

Probability and Vectors

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(We don't really know why these are the same category; just roll with it.)

Probability

Star Pizza™ Conundrum

Star Pizza™ advertises that they offer over 2 million combinations of pizza. They offer 4 crusts, 3 sauces, 5 cheeses, and 15 toppings. Are they telling the truth or have they been corrupted by capitalism and greed to advertise falsely?



SOLUTION

4 crusts * 3 sauces * 5 cheeses * 2^{15} toppings = **1966080** combinations of pizza.

Ans: Yes, they been corrupted by capitalism and greed to advertise falsely



Permutation

In the 2017 lunar fall olympics, there are 8 contestants in the gourd carving n' tossing event. How many ways can a gold silver and bronze award be given out among them?



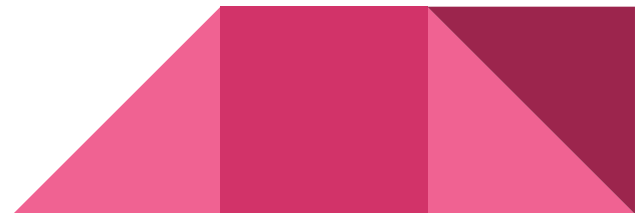
Solution

Since there are three different awards this is a permutation because order matters

The formulae for permutations: $\frac{n!}{(n - k)!}$

Since there are eight contestants it would be: $\frac{8!}{(8 - 3)!}$

This equals **336**.



Com - (recycling) bin - ations

Because of a lack of funding for the 2017 lunar fall olympics, instead of gold, silver and bronze awards, three recycled tin cans will be given out. Now how many combinations of the 8 contestants will be utterly disappointed by their recycled tin can?



Solution Time!

Since all three of the awards are the same, order does not matter in the outcome of who got which award, so this is a combination.

The formula for combinations is: $C(n, k) = \frac{n!}{(n - k)!k!}$

Given the 8 people and the 3 awards: $8! / (8-3)!3! = 56$



Little Jimmy's Got a Bucket

A bucket o' fish contains 8 red fish and 12 green fish. Little Jimmy catches 6 fish randomly from the bucket. What are the chances that at least one fish is green?



Solution

$$P(E) = 1 - P(E')$$

$P(E')$ = none of the fish are green


$$P(E') = C(8,6) / C(20, 6) = 7/9690 = .000722$$

$$1 - .000722 = .999278$$



Grand Master Wheel of Super Fortune

This is it: the big day. You've saved your money. You've made the trip. You're ready. Today is the day you play the Grand Master Wheel of Super Fortune at the Lucky Desert Rabbit Bouncy Castle and Casino Supercenter, in Las Vegas, Maine. The famed game features a spinning wheel with 31 slots. One of the slots is the Super mystery slot, which, if landed on, rewards you with an incredible fortune of 12 dollars. The game costs two dollars to play, and you've been saving your McDonald's wages for twelve years in preparation, so you've brought 1000 dollars with you. Are you going to win big, or have you made some kind of terrible mistake?



Solution

You gain \$9 with probability $1/12$. You lose \$1 with probability $11/12$. Therefore:

$$E = (10)(1/31) + (-2)(30/31) = -1.61$$

You manage to spend all your money and drive yourself into poverty.



Vectors

Disaster at the Angle Emporium

You are in Arnex's Angle Emporium when a flash flood suddenly lifts the building off of its foundation and it starts floating downstream. The current of the water is moving at 15 mph due southeast. There is a wind blowing at 7 mph due south. With what speed must you paddle to cancel out the motion of the building?



Solution

We can find the resulting speed of the building by adding the vectors of all the speeds, and then finding the opposite of the result. First we must convert them all into component forms using trigonometry.

$$\text{Current} = C = 15 \text{ mph, } 45^\circ \text{ S of E} = \langle 15\cos 45, -15\sin 45 \rangle = \langle 10.61, -10.61 \rangle$$

$$\text{Wind} = W = 7 \text{ mph, S} = \langle 0, -7 \rangle$$

$$0 = P + C + W, P = -(C + W) = -(\langle 10.61, -10.61 \rangle + \langle 0, -7 \rangle) = \langle -10.61, 17.61 \rangle$$

$$P = \langle -10.61, 17.61 \rangle = 20.56$$



Nuclear Manhole Mystery

A nuclear bomb explodes beneath a manhole. The manhole cover is shot straight up into the air at a velocity of 3,500 m/s. As it flies, it is hit by a strong horizontal wind of 20 m/s. By how many degrees does the wind change the trajectory of the manhole cover?



Solution

To answer this question, we just add together the speed vectors and find the angle of the resultant vector.

$$\text{Blast} = B = 3500 \text{ m/s up} = \langle 0, 3500 \rangle$$

$$\text{Wind} = W = 20 \text{ m/s horizontal} = \langle 20, 0 \rangle$$

$$W + B = \langle 0, 3500 \rangle + \langle 20, 0 \rangle = \langle 20, 3500 \rangle$$

$$\tan(\theta) = 20/3500$$

$$\theta = .33^\circ$$



The Great Skipper Adventure

Skipper is driving his carriage through the streets of Espoo, Finland. He has been having a grand time, but he just noticed that he forgot to harness the horses together. Magpie, the horse on the left, is obsessed with shiny objects and has begun veering sharply in the direction of a nearby jewelry shop, due West, with a force of 1 horsepower. The other equine, Rick, is perpetually hungry, driving him to trot towards a fruit vendor due northeast of Skipper with a force of 1 horsepower. What is the total force applied to the cart by the 2 equidae? (Force is a vector quantity)



Solution

This is just a simple vector addition problem.

Magpie = M = 1 HP, W = $\langle -1, 0 \rangle$

Rick = R = 1 HP, 45° N of E = $\langle \cos 45, \sin 45 \rangle = \langle \sqrt{2}/2, \sqrt{2}/2 \rangle$

Total Force = F = $\langle -1, 0 \rangle + \langle \sqrt{2}/2, \sqrt{2}/2 \rangle = \langle -.29, .71 \rangle = .77 \text{ HP}$



A Haiku by Mitchell

Hí

Mé

Býe

