

MARKS
8
(2, 1, 3, 2)

4. The 11 letters of the word ‘ENGINEERING’ are arranged in equiprobable (‘random’) order. Find:
- (a) the number of **distinguishable** arrangements;
 - (b) the probability the letters spell ‘ENGINEERING’;
 - (c) the probability the arrangement begins and ends with the **same** letter;
 - (d) the probability the G’s are **not** beside each other.

- (a) We regard the letters of ‘ENGINEERING’ as a collection of 11 items of which there are two pairs the same (the G’s and the I’s) and two groups of three (the E’s and the N’s);

hence, the number of **distinguishable** arrangements is: $\frac{11!}{2!2!3!3!} = 277,200$.

$277,200$	(a)
Arrangements	

- (b) Only **one** of the distinguishable arrangements spells ‘ENGINEERING’, so the probability is:

$$\frac{1}{277,200} \approx 0.000\ 000\ 3608.$$

$\frac{1}{277,200}$	(b)
Probability	

- (c) We consider *four* cases, of which two (starting and ending with G or I) are the *same*, and similarly for those starting with E or N, and then count the number of permutations of the remaining 9 letters, as in (a).

$$\frac{9!/2!2!3! + 9!/2!2!3! + 9!/2!3!3! + 9!/2!3!3!}{277,200} = \frac{8}{55} \approx 0.1455.$$

$\frac{8}{55} \approx 0.1455$	(c)
Probability	

- (d) Consider the G’s as a *single* item, and then count the 10 items as in (a), working via the *complement*.

$$1 - \frac{10!/2!3!3!}{277,200} = \frac{9}{11} \approx 0.8182.$$

$\frac{9}{11} \approx 0.8182$	(d)
Probability	