

Assignment 4: Error Propagation CM3215 Chem Eng Junior Transport Lab

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Learning Objectives of the Exercise

Obtain practice making error propagation calculations.

The Exercise

This is an individual assignment. You may work with your partner and other labmates during lab, but you must turn in your own memo. Please answer the 6 questions in “homework” style (portions may be handwritten) and transmit them to me with a brief memo of transmittal attached. **This assignment is due Wednesday 17 February 2016 in class.**

In Cycle 1, you and your partner calibrated the Honeywell differential pressure meter at your station by using an air-over-Blue-Fluid manometer as the standard. The report you wrote on that calibration did not include a complete error analysis, since we had not yet learned how to do error propagation.

1. Using only the single measurement of the masses of the pycnometer full/empty that you and your partner obtained, calculate the density of Blue Fluid 175. Evaluate the errors for the raw data (mass full, mass empty, volume of the pycnometer; consider all sources), and calculate the total error for the density from error propagation (include worksheet in your submission). Report your value of density with the 95% confidence interval that you obtain with this method.
2. Is the value for density obtained in question 1 consistent with the density you reported in Report 1, which was obtained from the average of replicates? Explain your answer to this question and include the effect of uncertainty in your discussion.
3. To calculate Δp values from manometer data, we need a value of Blue Fluid density, and we wish to use the most accurate value. Which value of density is more accurate, the one obtained from averaging replicates (you used this value in Report 1), or the single value of density you report in question 1? Explain.
4. For the manometer height/current data that you and your Cycle 1 partner collected, calculate the individual Δp versus I (current) values, using the most accurate value of $\rho_{Blue\ Fluid}$ that you have available. Using error propagation, what are the 95% confidence intervals we associate with these Δp values? These go on the points as vertical error bars, indicating the quality of each individual data point.
5. What are the correct horizontal error bars that we should include on the data for electrical current in the calibration curve? Justify your answer briefly and include appropriate error worksheets.
6. Provide a final version of your calibration curve, with a best-fit line, and with both horizontal and vertical error bars on the individual, original data points. The error bars should reflect the 95% confidence intervals of electrical current and differential pressure, respectively, as determined through error propagation.
7. *Not required, but fun:* Add the 95% confidence interval lines around the LINEST best-fit line. Add also the 95% prediction interval lines. The equations for doing this are in the most recent error analysis lecture; to get smooth lines, you may use closely spaced, arbitrary values of current (the x variable) to generate the y-data for the best-fit and the CI and PI lines.