A Freshman Mathematics Course to Develop Quantitative Reasoning

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- UL Lafayette is a public state university with approximately 17,000 students. ("Research University with High Research Activity")

- The Department of Mathematics has BS, MS, and PhD programs.

- 17% of Undergraduates Liberal Arts majors (2,600 students)

- Many struggle with abstract nature of mathematics

- Four years ago the Board of Regents dropped requirement that all students must take a version of College Algebra

- Giving us the opportunity to provide students in nontechnical fields with a mathematics course more suited to their future needs

- **Goal: Create an engaging course with topics that the students perceive as relevant to their lives as citizens and to their future professions.**

- **MATH 102. QUANTITATIVE REASONING FOR LIFE. (3, 0, 3). Critical thinking and applications of mathematical concepts to real-world topics such as descriptive statistics, growth and decay models, and personal finance.**

- Topics for the course were chose to support our goals of quantitative literacy, financial literacy and the ability to reason mathematically.

- Strongly encouraged by the university administration, the pilot course was offered in Spring 2013 rather than Fall 2014 as originally planned.

- Revising course each semester to match the course to our vision

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- Nontraditional course – taught by building conceptual understanding and covering fewer topics to encourage mastery

- While we have many career instructors, we also have an average of 30 teaching assistants teaching freshman math courses, who tend to teach the way they were taught

- All freshman courses have common syllabi and pacing guide

- Additionally, QR course needs standardized class examples and activities

- October 2013 submitted grant proposal to LA Board of Regent's Support Fund
  - Funding for equipping a designated room with technology including SmartBoard and "clicker" system
  - Summer support for faculty to work on instructional materials
  - Notice of Award received April 2014

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Challenges for the Grant Implementation and Evaluation

- **Room and Equipment**
    - Informed of award in April 2014
    - Completed contract from state do not arrive until June 26, 2014
    - University Purchasing Office performs no action until contracts arrive
    - Performing the needed work for the room low priority for facilities
    - Equipment installed weeks after semester started
    - Computer and internet access unavailable before November.

- **Personal problems for two PI's working on course**

- **PI in charge of evaluation left university at end of Fall Semester**

Challenges for the Course

- **Level of student**
  - Math ACT of 25+ → automatic credit for College Algebra
  - Math ACT of 21 - 24 → eligible for 3-hour College Algebra course
  - Math ACT of 19 - 20 or credit in developmental math → must enroll in 5-hour College Algebra

  NOW: 3-hour Quantitative Reasoning course option for some students

- **Expectation of some students (and some administrators)**

  While many student understand our vision for them, some students come in with the attitude that "different" means "easy for me to pass without work".

- **Limited Options for Students with Credit in this QR Course**
  - Accepted for Graduation Credit in Limited Number of Curricula
    True by design but may be problem for student who changes major
  - Serves as a prerequisite for only 2 courses:
    Math of Finance and Elementary Statistics

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Challenges for the Course (cont'd.)

- **Lower Than Expected Enrollment**
  - Many students who would benefit not aware of the course's existence or that it is an acceptable substitute for college algebra in some majors (exception: Criminal Justice added it to their curriculum)
  - Efforts:
    - Informed advisors at university-wide Advising Workshops
    - Publicized on campus NPR and articles in school newspaper and university magazine
  - Only 3 – 4 sections per semester with 35- 40 in each section.
  - Many liberal arts majors have inflexible schedules due to studio courses. Limited number of sections means they may not be able to schedule it around these courses.

- **Willing and Interested Teachers**
  - More work than teaching traditional college algebra
  - Weaker students

Topics

- Proportional Reasoning
- Appropriate Use and Understanding of Units
- Uses and Abuses of Percentages
- Financial Mathematics
    - Simple & Compound Interest
    - Savings & Investments
    - Credit Cards
    - Installment Loans
    - Mortgages
- Linear Growth vs Exponential Growth
- Graphical Representation of Data
- Special interest topics for students in the areas of Art and Music

Instructional and Learning Resources

- ***Using & Understanding Mathematics: A Quantitative Reasoning Approach***, 6th edition by Bennett & Briggs, Pearson Publishing

- **MyMathLab** used for online homework and practice

- ***Smart Notebook presentations,*** *including "clicker" questions*

- **Moodle** (LMS)
    - Partial notes for students to complete in class
    - Instructor created worksheets
    - Question forum for each chapter
    - Links to graphing calculator videos
    - Links to tutoring services
    - Links to MyMathLab and Student Solutions Manual
    - *Videos created in response to questions as needed.*

To be more prevalent in Sp15 than Fa14

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Sample Material

Quantitative Reasoning for Life – Day 1 Examples

A. What is wrong with each of the following?

> "The top half of the students are well-educated, the bottom half receive extra help, but the middle half we are leaving out."

23 UNIQUE RECIPES
MAIN DISHES, BREADS, DESSERTS, plus Clista's adult flavored fudge. Send money order for $6.95 with a S.A.S.E. and .64¢ postage to Recipes: % A. Burrows, ▬▬▬▬▬▬ Orange City, FL 32763.

Sample Material

A. What is wrong with each of the following?

$5 off
Your Next Purchase
Offer expires 12/31/10
On homes valued at $500,000 or more

Best Selection Ever of Name Brand Tennis Shoes

10% off any pair bought and get 2nd pair at 10% off and then take 1/2 price of that shoe. Higher price charged for 1st pair.

Marting's Shoes

2600 DODGE ST. • DUBUQUE

Assume we understand what the advertiser meant. If a customer purchased two pairs of tennis shoes at this store and the original prices were $60 and $80, what would the total be after the discount but before taxes?

Sample Material

B. **Examples of everyday situations involving quantitative reasoning:**

1. Alan decides to buy his ticket online for $33 plus a 10% surcharge rather than from the box office, where it costs $35 with no additional charges. Where would you buy your ticket?

2. You buy a cell phone plan that gives you up to 1000 minutes of calling for $20 per month. During a particular month, you use only 500 minutes. Your per-minute cost for **that month** is
   a.   2¢   b.   0.04¢   c.   4¢

3. Most people in Louisiana calculate the tip at a restaurant by doubling the tax. Oregon does not have a sales tax. How would you compute the tax on a $51?

Sample Material

C. **Does it Make Sense? (If you cannot decide, what additional information do you need.) Bennett-Briggs 6th edition**

- I drove at a speed of 35 miles for the entire trip.

- I have a box with a volume of 2 square feet?

- I drank 2 liters of water today.

- My car's gas tank holds 12 meters of gasoline.

Sample Notebook Lesson

1   Try This

Use the compound interest formula to compute the balance in the following accounts after the stated period of time.

$4,600 is invested for 18 years with an APR of 2.4% and daily compounding.

Note to instructor

Setup

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Sample Notebook Lesson

1   Try This

Use the compound interest formula to compute the balance in the following accounts after the stated period of time.

$4,600 is invested for 18 years with an APR of 2.4% and daily compounding.

Note to instructor

This question is a response enabled question.

The Setup tab shows only the setup.

The next page has students rework this problem at other compounding frequencies

Setup

$$A = 4600\left(1 + \frac{.024}{365}\right)^{365 \cdot 18}$$

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I Have, Who Has

I Have 11 **Who Has** *The number of feet in 4 yards?*	**I Have** 60 **Who Has** *The number of quarts in 10 gallons?*
I Have 12 **Who Has** *The number of ounces in 2 pounds?*	**I Have** 40 **Who Has** *The number of centimeters in 3 meters?*
I Have 32 **Who Has** *The number of feet in 2 miles?*	**I Have** 300 **Who Has** *The number of inches in half a yard?*
I Have 10,560 **Who Has** *The number of inches in 5 feet?*	**I Have** 18 **Who Has** *The number of ounces in 3 cups?*

Unit Conversion— US System—Distance

3 yd 2 mi — **IX** — 12 in 2 ft	24 in 1 ft — **XV** — 6 ft 9 ft	5 ft 2 yd — **XII** — 36 in 1,760 yd	5,280 ft 3 ft — **XIV** — 2 mi 1 mi
24 in 1.5 ft — **I** — 2 mi 1 yd	3 yd 10,560 ft — **X** — 120 in 3 ft	1 mi 10 ft — **XI** — 72 in 90 ft	5,280 ft 2 yd — **II** — 12 in 1.5 ft
36 in 1.5 mi — **VI** — 0.5 ft 1.5 yd	1 yd 6 in — **V** — 18 in 5 ft	30 yd 1.5 ft — **III** — 1.5 mi 72 in	18 in 7,920 ft — **IV** — 120 in 12 ft
4.5 ft 12 ft — **VIII** — 7 ft 36 in	60 in 84 in — **VII** — 5,280 in 3 ft	6 ft 440 ft — **XIII** — 12 ft 90 ft	144 in 4 yd — **XVI** — 440 ft 9 ft

Evaluation

- End of Course Assessment
  Comparing QR with 3-hour CA

- Grade Distributions
  of QR Compared to 5-hour CA

- End of Course Attitude Survey
  of QR Classes

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Evaluation

- ## End of Semester Assessment Comparing QR with 3-hr CA

  7 open response questions

  QR: $n = 110$
  CA (3 hr): $n = 64$

  Graded 0, 0.5, 1 (0.5 if essentially correct with one minor error)

  Performed a Chi-Squared Test of Independence for each question to see if answering quiz question correctly was dependent on the course taken.

  At a $p > .05$ level of significance, the results indicate that students' ability to correctly work problems was independent of the course taken. Quantitative Reasoning students who typically have a weaker mathematical background performed as well as students with stronger backgrounds in the 3-hour College Algebra.

End of Course Assessment Questions

1. Tammy bought some stock this week at $16 per share.
    Last week the stock was selling for $25 per share.
    What percent decrease was this?

    QR *Percent Change*

2. A sofa is advertised as "20% off the regular price."
    If you pay $845 for the sofa, what was the regular price?

    QR *Find the original when percent change and final value are given*

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3. John borrowed $500 from a friend and is repaying him $20 a week.
    a. Write John's debt, *d*, as a function of the number of weeks, *w,* that he has been paying off the loan.

    BOTH QR & CA *Write a linear function when starting value and rate of change are known*

    b. How many weeks will it take for John's debt to drop to $280?

    BOTH QR &CA *Find output value of linear function when input value is known OR use reasoning with meaning of rate of change*

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4. What is the slope of the line through the points (3, 10) and (8, 6)?

   CA Find slope

5. Harry invests $200 at 2.4% compounded annually. (He leaves the money in the account and does not add any more himself.)
   a. Write the function that gives the amount of money in the account after **x** years.

   BOTH *CA Write exponential functions given base and growth rate, QR Write function for value of account with compound interest or Write exponential function given starting value and growth rate*

   b. How much money will be in the account after 15 years?

   BOTH *CA and QR Evaluate function for t =15*

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Evaluation

- Grade Distributions of QR FA 14 compared to 5-hour CA FA 13

Chi-Square Test for Goodness of Fit

Testing to see if grade distribution in QR follows grade distribution of 5-hr CA

$$p_{QR\ As} = p_{CA\ As} \qquad p_{QR\ Bs} = p_{CA\ Bs} \ \ldots..$$

QR: $n = 145$
CA (5-hr): $n = 718$

The results were significant at $p < 0.0001$, indicating the proportion of letter grades differed between the courses for at least one of the letter grades.

Further testing was not performed to determine which letter grades differed statistically at this time. However from the graph on the next page it appears testing for statistical differences in the percentage of As, Bs, and Ws might indicate the proportion of As and Bs in QR is greater than in CA (5 hr)

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Grade Distributions for
Quantitative Reasoning FA 14 versus College Algebra (5 hr) FA 13
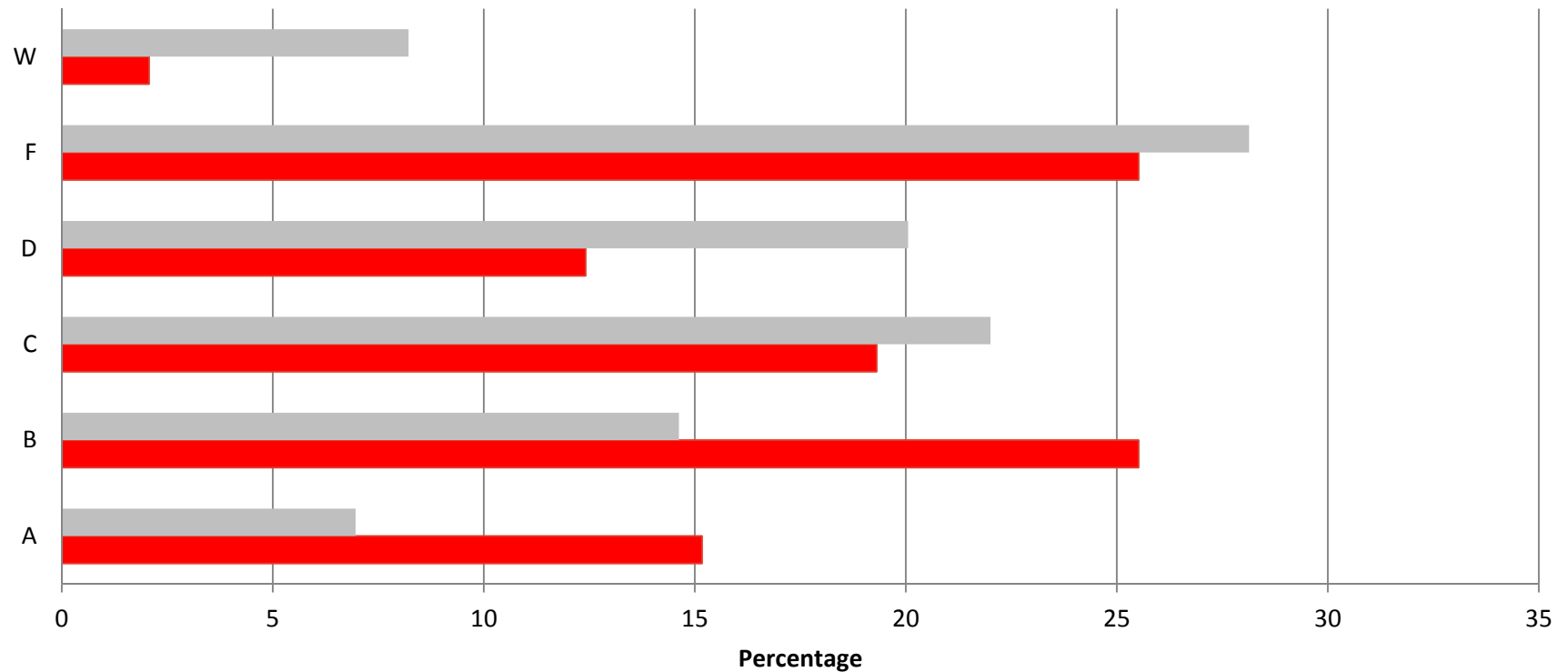
Evaluation

- ## End of Course Attitude Survey of QR Classes

  Students were asked to rate their agreement with 11 statements about their attitudes towards mathematics and the learning of mathematics.
  $n = 112$

  Fall 2014
  - Administered at end of semester to all four sections of QR
 - No survey prior to course to compare for changes in attitude

  Spring 2015
  - Will be administered to all sections of QR and two sections of 5 hr CA in first week of class and again last week of class

I know I understand the material when
I can work the assigned homework problems online.
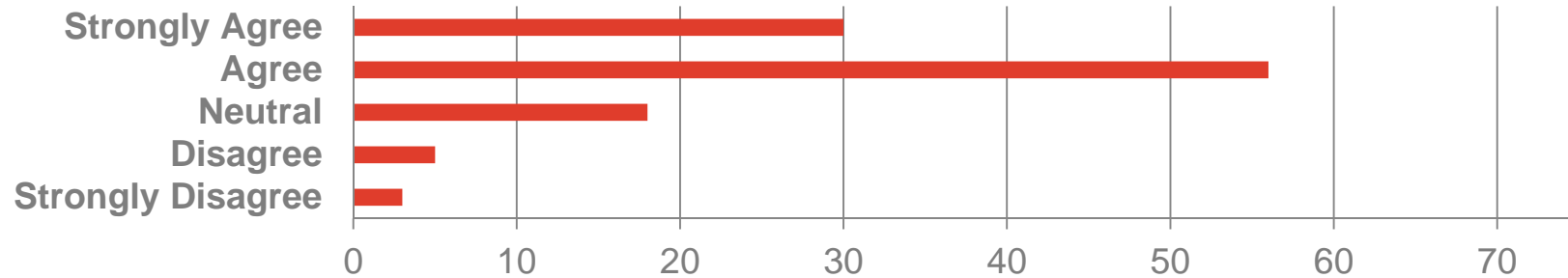
I know I understand the material when
I can work the assigned homework problems traditionally/paper&pencil.

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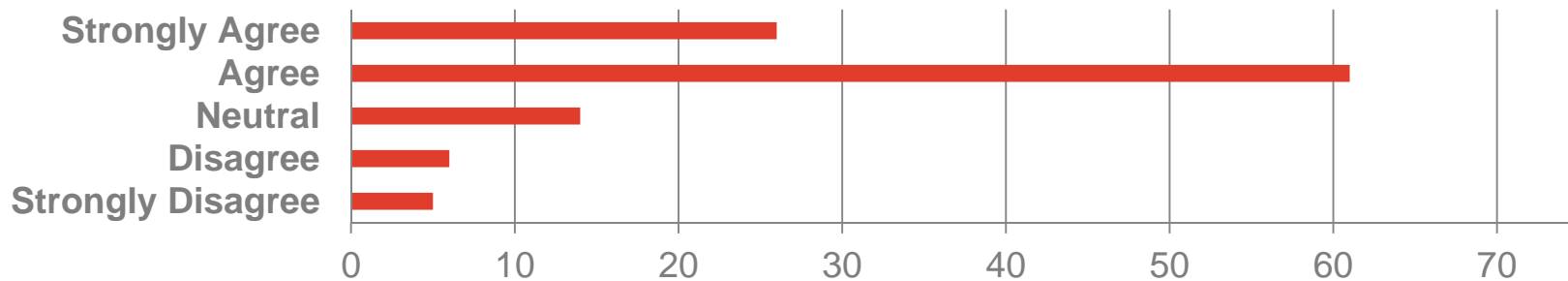
**I know I understand the material when I can apply concepts to multistep or multi-concepts problems.**
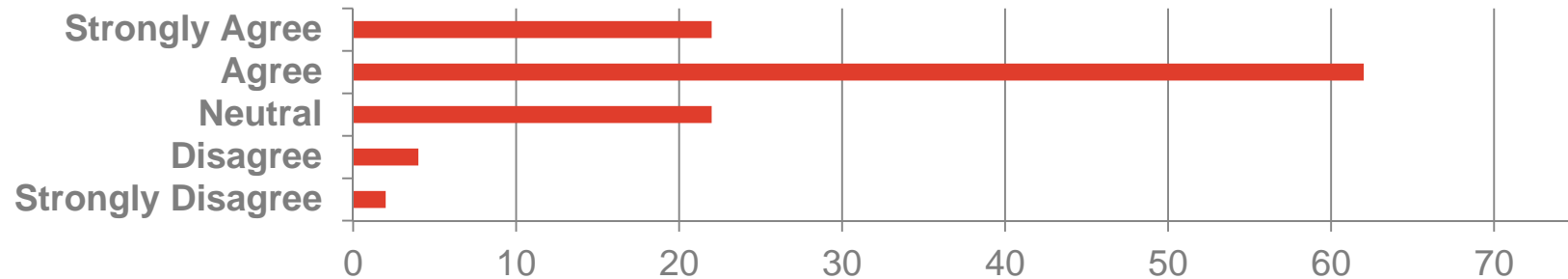
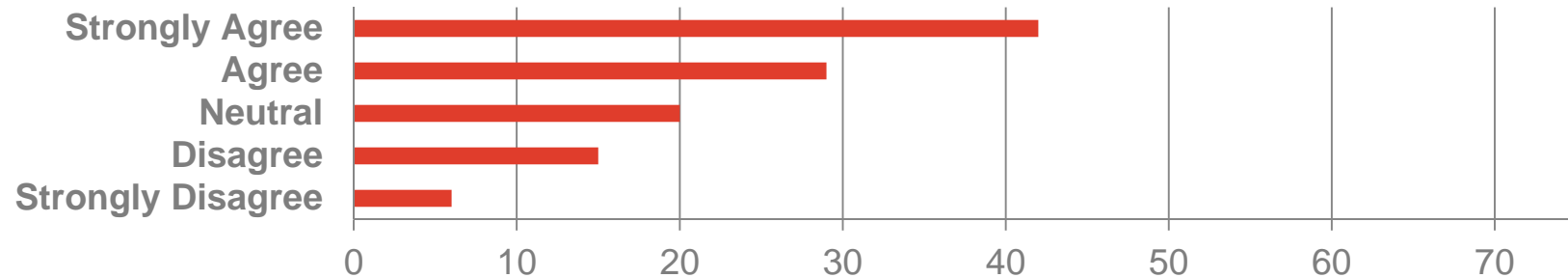**I know I understand the material when I get a good grade on an exam.**
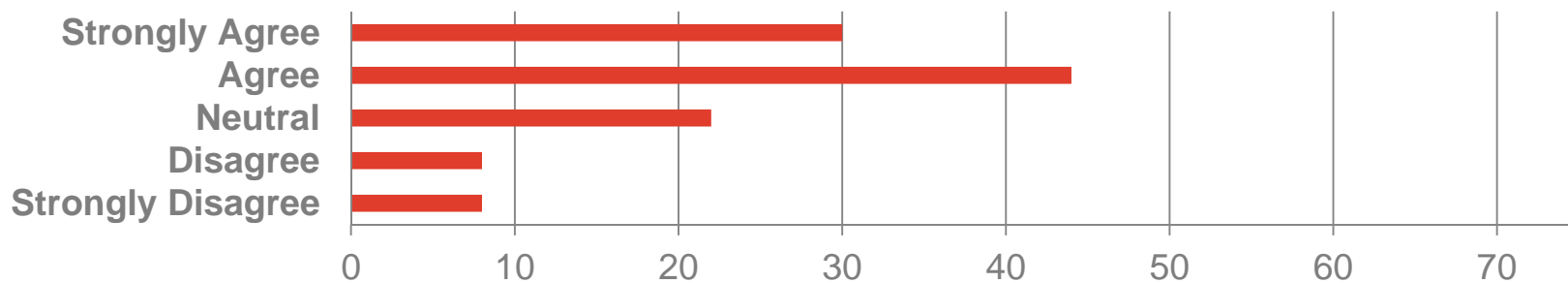
I know I understand the material when
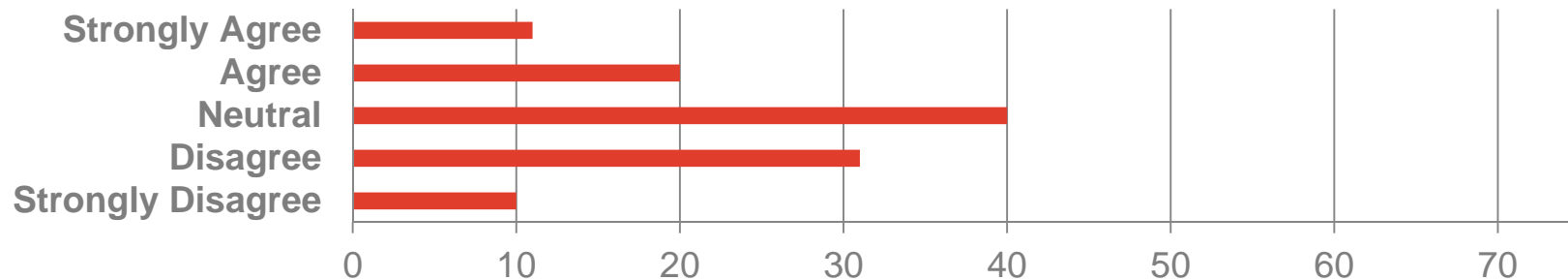I can explain the ideas to someone else.
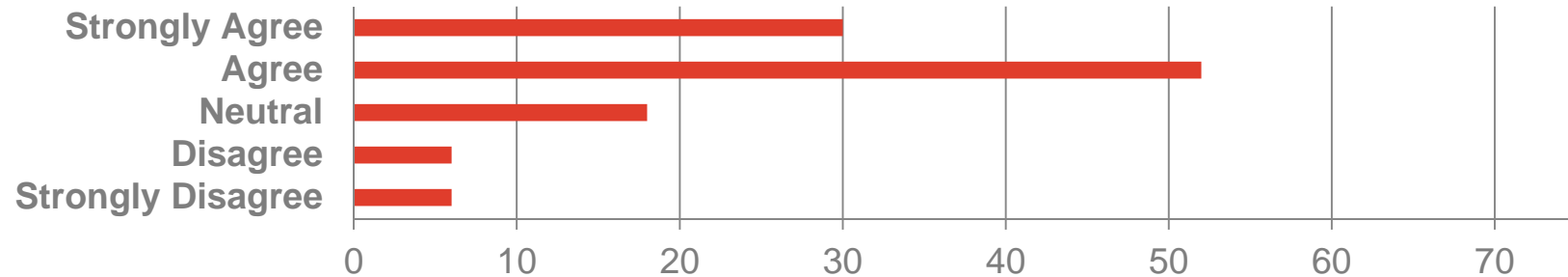
I know I understand the material when
I can see how concepts relate to one another.

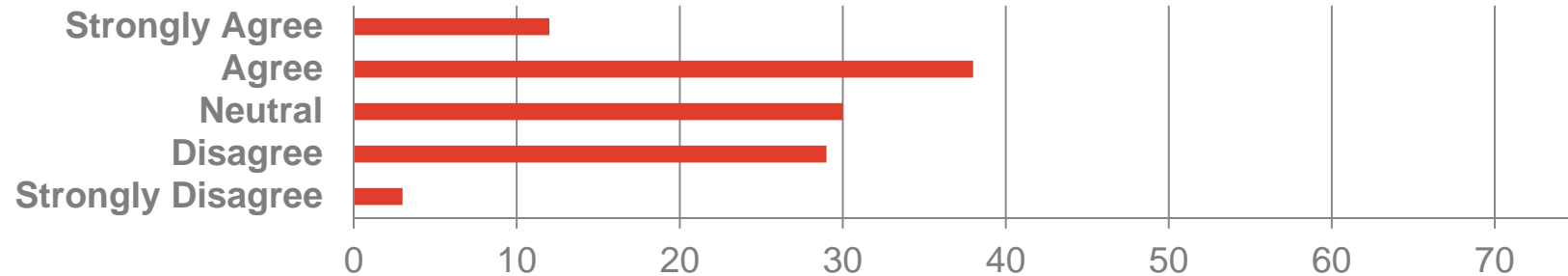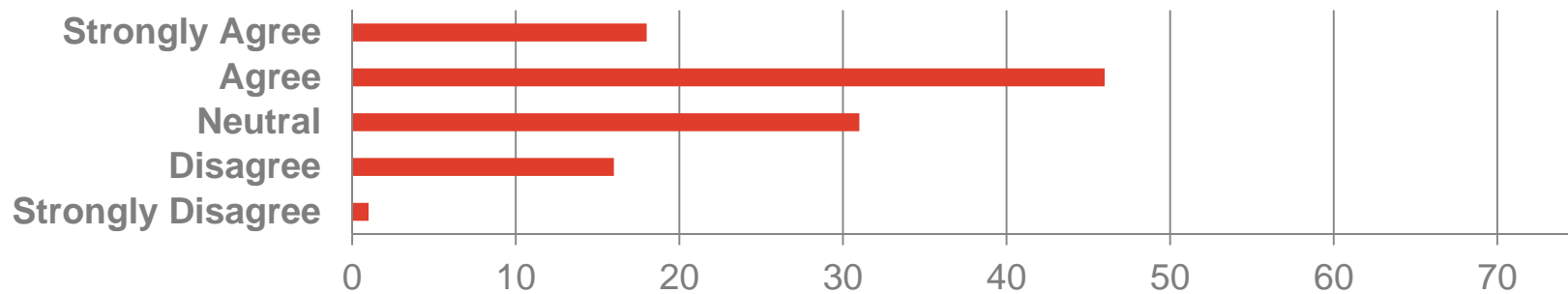Research for a reason.

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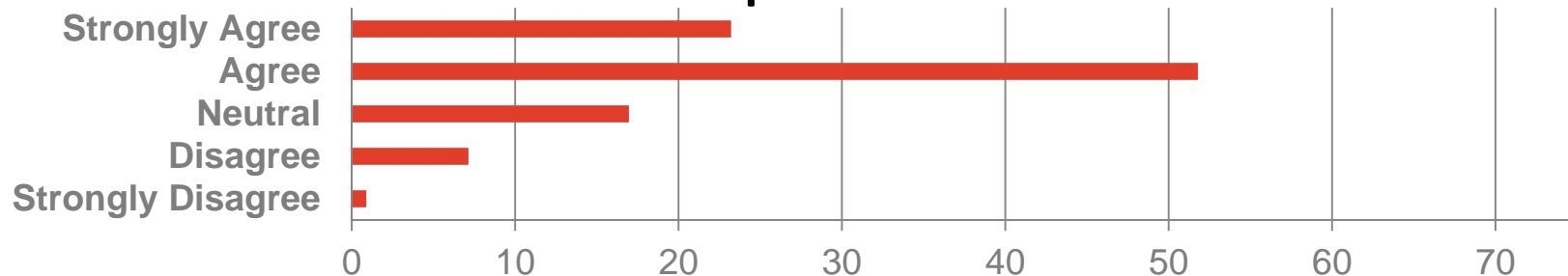
I have math anxiety.

Math has no relevance to my future profession.

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Graphs are always accurate representations of data.

I use mathematics every day.

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I can work any math problem if I have a formula.

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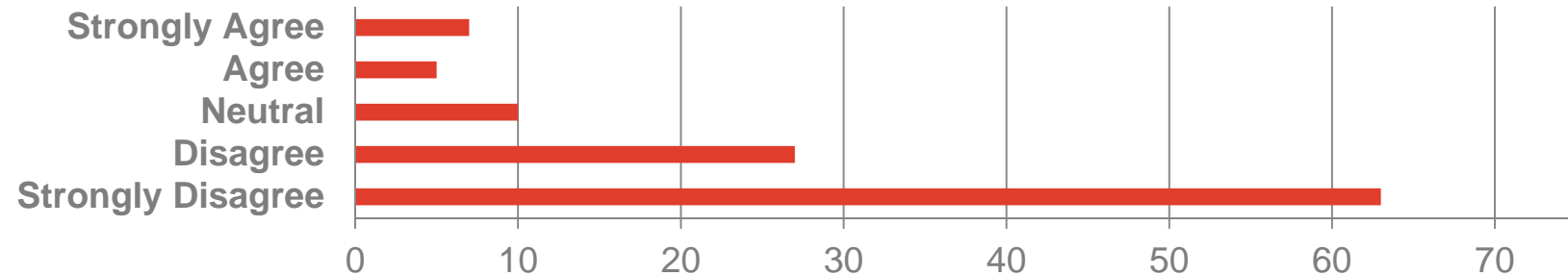
Plans for SP15 and Beyond

- Administer Pre and Post Attitudinal Surveys in QR and 5-hr CA

- Administer Pre and Post Assessment in QR and 5-hr CA

- Complete and use common Smart Notebook lessons for all sections

- Create more in-class activities

- Video course work on SmartBoard and make available to students for some sections covered

- Integrate "clicker" technology into lessons

- Include Math-Art and Math-Music examples, exercises and possibly projects

- Create videos for common questions about exercises

Research for a reason.

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Thank You for Attending Today's Presentation