Demonstrating the "Ratio Problem" Using A Cotyledon Experiment

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Introduction

- Scientists regularly use ratios, however, ratios can produce misleading interpretations.
  - Local importance: Ratios are extensively used for both terrestrial and marine research at University of Guam
- Ratio problems have been well–known for over a hundred years.
  - Scientists often ignore the issue and use inappropriate statistics.

Sources:

Objectives

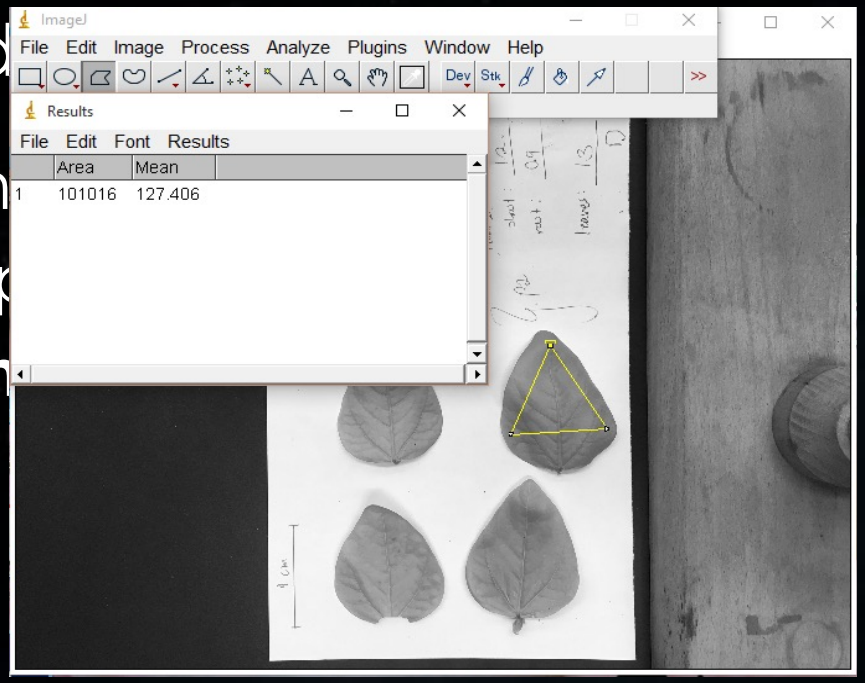
- To develop a laboratory experiment, using cowpea (*Vigna unguiculata*) plants, that would demonstrate the **"ratio problem"**
- To analyze the leaf darkness and shoot–root ratio of the plants

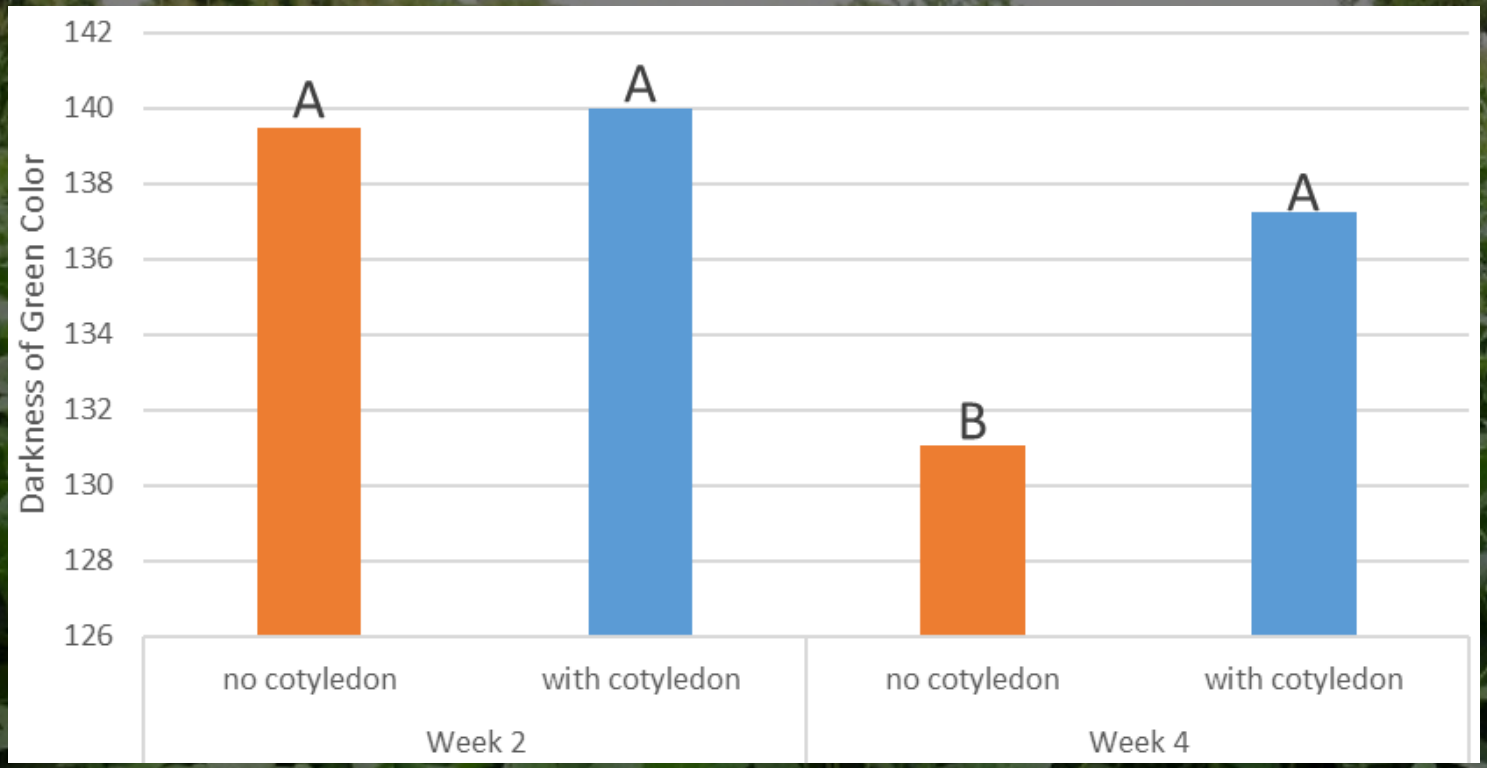
Hypothesis

- After making a very simple analysis (leaf pigmentation), students will misinterpret results, if unaware of ratio difficulties while analyzing shoot–root ratios.

Materials & Methods

- Planted 480 cowpeas (*Vigna unguiculata*) with various nitrogen and phosphorus treatments
- Removed cotyledons after a week
- Harvested 160 plants a week after the cotyledons were removed
- Measured the leaves' green
  of two and four-week old p
  (photographically using **Im**





Time	0.038
Cotyledon	0.001
Time x Cotyledon	0.078

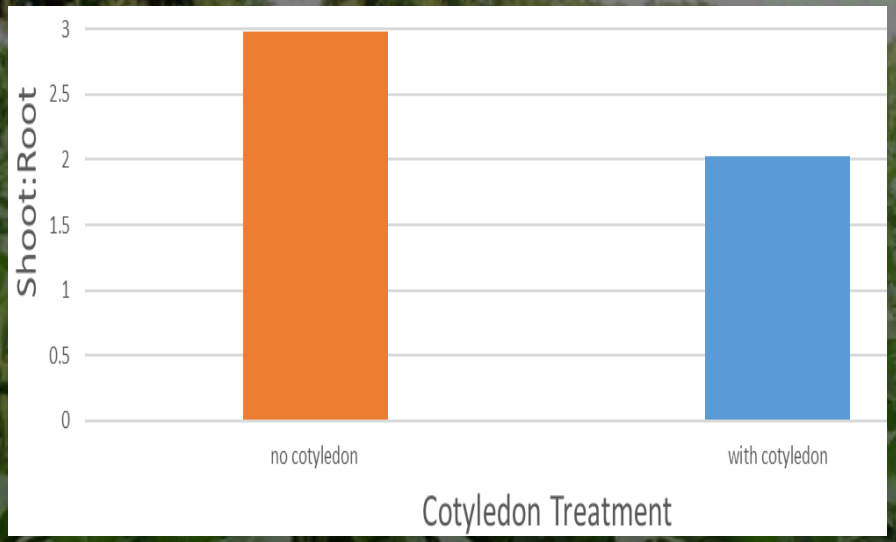
Finger Ratio

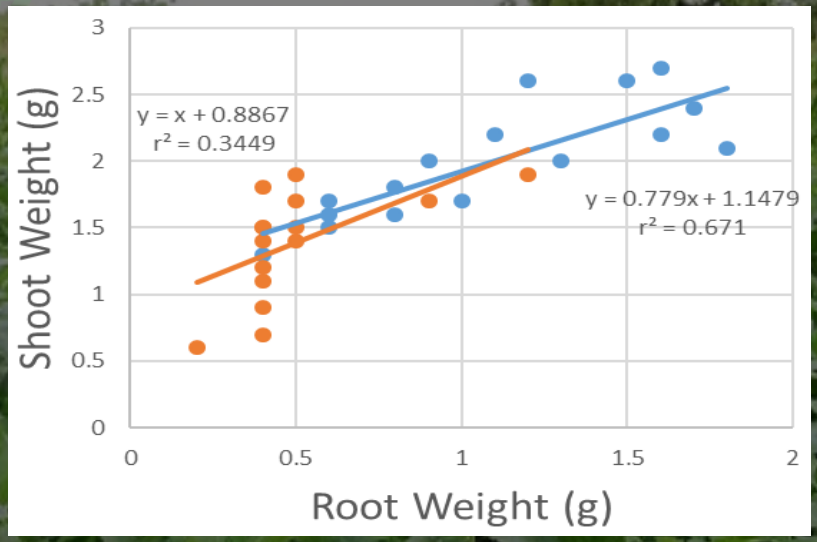
Finger Ratio:

- 2nd digit (index):4th digit (ring)

- Finger ratios have been associated with gender, testosterone, homosexuality and mouse behavior (an NIH–funded project).
- Two scientists presented evidence that the whole finger story is an artifact.

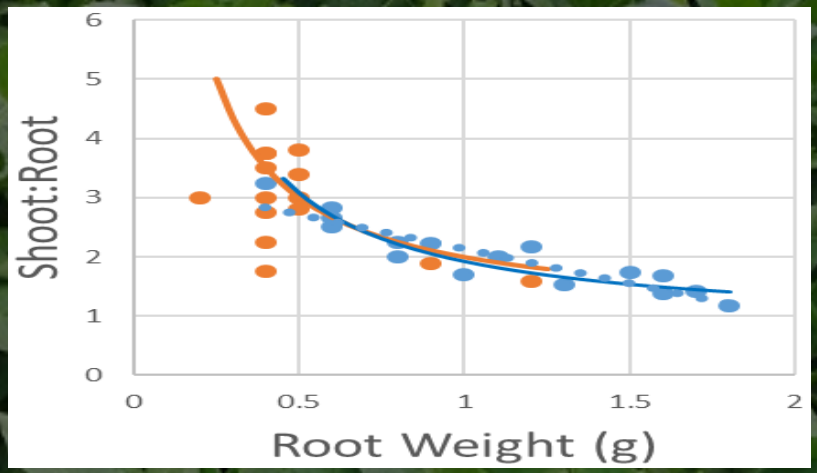
Data



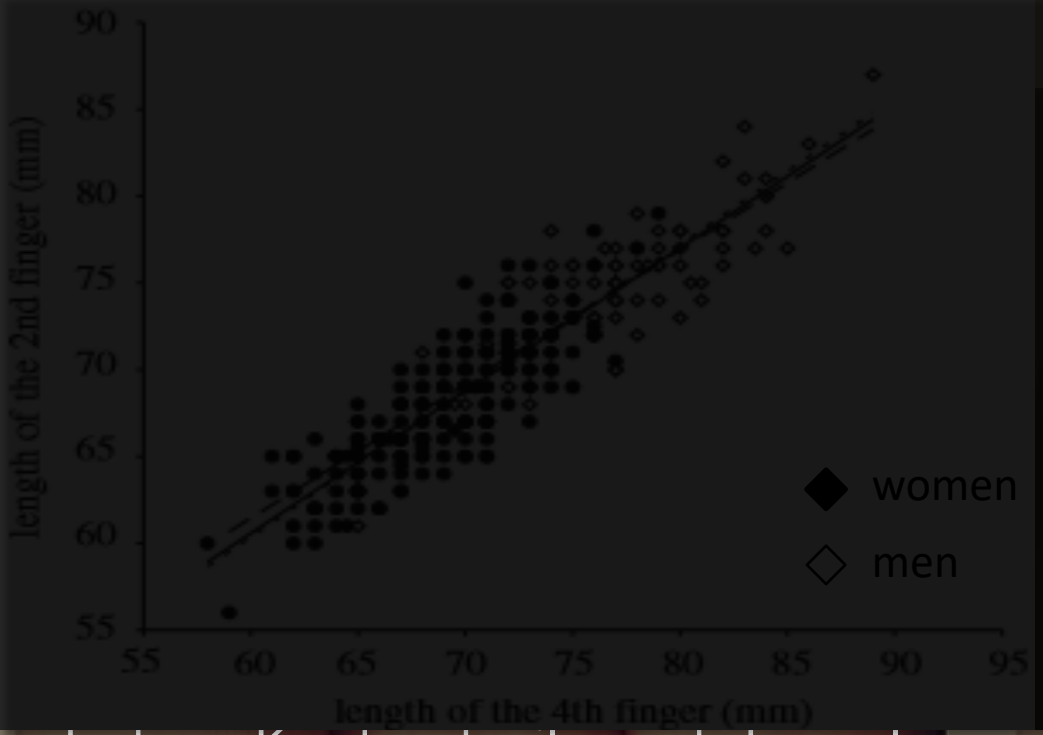


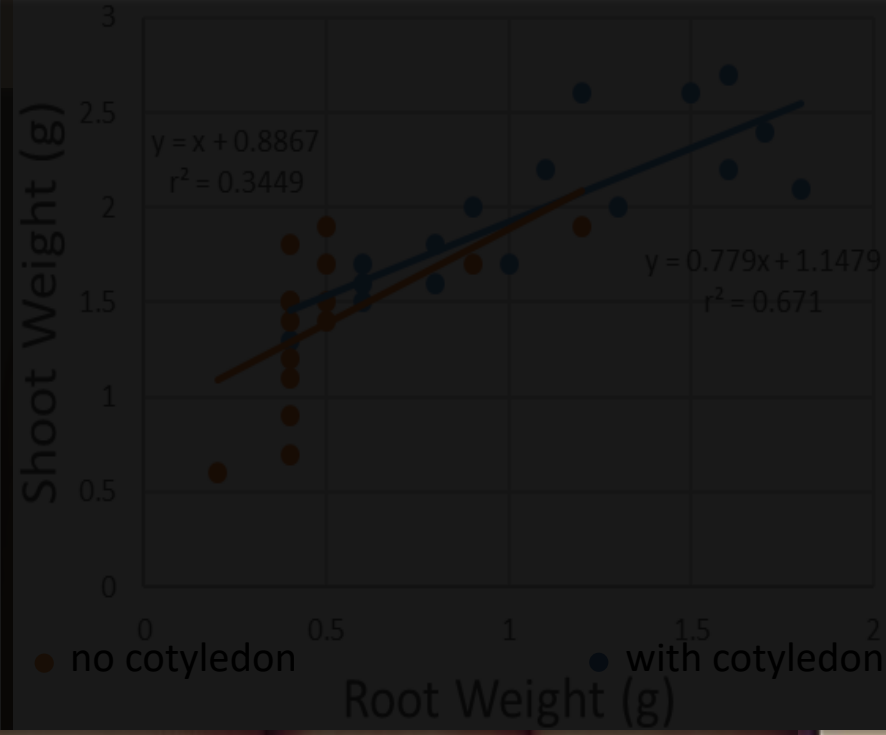
NO COTYLEDON

WITH COTYLEDON

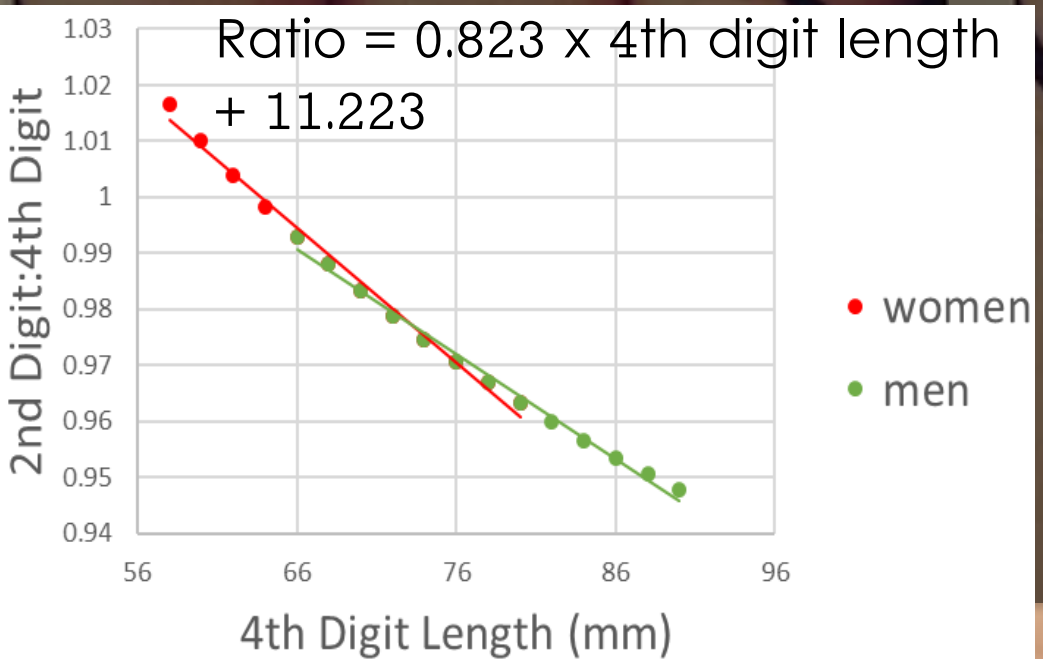


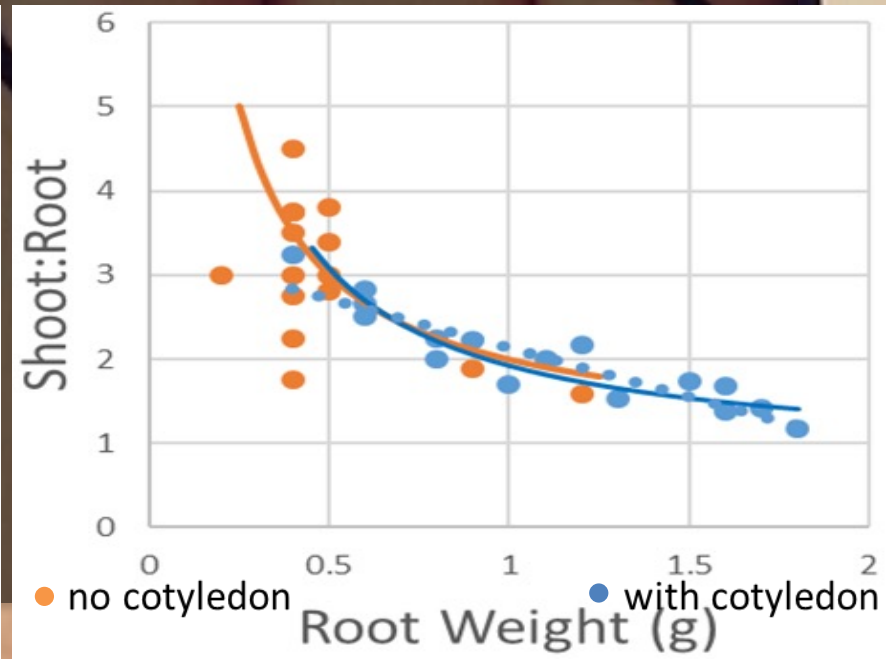
The effect of cotyledon removal upon emergence (week 1) on shoot–root ratio for two–week old cowpea (*Vigna unguiculata*) seedlings. The cotyledon removal effect approaches statistical





Lukas Kratochvil and Jaroslav





Conclusions

Color Analysis

- Results are straight-forward and easy to interpret. Removing cotyledons produces leaves that are lighter in green color after four weeks.

Shoot-Root Ratio

- The effect of the cotyledon removal on the shoot-root ratios of plants is indirect.
- Regression results produce a different conclusion than a traditional analysis of anatomical ratios.
- We make two different conclusions depending on how we analyze the data.

Always be careful when analyzing ratios!


ANY
QUESTIONS
?

References

Pearson, K. 1897. On a form of spurious correlation which may arise when indices are used in the measurement of organs. Proc. R. Doc. London. 60: 489–502.

Tanner, J.M. 1949. Fallacy of per–weight and per–surface are standards and their relation to spurious correlation. J. Appl. Physiology.

Kratochvil, L. and Flegr, J. 2009. Differences in the 2nd to 4th digit ratios in humans reflect shifts along the common allometric line. Biology Letters 5: 643–646.

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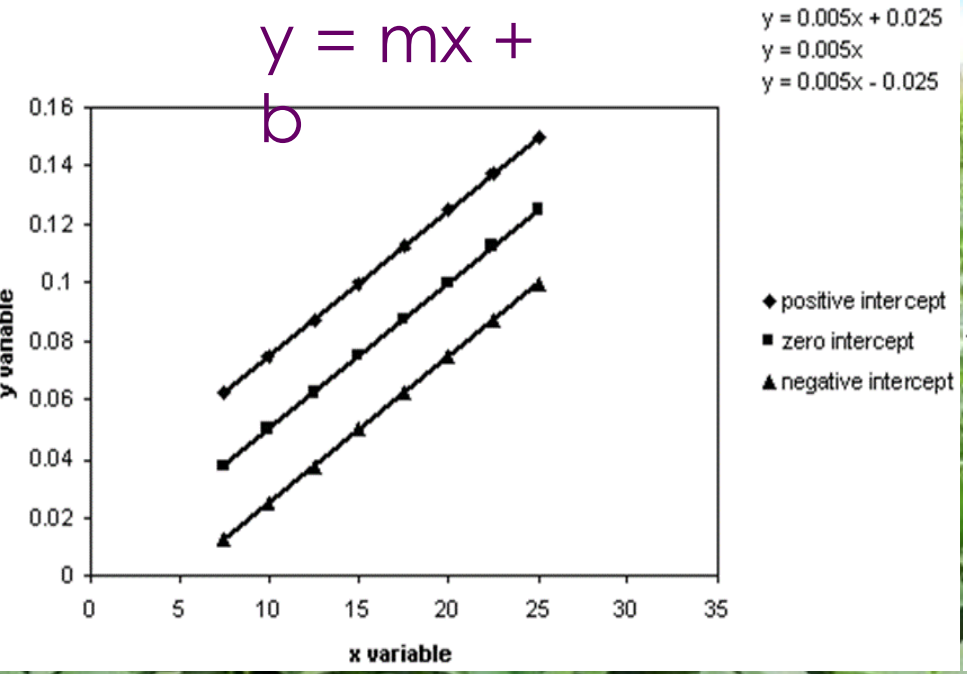
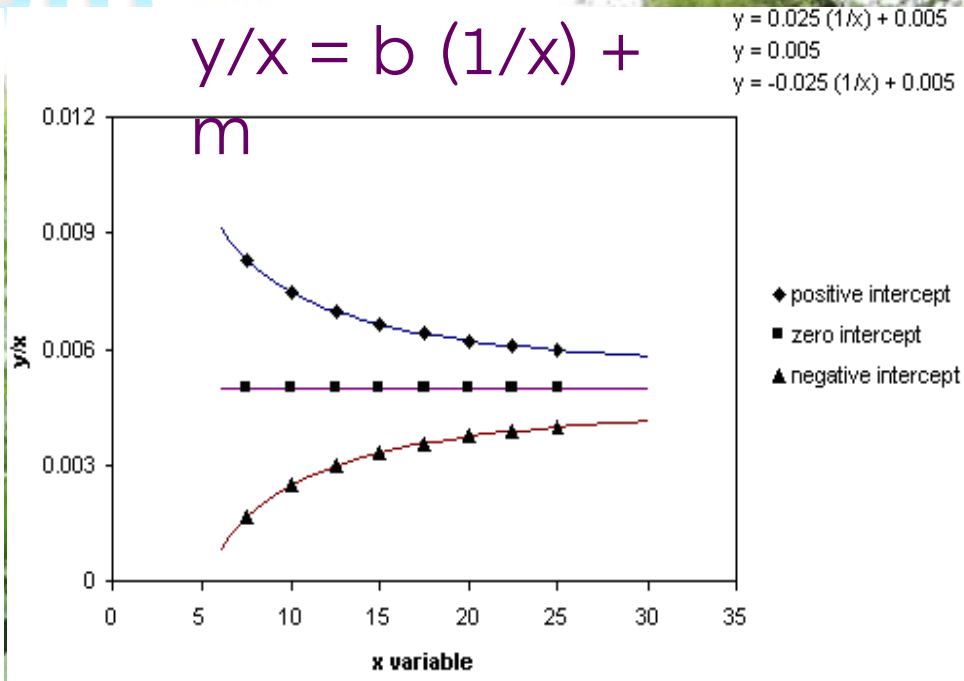
- Cathy and Tina Nguyen, and the rest of the crew who are working in Dr. Righetti's lab, for helping me

Math

y = mx + b



y/x = b (1/x) + m



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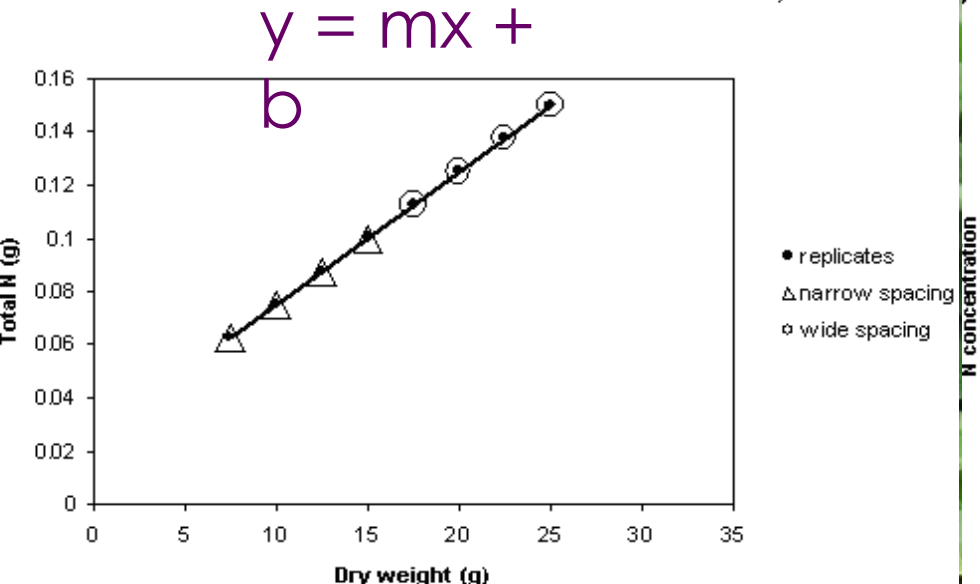

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