Math 202H Project - due Monday, April 20th

Flappy Bird is a mobile game released in May 2013 where the player tries to fly the bird (Faby) between rows of green pipes without hitting them. Once Faby has hit a pipe, the game is over. Flappy Bird soared in popularity in early 2014 and was the most downloaded free game in January 2014 from the iOS App Store. The developer, Dong Nguyen, claims he was making $50,000 per day at that time due to in-game advertisements. However, Flappy Bird was removed from Google Play and Apple's App Store in February 2014 due to the creator's guilt over the addictive nature of the game. Shortly after the game's removal, devices where the game was pre-installed were sold on ebay for thousands of dollars. One of the reason's this simplistic game is so addictive is its challenge. If you haven't played it yet, you'll soon see that flying Faby through the pipes is quite a task.

1. Play Flappy Bird ten times and record your best score and your average score over those ten trials. You can play for free online here: http://flappybird.io/.

2. Our goal in this project is to develop a formula for the expected score based on the probability of successfully getting through a single pipe. We'll start by modeling Flappy Bird scores as a series of independent success events (I realize that's a simplification, but I don't think an unreasonable one). The very simple model assumes you have a success rate of "p" for each pipe. Your score would then be a series of p successes followed by a single fail. So that should generalize to a score of n is $p^n(1-p)$. *Provide an argument for this.* Now, that's to get a score of exactly n. The probability of getting n or less would be

$$\sum_{k=0}^{n} p^k(1-p),$$

which means the probability of getting a score greater than n would be

$$1-\sum_{k=0}^{n} p^k(1-p).$$

So, to calculate the expected value (or score), we would have

$$n=\sum_{k=0}^{\infty} kp^k(1-p).$$

Again, fill in the steps and provide an argument for this. Khan Academy has some great lessons on expected value if you've never worked with it before.

This infinite series

$$\sum_{k=0}^{\infty} kp^k(1-p)$$

can be represented by a familiar function. Use techniques from class to derive a formula for the expected score based on the success rate "p."

3. Let's test our work from part 2. Let p be your average score divided by your average score plus one from your ten trials. *Why is this a good value for the success rate p?* Based on the formula you derived in part 2, what is your expected score? How does this compare to your average score?