

Airline Overbooking

Topic of Lesson: <i>Simulation</i>	Class Name and Level(s): AP Statistics	Date:
Learning Objective (Students will be able to...) Use the randint function in their calculator to simulate a situation involving a binomial random variable. Analyze a situation involving a binomial event using simulation and make a decision about the best course of action.	Assessment of each objective Walk around during the start of the seat work time and check to make sure everyone know how to use randint correctly. Check their worksheets after class.	
CCSS-M Standards addressed <ul style="list-style-type: none">• S-MD 5. (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.• S-MD 7. (+) Analyze decisions and strategies using probability concepts (e.g. product testing, medical testing, pulling a hockey goalie at the end of a game). CCSS-M Mathematical Practice emphasized <ul style="list-style-type: none">• 3. Construct viable arguments and critique the reasoning of others.		
Strategies you will use to link prior knowledge/personal experience to this lesson:		
Materials and or technology needed for this lesson: Teacher: Student: TI-83 or TI-84 calculators, airline overbooking worksheet		

Procedure/Sequencing of Lesson and Teaching Strategies

Procedure for Lesson: Please describe a step by step procedure for your lesson, including estimated times. The chart below may continue for several pages

Teacher Activity	Anticipated Student Thinking and Activities	Analysis about cognitive demand of activities, instructional choices, and curricular materials	Materials, Strategies, Other Notes
Hand out the worksheets. "Please read the paragraph WITHOUT discussing it with your neighbor."			Worksheets
"What advantages does overselling or overbooking have? What are some disadvantages?"	Would like to get kids thinking about customer satisfaction, not just numbers.		
"Based on what we learned yesterday, how can we simulate how many of 17 random people show up (or don't) for a flight?"	May have to review how to use the <code>randInt(min,max[,length])</code> command.		
<p>"I want everyone to do part 1 of the worksheet. Simulate 5 flights where 15 tickets are sold. Count how many people don't show up for each flight. Then do the same thing for flights where 16 tickets were sold and again for 17 tickets. When you're done, come up to the board and record your results in the tables. You can do more if you finish quickly. When you're finished up at the board take a look at part 3."</p> <p>Walk around and help everyone get started correctly.</p>	<p>Make sure people are doing this correctly before they record on the board!</p> <p>Students may not understand the tallying at first and try to write down other things in the table.</p>	Students should understand this process after a bit of initial confusion. Getting this part is our main objective.	
Make 3 tables on the board where students can make tick marks for 0 through 6 no-shows for each flight. Make a table for each of the 15, 16, and 17-ticket selling policies. Spread them out in different areas of the board to reduce traffic congestion. Ask students who are done quickly to help you add up results.		Part 3 is supposed to be a challenge.	
Walk around and answer questions about parts 2 and 3.			
When everyone's results are in the table, count them and write down the sums. You can get a student to help with this if you want, also.			

<p>Quickly discuss how no-shows translate to empty seats and coupons handed out for the different selling policies. Get students started on part 4.</p>	<p>Students often don't think about how the number of no-shows translates to empty seats differently depending on tickets sold.</p>	<p>Students may need help summing expected values correctly.</p>	
<p>With about 12 minutes left in the class, ask for a consensus on the average number of empty seats and coupons issued from part 4. Discuss how you could use that information.</p> <p><i>Conclusion:</i> <i>If the average number of people bumped per flight exceeds the average number of empty seats on the next flight, you have a unsustainable situation where the number of bumped people waiting for the next flight will continue to increase.</i></p>			

<p>Differentiation strategies:</p>
<p>At home work: Please describe any work to be done at home (if any) and approximate time it will take. If homework is assigned, describe why it is appropriate work to be done at home: Students may choose to take the worksheet home or turn it in at the end of the period.</p>
<p>Reflection on Lesson/Notes to self:</p>

Name: _____

Mudlark Airlines – Overbooking

Mudlark Airlines has a 15-seater commuter airplane that is used for short flights. Their data suggest that on average 8% of the customers who buy tickets are no-shows. Wanting to avoid empty seats (they see this as missed opportunity to increase revenue), they decide to sell 17 tickets for each flight. Ticketed customers who can't be seated on the plane will have to be seated on the next flight and be given a coupon for a free flight at a later date. You have been hired as a consultant to Mudlark. Your job is to determine if this overbooking is a sound strategy and/or if a different strategy would be better.

Part 1:

Use the randInt function on your calculator to simulate 5 flights where 15 tickets were sold, 5 flights with 16 tickets sold, and 5 flights with 17 tickets sold. Use tick marks to record how many no-shows you get for each flight. Simulate more if you have extra time.

Tally your personal simulation results here:

no-shows	tickets sold		
	15 tickets	16 tickets	17 tickets
↓			
0			
1			
2			
3			
4			
5?			
6??			

Part 2:

As a class, tabulate everyone's results on the board to make one larger simulation.

Part 3:

While your classmates are putting their results on the board, try to answer the following. Work together to figure it out! Find the probabilities of the following:

1. nobody showing up when 15 tickets are sold
2. everyone showing up when 16 tickets are sold (1 bumped)
3. everyone showing up when 17 tickets are sold (2 bumped)
4. (*!) 16 people showing when 17 tickets are sold (1 bumped)

Once the full-class simulation results are totaled we can figure out the average number of empty seats per flight and the average number of people bumped off each flight. What can we do with these numbers?

Name: _____

Part 4: Complete the tables below using the whole-class simulation results. To complete the empty seats column, multiply the number of empty seats on the flight by the frequency. Do the same for the coupons issued column.

15-ticket policy

no-shows	Frequency	Probability	Empty Seats
0 (full)			
1			
2			
3			
4			
5			
Total:			
Average per flight:			

Part 5:

How would you calculate how much money you made on an average flight given a fixed ticket price “p”? Be sure you account for the free flight coupons.

16-ticket policy

no-shows	Frequency	Probability	Empty Seats	Coupons Issued
0				
1 (full)				
2				
3				
4				
5				
Total:				
Average per flight:				

Which of the three situations we simulated makes the most money?

What other factors might we want to consider?

17-ticket policy

no-shows	Frequency	Probability	Empty Seats	Coupons Issued
0				
1				
2 (full)				
3				
4				
5				
Total:				
Average per flight:				

What is the best number of tickets to sell for each flight?