Pi Day Activity in AP Statistics

Objectives:

* Explore geometric probability using Monte Carlo methods
* Estimate pi from simulation
* Visualize the Law of Large numbers to demonstrate connection between experimental probability and theoretical probability

**Introduction:**

Show figure of circle inscribed in the square.

Ask: *“What is the probability of a dart landing in the circle?”*

Probability of landing in the circle:

*How could we create an experiment to estimate pi?*

Estimate of pi:

**Experiment: Run applet (**[**http://polymer.bu.edu/java/java/montepi/montepiapplet.html**](http://polymer.bu.edu/java/java/montepi/montepiapplet.html) **)**

#1. Throw 1 dart at a time, for a total of 5 darts. What is your estimate of pi?

#2. Now throw 500 more darts. What is your estimate of pi?

#3. Now throw 5000 more darts. What is your estimate of pi?

#4. Continue throwing darts at the rate you choose (either 1, 100, 1000, or 10000 at a time). Record how your estimate of pi changes as you throw more darts. Include at least 5 more estimates.

**Class Discussion:**

*What happens as you throw more darts?*

Sometimes closer to pi, sometimes not

*If we continued this experiment infinitely, what would the estimate of pi be?*

Pi—estimate would approach pi.

Why do you think this is the case?

* Experimental vs. Theoretical Probability
* Law of Large Numbers
  + (Depending on where the class is, you can emphasize the Law of Large Numbers as appropriate)
  + LLN states: when
  + 4

**Extension:**

Take the averages of student estimates at each stage. Discuss how well the estimates approximate pi as compared to the individual experiments.

|  |  |
| --- | --- |
| Number of Darts Thrown | Estimate of |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 505 |  |
| 5505 |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |