



# Probability Methods in Engineering

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Lecture 5



# Counting Methods

- Sampling without replacement without ordering
  - ❑  $k$  draws from  $n$  objects
  - ❑ Combinations
- Sampling with replacement without ordering
  - ❑  $k$  draws from  $n$  objects
  - ❑ Object replaced after draw



# Examples

- Find the number of ways of selecting two objects from  $A = \{1, 2, 3, 4, 5, 6\}$ 
  - ☐ Without regard to order
  - ☐ With regard to order



# Examples (cont.)

- Find the number of distinct permutations of
  - ❑ Balls labeled 1, 2, 3 and 4
  - ❑ 2 white balls and 2 black balls
  - ❑ 3 white balls and 2 black balls



# Examples (cont.)

- A set of 6 laptops contains 3 defective ones. Suppose 4 of them are selected at random and checked. What is the probability that 2 of the defective laptops are selected?



# Examples (cont.)

- A batch of 10 items contains 4 defective items. Suppose 5 items are selected at random and tested. What is the probability that exactly 2 of the items tested are defective?



# Counting Methods (cont.)

## *Sampling with replacement without ordering*

- $n$  objects and  $k$  draws
- $k$  can be greater than  $n$
- Make a table of x's and /'s
  - E.g. the number of objects,  $n = 4$  and draws,  $k = 5$

Object 1	Object 2	Object 3	Object 4
xx	/	x	xx

- In summary, xx//x/xx
- $n - 1$  /'s and  $k$  x's
- So the number of different arrangements would be

$${}^{n-1+k}_k C = \binom{n-1+k}{k} = \binom{n-1+k}{n-1}$$



# Counting Methods (cont.)

*Sampling with replacement without ordering*

- Three balls placed in an urn are labeled as 1, 2 and 3. Five draws are performed in such a way that ball is placed back in the urn after each draw. Find the number of possible outcomes of this random experiment. What is the probability of getting the same ball in all draws?

$$n = 3$$

$$k \geq n$$

$$k = 5$$

$$n - 1 + k$$

$$\left[ \begin{matrix} n-1+k \\ k \end{matrix} \right] = ?$$