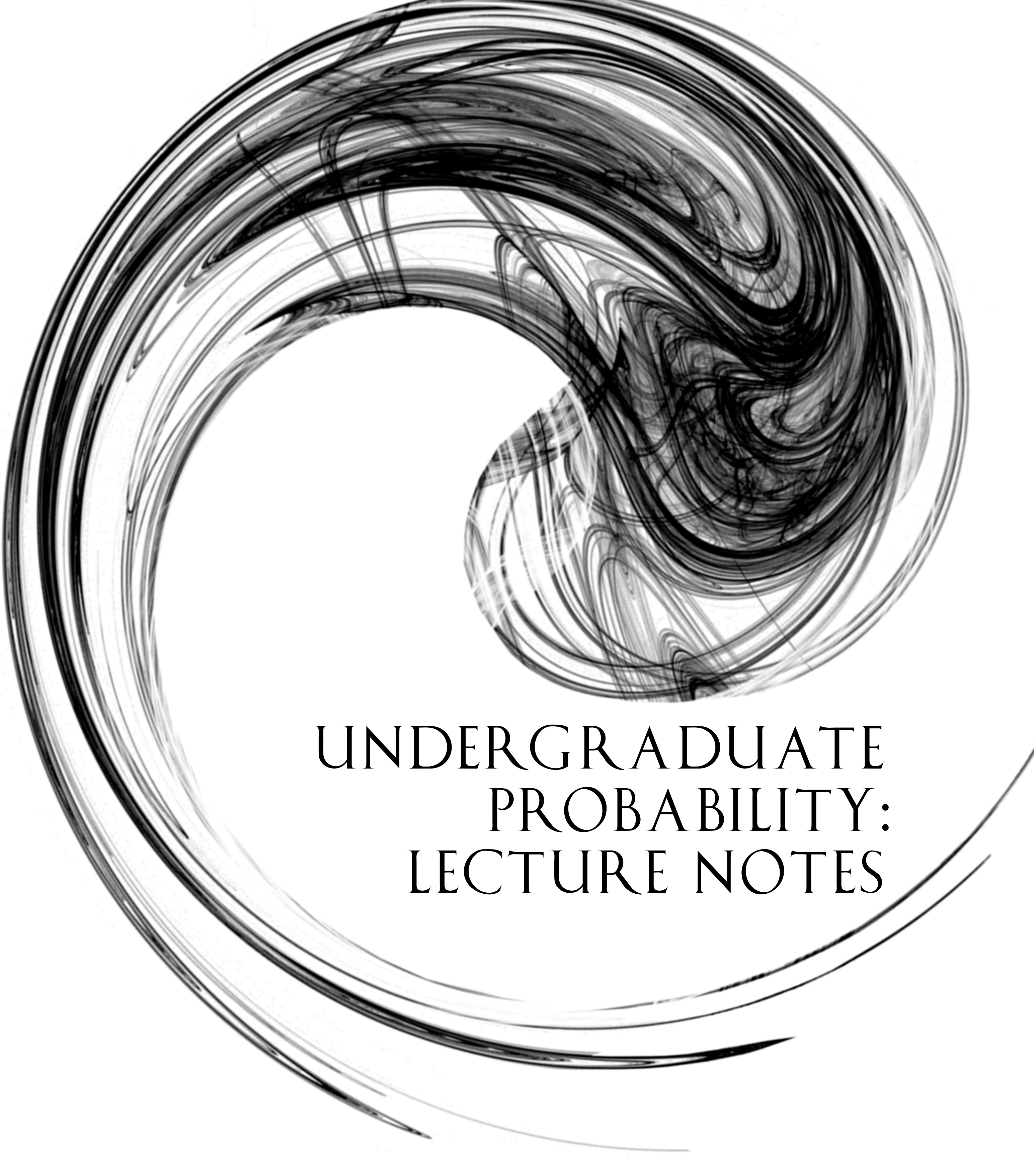

UNDERGRADUATE PROBABILITY: LECTURE NOTES

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PUBLISHED BY PUBLISHER

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These notes are based on "A First Course in Probability Theory", 8th edition, by S. Ross.

First printing, March 2013

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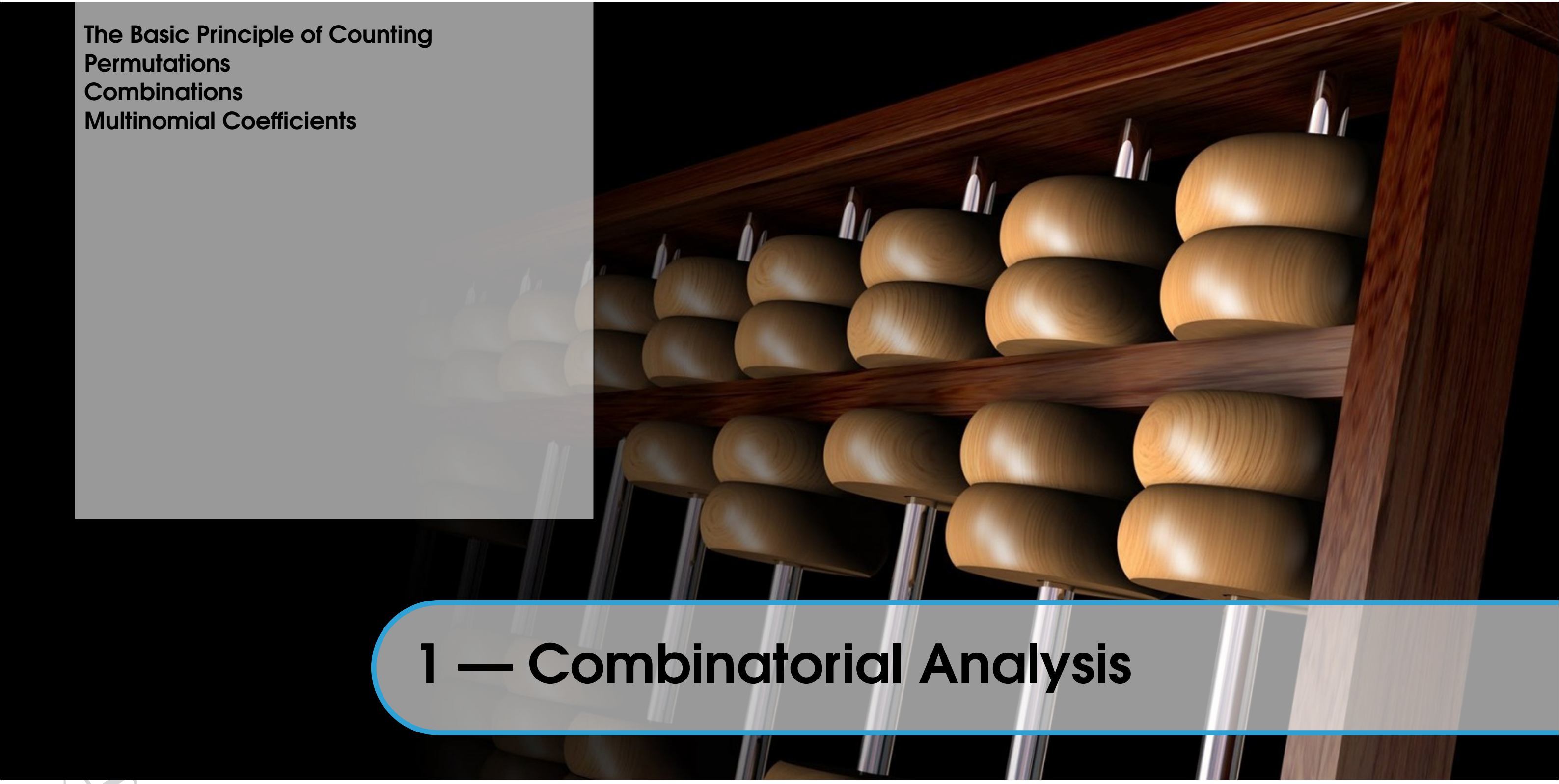
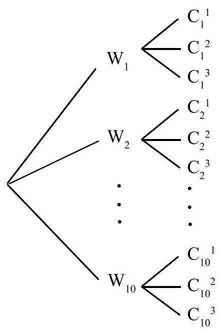


1 — Combinatorial Analysis

Before introduction of any notion about probability, it is important to go over some basics about counting principles.

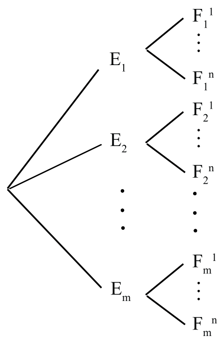
1.2 The Basic Principle of Counting

Question 1. *A community consists of 10 women, each of whom has 3 children. How many children are present in total?*



This simple diagram shows that there are $10 \cdot 3 = 30$ children. This is based on the following fact.

The Basic Principle of Counting: Suppose that two experiments are to be performed. Then if experiment 1 can result in any one of m possible outcomes and if, for each outcome of experiment 1, there are n possible outcomes of experiment 2, then together there are $m \cdot n$ possible outcomes.



The Generalized Basic Principle of Counting: Suppose that r experiments are to be performed. If

1^{st} experiment may result in n_1 possible outcomes,
2^{nd} experiment may result in n_2 possible outcomes,
...
r^{th} experiment may result in n_r possible outcomes,

then there is a total of

$$n_1 \cdot n_2 \cdot \ldots \cdot n_r$$

possible outcomes of r experiments.

■ **Example 1.1** i. How many different 2 digit-3 letter- 2 digit licence plates are possible? (No restriction) (e.g. 34 ABC 01)

10	10	29	29	29	10	10
↑	↑	↑	↑	↑	↑	↑
Exp. 1	Exp. 2	E. 3	E. 4	E. 5	E. 6	E. 7

So there are $10^4 \cdot 29^3$ such plates.

ii. How many different 2 digit-3 letter- 2 digit licence plates are possible if **no** repetition of letters is allowed?

10	10	29	28	27	10	10
↑	↑	↑	↑	↑	↑	↑
Exp. 1	Exp. 2	E. 3	E. 4	E. 5	E. 6	E. 7

So there are $10^4 \cdot 29 \cdot 28 \cdot 27$ such plates.

■