

## Answer on Question #60347 – Math – Statistics and Probability

### Question

Assume that you have a bag of 10 billiard balls. You know that there may be either black or white balls in the bag, but you do not know how many black and white balls there are. Using the Bayesian formula answer the following:

1. What is the initial probability  $P(nB)$  that the bag contains  $nB$  black balls?

### Solution

Bayes' theorem (also known as Bayes' rule) is a useful tool for calculating conditional probabilities.

**Bayes' theorem.** Let  $A_1, A_2, \dots, A_n$  be a set of mutually exclusive events that together form the sample space  $S$ . Let  $B$  be any event from the same sample space, such that  $P(B) > 0$ . Then

$$P(A_k|B) = \frac{P(A_k)P(B|A_k)}{P(B)}.$$

In this problem there is a bag of 10 billiard balls and we do not know how many black and white balls are there. Consider all possible events concerning 10 billiard balls in a bag.

$A_1$  – all 10 billiard balls in a bag are white;

$A_2$  – there are 9 white and 1 black billiard balls in a bag;

$A_3$  – there are 8 white and 2 black billiard balls in a bag;

$A_4$  – there are 7 white and 3 black billiard balls in a bag;

$A_5$  – there are 6 white and 4 black billiard balls in a bag;

$A_6$  – there are 5 white and 5 black billiard balls in a bag;

$A_7$  – there are 4 white and 6 black billiard balls in a bag;

$A_8$  – there are 3 white and 7 black billiard balls in a bag;

$A_9$  – there are 2 white and 8 black billiard balls in a bag;

$A_{10}$  – there is 1 white and 9 black billiard balls in a bag;

$A_{11}$  – all 10 billiard balls in a bag are black.

If all these cases have the same probability  $P(nB)$  that the bag contains  $nB$  black balls, then it equals

$$P(nB) = \frac{1}{11}.$$

**Answer:**  $\frac{1}{11}$ .