Texas Prefreshman Engineering Program (TexPREP) III: Probability/Statistics and Technical Writing

PEIMS Code: N1303754

Abbreviation: TXPRENG3

Grade Level(s): 9-12

Award of Credit: 1.0

Approved Innovative Course

- Districts must have local board approval to implement innovative courses.
- In accordance with Texas Administrative Code (TAC) §74.27, school districts must provide instruction in all essential knowledge and skills identified in this innovative course.
- Innovative courses may only satisfy elective credit toward graduation requirements.
- Please refer to TAC §74.13 for guidance on endorsements.

Course Description:

TexPREP III: Probability, Statistics and Technical Writing, coursework includes probability and statistics, STEM technical writing, topics in problem solving, and college and career awareness components. Technical writing is a critical pedagogical tool to help students make sense of knowledge and translate their understanding. TexPREP III develops a student's skills, content knowledge, and literacy in STEM fields. Students will also be exposed to ethical and professional responsibilities in engineering decision-making.

Essential Knowledge and Skills:

(a) General Requirements. This course is recommended for students in Grades 9-12. Required Prerequisite: TexPREP II or Algebra 2. Students shall be awarded one credit for successful completion of this course.

(b) Introduction.

(1) Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.

(2) The Science, Technology, Engineering, and Mathematics (STEM) Career Cluster focuses on planning, managing, and providing scientific research and professional and technical services, including laboratory and testing services, and research and development services.

(3) TexPREP III: Probability, Statistics and Technical Writing, coursework includes probability and statistics, STEM technical writing, topics in problem solving, and college and career awareness components. Technical writing is a critical pedagogical tool to help students make sense of knowledge and translate their understanding. TexPREP III develops a

student's skills, content knowledge, and literacy in STEM fields. Students will also be exposed to ethical and professional responsibilities in engineering decision-making. Students will work collaboratively during a combination of inquiry-, problem-, project- and challenge-based educational experiences. Students experience unique applications of probability, statistics and technical writing by learning from visiting speakers and university presentations.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the work "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and Skills.

(1) Employability skills. The student researches and exhibits employability skills as required by STEM business and industry. The student is expected to:

(A) create a professional electronic portfolio, including a two-to-four-year individual career plan of study, resume, cover letter, awards, commendations, and thank you letters;

(B) examine self-assessment of interest, abilities, priorities and family responsibilities affecting college and career choice; and

(C) discuss ethical issues related to engineering and technology and document ethical decisions in submitted projects.

(2) STEM process standards. The student distinguishes the influence of science, engineering, and technology on society. The student is expected to:

(A) assess the impact probability and statistics can have on society and the environment using new technologies, including impacts that were not anticipated;

(B) relate the impact of past and current data analysis research on scientific thought, engineering practices and society, including contributions of diverse scientists as related to the context; and

(C) evaluate the benefits of a technological system by applying probability and statistics.

(3) STEM process standards. The student participates in team projects in various roles. The student is expected to:

(A) create timelines, organize ideas, and document findings using an engineering notebook;

(B) outline and demonstrate effective communication and interaction as a member of a group to contribute questions and concerns to achieve a positive collective outcome;

(C) communicate solutions verbally and in writing using various media; and

(D) apply ethical decision making and standards of professionalism when working alone and when collaborating with others.

(4) STEM process standards. The student applies STEM principles and reasoning to solve problems. The student is expected to:

(A) gather evidence and data systematically to support arguments, findings, or lines of reasoning;

(B) apply mathematical and computational thinking to identify patterns in data sets, use statistical analysis to analyze and represent data, and to support explanations and arguments;

(C) support or modify claims with evidence based on the results of scientific inquiry;

(D) implement the engineering design process to develop engineering solutions in global, economic, environmental, and societal context;

(E) describe and model solutions using systems thinking tools such as graphs, connection circles, causal loop diagrams, and stock/flow maps; and

(F) evaluate sources for quality of content, validity, credibility, and relevance.

(5) Probability and statistics. The student explores probability and statistics concepts, models, methodology, and applications. The student is expected to:

(A) collect, organize, and evaluate data;

(B) apply basic probability theory, including counting procedures, addition rule, multiplication rule, and independence;

(C) differentiate between probability models, including binomial, exponential, and normal;

(D) analyze descriptive statistics, including tables and charts, measures of center, and measures of spread;

(E) analyze analytical statistics, including confidence intervals for means and proportions, test of hypothesis for means and proportions, and simple regression;

(F) construct and analyze arguments based on data analysis, using logic, reasoning, and problem-solving techniques; and

(G) assess numerical data using statistical software.

(6) STEM technical writing. The student practices the elements of engineering and scientific writing. The student is expected to:

(A) use informal, standard, and technical language appropriately to effectively record lab data and data analysis reports;

(B) organize ideas in writing to ensure coherence, logical progression, and support ideas;

(C) collect, analyze, document, and report research clearly, concisely, logically, and ethically;

(D) attribute sources with proper citation as determined by the American Psychological Association (APA) Publication Manual;

(E) apply technical information and knowledge in documents to communicate evidence-based research in a chronological order;

(F) produce clear, persuasive, and efficient technical reports using word processing software and graphic techniques; and

(G) report results of statistical studies to a particular audience, including selecting an appropriate presentation format, creating graphical data displays, and interpreting results in terms of the question studied.

Recommended Resources and Materials:

Resources include:

- Volunteer guest speakers with STEM backgrounds
- Materials for prototypes, such as regular household items, alligator clips, binder clips, copy paper, rubber bands, straws, painters' tape, small boxes, foil, cellophane, pipe cleaners etc.
- Science, and/or engineering labs
- Lab supplies and equipment such as Vernier LabQuest Mini, dynamics carts and track system, lasers, beakers, graduated cylinder, radiometer, goggles, sensors, spectrum tube power supply, etc.
- Engineering notebook

American Psychological Association. 2020. *Publication Manual of the American Psychological Association 2020: The Official Guide to APA Style*. 7th ed. Washington, D.C., DC: American Psychological Association.

"Simulations", University of Colorado Boulder: PhET Interactive Simulations, accessed February 27, 2023, http://www.phet.colorado.edu/en/simulations/browse.

"Math: Statistics and Probability", Khan Academy, accessed March 1, 2023, https://www.khanacademy.org/math/statistics-probability.

"Introduction to Statistics", Stanford: Online, accessed March 1, 2023, https://online.stanford.edu/courses/xfds110-introduction-statistics.

"Probability & Statistics - Open & Free", Carnegie Mellon University, accessed March 1, 2023, https://oli.cmu.edu/courses/probability-statistics-open-free/.

"Useful Websites for Teachers", American Statistical Association, accessed March 1, 2023, https://www.amstat.org/education/useful-websites-for-teachers.
"My NASA data", NASA, accessed March 1, 2023, https://mynasadata.larc.nasa.gov/.

"High School Statistics & Probability", PBS Learning Media, accessed March 1, 2023, https://klrn.pbslearningmedia.org/subjects/mathematics/high-school-statistics--probability/.

Recommended Course Activities:

Course activities may include:

- Career awareness seminars: Students research and make connections between STEM careers such as mathematician, data analyst, and software engineer, and the academic content covered.
- Speaker Series: Unique speaker events meant to connect students with diverse professionals in STEM fields are held.
- Research Lab Tours: Students visit research labs on campus aligned with the content covered in class, allowing students to make the connection between academic content and its application to research.
- Research symposium and prototype design presentations: After students evaluate their working/physical model prototype, they present their results to other teams and discuss possible modifications that can be made to improve their design. The research symposium occurs at the end of the course, and students present their research to multiple stakeholders.
- Classroom discourse: Allow students to periodically discuss ideas and content with teacher and classmates to help solidify understanding and address misconceptions.
- Design reflections: Students write a reflection based on how well their working/physical model prototype worked, if it would help solve the problem, potential constraints, and what could be done differently next time.

Suggested methods for evaluating student outcomes:

Methods for evaluating student outcomes:

- Final exam for course, used to determine mastery of course content
- Multi-dimensional performance assessments and rubrics
- Student reflections
- Traditional assessments incorporating three levels of thinking, reproduction, connections, and analysis: including writing prompts, open-ended questions, multiple choice questions,
- Student designed infographics
- Quizzes
- Exit tickets
- Summative projects
- Summative writing prompts

Teacher qualifications:

- Master Science Teacher (Grades 8-12)
- Mathematics/Physical Science/Engineering: Grades 6-12
- Mathematics/Physical Science/Engineering: Grades 8-12

- Physical Science: Grades 6-12
- Physical Science: Grades 8-12
- Physics/Mathematics: Grades 7-12
- Physics/Mathematics: Grades 8-12
- Science: Grades 7-12
- Science: Grades 8-12
- Science, Technology, Engineering, and Mathematics: Grades 6-12
- Secondary Industrial Arts (Grades 6-12)
- Secondary Industrial Technology (Grades 6-12)
- Secondary Physics (Grades 6-12)
- Secondary Science (Grades 6-12)
- Secondary Science, Composite (Grades 6-12)
- Master Mathematics Teacher (Grades 8-12)
- Mathematics: Grades 7-12
- Mathematics: Grades 8-12
- Secondary Mathematics: Grades 6-12
- Principles of Applied Engineering, Grades 9-12
- Scientific Research and Design, Grades 9-12
- Computer Science: (8-12)
- Technology Applications: Early Childhood-Grade 12
- Technology Applications: Grades 8-12
- English Language Arts and Reading: Grades 7-12
- English Language Arts and Reading: Grades 8-12
- *Junior High School (Grades 9-10 only, High School, Secondary, Grades 6-12, or Grades 9-12: English Language Arts, Composite

*Certification required to teach TexPREP III STEM technical writing component only

Additional information:

There is no required training for TexPREP III- Probability Statistics and Technical Writing. However, it is strongly recommended that each site develop its own professional development schedule to preview curriculum and instructional strategies with teachers. Curriculum documentation files are available upon request. Periodic opportunities for curriculum review and general preparation may be offered by the UTSA TexPREP program curriculum and professional development team. There is no cost associated with this professional development. Additionally, recorded professional development units will be readily made available to TexPREP to teachers. Curriculum documents and recordings may be requested by emailing prep@utsa.edu.