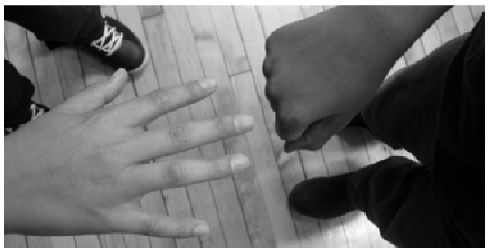
Drexel-SDP GK-12 ACTIVITY

Activity: RPS - Independent Events

Subject Area(s) Data Analysis & Probability

Associated Unit Rock, Paper, Probability

Activity Title RPS - Independent Events



Rock, Paper, Scissors: better than flipping a coin.

Grade Level 7 (6-10)

Time Required 40 minutes

Group Size 2-4

Expendable Cost per Group US$0

Summary

Students play matchups and rounds of rock, paper, scissors (RPS) along a tournament bracket format and then answer questions that cover probability and/or current course topics.

Engineering Connection

In comparative studies, particularly those in the biomedical field, statistics are used to compare data sets and determine the effectiveness of treatments by calculating each treatment's chance of occurring, known as probability. Experimental and theoretical probability are central concepts to the engineering field, since physical phenomena do not always follow the

mathematical descriptions of behavior, known as *mathematical models*, because they are typically derived from idealized assumptions.

Keywords

rock, paper, scissors, probability, bracket, tournament, independent event, fair game, theoretical probability, experimental probability

Educational Standards

- PA Math:
    - 2.7.3.A. Predict and measure the likelihood of events and recognize that the results of an experiment may not match predicted outcomes.
    - 2.7.5.A. Perform simulations with concrete devices (e.g., dice, spinner) to predict the chance of an event occurring.
    - 2.7.5.B. Determine the fairness of the design of a spinner.
    - 2.7.5.C. Express probabilities as fractions and decimals.
    - 2.7.5.D. Compare predictions based on theoretical probability and experimental results.
    - 2.7.5.E. Calculate the probability of a simple event.

Pre-Requisite Knowledge

Students must know how to follow a tournament bracket and play rock, paper, scissors.

Learning Objectives

After this activity, students should be able to:

- Define *experimental probability* and *theoretical probability*
- Determine if a game is "fair"
- Calculate the probability of a student advancing through the tournament
- Relate the activity to a real-world situation

Materials List

Each group needs:

- RPS Tournament Worksheet

To share with the entire class:

- 1 deck of playing cards (poker deck)

Introduction / Motivation

We hear the term "probability" a lot. Could someone tell me how they've heard it expressed? (As a percentage or fraction). Casinos use probability to their advantage by offering high payouts on games in which players have a low probability of winning, and low payouts on games that have high probabilities of winning. In this exercise, we are considering independent events. Casino games based on independent events are ones like slots, craps, or roulette.

Engineers use probability differently: we use statistics to compare the probability of events occurring. You will see probability more often in biomedical studies than other areas of engineering, since there are many studies that analyze the outcome of different treatments and might base their conclusions on the probabilities of an outcome occurring from a treatment. For example, many medical studies use a control population, such as a healthy test subject. The effect of treatment on a "normal" test subject is directly compared to the outcome, whereas

"unhealthy" test subjects may have some sort of precondition that must be monitored in addition to the intended outcome.

We have covered the concept of probability earlier this year, with determining the results of tossing a coin multiple times. Who found that the experiment matched their prediction? Who found that there was a difference between your prediction and the experiment? (Most students who completed this exercise – tossing a coin 30 times and recording the results – did not equal experimental probabilities of heads and tails). Would tossing a coin be considered a "fair" game? (Yes). Who has played Rock, Paper, Scissors? (See if any students do not know how, and/or ask a student to re-cap the rules). Who believes that Rock, Paper, Scissors is a "fair" game? (Some students will not be sure, so this is a good segue into a class activity of completing worksheet question #1, which instructs to create a tree diagram).

Rock, Paper, Scissors is a "fair" game but its possible outcomes are evenly distributed three ways as opposed to a heads-tails 50-50 outcome.

Vocabulary / Definitions

Word	Definition
Experimental probability	The expected chance of an outcome. Defined as $$p_{exp} = \frac{Actual\ Outcome}{Number\ of\ Expected\ Outcomes}$$
Theoretical probability	The observed chance of an outcome. Defined as $$p_{theor} = \frac{Expected\ Outcome}{Number\ of\ Expected\ Outcomes}$$
"fair" game	A game in which winning and losing have equal theoretical probabilities.
Independent event	An event whose outcome is not affected by another event, i.e. a player winning two matchups of RPS while having the ability to throw a rock, paper, or scissors each time.
Dependent event	An event whose outcome is influenced by another event, i.e. a player winning two matchups of RPS if, in the second matchup they cannot throw the object that they used in the first matchup.

Procedure

Background

The worksheet linked to this activity includes a bracket that accommodates 28 students. For classes with less than 28 students, remove the 2's before any other face value. The bracket is "seeded" as students draw playing cards with face values ranging from 2 through 8. Bracket "divisions" corresponding to the suits: hearts, diamonds, clubs, and spades, can be arranged in different areas of the classroom.

Rock beats scissors.

Before the Activity

- Distribute worksheet packet
- "Seed" the bracket by allowing students to choose playing cards

With the Students

1. Solve the first worksheet problem to assure students that Rock, Paper, Scissors is a fair game.
2. Review the rules: Rounds 1-4 are based on best of three series (one person must win 2 matchups); Round 5 is based on best of five series (one person must win 3 matchups)
3. Students must track their wins, losses, and ties on *for their first matchup* by recording a "W," "L," or "T" for game in the table.
4. Assist with keeping the order of the brackets once the "divisions" are decided.

Attachments

rock_paper_probability_1_activity_rps-independent_events_worksheet.pdf

Assessment

If group work is preferred, students can group by face value of their drawn card to form groups of four. Allow the class/groups to work on each remaining worksheet question for 5 minutes before reviewing the answers. Encourage class participation when reviewing the answers.

Question #2 asks for theoretical probability based on a 3-game series. Theoretical calculations consider wins but not ties. Ask the students how their experimental probability compares with this value for their first-round matchup. (More matchups played would decrease the probability)

Questions #3-4 is along the lines of critical thinking with an aim at reinforcing the concept of percentages.

Question #5 applies the activity to a real-world situation.

References

Probability Activities < http://www.math.wichita.edu/history/activities/prob-act.html#prob1>

Other

Bracket Generator <http://www.crowsdarts.com/brackets/tourn.html>

Owner

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