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Empirical Probability

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In the experiment of drawing a card from a deck of 52, there are 52 possible outcomes.

The event "a face card is drawn" contains twelve of the 52 outcomes.

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The empirical method is the basis of what are called *simulation* or *Monte Carlo* methods. If you can't determine the probability of an event easily but can simulate the experiment, you can get an approximate value by this method.

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- A fair coin is tossed (two outcomes)
- A die is rolled (6 outcomes)
- A card is drawn from a shuffled deck (52 outcomes)
- A roulette wheel is spun (38 outcomes)
- A 4-digit winning lottery number is chosen (10,000 outcomes)

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In other situations a scientist or engineer might make that judgement.

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The *addition rule* for probabilities says that if two events are mutually exclusive, the probability that one or the other occurs is just the sum of the probabilities of the two events occurring:

$$P(E \ or \ F) = P(E) + P(F)$$

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The *general addition rule* for probabilities says that if two events are *not* mutually exclusive, the probability that one or the other occurs is the sum of the probabilities of the two events, *minus the probability that they occur simultaneously*:

$$P(E \text{ or } F) = P(E) + P(F) - P(E \text{ and } F)$$