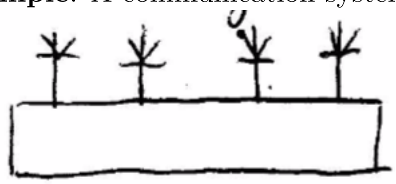
1 Combinational Analysis

1.1 Introduction

Example: A communication system consists of 4 antennas



Assume that this system will be functional if no two consecutive antennas are defective.

Q: If there are exactly 2 antennas defective, what is the probability that the resulting system will be functional?

Solution:

0 1 1 0	0 1 0 1	1 0 1 0	0 0 1 1	1 0 0 1	1 1 0 0
✓	✓	✓	X	X	X

If all the cases are equally likely, the probability is $\frac{3}{6} = \frac{1}{2}$.

1.2 The Basic Principle of Counting

Suppose that two experiments are to be performed. 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 $m \times n$ possible outcomes of the two experiments.

$$\begin{matrix} (1,1) & (1,2) & \ldots & (1,n) \\ (2,1) & (2,2) & \ldots & (2,n) \\ \vdots & \vdots & \ddots & \vdots \\ (n,1) & (n,2) & \ldots & (n,m) \end{matrix}$$

Example: A small community, 10 women, each has 3 children. If one women and one of her children are to be selected as mother and child of the year. How many possibilities?
Solution: $10 \times 3 = 30$

Generalize:
Experiment 1 with n_1, possible outcomes, for each of them. There are n_2

outcomes of experiment 2, for each of them. There are n_3 possible outcomes of experiment 3. . . . . . then there are totally,

$$n_1 \cdot n_2 \cdot n_3 \ldots n_r$$

possible outfcomes of the r experiments.