Lesson Plan - Risky Allowance – Problem-Solving and Probability

Grade Level: 8th grade

Objectives

- Student will calculate allowances for 12 days and then 16 days under four different plans in the "Risky Allowance" problem.
- Student will make a table for each plan with the day number, daily allowance, and cumulative allowance for 12 days and then for 16 days.
- Student will calculate the experimental probability for Plan C using a spinner.
- Student will calculate the experimental probability for Plan D flipping a coin.
- Student will analyze the data and make a decision as to which Plan would produce the greatest allowance for 12 days and then for 16 days.
- Student will calculate the theoretical probabilities for Plans C and D to see if there was a significant variation and if it would have changed his initial conclusion.
- Student will create an Excel spreadsheet to calculate the daily allowance of rice in the "One Grain of Rice" Indian folktale, exploring exponential growth.

Michigan GLCEs

D.PR.08.05 Find and/or compare the theoretical probability, the experimental probability, and/or the relative frequency of a given event.

A.RP.08.01 Identify and represent linear functions, quadratic functions, and other simple functions including inversely proportional relationships ($y=k/x$), cubics ($y=ax^3$), roots ($y=\sqrt{x}$), and exponentials ($y=a^2$, a>0); using tables, graphs and equations.

Materials

Risky Allowance student directions sheet (see attached)
Risky Allowance student worksheet, blank and answer key (see attached)
Pencil and calculator
One Grain of Rice Indian folktale (obtained from:
http://jwilson.coe.uga.edu/EMT668/EMAT6680.F99/Martin/instructional%20unit/day4.exponential/excel/grainofrice.html), or from the book, *One Grain of Rice* by Demi (Charlotte Dumaresq Hunt)

One Grain of Rice spreadsheet, blank and answer key (see attached), computer with Excel

Procedures

For this lesson, the teacher will give the student the Risky Allowance student directions sheet, along with the Risky Allowance student worksheet, a pencil and a calculator. *Today you are going to participate in a problem-solving exercise that will draw on your knowledge of how to calculate probability, how to complete a data chart, how to analyze the data, how to look for patterns and making a decision as to which would be the best selection. The problem is called the "Risky Allowance" problem and you will be calculating your allowance under 4 different plans.* At this time, the teacher will let the student read the problem and look at the chart. The teacher will ask if he has any questions that need to be clarified before he begins. When the student is done, the teacher asks the student what choices he made at the end of day 12 and then

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day 16. *Why did you make the choice you made at the end of 12 day? Did your answer change at the end of 16 days? What plan do you think would be the best at the end of 30 days? A year?* At this time, the teacher asks the student what type of probability did he compute for Plans C & D?....theoretical or experimental? If the student is unaware (he should know this as they just covered it), the teacher will explain the difference. The teacher then shows the student how to calculate the theoretical probability of Plan C:

$$P (.5) = ¾$$
$$P (5.00) = ¼$$
$$EV \text{ (daily allowance)} = ¾ (.5) + ¼ (5.00) = \$1.63$$
$$EV \text{ (allowance} > 12 \text{ days)} = 12 \times 1.63 = \$19.50$$
$$EV \text{ (allowance} > 16 \text{ days)} = 16 \times 1.63 = \$26.00$$

Now the teacher gives the student the opportunity calculate the theoretical probability of Plan D:

$$P (0) = ½$$
$$P (7.00) = ½$$
$$EV \text{ (daily allowance)} = ½ (0) + ½ (7.00) = \$3.75$$
$$EV \text{ (allowance} > 12 \text{ days)} = 12 \times 3.75 = \$45.00$$
$$EV \text{ (allowance} > 16 \text{ days)} = 16 \times 3.75 = \$60.00$$

Once the student is done calculating the theoretical probability of Plan D, the teacher asks the student if knowing the theoretical probabilities of Plan C and D would change his answer after 12 days? 16 days?

The teacher wraps up the session by reading the "One Grain of Rice" Indian folktale and letting the student build a spreadsheet based upon this very ancient folktale to determine the amount of rice given to Rani on any given day and at the end of 30 days. The student will start the spreadsheet by listing under the heading, "day," 1....30. Then proceed with the following formula: 2*(previous cell address) and fill down. After each day, read the part of the story that corresponds to that day. (Read the number AFTER they find it using the spreadsheet). At the end of the story, the student will construct a total column using the formula +that day's allowance (cell to the left) +the previous day's total (cell immediately above) and fill down. {Because the student is using the Excel spreadsheet to do the math, this part of the lesson will go very quickly}.