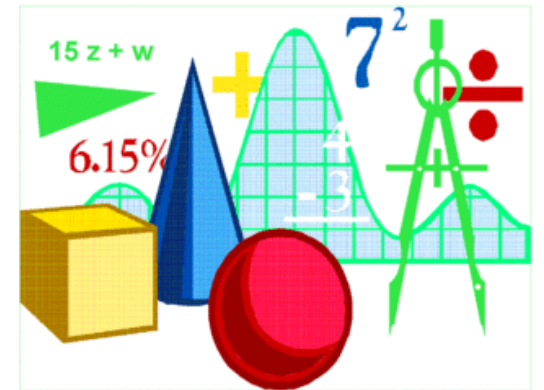


# Colorado Math Pathways Task Force Recommendations



# Mission

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- Draft a public statement on the importance of better alignment of and advising into gateway math courses.
- Identify and suggest alternative gateway math courses, that are rigorous and of quality in content and competencies, and that are appropriately aligned with the math skills students need to succeed in their programs of study.
- Work with representatives from academic disciplines and advisors to review math requirements and consider alternative courses to college algebra for non-calculus based majors.

# Distribution of students enrolled in three gateway courses by four year institution

<b>INSTITUTION NAME</b>	<b>% ENROLLED COLLEGE ALGEBRA</b>	<b>% ENROLLED MATH FOR THE LIBERAL ARTS</b>	<b>% ENROLLED INTRO TO STATS</b>
Adams State University	89	7	4
Colorado Mesa University	67	24	9
Colorado State University	73	27	0
Colorado State University - Pueblo	44	23	33
Fort Lewis College	45	12	43
Metropolitan State U. of Denver	25	43	32
University of Colorado Boulder	35	48	17
University of Colorado Denver	39	35	26
University of Northern Colorado	27	21	51
Western State Colorado University	85	15	0

# Distribution of students enrolled in three gateway courses by institution – Community Colleges

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<b>INSTITUTION NAME</b>	<b>% ENROLLED COLLEGE ALGEBRA</b>	<b>% ENROLLED MATH FOR THE LIBERAL ARTS</b>	<b>% ENROLLED INTRO TO STATS</b>
Aims Community College	66	12	22
Arapahoe Community College	66	12	22
Colorado Mountain College	74	9	17
Colorado Northwestern CC	65	20	15
Community College of Aurora	64	15	21
Community College of Denver	62	18	20
Front Range Community College	73	7	20
Lamar Community College	70	23	7
Morgan Community College	60	3	37
Northeastern Junior College	79	1	19
Otero Junior College	70	18	11
Pikes Peak Community College	75	12	12
Pueblo Community College	54	22	25
Red Rocks Community College	69	13	18
Trinidad State Junior College	75	7	18

# Summary

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- ❑ Four 4-year institutions have the majority of students in college algebra; the others have students distributed almost equally across the 3 gateway math courses.
- ❑ Nearly all of the community colleges have much larger enrollments in College Algebra

# Recommendations from the Task Force

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- ❑ Curriculum
- ❑ Advising
- ❑ Support & Professional Development



# Recommendation 1 - Curriculum

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- Revise current math pathways into more well defined pathways
  - **CalcPath**
  - **StatPath**
  - **QuanThinkingPath**



# Recommendation - CalcPath

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## ■ CalcPath

- Current course options:
  1. Go right into Calculus I
  2. Take Pre-Calculus and then Calculus I
  3. Follow the current sequence of College Algebra, Trigonometry, and Calculus I
  
- Potential support options to assist students in completing Calculus I in first year/first 30 credit hours
  1. Co-requisite instruction/support
  2. Stretch courses (the risk here is transferring before completing the entire course)
  3. Online support modules
  4. Compressed/accelerated modules



# Recommendation - StatPath

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## ■ StatPath

- Primarily use the existing Intro to Statistics content
- Encourage use of modeling as an approach for the course
- Students should take Intro to Stats without a credit-bearing pre-requisite
  - No college-level math pre-requisites are necessary, e.g., College Algebra
  - Enter the course when college ready (that is, have completed remedial if needed, like MAT 050: Quantitative Literacy)

# Recommendation – QuanThinkingPath, I

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- **QuanThinkingPath**

- MAT 050 as the developmental education path
- Meets the GT Pathways/core Gen Ed requirement
- Generally is a terminal math course
- Recommendation is for courses to be rigorous, support problem solving, numerical and reasoning skills, and address the state competencies.
- Courses may include:
  - Revised Math for Liberal Arts course
  - New algebra-based modeling course

# Recommendation – QuanThinkingPath, II

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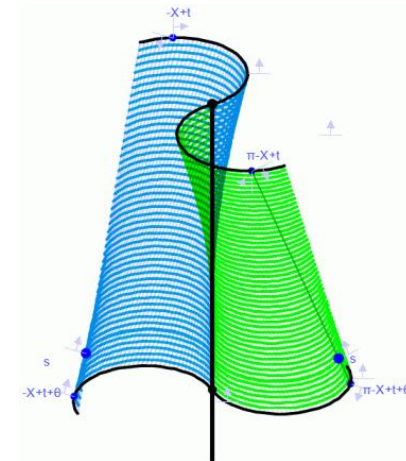
## ■ **QuanThinkingPath**

- Recommended revisions for existing Liberal Arts course
  - Consistency in key topics
    - ✓ Financial literacy, descriptive statistics, algebraic models, and reasoning
    - ✓ Additional topics to include use CCCNS content/competencies
  - More depth, less breadth
  - Emphasis on modeling, problem solving, and quantitative reasoning
  - Less emphasis on appreciation of math topics

# Recommendation – QuanThinkingPath, III

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- Develop new algebraic modeling course for the CCCNS/4-year schools
  - Focus intended for majors that need Algebra skills but not Calculus
  - More conversation to come
    - Intended Learning Outcomes to be determined
    - Assessment Approaches
    - Content to be determined
    - Goal of fall 2017 for pilot



# Content Revisions

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CONNECTING UPDATED COMPETENCIES AND REVISED COURSE  
LEARNING OUTCOMES

# Using Statistics as an example

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Where are we now...

- Currently 47 course objectives
- Written as a “laundry list” for faculty to cover
- See Handout 1

## **MAT 135/BUS 226**

### **Course Objectives:**

1. Have a working knowledge of and distinguish between the two branches of statistics, descriptive statistics, inferential statistics.
2. Distinguish between qualitative, quantitative data.
3. Distinguish between the following levels of measurement: A. Nominal B. Ordinal C. Interval D. Ratio.
4. Define a population and a sample.
5. Define parameter and statistic.

Down to...

47. Read, analyze, and apply to problems written material related to statistics.

# April 2013 Fac2Fac

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- Faculty convened to begin work on content revisions
- Many working groups struggled with revising content and writing learning outcomes
- Why Competencies were revised first
- Statistics working group made some strides in content revisions
- See Handout 2
- Better than the list of 47 but...

## *Learning Outcome 1: Descriptive Statistics*

### **Learning Outcome 1:** Descriptive Statistics

- . The student should be able to:
  - compute and interpret measures of center and measures of variation of data.
  - construct and analyze graphical displays to summarize data

# Trying to map and measure

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- While the course learning outcomes are improved, there are still some issues:  
Compound learning outcomes are difficult to map and measure
  - Which part of the statement is actually being addressed in the student work?
  - How can you use data to improve student learning if you are not sure what you are measuring?
- Need to map each course learning outcomes to a competency learning outcome...





# Outcome vs Objective

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## **Outcome**

Focused on Learner

Student-centered

Performance-based

Observable in students

Measureable

## **Objective**

Focused on Content

Teacher-centered

“Coverage”

Observable in teacher

Difficult to measure

# Definitions of Learning Outcome

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Learning outcomes are statements that describe significant and essential learning that learners have achieved, and can reliably demonstrate at the end of a course or program. In other words, learning outcomes identify what the learner will know and be able to do by the end of a course or program.

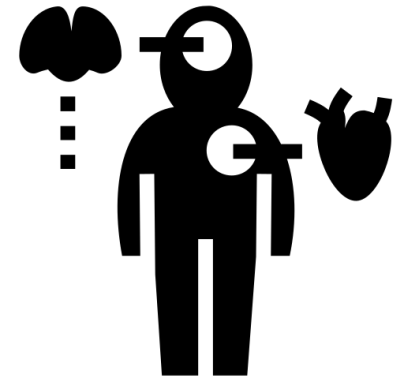
Learning outcomes are statements of what a learner is expected to know, understand and/or be able to demonstrate after completion of a process of learning.

# Anatomy of Learning Outcome

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Learning Outcome statements may be broken down into three main components:

- an **action word** that identifies the performance to be demonstrated;
- a **learning statement** that specifies what learning will be demonstrated in the performance;
- a broad statement of the **criterion** or standard for acceptable performance.



# Writing Learning Outcomes

<b>ACTION WORD</b> (performance)	<b>LEARNING STATEMENT</b> (the learning)	<b>CRITERION</b> (the conditions of the performance demonstration)
Summarize	the 3 techniques	used to evaluate trigonometric integrals
Demonstrate	basic communicative strategies	for everyday situations
Organize	clinical data ( including history, physical exam, laboratory Assessments)	to create an appropriate treatment plan based on patient data

Action word + Learning Statement + Criterion

COMPREHENSION			EVALUATION		
KNOWLEDGE		APPLICATION	ANALYSIS	SYNTHESIS	
	Associate			Arrange	Appraise
Cite	Classify		Analyze	Assemble	Assess
Count	Compare	Apply	Appraise	Collect	Choose
Define	Compute	Calculate	Calculate	Compose	Compare
Draw	Contrast	Classify	Categorize	Construct	Criticize
Identify	Differentiate	Demonstrate	Classify	Create	Determine
List	Discuss	Determine	Compare	Design	Estimate
Name	Distinguish	Dramatize	Debate	Formulate	Evaluate
Point	Estimate	Employ	Diagram	Integrate	Grade
Quote	Explain	Examine	Differentiate	Manage	Judge
Read	Express	Illustrate	Distinguish	Organize	Measure
Recite	Extrapolate	Interpret	Examine	Plan	Rank
Record	Interpolate	Locate	Experiment	Prepare	Rate
Repeat	Locate	Operate	Inspect	Prescribe	Recommend
Select	Predict	Order	Inventory	Produce	Revise
State	Report	Practice	Question	Propose	Score
Tabulate	Restate	Report	Separate	Specify	Select
Tell	Review	Restructure	Summarize	Synthesize	Standardize
Trace	Tell	Schedule	Test	Write	Test
Underline	Translate	Sketch			Validate
		Solve			
		Translate			
		Use			
		Write			

	COMPREHENSION			EVALUATION	
KNOWLEDGE	APPLICATION	ANALYSIS	SYNTHESIS		
	Associate			Arrange	Appraise
Cite	Classify		Analyze	Assemble	Assess
Count	Compare	Apply	Appraise	Collect	Choose
Define	Compute	Calculate	Calculate	Compose	Compare
Draw	Contrast	Classify	Categorize	Construct	Criticize
Identify	Differentiate	Demonstrate	Classify	Create	Determine
List	Discuss	Determine	Compare	Design	Estimate
Name	Distinguish	Dramatize	Debate	Formulate	Evaluate
Point	Estimate	Employ	Diagram	Integrate	Grade
Quote	Explain	Examine	Differentiate	Manage	Judge
Read	Express	Illustrate	Distinguish	Organize	Measure
Recite	Extrapolate	Interpret	Examine	Plan	Rank
Record	Interpolate	Locate	Experiment	Prepare	Rate
Repeat	Locate	Operate	Inspect	Prescribe	Recommend
Select	Predict	Order	Inventory		Revise
State	Report	Practice			
Tabulate	Restate	Report			
Tell	Review	Restructure			
Trace	Tell	Schedule			
Underline	Translate	Sketch			
		Solve			
		Translate			
		Use			
		Write	Test	Write	Test
					Validate

Lower division course  
outcomes

COMPREHENSION			APPLICATION ANALYSIS SYNTHESIS		EVALUATION
KNOWLEDGE					
	Associate			Arrange	Appraise
Cite	Classify		Analyze	Assemble	Assess
Count	Compare	Apply	Appraise	Collect	Choose
Define	Compute	Calculate	Calculate	Compose	Compare
Draw	Contrast	Classify	Categorize	Construct	Criticize
Identify	Differentiate	Demonstrate	Classify	Create	Determine
List	Discuss	Determine	Compare	Design	Estimate
Name	Distinguish	Dramatize	Debate	Formulate	Evaluate
Point	Estimate	Employ	Diagram	Integrate	Grade
Quote	Explain	Examine	Differentiate	Manage	Judge
Read	Express	Illustrate	Distinguish	Organize	Measure
Recite	Extrapolate	Interpret	Examine	Plan	Rank
Record	Interpolate	Locate	Experiment	Prepare	Rate
Repeat	Locate	Operate	Inspect	Prescribe	Recommend
		Order	Inventory	Produce	Revise
		Practice	Question	Propose	Score
		Report	Separate	Specify	Select
			Summarize	Synthesize	Standardize
			Test	Write	Test
Underline	Translate	Use			Validate
		Write			

Upper division  
Course / Program  
outcomes

# Meaningful, Measureable, Manageable

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## COMPOUND ACTION STATEMENTS

### *Learning Outcome 1: Descriptive Statistics*

#### **Learning Outcome 1:** Descriptive Statistics

- . The student should be able to:
- compute and interpret measures of center and measures of variation of data.
  - construct and analyze graphical displays to summarize data

## SINGLE ACTION STATEMENTS

### *Learning Outcome 1: Descriptive Statistics*

#### **Learning Outcome 1:** Descriptive Statistics

The student should be able to:

- compute measures of center and measures of variation of data.
- interpret measures of center and measures of variation of data.
- construct graphical displays to summarize data.
- analyze graphical displays to summarize data.



# Mapping to Quantitative Literacy

Quantitative Literacy Learning Outcomes					
Learning Outcome 1	Learning Outcome 2	Learning Outcome 3	Learning Outcome 4	Learning Outcome 5	Learning Outcome 6
Students should be able to interpret Information a. Explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words).	Students should be able to represent Information a. Convert information into and between various mathematical forms (e.g., equations, graphs, diagrams, tables, words).	Students should be able to perform calculations a. Solve problems or equations at the appropriate course level. b. Use appropriate mathematical notation. c. Solve a variety of different problem types that involve a multi-step solution and address the validity of the results.	Students should be able to apply and analyze information a. Make use of graphical objects (such as graphs of equations in two or three variables, histograms, scatterplots of bivariate data, geometrical figures, etc.) to supplement a solution to a typical problem at the appropriate level. b. Formulate, organize, and articulate solutions to theoretical and application problems at the appropriate course level. c. Make judgments based on mathematical analysis appropriate to the course level.	Students should be able to communicate using mathematical forms a. Express mathematical analysis symbolically, graphically, and in written language that clarifies/justifies/summarizes reasoning (may also include oral communication).	Students should be able to address assumptions a. Describe and support assumptions in estimation, modeling, and data analysis, used as appropriate for the course

# Mapping + Single Action =



WHERE DO THESE GO IF THEY FIT  
TWO PLACES?

## *Learning Outcome 1: Descriptive Statistics*

### **Learning Outcome 1: Descriptive Statistics**

. The student should be able to:

- compute and interpret measures of center and measures of variation of data.
- construct and analyze graphical displays to summarize data

EASY TO MAP TO QL LEARNING OUTCOMES:  
SEE HANDOUT 4

## *Learning Outcome 1: Descriptive Statistics*

### **Learning Outcome 1: Descriptive Statistics**

The student should be able to:

- compute measures of center and measures of variation of data.
- interpret measures of center and measures of variation of data.
- construct graphical displays to summarize data.
- analyze graphical displays to summarize data.

# Goal for the day in content groups

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- 1) Determine the “big ideas” or major themes within the content for the course being revised
  - Keep in mind that College Algebra is part of the Calc Path
  - Only students taking the Calculus Sequence should be in this path.
  - Examine course content with advanced coursework in mind...scaffold for success
- 2) Use these “big ideas” or major themes to write a set of learning outcomes for the course
  - This is only the first draft
  - Don't expect them to be perfect
  - Use measurable action words
- 3) Writing compound statements to start is okay
- 4) Try for 8-12 at most