Teacher Instructions: Pizza Hut ® Promotion

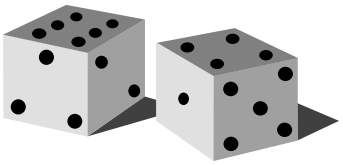
Grade Level: 6 - 8

Task: Pizza Hut ® Promotion

Standard: Data Analysis, Statistics, and Probability

Pizza Hut ® had the following promotion:
Fantastic Friday
Early Bird Special!

Every Friday Afternoon from 3pm – 5pm
You'll roll the die when you're ready to pay to obtain your discount.



It's free! For a die roll of 6

Get 30% off! For a die roll of 3

Get 20% off! For a die roll of 2 or 4

Get 10% off! For a die roll of 1 or 5

Valid only at participating Capital Pizza Hut locations. Subject to cancellation at any time. Dine-In and Carryout orders only, applies to guest checks cashed out between 3pm & 5pm.
Does not apply to the purchase of gift certificates, alcohol (it's the law!) or Premium items like basketballs or puppets. Not valid with any other offer. No purchase necessary. Discount cannot exceed $25.

As you can see, contestants had a 1/6 or a 17% chance of rolling a 6, and getting a free pizza.

- Contestants had a 1/6 or a 17% chance of rolling a 3, and getting 30% off the price of their meal.
- Contestants had a 2/6 or a 33% chance of rolling a 2 or 4, and getting 20% off the price of their meal.
- Contestants had a 2/6 or a 33% chance of rolling a 1 or 5, and getting 10% off the price of their meal.

Your task is to create a new game for Pizza Hut ® that deals with finding the sum of two dice that are rolled. Draw an advertisement for your game, and write a letter to the company with your recommendations and how you made them.

Context – From the Task Author: This task was given to students during a unit on probability. See 'teaching tips' for resources for additional probability activities.

I had gotten this advertisement at Pizza Hut ® a while ago, and finally translated it into a problem-solving task.

What the task accomplishes…

- This task allows students to explore the probability of rolling sums with two addends.

- It also requires students to use creativity in an open-ended, problem-solving situation.
- This made solving the task very motivational for students, along with the fact that it dealt with pizza!

What students will do…

- Most students get obsessed first with creating a unique game, before they deal with the underlying mathematics in the task. I didn't have a problem with this, because it led to a student investment in solving the task.
- Students came up with a variety of games that included using different-sided dice, spinners, cups, and other creative elements. There were more traditional approaches as well.
- After creating a game, students focused on determining the theoretical probability of each outcome, and assigning food discounts to match those probabilities.

Time Required: Students spent about eight, 40-minute class periods with this task. This included coming up with a game idea, creating the game, determining the probabilities, assigning discounts, creating brochures to advertise their games, and writing letters to Pizza Hut.

Interdisciplinary Links: This task links well to a unit on advertising, economy, business, and consumer science. My students actually sent their games, brochures, and letters to Pizza Hut, and are anxiously awaiting a response. Art was incorporated with this task, in that students were required to create attractive brochures to advertise their games. The art teacher could have taken this part of the task even further.

Teaching Tips…

- Students should have some probability experience before they attempt this task. The solutions will be more mathematically based with the proper pre-instruction.
- I have found several books that have excellent pre-assessment activities. One good resource is *Statistics and Probability Grades 5-8,* by Mrye Shireman.
- I often find students more motivated to solve and communicate task solutions when they have an audience. Writing to Pizza Hut with their ideas was very motivating and produced high quality work.
- Some students, who have difficulty getting started with most tasks, jumped right in with this task in that it was hands-on, and had many avenues from which it could be approached.
- Originally, I had worded the task in a way that required students to create a game with two dice that would result in similar odds as the original game. This limited student creativity, and I chose to remove this requirement. You can introduce this element back into the task, making the students focus more on finding probabilities equivalent to those presented.

Teaching Note: To avoid advertising pizza restaurants, teachers may choose to use a generic restaurant name when presenting this task.

Suggested Materials: Provide dice, calculators, markers, paper, and other art supplies for creating brochures and games.

Possible Solution…

- ✓ The solutions will vary, depending on how students approach the task.
- ✓ Look for correctness of supporting mathematics, a proper ratio between the amount students assigned to discounts, and the theoretical probability of the outcomes. For instance, the more unlikely an outcome is to occur, the better the discount should be.

Benchmark Descriptors:

- ❑ The benchmark descriptors and rubric are designed to help the teacher analyze student thinking and understanding at each of the four performance levels.
- ❑ The descriptors are generalizations of what student work could look like.
- ❑ It is not possible to anticipate every answer a student can give, so in scoring student work the teacher must use these generalizations to come to their own conclusions as to where a student is performing on the assessment.
- ❑ It is recommended that teachers create their own task specific rubric by listing the specific math skills that would make up each section of the four performance levels.

Novice

- ✓ The novice will not be able to find a strategy that will result in a correct solution.
- ✓ There will be no work to support the solution and only basic math language will be used.

Apprentice

- ✓ The apprentice will attempt to address the problem.
- ✓ The student will more likely use an experimental model that may not get at the underlying mathematics in the task.
- ✓ The apprentice may not have a full understanding of the task and may focus mostly on the discounts without considering a proper relationship between the discount and the probability of each outcome.
- ✓ Little math language will be used, and a representation will be attempted.

Practitioner

- ✓ The practitioner will solve the problem theoretically, and maybe even experimentally.
- ✓ There will be a reasonable relationship between the discount and the probability of achieving outcomes.
- ✓ The practitioner will use math language of probability to communicate, and will create an accurate and appropriate representation in which to record his/her approach and decision making.

Expert

- ✓ The expert will solve the problem theoretically, and may verify the solution experimentally.
- ✓ The expert will make mathematically relevant observations and will use precise and accurate math language.
- ✓ The representation will be complete and accurate to the student's solution.
- ✓ The expert will have a creative approach to the task, and will exhibit a command of probability concepts.
- ✓ The expert will make mathematically relevant observations and connections.

APS Mathematical Standards…

❖ **The math standards stated for this task are aligned to the APS Draft Standards 2000.**

Strand – Data Analysis, Statistics, and Probability

Students will identify patterns and special features of data and events of chance through experiences with meaningful mathematical problems while focusing on comparing, predicting, representing data, and making decisions to communicate mathematical understanding.

Benchmark (6 – 8): The student will design a data question with two variables and collect, represent and analyze the data. The student will use a variety of graphical representations to display data and understand measures of center and spread. The student will make conjectures and compute simple probability outcomes using a variety of tools.

Performance Standards:

Fifth Grade:

- **Perform** simple probability experiments and organize data in a useful way.
- **Identify** patterns.
- **Predict** outcomes.
- **Explain** effects on outcomes when a probability experiment is conducted several times.
- **Explain** the fairness of games and outcomes of events using knowledge of probability concepts.
- **Explain** that the measure of the likelihood of an event can be represented by a number from 0 to 1.

Sixth Grade:

- **Select and develop** appropriate display(s) of data.
- **Develop and evaluate** inferences, predictions, and arguments that are based on data.

Seventh Grade:

- **Determine** simple probability in experimental and theoretical situations.
- **Determine** probability of dependent and independent events in experimental and theoretical situations.
- **Explain and use** appropriate terminology to describe complementary and mutually exclusive events.

Strand – Number Sense and Operations:

Students will demonstrate number sense through experiences with meaningful mathematical problems that focus on number meaning, number relationships, place value concepts, relative effects of operations, and multiple representations to communicate sound mathematical thinking.

Benchmark (6 – 8): The student will understand problems involving fractions, decimals, and percents and develop, analyze, and explain a variety of algorithms and methods to solve problems.

Performance Standards:
Sixth Grade:

- **Select and use** the appropriate number form (fractions, decimals, or percents) in a variety of situations, including measurement in U.S. and metric systems.

Seventh Grade:

- **Explain** the relationship that can be expressed as ratios of part-to-whole.
- **Explain** the relationship that can be expressed as part-to-part.
- **Explain** relationships that can be expressed as proportions or percents.

Strand - Global Mathematical Processes:

Students will understand and use mathematical process.

Benchmark (K - 12): The student will use problem solving, reasoning and proof, communication, connections, and representation as appropriate in all mathematical experiences.

Performance Standards:
Grades Kindergarten through twelve:

- **Develops** resourcefulness and perseverance in problem solving in mathematics and other disciplines.
- **Recognizes** when to use previously learned strategies to solve new problems.
- **Develops and uses** strategies for solving given problems.
- **Monitors and reflects** on the process of mathematical problem solving.
- **Makes and investigates** mathematical conjectures and use them successfully in developing and evaluating mathematical arguments and proofs.
- **Uses** the concept of counterexample to test the legitimacy of an argument.
- **Develops** a logical sequence of arguments leading to a valid conclusion or solution to a problem (statement/reasons, proof, informal proof, and algebraic steps).
- **Works** in teams to share ideas, to develop and coordinate group approaches to problems, and to share from each other in communicating findings.
- **Relates** applications to mathematical language in various modalities.
- **Communicates** mathematical thinking coherently and clearly to others.
- **Analyzes and evaluates** mathematical thinking and strategies of others.
- **Identifies** and **connects** functions with real-world applications.
- **Identifies** how seemingly different mathematical situations may be essentially the same (e.g. the intersection of two lines is the same as the solution to a system of linear equations).
- **Investigates** and **explains** the mathematics required for various careers.
- **Recognizes** and **applies** mathematics in contexts outside the mathematics course.
- **Develops** a repertoire of mathematical representation that can be used purposefully, and appropriately interchangeably (e.g. pictures, written symbols, oral language, real-world situations, and manipulative models).
- **Selects, applies,** and **translates** among mathematical representations to solve problems.
- **Uses** representations to model and interpret physical, social, and mathematical phenomena.

Benchmark Papers

Novice

There is little evidence of understanding.

Roll doubles 50% off(not 1)
Sum of 6+2 30% off
Sum of 5+4 20% off
Sum of 3+2 10% off
sum of 4+2 1 kids meal for you
Sum of 5+6 some bread sticks.
If the =7 your in heaven (Free)
get a 1 without a 2 nothing free
for you.

Math language is used, but it is unclear that the student understood its meaning.

No math representation is created.

There is no support for the solution nor for mathematical reasoning.

Apprentice

Some correct math language is used.

Not all combinations are found, leading to an incorrect answer.

Percent chances of winning	chance of winning	numbers prizes		Combinations	
5%	1/18	2	Free meal	1+1	
5%	1/18	3	Free meal	1+2	
10%	2/18	4	30% off	1+3	2+2
10%	2/18	5	Free calzone	1+4	2+3
10%	2/18	6	Free soda	1+5	3+3
10%	2/18	7	Sorry Nothing	1+6	4+2
10%	2/18	8	Free Soda	2+6	4+4
10%	2/18	9	Small pizza	5+4	6+3
10%	2/18	10	Small pizza	4+6	5+5
5%	1/18	11	50% off next mea	5+6	
5%	1/18	12	50% off next mea	6+6	

The student incorrectly rounded some of these percentages.

$1/18 + 1/18 = 2/18 = 1/9$

$5\% + 5\% = 10\%$

Parts of this representation could be better organized.

Some work is present.

Practitioner

The student has an approach that works and a correct solution.

The student explains the approach and the reasoning used.

Dear Pizza Hut Incorporated,

I am writing to you about something my class and I have been working on in school. We have been studying probability and we have seen your advertisement for the *Fantastic Friday Early Bird Special*. Our task is to create a new game for you that gives contestants similar odds of winning, but deals with finding the sum of 2 dice that are rolled. We were allowed to work with a partner or work individually, and when we completed our games we made advertisements to go along with them. I worked alone to make my game, rather than with another student.

My game is named *Free Friday* because well, the contestant is only eligible on a *Friday*. This game takes place only 3-6pm on Fridays and is only valid for food products (not valid on items like gift certificates), and is not to be used to purchase alcohol (it's the law). This game works like this; a contestant comes in to his or her nearest pizza hut location and rolls a 8-sided and a 6-sided die. If the sum is 2,3, or 14 the person gets a free meal (must be $30 meal or less) . If the contestant's sum is 4 or 13 he/she gets 50% off the meal (must be $50 meal or less). If the sum of the two dice is 5 the purchaser gets 30% off the meal. When the contestant rolls a sum of 6, 7, 11, or 12 they get 25% off their meal, and finally if the purchaser rolls a sum of 8,9, or 10 he or she get 10% off the meal and a free soda.

Attached to this paper I have made a representation showing the percent chance of obtaining a particular sum. When using a six and a eight sided die all the possible numbers you can sum are 2-14. So, to find the percent chance of getting the sum of any of these numbers, first I found how many possible combinations there were for rolling the sum of any of these numbers. There were 33 total combinations for all of the numbers 2-14, so this gave me the fraction of combinations for each number. I had the theoretical fractional probability but I needed to turn that into a theoretical percent. I accomplished this by using the following formula:

$(F / T) \times 100 = P$ Where;

F=number of combinations for specific number
T=total number of combinations
P=theoretical percent of specific number.

Correct math language is used throughout to communicate the solution.

Number	Percent Chance of Getting That Sum
2	3%
3	3%
4	6%
5	6%
6	9%
7	9%
8	12%
9	12%
10	12%
11	9%
12	9%
13	6%
14	3%

Sums using digits 1-6 and 1-8

1	None			
2	1+1			
3	1+2			
4	1+3	2+2		
5	1+4	2+3		
6	1+5	2+4	3+3	
7	1+6	2+5	3+4	
8	1+7	2+6	3+5	4+4
9	1+8	2+7	3+6	4+5
10	2+8	3+7	4+6	5+5
11	3+8	4+7	5+6	
12	6+6	5+7	4+8	
13	6+7	5+8		
14	6+8			

The student lists all of the possible combinations.

An accurate and appropriate math representation is used to communicate an aspect of the solution.

Practitioner (cont.)

You May Come In To Your Closest Pizza Hut Location Next Friday Between 3 and 6pm and Try To Win a FREE Meal! If You Roll a 2, 3, or 14 On Our 6 and 8 Sided Dice You Win a Free Meal! If You Roll a 4, or 13 You Get 50% Off! If You Roll a 5 You Get 30% Off If You Roll a 6, 7, 11, or 12 You Get 25% Off! And Finally If You Roll A 8, 9, or 10 You Get 10% Off and a FREE Drin

PIZZA HUT®

Valid only at participating Pizza Hut locations. If you win 50% off your meal must be $50 or under. If you win a FREE meal your meal must be $30 or under. Only valid 3-6pm on Fridays. Does not apply to purchase of gift certificates, alcohol (it's the law), or any other non-food products®

FREE FRIDAY

It You Would Like To Win a FREE Meal Then Keep On Reading.....

Pizza Hut®

The student creates a brochure to advertise the game.

Expert

Pizza Hut Management,

I made up a game for Pizza Hut, like your earlier Early Bird Special. Our class was learning about probabillity, so our teacher decided we should invent a similar game, rolling *2* dice. We had to change our first game eventually because it was *way* too hard to win. At first we were going to have the person roll 2 dice 4 times and if the sums were consecutive, they would win a free pizza. But there was only a .03% chance of winning so we made that a bonus.

In our game you roll 2 dice 1 time. If the numbers making up that sum were consecutive, they win a free pizza.

If you roll a sum of 3 or an 11, you have a 100% chance of winninga If you roll a sum of 5 or 9 you have a 50% chance. If you roll a 7 you have a 33% chance. If you roll a sum of 2, 4, 6, 8, 10, or 12 you have a 0% chance of winning. It's impossible to roll a sum of 1 with 2 dice. To figure out these percents, I found the total possible outcomes you could roll on a dice to get each sum. Then I found what percent of those sums ~~are~~ include consecutive digits. After I had found the probabillity of rolling a favorable outcome, I had to find the ~~chance of total~~ probability of winning. I did that by using Probability of Joint Occurrence. I used this formula:

because all sums are made of consecutive numbers.

A/B x C/D = E/F

where A equals the favorable outcomes for getting a cetian sum, B equals the favorable outcomes of getting consecutive digits (of all the numbers you can roll on 2 dice), C and D equal the total possible combinations, E equals AxC, and F equals BxD (the result of the equation). Example to find the Probobility of Joint Occurrence for the number 5 it would be 3/21 x 1/2 = 3/42. When you reduce that it equals 1/14, so you have a 1/14 chance of rolling a 5. I noticed that all the even numbers had a 0% chance of having consecutive addends because you have to add two even numbers to get an even sum, and 2 even numbers in a row aren't consecutive.

I hope you can accept our game and the next time I go to Pizza Hut I hope to see it there!

Sincerely,

% Chance of getting consecutive sum	Number	Combinations
0%	1	0
0%	2	1+1
100%	3	1+3
0%	4	2+2 | 1+3
50%	5	2+3 | 1+4
0%	6	3+3 2+4 1+5
33%	7	1+6 2+5 3+5
0%	8	4+4 3+5 2+6
60%	9	3+6 4+5
0%	10	5+5 6+4
100%	11	5+6
0%	12	6+6

Correct math language is used throughout.

It would have been nice if the student included this work, even though it was not used.

The student shows a command of probability concepts.

The student's reasoning is explained.

The student analyzes the solution and makes a mathematically relevant observation.