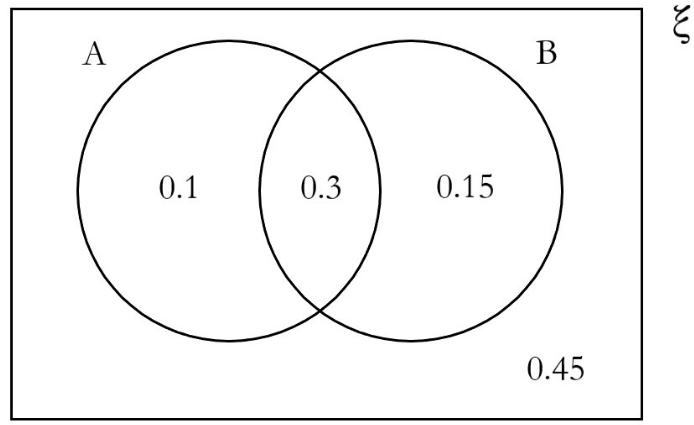
Addition Formula

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

The construction $P(\ )$ represents the "probability of… occurring" so $P(A)$ is the probability of A occurring. $P(A \cup B)$ means the probability of A or B or both occurring, whereas $P(A \cap B)$ means the probability of both A and B occurring. $A \cup B$ is also the entire area enclosed by A and B, 
whereas $A \cap B$ is the area of overlap between A and B 

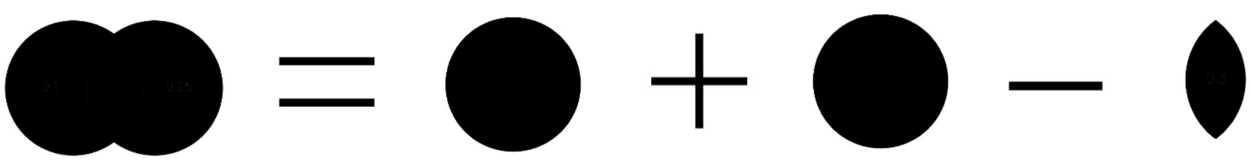


From the diagram to the right, we can see that
$P(A) = 0.1 + 0.3 = 0.4$
$P(B) = 0.15 + 0.3 = 0.45$
$P(A \cup B) = 0.1 + 0.3 + 0.15 = 0.55$
$P(A \cap B) = 0.3$

And we can confirm our equation
$P(A \cup B) = P(A) + P(B) - P(A \cap B)$
$0.55 = 0.4 + 0.45 - 0.3$

Which is true.

Proof
Here is a visual proof, as there is no particular proof for this – it merely requires some careful thought.



It should be obvious that the silhouettes on the right hand side are equal to the silhouette on the left. If we were to overlap A and B (represented by the two full circles) we would create $A \cup B$ but with an extra area, which is counteracted by the minus of the $A \cap B$.

See also
- Multiplication Formula

References
Attwood, G. et al. (2017). *Edexcel A level Mathematics - Statistics and Mechanics - Year 2*. London: Pearson Education. p.27.