

# Gen. Ed. Study of Quantitative Skills

Truman College Assessment Committee

General Education Assessment

Spring and Fall 2018

# Truman College Gen.Ed. Goals & Outcomes: Quantitative Skills

1. Communication - Written & Oral *(Last assessed 2015 and 2016)*
2. Inquiry & Analysis *(Last assessed 2017, 2010-11)*
3. Critical Thinking *(Last assessed 2017, 2010-11)*
4. Civic Engagement and Human Diversity *(Last assessed 2013, 2011)*
5. Quantitative Skills ***First assessed 2018!***

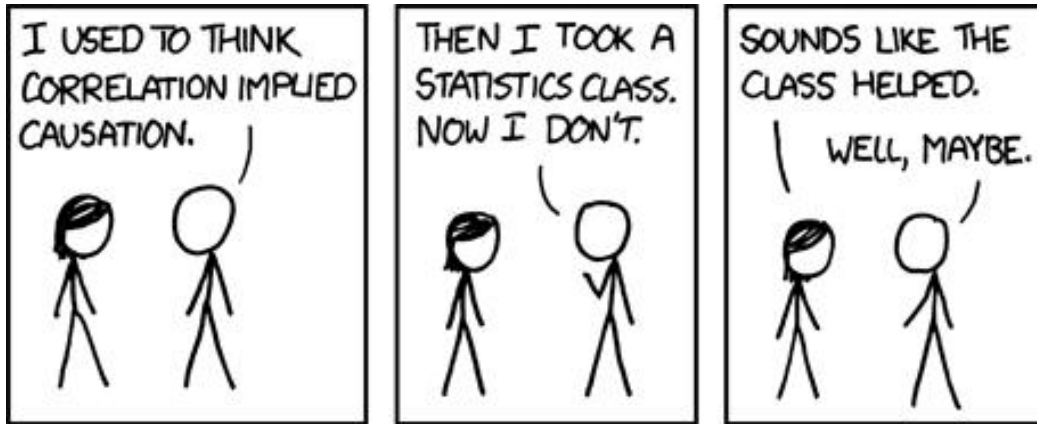
**Goal:** The student considers mathematical models within real-world contexts to make good predictions, judgements, and decisions.

**Student Learning Outcomes:**

1. Represent information symbolically, visually, numerically, and verbally
2. Use mathematics to determine reasonableness, evaluate models, and select optimal results
3. Recognize and show good judgment regarding the limitations of mathematical and scientific methods
4. Interpret information and develop and draw conclusions from mathematical models (e.g. formulas, graphs, tables, schematics)\*

\*Applicable only to AS degree program

# Assessing Quantitative Skills



source: xkcd.com

**Research Goal: During Spring and Fall 2018, the Assessment Committee sought to evaluate students' demonstration of quantitative skills, and to gather faculty perspectives on the challenges and opportunities of assessing these skills.**

## Timeline for Truman's Study of Quantitative Skills

- Explore assessment options for Quant. skills (Oct.-Dec. 2017)
- Conduct all-faculty workshop on Quant. skills, led by Math faculty (Jan. 2018)
- Create rubric for assessing Quant. skills (Feb.-Mar 2018)
- Generate structured sample, faculty letters, section rosters (Mar.-Apr. 2018)
- Collect student work samples (artifacts) (May 2018)
- Departmental evaluation of student work samples (Aug. 2018)
- Evaluate data and generate report (Sep.-Dec. 2018)
- Share study results with faculty and staff (Jan. 2019)

# Parameters and Challenges

- **Evaluators:** All full-time faculty gathered for a morning of artifact evaluation within their departments
  - **Quantitative Data:** Evaluators scored each artifact along the following scale: 5 - Completely meets expectations, 3 - Mostly meets Expectations, 1 - Partially meets expectations, 0 - Does not meet expectations, or Not Applicable
  - **Qualitative Data:** 5-question evaluator survey to collect feedback, concerns, and suggestions
- **This Gen.Ed. study sought to gain better understanding of broad trends in student quantitative skills at Truman College**
  - This study does not critique individual student's abilities
  - This study does not critique an individual faculty member's assignment
- **Student IDs intentionally *not* collected given that video recording is not anonymous.** (This purposefully limited any student demographic analysis)
- **Quantitative skills are difficult to assess college-wide:**
  - challenge of collecting appropriate "artifacts" to evaluate
  - challenge of wide-range of assignments across the college
  - challenge of using a common General Education rubric for presentations with different assignment expectations

# Quantitative data: Rubric scoring

# Gen.Ed. Rubric:

## Quantitative Skills

### Gen.Ed. Outcome #5: Quantitative skills

Goal: The student considers mathematical models within real-world contexts to make good predictions, judgements, and decisions.

	Completely meets expectations <b>5</b>	Mostly meets expectations <b>3</b>	Partially meets expectations <b>1</b>	Does not meet expectations <b>0</b>	ap
<b>1. Interpret:</b> Explains quantitative information as having particular meaning or significance	Provides perfectly accurate explanations of information.	Provides mostly accurate explanations of information.	Provides somewhat accurate explanations of information, but occasionally makes minor errors.	Mostly incorrect understanding.	
<b>2. Represent:</b> Converts quantitative information symbolically, visually, numerically, or verbally	Competently converts all relevant information into an appropriate and desired portrayal.	Competently converts most relevant information into an appropriate and desired portrayal.	Resulting portrayal is only partially appropriate or accurate.	Resulting portrayal is inappropriate or inaccurate.	
<b>3. Calculate:</b> Computes or assesses quantities to generate new information	Calculations attempted are all successful and sufficiently comprehensive to solve the problem.	Calculations attempted are essentially all successful and sufficiently comprehensive to solve the problem.	Calculations attempted are either unsuccessful OR represent only a portion of the calculations required to comprehensively solve the problem.	Calculations attempted are unsuccessful AND represent only a portion of the calculations required to comprehensively solve the problem.	
<b>4. Analyze:</b> Determine reasonableness of data, evaluate models, recognize limits and draws conclusions	Uses information to correctly draw conclusions; create or defend an argument.	Uses information to draw conclusions; create or defend an argument.	The attempt to draw a conclusion is based on a partially faulty analysis.	Ignores the data.	

**What is considered “Quantitative Information” or “Quantitative Skills” will vary by discipline. Some examples:**

- Poetry: mathematical imagery, mathematical ideas influencing the structure of the poem (its shape, the lengths of its lines and stanzas, its patterns and rhyme)
- Music: Musical notation, counting, rhythm, scales, intervals, patterns, symbols, harmonies, time signatures, overtones, tone, pitch.
- STEM Disciplines: formulas, graphs, tables, schematics

# Rubric Data: Mean Analysis

Truman College Study of Quantitative Reasoning: Mean Score by Course

Course	Auto Tech 101	Auto Tech 204	Bio 121	Bio 226	Bus 111	Chem 201	Econ 201	Econ 202	English 101	English 102	Math 125	Math 207	Physics 235	Overall
Number of Evaluations	2	2	23	31	10	24	33	24	51	27	33	50	31	341
1. Interpret: Explains quantitative information as having particular meaning or significance	3.00	5.00	2.91	3.00	1.00	NA	3.42	3.00	1.40	1.00	2.15	1.40	2.29	2.20
2. Represent: Converts quantitative information symbolically, visually, numerically, or verbally	3.00	5.00	2.95	2.41	1.00	2.25	2.00	3.13	1.53	1.05	2.06	1.48	2.61	2.08
3. Calculate: Computes or assesses quantities to generate new information	3.00	5.00	2.17	3.00	1.00	1.92	2.33	2.88	1.04	0.65	2.45	1.48	2.58	1.90
4. Analyze: Determines reasonableness of data, evaluates models, recognizes limits, and draws conclusions	3.00	5.00	2.78	2.21	1.10	1.83	2.50	2.75	1.12	1.33	2.18	1.32	1.90	1.90
Number Imputed						1	3		1			1		6

## 1. Auto Tech

Students in Auto Tech 204 performed better on quantitative tasks than students in Auto Tech 101, which aligned with evaluators' expectations.

## 2. Econ 201 -> 202

Students in Econ 202 "mostly met expectations," but the comparison to Econ 201 was skewed by a high number of "N/A" entries due to the selected assignment consisting almost entirely of True / False statements. This prompted faculty to discuss assignment design and selection.

## 3. Business 111

Students "did not meet expectations" across the Gen. Ed. outcomes, which has prompted discussions among BUS/CIS faculty regarding the course curriculum, as well as the assignment selected for inclusion in this study.

## 4. English 101 ->102

*See next slide*

## 5. Math 207

Evaluators found students proficient in performing calculations but struggling to interpret and explain their findings. (See survey responses for in-depth reflections and suggestions for improving student learning.)

# Rubric Data: Course Level

Truman College Study of Quantitative Reasoning: Distribution of Scores by Course

Course	1. Interpret: Explains quantitative information as having particular meaning or significance					Mean	2. Represent: Converts quantitative information symbolically, visually, numerically, or verbally					Mean	3. Calculate: Computes or assesses quantities to generate new information					Mean	4. Analyze: Determines reasonableness of data, evaluates models, recognizes limits, and draws conclusions					Mean
	Does not meet expectations (0)	Partially meets expectations (1)	Mostly meets expectations (3)	Completely meets expectations (5)	Not applicable		Does not meet expectations (0)	Partially meets expectations (1)	Mostly meets expectations (3)	Completely meets expectations (5)	Not applicable		Does not meet expectations (0)	Partially meets expectations (1)	Mostly meets expectations (3)	Completely meets expectations (5)	Not applicable		Does not meet expectations (0)	Partially meets expectations (1)	Mostly meets expectations (3)	Completely meets expectations (5)	Not applicable	
Auto Tech 101			2			3.00			2			3.00			2			3.00			2			3.00
Auto Tech 204				2		5.00				2		5.00			2			5.00				2		5.00
Bio 121	2	6	6	8	1	2.91	3	4	7	8	1	2.95	1	3	2	17	2.17	3	6	6	8		2.78	
Bio 226	2	7	12	10		3.00	3	5	11	3	9	2.41			1	30	3.00	4	7	15	2	3	2.21	
Bus 111	2	7	1			3.00	4	3	2			3.00	4	3	2		3.00	3	5	2			2.10	
Chem 201						3.25	4	5	13			3.25	6	7	8	3	2.92	8	4	10			3.83	
Econ 201	2	5	11	15		3.42	1	1				3.00			2		3.00	5	1	3			2.75	
Econ 202	2	2	15	5		3.00	1	2	16	5		3.13	1	3	17	3	2.88	2	4	14	4		2.75	
English 101	8	16	11		16	1.40	5	16	11		19	1.53	9	12	5	25	1.04	10	16	7		18	1.12	
English 102	10	9	5		3	1.00	11	6	4	1	5	1.05	13	4	3	7	0.65	9	5	6	1	6	1.33	
Math 125	4	14	9	6		2.15	5	14	8	6		2.06	4	9	14	6	2.45	5	13	8	7		2.18	
Math 207	16	18	14	2		1.40	12	23	12	3		1.49	10	24	15	1	1.48	14	23	11	2		1.32	
Physics 235	6	12	3	10		2.29	6	7	8	10		2.61	5	10	5	11	2.58	8	12	4	7		1.90	
Grand Total	54	96	89	58	44	2.20	54	86	95	41	66	2.08	53	77	72	29	1.90	71	96	88	40	46	1.90	

## English 101

Evaluators noted that students overwhelmingly do not perform quantitative skills as part of essay composition. This prompted much enthusiastic discussion, with faculty deciding to reconsider both the sources of information they assign in class and the extent to which they ask students to interpret quantitative information. English faculty also decided to collaborate with the Math department to create a teaching resource for introducing this new material.

# Action: Teaching Resources

## Cross-disciplinary Collaboration

Math and English faculty worked together to create teaching resources for English 101 instructors who wish to introduce basic quantitative skills into their classes.

## Calculation, Interpretation, Explanation

The tables, charts, graphs, and word problems provide sample exercises that emphasize the Gen. Ed. learning outcomes assessed for this study.

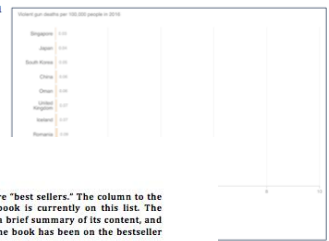
## Voluntary Adoption

It should be noted that faculty adoption of these materials is completely voluntary. A goal will be to follow-up with early adopters to evaluate the impact these resources may have, and to consider revising or expanding the materials.

### Reading and Interpreting Graphs

Name: \_\_\_\_\_

Graph #1



Part 3. The following list is a list of books that are "best sellers." The column to the left under "Nonfiction" tells what number the book is currently on this list. The middle column gives the name of the book with a brief summary of its content, and the number to the right tells how many weeks the book has been on the bestseller list.

## Los Angeles Times

Nonfiction	Book Title	Weeks on Bestseller List
1	The Big Short by Michael Lewis (W. W. Norton: \$27.95) An account of how the U.S. economy was driven to collapse by the bond and real estate markets.	44
2	Dawson's Creek by John Deeken and Rick Kessler (Warner: \$19.95) How the drama of the U.S. presidential campaign of 2004 unfolded.	43
3	Story of a Wintery Day (Novel) by Jeff Kinney (Amulet: \$14.95) Behind the scenes during the making of the "Diary of a Wimpy Kid" movie.	42
4	Just Kids by Patti Smith (Simon & Schuster: \$17.95) A memoir of the singer's early days and relationship with Robert Mapplethorpe.	41
5	Electra Culture Being Being by Chelsea Handler (Grand Central: \$19.95) Funny, personal jokes and amusing tales from the comic's personal life.	40
6	Women Find and Get by Gretchen Rubin (Harper: \$14) How the connection between your relationship with food and your own beliefs can bring fulfillment.	39
7	The Pacific by Hugh Anderson (Publisher: \$14.95) The real-life stories of four Marines.	38

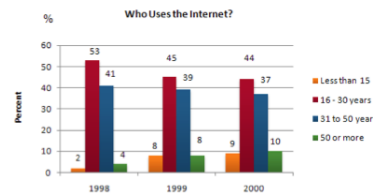
Part 4. Below is a chart that has two budgets. One is for a family that makes under \$90,000 per year, and the other is for a family that makes over \$90,000 per year.

MONTHLY EXPENDITURES	Under \$90,000	Over \$90,000
Groceries	\$ 226.75	\$ 370.92
Eating Out	\$ 134.00	\$ 379.92
Housing	\$ 787.33	\$ 2,093.42
Utilities, Fuel, Public Services	\$ 174.25	\$ 290.92
Household Operations	\$ 35.25	\$ 156.33
Housekeeping Supplies	\$ 34.33	\$ 80.58
Household furnishings and equipment	\$ 106.00	\$ 354.58

### Reading Graphs

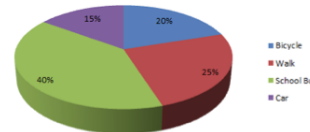
Look at the following graphs, and answer the questions below.

Name: \_\_\_\_\_



1. What was the lowest time for internet usage among people between the ages of 31-50 years old?
2. What is the difference between the internet use of children under the age of 15 from 1998 to 2000?
3. Which group had the largest increase in internet use between the time of 1998-2000?

### Method of Transportation to school



### PART 2

1. Which two methods of transportation are the furthest away from each other in number?
2. Which two methods of transportation, if added, still would not equal the amount of those who take the bus?
3. Infer why more students use the bus as their method of transportation.

thousand a year spend on healthcare  
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over \$90,000 per year spends more  
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s on the next page.

# Qualitative data: Evaluator survey

# Evaluator Survey: Question 1

1. What impresses or surprises you, in general, about students' quantitative skills? (32 responses)

*Summary: Faculty noted that students do well with calculating equations, but struggle to interpret data and draw conclusions.*

“Impressed by calculations and concerned about interpretation skills”

“Student lack of ability to discern the relevance of the data obtained”

“Their inability to formulate a conclusion using quantitative skills”

“Their calculation skill is ... much better than their understanding of the material!”

“I wonder if we should do more to incorporate quantitative reasoning into our essays [...] I find that often times it is hard for students to draw bigger conclusions.”

“Some students can impress with their mathematical equations and solutions but fail miserably in understanding the significance of such calculations or in connecting them to practical applications.”

# Evaluator Survey: Question 2

2. What concerns do you have about students' quantitative skills based on the artifacts you have been evaluating? (33 responses)

*Summary: Faculty echoed concerns about students' ability to interpret data and draw original conclusions, raised questions about other opportunities for students to demonstrate quantitative skills, and expressed concern that these Gen. Ed. skills do not apply to all disciplines.*

“One concern that I have is that these skills may not be seen as relevant, ever, in writing essays for an English class.”

“Many students can perform the correct calculations but not all can articulate or explain what they mean”

“Students are not doing a good job of explaining...They are only **using data without explaining the significance of it.**”

“We had artifacts that looked very impressive, with lots of calculations, but devoid of interpretation and meaning - and resulting in a low score. **We should signpost this difference between calculation skill and interpretation,** and emphasize understanding over manipulation of symbols.”

“[M]any of our students seem to think numbers speak for themselves. More work needs to go into helping students interpret and draw conclusions from quantitative data.”

# Evaluator Survey: Question 3

**3. How might faculty across the disciplines enhance their assignments to improve students' quantitative skills?**  
(32 responses)

*Summary: Faculty suggested additional professional development around the integration of quantitative skills into classroom activities, across disciplines. Several faculty gave strong ideas for writing courses, specifically.*

“Hosting faculty discussions on assignments, exams, and activities might be helpful for instructors to explore alternate assessment methods.”

“Talk about the difference between calculation (manipulation of numbers and symbols) and understanding, and set high expectations for the latter. In addition, **make sure that assignments explicitly require an interpretation component.**”

“For [English] 101 and 102, **add in a portion of how to read statistics or percentages** and what information will be necessary for the reader to understand the significance of your numbers (so, for example, if you say 637 goals in soccer, **show by comparison that this is a lot.**)

“**Include sources that show graphical representations of data.** Encourage students to create their own surveys and interpret results. Review/revise rubrics to specify that (when applicable) evidence should include quantitative data and effective interpretation, analysis and representation of data.”

# Evaluator Survey: Question 4

4. How might your own approaches to teaching and assignment-creation improve because of this Gen.Ed. Assessment study? (31 responses)

*Summary: Faculty identified a number of next steps for continued improvement of teaching and learning, including changes to existing assignments, new learning outcomes related to quantitative skills, and renewed emphasis on the gen. ed. goals and outcomes.*

“Make sure that the transference of the quantitative reasoning is transferred to visual representations and or formulas.”

“I need to spend more time on how to create graphs.”

“Perhaps it would be worthwhile to spend more time on reading and interpreting data.”

“I need to provide alternate forms of data to help my students learn how to play with data.”

“I might create a lesson or handout on the steps of using quantitative data as evidence and include the gen ed rubric criteria in my own evaluations.”

“When assigning a research paper, I will add that students need to use data to illustrate their points.”

# Evaluator Survey: Question 5

5. What thoughts or concerns do you have about Truman's Gen.Ed. Outcome #5 (Quantitative Skills) or the rubrics used for this assessment? (31 responses)

*Summary: Faculty provided actionable suggestions, such as changes to the process for sampling student work, expansion of the rubric's scoring, and recommendations for streamlining department discussion during professional development opportunities.*

“Some colleagues expressed that **we should have hand picked the papers** to make sure they all had recognizable quantitative information in them.”

“I feel that **stronger examples** of quantitative skills would have produced more meaningful discussion.”

“While Communications Department faculty may question whether or not the categories on the Quant Skills rubric are applicable to the types of assignments they give, they do agree that the **categories on this rubric are relevant and sound.**”

“The **rubrics need to expand** in order to have values 5, 4, 3, 2, 1, and 0.”

“As a whole, I believe that our students need some exposure to both quantitative and qualitative skills [and] that **our programs will reflect coursework that captures both.**”



# Key Takeaways, Next Steps

# Key Takeaways and Next Steps

Key Takeaways	Next Steps
<ol style="list-style-type: none"><li>1. Students do well with calculating equations, but struggle to interpret data and draw conclusions.</li></ol>	<ol style="list-style-type: none"><li>1. Share the teaching resources widely, and follow up with faculty who adopt the materials to seek feedback for further improvement.</li></ol>
<ol style="list-style-type: none"><li>1. Faculty expressed concern that students have adequate opportunities to demonstrate quantitative skills.</li></ol>	<ol style="list-style-type: none"><li>2. Modify the selection process for student work samples to ensure quality and consistency for future Gen. Ed. studies.</li></ol>
<ol style="list-style-type: none"><li>2. Gen. Ed. skills do not apply to all disciplines, so perhaps the next study should sample only from courses with SLOs related to quant. skills.</li></ol>	<ol style="list-style-type: none"><li>3. Build professional development around designing course assignments that assess student learning in a variety of formats and question types.</li></ol>
<ol style="list-style-type: none"><li>3. Student work samples selected for inclusion in future Gen. Ed. studies must be chosen intentionally so as to limit “N/A” entries.</li></ol>	<ol style="list-style-type: none"><li>4. Foster a culture of intra- and interdisciplinary collaboration to utilize faculty expertise in improving course assignments and assessment practices.</li></ol>
<ol style="list-style-type: none"><li>4. Faculty requested professional development around the integration of quantitative skills into classroom activities.</li></ol>	
<ol style="list-style-type: none"><li>5. Faculty identified numerous methods for improving instruction of quantitative skills in their own classes.</li></ol>	

# Assessment Committee

## AY2018-2019

### AY2018 Committee Members

Maggie Ayala (Social Science)  
Diego Báez (Chair)  
Angela Cotromanes (Child Development)  
Akbar Ebrahim (Biology)  
Joe Farrell (Physical Science and Engineering)  
Ritch Keitel (Humanities)  
Ana King (Communications)  
Sarah Ladino (Communications)  
Derek Lazarski (Academic Support Services)  
Susan Marcus (Office of Instruction)  
Leone McDermott (Library)  
Farzana Najam (Biology)  
Maureen Pylman (Institutional Research)  
LaSandra Skinner (Business)  
DeShaunta Stewart (Office of Instruction)  
Dianne Torres (Humanities)  
Helen Valdez (Mathematics)

### Teaching Resource Subcommittee

Sarah Ladino (Communications)  
Maeve Masini (Math)

### Study Lead

Diego Báez

### A Note of Thanks:

*The Truman College Assessment Committee would like to thank, most of all, the anonymous faculty of this study's sampled courses for helping us gather student work samples and to the faculty evaluators who participated in the study. Special thanks to the Humanities department for pushing against assessment norms in a productive way, leading to important findings about ongoing assessment needs at the college. Finally, thank you to the Truman administration for providing funding to support our assessment studies, which seek to better understand --and to improve-- student learning at the college.*