We All Scream for Ice Cream – August 5, 2019

Problems & Solutions

Moo's Ice Cream shop just opened for the summer season. Moo's has five different flavors of ice cream – chocolate, vanilla, strawberry, bubble gum and mint chocolate, as well as, three topping choices – sprinkles, whipped cream and chocolate chips. If a small sundae comes with one scoop and one topping, a medium sundae comes with two scoops and one topping and a large sundae comes with three scoops and two toppings. If medium and large sundaes can come with scoops of the same or different flavors of ice cream, how many different ice cream sundae combinations can be ordered at Moo's?

*For a small sundae there are five choices for the scoop of ice cream and three choices for the topping, $5 × 3 = 15$ combinations. For a medium sundae, the problem tells us the scoops can be the same or different. If the two scoops are different flavors, there are $_5C_2 = 5!/(2! × 3!) = (5 × 4)/(2 × 1) = 10$ possibilities. If the two scoops are of the same flavor, there are 5 possibilities, one for each of the five flavors. For the toppings there are three choices, therefore, for a medium sundae there are $(10 + 5) × 3 = 15 × 3 = 45$ combinations. Similarly, for three scoops of all different flavors, there are $_5C_3 = 5!/(3! × 2!) = (5 × 4)/(2 × 1) = 10$ possibilities. For three scoops with two or three scoops of the same flavor, there 5 double scoops to choose from and 5 single scoops to choose from giving $5 × 5 = 25$ possibilities. To choose the two toppings, there are $_3C_2 = 3!/(2! × 1!) = 3$ possibilities. So, the total number of large sundae combinations is $(10 + 25) × 3 = 35 × 3 = 105$ combinations. In total, at Moo's ice cream shop, there are $15 + 45 + 105 =$ **165** ice cream sundae combinations.*

Billy and his friends went to Moo's, and each ordered a small sundae. The ice cream shop scooper made them each a small sundae by randomly selecting a flavor and a topping. Billy doesn't like chocolate very much, so he won't enjoy a sundae made with chocolate or mint chocolate ice cream or topped with chocolate chips. What is the probability that Billy will be handed a small sundae that he will enjoy?

*There are nine small sundae combinations that Billy will not like. Chocolate with any of the three toppings, mint chocolate with any of the three toppings, and each of the three remaining ice cream flavors if they are topped with chocolate chips. From the previous problem, we know there are 15 small sundae combinations. If 9 of them will include some chocolate, then there are $15 − 9 = 6$ combinations Billy will like. The probability, therefore, is $6/15 =$ **2/5**.*

Moo's buys all its ice cream for $32 a tub, and each tub has 50 scoops of ice cream. They also buy all their toppings in bulk for $8 per package, and each package contains enough to top 20 small sundaes. When Billy orders his small sundae, he is charged $2. By what percent does Moo's increase the cost of a small sundae in order to make a profit? Express your answer to the nearest tenth.

*Each scoop of ice cream costs Moo's $32/50 = \$0.64$. Topping a small sundae costs Moo's $8/20 = \$0.40$. In total, a small sundae costs Moo's $0.64 + 0.40 = \$1.04$. If they charge \$2 for a small sundae, their percent increase in cost is $(2 − 1.04)/1.04 × 100 ≈ 0.923 × 100 =$ **92.3**%.*

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