1. **Long-term Behaviors** — *What the student should learn to practice in life, personally and professionally*

2. **Broad Learning Goals** — *Key learning objectives*

3. **Course Intentions** — *Intended results of the course*

4. **Learning Outcomes** — *What the student should have learned at the end of the course; measurable*

5. **Knowledge Table** — *Types of knowledge the student should master to achieve learning outcomes*

6. **Methodologies** — *Explicit models of key practices*

7. **Themes** — *Support the development of long-term behaviors; connect multiple activities*

8. **Learning Skills** — *Transferable skills that improve the student's ability to learn across contexts*

9. **Activity Table** — *Learning activities developed for achievement of learning outcomes*

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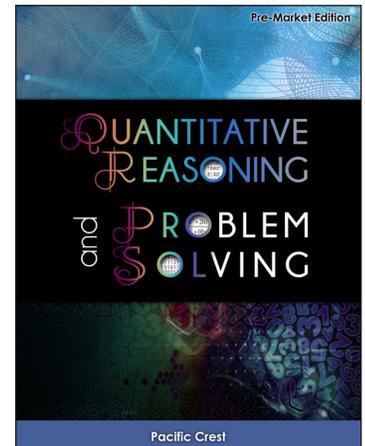
1. Long-Term Behaviors promoted by *Quantitative Reasoning and Problem Solving*

1. **Knowledge**: Has a working foundation of key mathematical ideas that can be effectively and efficiently applied in future mathematical learning and problem solving.

2. **Problem Solving**: Locates and identifies key problems that are consensually defined, clearly articulating issues and working assumptions and then systematically partitioning and integrating known workable solutions into validated and documented solutions that are generalized across additional opportunities and contexts.

3. **Life-long Learner**: Has developed and uses strong mathematical learning skills that align with their long-term learning plan, daily leveraging mathematical situations as opportunities for learning and ongling mathematical development.

4. **Modeler**: Is purposeful in thought and takes in ideas and models from a variety of sources, identifying key variables and relationships, making solid connections, and synthesizing them into a simple, coherent, and well-developed framework.

5. **Reflective Practice**: Appreciates and practices both self-assessment and reflection to help improve performance both personally and professionally, using these skills to help others improve their performance through high-quality peer-assessment, mentoring, and systematic continuous quality improvement.

6. **Sophisticated Consumer**: Is able analyze a financial situation, its risks, and determine the more valued alternative in decision making whether it is a purchase, investment, or financial planning.

7. **Data Analyst**: Can consistently produce or obtain a data set, evaluate the quality of that data, analyze and align its meaning to a purpose, sharing findings in a quantitative presentation.

2. **Broad Learning Goals** of *Quantitative Reasoning and Problem Solving*

- Advance the problem solving process
- Connect math to problem solving
- Explore and improve performance in elevating learning to Level 4 on Bloom's Taxonomy
- Improve and increase reflective practice
- Build and apply mathematical models
- Increase tool usage in data, statistical, and graphical analysis and mathematical modeling
- Increase mathematical reasoning
- Advance quantitative reasoning
- Address life situations and problems effectively with a quantitative mindset

3. **Course Intentions** of *Quantitative Reasoning and Problem Solving*

- Produce a new way of viewing mathematics to increase its value to students and elevate its relevance both in their discipline and in life
- Increase learner efficacy in learning mathematics
- Build a problem solving mindset
- Provide leverage for other programs to advance quantitative reasoning
- Document advancement in quantitative reasoning
- Produce a quantitative literate person at Level 3 in the Measure of Quantitative Reasoning

4. **Learning Outcomes** for *Quantitative Reasoning and Problem Solving*

Competencies	*The collection of knowledge, skills, and attitudes needed to perform a specific task effectively and efficiently at a defined level of performance*

- Can learn a new mathematical software tool and use its basic features and functions within three hours
- Can produce an effective reading of a mathematically-based article
- Can write a quantitative technical report that meets given specifications
- Can analyze a mathematical model and perform "What if?" scenarios based upon changing variables
- Can produce accurate computations with basic mathematical and graphics analysis
- Can read, interpret, and produce a wide-range of functional and analytical graphs
- Can use a reflective journal for consistent assessment of one's own learning processes for the continual improvement of learning performance
- Can analyze the larger context in order to determine non-quantitative factors and considerations (i.e., social, economic, political, or cultural) that must be taken into account when solving a problem

Achievement	*Significant work products or performances that transcend normal class requirements and are externally valued or affirmed by an outside expert or client*

Create a four-year personal financial plan that models the academic and living expenses during the college years. This plan will explore different methods of obtaining financial resources and take into consideration the realities and requirements of post-graduation financial security (e.g., paying off student loans) as well as the potential impact of continuing education (graduate school).

Movement	*Documented growth in a transferable process or learning skill*

- **Problem Solving**: Advance in identifying, defining, clarifying issues and assumptions, partitioning, modeling, integrating, testing, generalizing, and documenting the problem solving process

- **Learning Math**: Become increasingly proficient in identifying schema, clarifying the key principles, obtaining and processing examples or models of principles, knowing the underlying fundamental assumptions and relationships, and testing understanding by contextualizing and applying to familiar and unfamiliar situations (building skills in transferring knowledge across contexts)

- **Modeling**: Improve in defining a system, its key components, the significant variables, inputs and outputs of the system, diagramming it, and describing the relationships among its members and between it and other models, both in visual and symbolic forms

- **Self-development**: Increase self-development through on-going reflections and self-assessment, identifying key areas for growth, finding mentors, structuring self-improvement projects, assessing progress (strengths and accomplishments along with areas for improvement), and celebrating growth with those who have made a positive impact on this development

Experience	*Interactions, emotions, responsibilities, and shared memories that clarify one's position in relation to oneself, a community, or discipline*

Students will be given challenging learning situations that require both collaboration and cooperation to meet a set of performance criteria in a public arena, where the performance is interdependent on the performance of others. They will then be given an increasingly difficult set of problems to solve individually as well as in teams. These problems will be assessed and their solutions improved upon through peer-assessment. The results of learner efforts will always be public with the opportunity for assessment that can be integrated into future plans for growth. Through these challenges, students will feel many ups and downs that are fairly significant, each giving the opportunity for learners to grow their emotional maturity and affective skill set. The learning processes and the environment created will expect learners to be consistently professional, coming to activities well-prepared, seeking to maintain peak performance, and reflecting on practice to help themselves and others improve daily performance. The enriched learning environment will constantly challenge students to seek higher levels of learning and developing action plans for improvement and growth.

Integrated Performance	*The synthesis of prior knowledge, skills, processes, and attitudes with current learning needs to address a difficult challenge within a strict time frame and set of performance expectations*

Independently tackles a new area of knowledge with purpose and direction by

- identifying the learning outcomes
- identifying the schema for the discipline and the knowledge
- clarifying the key knowledge items, their type and levels of learning that are expected in order to meet all learning outcomes
- reading to gain independent understanding while formulating and seeking to answer inquiry questions
- knowing how to use models and examples to contextualize and transfer knowledge
- integrating new and past knowledge through applying the knowledge in difficult problem solving situations
- validating learning by differentiating *thinking you know* (clouds) from *knowing you know* (bricks)

5. Knowledge Table for *Quantitative Reasoning and Problem Solving*

Concept: *an idea that connects a set of relationships; a generalized idea about something*
Process: *a sequence of steps, events, or activities that results in a change or produces something over time*
Tool: *any device, implement, instrument, or utensil that serves as a resource to accomplish a task*
Contexts: *the whole situation, background, or conditions relevant to the process*
Way of Being: *the set of behaviors, actions, & language associated with a particular discipline or knowledge area; a culture*

Concepts	Processes	Tools	Context	Way of Being
Time value of money	Problem solving methodology	Graphical analysis	Business	Persistence
Probability Distribution	Interpreting a Math model	Spreadsheet	Health	Risk taking
Central Tendency	Validation	Computational skills	Government	Validation
Variation	Learning Process methodology	Tables	Personal Finance	Problem Solver
Equations/Formulas	Self-assessment/reflection	Venn Diagram		Confidence
Randomness	Reading process	Truth Table		
Confidence interval (statistical inference)	Interpreting Word Problems	P&L Statement		
Sampling	Solving an equation	Balance Sheet		
Set	Data Analysis			
Intersection	Analyzing a function			
Union	Logical Reasoning			
Discounting	Sampling			
Correlation				
Linear Regression				

6. Core Methodologies for *Quantitative Reasoning and Problem Solving*

Analyzing Randomness	Learning Process
Calculating Likelihood	Logical Reasoning
Creating a Measure of Central Tendency	Making Sense of Numbers
Data Analysis	Mathematical Modeling
Evaluating a Formula	Organizing Data
Generating Data	Problem Solving
Graphical Analysis	Quantitative Communication
Interpreting a Math Model	Quantitative Decision Making
Interpreting a Word Problem	Reading
Isolating a Variable	Simulation

7. Themes for *Quantitative Reasoning and Problem Solving*

Learning to Learn Math (reading and learning)

Mathematical Reasoning and Thinking

Mathematical Modeling

Quantitative Problem Solving

Self-Growth, Self-Assessment, and CQI

8. Learning Skills for *Quantitative Reasoning and Problem Solving*

1. **Estimating (number sense)** — *approximating from mathematical models*
2. **Identifying issues** — *inventorying key stakeholder desires and concerns*
3. **Identifying assumptions** — *examining preconceptions/biases*
4. **Thinking skeptically** — *testing against fundamental principles/schema*
5. **Persisting** — *continuing despite difficulties*
6. **Identifying differences** — *recognizing/distinguishing attributes of parts*
7. **Identifying similarities** — *recognizing common attributes of parts*
8. **Validating** — *using alternative methods to test results*
9. **Simplifying** — *representing only primary features*
10. **Inquiring** — *asking key questions*
11. **Envisioning** — *imagining desired conditions*
12. **Predicting** — *forecasting from experience*
13. **Checking perceptions** — *feeding back implied meaning*
14. **Believing in oneself** — *developing and maintaining self-esteem*
15. **Exploring context** — *seeing the relationship of parts to the environment*

9. **Activity Table** for *Quantitative Reasoning and Problem Solving*

Chapter 1: Learning to Learn Math

1-1 The Learning Process Methodology

1-2 Applying the Learning Process Methodology

1-3 Reading Mathematics

1-4 Best Practices for Learning Math

1-5 Number Sense

Chapter 2: Key Mathematical Structures

2-1 Modeling Using Set Concepts

2-2 Using Logic

2-3 Evaluating a Formula

2-4 Solving an Equation

2-5 Analyzing a Function

Chapter 3: Probability

3-1 Likelihood

3-2 Randomness

3-3 Probability Distribution

3-4 Sampling

Chapter 4: Mathematical Problem Solving

4-1 The Problem Solving Methodology

4-2 Applying the Problem Solving Methodology

4-3 Interpreting a Word Problem

4-4 Validation

Chapter 5: Making Data Valuable

5-1 Data Generation

5-2 Using Data from Other Sources

5-3 Organizing Data

5-4 Transforming Data

Chapter 6: World of Graphics

6-1 Interpreting Graphs and Diagrams

6-2 Translating between Symbolic, Numerical, and Graphical Representations

6-3 Graphical Analysis

6-4 Presentation Graphs

Chapter 7: Data and Statistical Analysis

7-1 Central Tendency

7-2 Variation

7-3 Data Analysis

7-4 Correlation, Regression, and Causation

Chapter 8: World of Finance

8-1 Time Value of Money

8-2 Credit and Loans

8-3 Budgeting

8-4 Consumer Finance

8-5 Corporate Finance

Chapter 9: Modeling the Real World Mathematically

9-1 Interpreting a Mathematical Model

9-2 Constructing a Mathematical Model

9-3 What-if Modeling

9-4 Simulation

10. Performance Criteria

- Given a learning challenge or to problem to solve, recognizes which mathematical ideas are needed by analyzing the issues, visualizing application of the ideas, and verify that their use was valid

- Consistently strives to learn more about related ideas by formulating strong inquiry questions, experimenting and asking "what if," and by seeking out additional resources and connections to experts

- Easily grasps new mathematical concepts, manipulates and analyzes data effectively, models phenomena mathematically and graphically by using careful, precise, and logical thought

- Can see, identify and define shared problems, motivate others and, through consensus, take a problem apart by identifying issues and assumptions, use past solutions or create new solutions, integrate, and finally test solutions so that they meet stakeholder approval

- Analyzes performance in learning and problem solving on a frequent basis in order to understand strengths gained and feasible action plans for short term and long term growth while using mentors and peers to assist in the individual and community journey for growth and development

- Makes solid quantitative decisions through analyzing situations, obtaining all critical information, modeling possible solutions, and based upon effective risk analysis, makes the best quantitative decisions based upon the circumstances and defined values

11. Performance Measures

1. Self-directed Learning (Engaged Learner Rubric)

2. Quantitative Reeasoning

3. Teaming

4. Problem Solving

5. Self-Growth (from the Faculty Guidebook)

6. Effectiveness of formal and informal communication (Oral Communication Rubric, Writing in a Disciplinary Context Rubric)

12. Evaluation System (Grading System)

1. Group problem solving project for the campus: self-solicited (20%)

2. Personal financial plan (20%)

3. Student Success Toolbox and self-growth paper (10%)

4. Team learning portfolio (group activities, group quizzes, problem solving exercises, mini-design projects, peer-assessment) (10%)

5. Individual Portfolio (homework, reading assignments, individual quizzes,) (10%)

6. Two level 2/3 exams (30%)