AIME Counting and Probability (Live virtual classes)

Instructor: Dr. Ke Shi

Lecture Time: Fridays 8:00pm – 10:00pm EST via Zoom, Feb. 13 – May 22. (15 lectures)
Homework Discussion: Recordings

Course Description:

This course is specially designed for highly motivated students who are either qualified for AIME or are on the verge of achieving qualification. Our intensive program focuses on providing students with the essential tools to enhance their problem-solving skills in counting and probability, with the goal to excelling in the AMC 10/12, AIME exams. These tools are also the foundation for students to solve combinatorics problems in proof-based competitions such as USA(J)MO and MOP.

Targeted Level

Combinatorics is one of the most important topics in AIME as well as AMC 10/12 exams. On average, each AIME test comprises 4-5 questions related to counting and probability. Furthermore, in almost every year's AMC 10/12 and AIME, there are at least 2 questions among the most difficult ones (Q21-Q25 in AMC 10/12, Q11-Q15 in AIME) that require a strong understanding of combinatorics principles. The difficulty level of this course is comparable to that of problems 18-25 in AMC 10/12, and problems 1-12 in AIME.

Prerequisite:

To benefit fully from this course, we recommend that students have completed the introductory level courses in counting and probability (e.g., AoPS "Introduction to Counting and Probability").

Recommended Textbook and Course Materials:

- Lecture Notes by Dr. Shi
- Awesomemath 112
- AoPS Intermediate Counting and Probability and Solution Manual
- Past AMC 12, AIME tests

Signature Features of the Course:

Dr. Shi has developed a unique training program that combines his experience in math competitions since childhood in China, his undergraduate and graduate studies in mathematics at Peking University and the University of Minnesota, and his experience as a math professor in the United States. These courses are designed to help students excel in math competitions such as the AMC10 and AIME that have an impact on college admissions.

Dr. Shi's teaching approach is distinctive in its emphasis on integrating various topics coherently, which simplifies complex concepts and makes them easier to grasp. Dr. Shi is especially sharp at identifying the "key" to solving difficult problems and helping students see through complex problems with ease. This teaching method is especially helpful for students who have a certain foundation but have reached a bottleneck stage.

Course schedule

Lesson	Topic
2/13/26	Combination and Permutation Review
2/20/26	Balls and Bins, Stars and Bars
2/27/26	Constructive Counting, 1-1 Correspondences
3/6/26	Principle of Inclusion Exclusion
3/13/26	Multinomial Theorem and Generating Function
3/20/26	Counting in more than one way I
3/27/26	Counting in more than one way II
4/3/26	Mathematical Induction
4/10/26	Recursive Sequences – Closed Form
4/17/26	Recursion I
4/24/26	Recursion II
5/1/26	Expectation
5/8/26	Markov Chain and States counting
5/15/26	Pigeonhole Principle
5/22/26	Proof-based Combinatorics

Dr. Shi's Background:

Dr. Ke Shi is a highly respected mathematics professor at a top-tier (R1) research university in the US. He obtained his bachelor's degree in mathematics from Peking University in China and his PhD in Applied Mathematics in US. Dr's Shi's exceptional talent and dedication to mathematics have been recognized throughout his academic and professional career. He began participating in math contests at the age of 10 and received numerous awards in national and international math competitions. Notably, he earned a Silver Medal in the Chinese Mathematics Olympiad (CMO), which is considered analogous to the USAMO, and a Silver Medal in the Bulgarian Mathematics Olympiad. Dr. Shi was also invited to attend the prestigious Chinese Mathematical Olympiad Program (MOP). As a result of his outstanding performance in national and international math competitions, Dr. Shi was admitted to Peking University without having to take the admission test, a rare achievement that further demonstrates his exceptional abilities in mathematics.