2: Measuring Volume with a Graduated Cylinder

Use a graduated cylinder to measure 15 mL of distilled water. Use a balance to measure the mass of this 15 mL sample. Calculate the density of the water. Pour the water out and repeat 4 more times. Calculate the mean and standard deviation for the density of the water. Put your mean on Canvas in the table entitled "Part 2: Graduate Cylinders".

Part 3: Measuring Volume with a Pipette

Volumetric Pipette

Use a volumetric pipet to measure 15 mL of distilled water into a clean, dry beaker. Use a balance to measure the mass of this 15 mL sample. Calculate the density of the water. Pour the water out and repeat 4 more times. Calculate the mean and standard deviation for the density of the water. Put your mean on Canvas in the table entitled "Part 3A: Transfer Pipettes".

Mechanical Pipette

Use a 5 mL mechanical pipet to measure 15 mL of distilled water. Get the mass of a small beaker, then collect the 15 mL of water in the dry beaker. Use a balance to measure the mass of this 15 mL sample. Calculate the density of the water. Pour the water out and repeat 4 more times. Calculate the mean and standard deviation for the density of the water. Put your mean on Canvas in the table entitled "Part 3B: Mechanical Pipettes".

Part 4: Density Determination for an Unknown Liquid

Use one of the above methods to measure the density of an unknown liquid 5 times. Use 5 mL of the unknown liquid for each measurement of the mass. Calculate the mean and standard deviation for the density of your unknown. In your lab report, indicate which of the above methods you used to determine the density.

Part 5: Other Factors Affecting Precision

Factors other than the precision of equipment can affect the precision of an experiment. For example, sample size may affect precision. Personal bias, especially in reading volume from a graduated cylinder or a beaker, may also affect precision. Design a couple of short experiments to investigate some other factors (other than precision of equipment) that may affect precision. In your notebook, be sure it is clear what factors you are looking at and what your experiment is.k

What to turn in

1. Before leaving lab, enter your data in the class data spreadsheet on Canvas.
2. Before you leave, scan your notebook pages using the scanners in the hallway.
    - Scanners are available across from room 318 and in the copy room at the end of the hall by the restrooms.
    - To use the scanners, hold your CatCard up to RFID reader on the top of the printer/copier/scanner to log in with your ID.
    - Use the on-screen prompts to choose to scan your document.
    - You can have the scan sent to your email or to your OneDrive/Vault folder, where you can then download it to your computer.
3. Upload your scanned pages to the Week 1 Lab Notebook assignment on Canvas.
4. Complete the Excel answer sheet in the Experiment 1 assignment on Canvas by next week.
