CUNY Common Core
Course Submission Form

Instructions: All courses submitted for the Common Core must be liberal arts courses. Courses may be submitted for only one area of the Common Core. All courses must be 3 credits/3 contact hours unless the college is seeking a waiver for another type of Math or Science course that meets major requirements. Colleges may submit courses to the Course Review Committee at any time. Courses must also receive local campus governance approval for inclusion in the Common Core.

College	Lehman College
Course Prefix and Number (e.g., ANTH 101, if number not assigned, enter XXX)	MAT 125
Course Title	Explorations in Geometry, Probability, and Statistics for Educators
Department(s)	Mathematics
Discipline	Mathematics
Credits	3
Contact Hours	3
Pre-requisites (if none, enter N/A)	Departmental permission
Co-requisites (if none, enter N/A)	n/a
Catalogue Description	Foundational content in geometry, probability, and statistics using accessible and relevant technology. Measurement, length, area, volume, transformations, experimental design, descriptive measures, sample space, and success. Note. Intended for pre-service elementary and middle school teachers.
Special Features (e.g., linked courses)	
Sample Syllabus	Syllabus must be included with submission, 5 pages max recommended

Indicate the status of this course being nominated:

☐ current course ☐ revision of current course ☒ a new course being proposed

CUNY COMMON CORE Location

Please check below the area of the Common Core for which the course is being submitted. (Select only one.)

Required	Flexible	
☐ English Composition	☐ World Cultures and Global Issues	☐ Individual and Society
☒ Mathematical and Quantitative Reasoning	☐ US Experience in its Diversity	☐ Scientific World
☐ Life and Physical Sciences	☐ Creative Expression	

Waivers for Math and Science Courses with more than 3 credits and 3 contact hours

Waivers for courses with more than 3 credits and 3 contact hours will only be accepted in the required areas of "Mathematical and Quantitative Reasoning" and "Life and Physical Sciences." Three credit/3-contact hour courses must also be available in these areas.

If you would like to request a waiver please check here:	☐ Waiver requested
If waiver requested: Please provide a brief explanation for why the course will not be 3 credits and 3 contact hours.	
If waiver requested: Please indicate whether this course will satisfy a major requirement, and if so, which major requirement(s) the course will fulfill.	

Learning Outcomes **In the left column explain the course assignments and activities that will address the learning outcomes in the right column.**	
B. Mathematical and Quantitative Reasoning: Three credits A course in this area must meet all the learning outcomes in the right column. A student will:	
This SLO will be assessed in multiple ways: in-class discussions, assignments, quizzes, and exams. Students will demonstrate competency in this SLO by • Understanding and applying ideas of measurement, area, volume, and transformation to solve geometric problems. • Recalling, understanding, and utilizing appropriate formulas to solve counting, sample space, and probability problems. • Distinguishing between and categorize different forms of data and appropriate statistics associated to this data. The following represent a sample of problems that students will be expected to solve throughout the class: • Describe one-dimensional, two-dimensional, and three-dimensional parts or aspects of a water tower. In each case, name an appropriate U.S. customary unit and an appropriate metric unit for measuring or describing the size of that part or aspect of the water tower. What are practical reasons for wanting to know the sizes of these parts or aspects of the water tower? • How many different 3-digit numbers can you write using only the digits 1, 2, and 3 if you do not repeat any digits? Show how to solve this problem using an organized list and also with an appropriate formula. • Samantha collects the favorite colors of all of her classmates. What type of data has she collected, quantitative or qualitative? What type of graph could she use to share the data she collected with her teacher? Justify your answer.	• Interpret and draw appropriate inferences from quantitative representations, such as formulas, graphs, or tables.
This SLO will be assessed on graded take-home assignments and on in-class graded quizzes and exams. Students will demonstrate mastery in this SLO by: • Extending and connecting geometric reasoning to algebraic thinking, including using equation-solving techniques to solve geometric problems. • Applying descriptive statistics to draw conclusions about data sets. • Using probabilities to draw conclusions about the likelihood of success. Below is a collection of example problems that students will be expected to solve aligned with the above objectives: • Your students have an open-top box that has a 2-in.-by-2-in. rectangular base and is 3 in. high. They also have a bunch of cubic inch boxes and some rulers.	• Use algebraic, numerical, graphical, or statistical methods to draw accurate conclusions and solve mathematical problems.

- What is the most intuitive way for your students to determine the volume of the box? - What is a more advanced way for your students to determine the volume of the box? Why do these methods work? - Julia's average on her first 3 math tests was 80. Her average on the next 2 math tests was 95. What is Julia's average on all 5 math tests? - A family math night at school features the following game. There are two opaque bags, each containing red blocks and yellow blocks. Bag 1 contains 2 red blocks and 5 yellow blocks. Bag 2 contains 4 red blocks and 9 yellow blocks. To play the game, you pick a bag and then you pick a block out of the bag without looking. You win a prize if you pick a red block. Tom says that he is more likely to pick a red block out of Bag 2 than out of Bag 1 because Bag 2 contains more red blocks than Bag 1. Is this correct? Explain your reasoning.	
This SLO will be assessed on written assignments, quizzes, and exams. The following objectives, each aligned with this SLO, will be used to assess student's ability to meet this SLO: - Formulate natural language geometric statements into suitable conditional and biconditional logical sentences. - Understand natural language statements in the context of formal axiomatic systems in geometry. - Apply formulas in probability and statistics to model and solve word problems. The following examples give concrete questions students will be asked to solve related to this SLO: - Write the following statement as a conditional or biconditional sentence as appropriate: Each angle of an equilateral triangle measures 60 degrees. - Prove the following statement using only the axioms of incidence geometry: if l is any point, then there exists a point P such that P does not lie on l. - An amazon driver has 15 stops to make for the day. How many different routes can he choose from? If he can only make 7 of these 15 stops, then how many different routes does he have to choose from?	Represent quantitative problems expressed in natural language in a suitable mathematical format.
This SLO will be assessed using in-class presentations and discussions. Questions targeting this SLO will also be included on assignments, quizzes, and exams. Students will demonstrate competency in this SLO by: - Explaining, describing, and effectively communicating the fundamentals of geometry, probability, and statistics to audiences of varied mathematical maturity: K-8 learners, 9-12 students, and college-level peers. - Familiarizing themselves with, interpreting, and explaining common mathematics errors made by elementary and middle school students with geometry, probability, and statistics.	Effectively communicate quantitative analysis or solutions to mathematical problems in written or oral form.

• Explaining and describing why/how probability/statistical models describe a given situation, recognizing when they do not, and determining an appropriate alternative when feasible. • Determining if various geometric models/constructions are feasible given a set of constraints. The following sample questions illustrate what types of problems students will address in relation to these objectives: • Informally, describe what a circle is and what a sphere is giving real-world examples of both and noting the important similarities and differences between the two. Then, provide formal definitions of a circle and a sphere. • George and Thomas are flipping a penny. Thomas tells George that flipping three heads is way harder than flipping heads, followed by tails, followed by heads. Is Thomas right? Explain your reasoning. • It's time for Penny Wars at Raritan Valley School. Grades 1-4 compete to see which grade can raise the most money by collecting and submitting pennies. The fundraiser lasts the full week, Monday through Friday, and each day the pennies received are counted. The grades want to create a display to be posted online that will show the daily progress. What do you recommend? Be specific, make sure your recommendations can be carried out realistically, and explain what you think the display should look like. • Can you draw two great circles on a sphere that do not intersect? Explain your answer.	• Evaluate solutions to problems for reasonableness using a variety of means, including informed estimation.
This SLO will be assessed using groupwork sessions, assignments, quizzes, and exams. In these tasks, students will be expected to apply techniques in geometry, probability, and statistics to solve real-world problems including ones involving spatial reasoning, counting, and drawing conclusions from data. An example of a problem that students would be asked to solve working together in a small group is as follows: Who has longer last names Major League Baseball Players or National Football League Players? Design a plan using online resources and tools we have learned in statistics to address this question. Then, put this plan into action as best you can to come up with a preliminary hypothesis for this question.	• Apply mathematical methods to problems in other fields of study.

MAT 125 Syllabus

MAT 125: Explorations in Geometry, Probability, and Statistics for Educators (*3hr, 3cr*)

Course Description: This course covers topics in geometry, probability, and statistics using relevant and appropriate technology. Geometry in one, two, and three dimensions is discussed. Topics include: measurement, length, areas, volume, angles, transformation, congruence, and constructions. Introductory topics from probability and statistics include notions of sample space, success, descriptive data measures, and elements of experimental design.

Prerequisites: Departmental Permission

Note: Material covered in this class will help teachers/teacher candidates prepare for a leadership position as elementary mathematics specialist.

Instructor: Your instructor will provide contact information, office hours and meeting times for your section.

Course Format and Grading

Expectations: This course covers topics in geometry, probability, and statistics using relevant and appropriate technology. Geometry in one, two, and three dimensions is discussed. Topics include measurement, length, areas, volume, angles, transformation, congruence, and constructions. Introductory topics from probability and statistics include notions of sample space, success, descriptive data measures, and elements of experimental design.

This course uses the problem-solving approach to teaching and learning mathematics concepts. Students are encouraged to ask questions. Class participation is essential. You are strongly encouraged to take good notes and do not miss class. Bring your concerns and challenges to the instructor's attention early on in the course so that they can address them effectively.

Homework: Homework will be assigned in class. Solutions to most problems from the previous session will be reviewed and discussed in class. In order to be successful in this course it is essential that you devote a lot of time to your homework.

Grades: Your grade will be made up of 70% exams and 30% assignments that include homework.

Text, Materials, and Accommodating Disabilities

References:

- Beckmann, S. (2018). Mathematics for elementary teachers (5^{th} ed). Pearson.
- Billstein, R., Libeskind, S., & Lott, J. W. (2016). A problem solving approach to Mathematics for elementary school teachers (12^{th} ed). Pearson.

- Sonnabend, T. (2010). Mathematics for teachers: an interactive approach for grades k-8 (4th ed). Brooks/Cole Cengage Learning.

Materials: Physical and Virtual Manipulatives; Learning Tools

Calculator: Texas Instruments

Accommodating Disabilities: Lehman College is committed to providing access to all programs and curricula to all students. Students with disabilities who may need classroom accommodations are encouraged to register with the Office of Student Disability Services. For more info, contact the Office of Student Disability Services, Shuster Hall, Room 238, 718-960-8441.

Course Objectives and Content:

Course Objectives: This course meets all of the overall objectives for a CUNY common core Quantitative Reasoning course; these objectives and how they are met in this course are detailed below.

At the end of this course, students will be able to:

1. Interpret and draw appropriate inferences from quantitative representations, such as formulas, graphs, or tables.
    - Understand and apply ideas of measurement, area, volume, and transformation to solve geometric problems.
    - Recall, understand, and utilize appropriate formulas to solve counting, sample space, and probability problems.
    - Distinguish between and categorize different forms of data and appropriate statistics associated to this data.

2. Represent quantitative problems expressed in natural language in a suitable mathematical format.
    - Formulate natural language geometric statements into suitable conditional and biconditional logical sentences.
    - Understand natural language statements in the context of formal axiomatic systems in geometry.
    - Apply formulas in probability and statistics to model and solve word problems.

3. Use algebraic, numerical, graphical, or statistical methods to draw accurate conclusions and solve mathematical problems.
    - Extend and connect geometric reasoning to algebraic thinking, including using equation-solving techniques to solve geometric problems.
    - Apply descriptive statistics to draw conclusions about data sets.
    - Use probabilities to draw conclusions about the likelihood of success.

4. Effectively communicate quantitative analysis or solutions to mathematical problems in written or oral form.
    - Explain, describe, and effectively communicate the fundamentals of geometry, probability, and statistics to audiences of varied mathematical maturity: K-8 learners, 9-12 students, and college-level peers.
    - Familiarize self with, interpret, and explain common mathematics errors made by elementary and middle school students with geometry, probability, and statistics.

5. Evaluate solutions to problems for reasonableness using a variety of means, including informed estimation.
    - Explain and describe why/how probability/statistical models describe a given situation, recognize when they do not, and determine an appropriate alternative when feasible.
    - Determine if various geometric models/constructions are feasible given a set of constraints.

6. Apply mathematical methods to problems in other fields of study.
    - Apply techniques in geometry, probability, and statistics to solve real-world problems including ones involving spatial reasoning, counting, and drawing conclusions from data.

Course Topics

There is flexibility in the order and time allotted to each of the topics below, but all topics must be covered by the instructor and understood by the student. Historical development and perspective will be embedded within the topics where appropriate.

1. Core Concepts
    - Points, lines, planes, parallel, perpendicular
    - Principles of Euclidean Geometry

2. Basic Geometric figures and Measurement
    - 1-Dimension
        - Lines, line segments, rays
        - Distance
    - 2-Dimensions
        - Angles
        - Polygons, circles, arcs,
        - Area and Surface area
    - 3-Dimensions
        - Polyhedral solids, cylinders, cones, spheres
        - Volume
    - Classification, Identification

- Construction

3. Transformations
    - Rigid
        - Translations, reflections, rotations, glide reflections
    - Non-rigid
        - Dilation

4. Congruence, Symmetry and Similarity

5. Coordinate Geometry

6. Measures of Center
    - Mean, Median, Mode, Interquartile range

7. Measures of Variation and Relative Standing
    - Standard deviation, variance, range
    - Percentile, quartile

8. Representing and Categorizing Data

9. Basic Concepts of Probability
    - Empirical and theoretical probability
    - Conditional probability
    - Probability distribution
    - Normal distribution

10. Elements of Experimental Design

Professional Standards

(Specific content and objectives will include the following standards from **NCTM CAEP Mathematics Content for Elementary Mathematics Specialist (Addendum to the NCTM CAEP Standards 2012)**

C.3. Geometry and Measurement

To be prepared to support the development of student mathematical proficiency, all elementary mathematics specialists should know the following topics related to geometry and measurement with their content understanding and mathematical practices supported by appropriate technology and varied representational tools, including concrete models:

C.3.1 Core concepts including angle, parallel, and perpendicular, and principles of Euclidean geometry in two and three dimensions

C.3.2 Transformations including dilations, translations, rotations, reflections, glide reflections; compositions of transformations; and the expression of symmetry and regularity in terms of transformations

C.3.3 Congruence, similarity and scaling, and their development and expression in terms of transformations

C.3.4 Basic geometric figures in one, two, and three dimensions (line segments, lines, rays, circles, arcs, polygons, polyhedral solids, cylinders, cones, and spheres) and their elements (vertices, edges, and faces)

C.3.5 Identification, classification into categories, visualization, two- and three-dimensional representations, and formula rationale and derivation (perimeter, area, and volume) of two- and three-dimensional objects (triangles; classes of quadrilaterals such as rectangles, parallelograms, and trapezoids; regular polygons; rectangular prisms; pyramids; cones; cylinders; and spheres)
C.3.6 Geometric measurement and units (linear, area, surface area, volume, and angle), unit comparison, and the iteration, additivity, and invariance related to measurements 3 NCTM CAEP Mathematics Content for Elementary Mathematics Specialist (2012)

C.3.7 Geometric constructions, axiomatic reasoning, and making and proving conjectures about geometric shapes and relations

C.3.8 Coordinate geometry including the equations of lines and algebraic proofs (e.g., Pythagorean Theorem and its converse)

C.3.9 Historical development and perspectives of geometry and measurement including contributions of significant figures and diverse cultures

C.4. Statistics and Probability

To be prepared to support the development of student mathematical proficiency, all elementary mathematics specialists should know the following topics related to statistics and probability with their content understanding and mathematical practices supported by appropriate technology and varied representational tools, including concrete models:

C.4.1 Statistical variability and its sources and the role of randomness in statistical inference

C.4.2 Construction and interpretation of graphical displays of univariate and bivariate data distributions (e.g., box plots and histograms), summary measures (mean, median, mode, interquartile range, and mean absolute deviation) and comparison of distributions of univariate data, and exploration of categorical (discrete) and measurement (continuous) data

C.4.3 Empirical and theoretical probability for both simple and compound events

C.4.4 Random (chance) phenomena and simulations

C.4.5 Historical development and perspectives of statistics and probability including contributions of significant figures and diverse cultures