Wrapping Problems

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Circular Wraps

Let's say that we were given a long sheet of paper and a roll to roll it around. We knew the length of the paper and the radius of the roll and we want to figure out how many revolutions around the roll we must make before we're out of paper. Our first intuition is to divide the length of the paper by the circumference of the circle $\frac{length}{2\pi r}$, but we realize that the circumference is changing as we complete each roll. So we must apply a summation of some sort across this varying circumference.

You can't simply take the average circumference and divide the length by this value because you can't discover the average circumference throughout the process without knowing the number of rolls you'll need to complete.

I suppose one way to do it is to set up the equation for the number of rolls implicitly:

$$rolls = \frac{(length)}{2\pi(radius + thickness \times rolls)}$$

Non-Circular Wraps

Now let's say that we were given the same long sheet of paper but instead of a circular roll, we were given a square roll.