Online Research Seminar Syllabus

1. Overview

<table>
<tr><td>Title</td><td colspan="3">Probability, Statistics and Applications</td></tr>
<tr><td>Mode</td><td colspan="3">Online lectures and mentor sessions</td></tr>
<tr><td>Hours</td><td colspan="3">4*2 hours lecture +2*2 hours final project discussion session+ 1*2 hours final presentation session+ 6*1.5 hours mentor sessions (conducted by mentor)</td></tr>
<tr><td>Targeted Students</td><td colspan="3">College students and advanced high school students</td></tr>
<tr><td rowspan="4">Prerequisites</td><td rowspan="2">High School Students</td><td>Required course/Knowledge</td><td>• Elementary probability & combinatorics
• Calculus</td></tr>
<tr><td>Recommended Materials for preparing for the course</td><td></td></tr>
<tr><td rowspan="2">College Students</td><td>Required course/Knowledge</td><td>• Elementary probability & combinatorics
• Calculus</td></tr>
<tr><td>Recommended Materials for preparing for the course</td><td></td></tr>
</table>

2. Program Introduction and Objectives

Course Description	Probability theory has important applications in the natural sciences and engineering as well as in several social sciences. This includes statistics, game theory, etc. The topics for the final project arise in game theory and optimal decision theory.
Program Material	*Probability Theory: A Concise Course (Dover Books on Mathematics)* by Yuri Rozanov
Software/Tools (if any)	none

3. Program Schedule

Week		Lecture	Mentor Session (lab/case study, etc.)	Assignment	Reading Materials
1	**Topic**	Random variables		Simpson's paradox problem 15, page 23	Chapters 4, 5 of book
	Detail	3 important distributions			
2	**Topic**	Limit theories		Example 3, page 29 Problem 9, page 51	Chapter 6 of book
	Detail	Law of large numbers			
3	**Topic**	Statistical Inference		Problem 20, page 53 Problem 21, page 53	Class notes
	Detail	Estimation of parameters and hypothesis testing			
4	**Topic**	Limiting probabilities		Problem 6, page 99 Problem 13, page 101 Problem 14, page 101	Chapter 7 of book
	Detail	Markov chains			
5	**Topic**	Final Project Discussion Session			Appendix 4 Class notes
	Detail	Optimal choice Parrondo paradox			
6	**Topic**	Final Project Discussion Session			Appendix 4 Class notes
	Detail	Optimal choice Parrondo paradox			
7	**Final Oral Presentation and Written Reporting**				