



Casa Grande Union High School

Teacher: Connie Dolezal

Fellow: Victor I. Piercey



Connie Dolezal was born and raised in a small town less than half the population of Casa Grande Union High School. In 1993, the Dolezal family moved to Arizona where she has taught ever since. She has taught math at Desert Winds, Casa Verde, and the main campus, everything from Basic Math through Calculus. Her daughter, Casey, is a teacher at Palo Verde Elementary School in Casa Grande and her husband, Ted, works for Homeland Security at the Phoenix International Airport. Aside from doing math for fun, Mrs. Dolezal enjoys traveling and reading.

Victor Piercey is originally from Kalamazoo, Michigan. Before studying mathematics, Victor earned a J.D. from Columbia Law School and practiced law in New York City for two years. After September 11, 2001 Victor decided to change careers and is now a Ph.D. candidate in Mathematics at the University of Arizona. He studies Algebraic Geometry with Yi Hu. His wife, Courtney, is pursuing a D.M.A. in vocal performance at Arizona State University. When not studying, Victor likes to travel with his wife, read, play guitar, learn foreign languages, and go to the movies.

A.P. Statistics

Activity on the Logic of Significance Tests:



Random Variables and Coin Tossing

November 23, 2009

Suppose you toss a coin four times. For each toss, write T for the outcome of "tails" and H for the outcome of "heads". For the four tosses, string the H's and T's together. For example, if the first toss results in a head and the remaining three tosses result in tails, write H T T T.

Let X be a variable whose value is the total number of heads in the given toss. For example, for the outcome H T T T, $X = 1$. For each value of X , list all the corresponding possible outcomes of the four coin tosses:

1. $X = 0$;
2. $X = 1$;
3. $X = 2$;
4. $X = 3$;
5. $X = 4$;

Now fill in the following table:

Value of X (number of heads)	0	1	2	3	4
Probability					

What do the probabilities add to?

The Mean, Variance and Standard Deviation of a Random Variable: Coin Tossings

November 30, 2009

1. Suppose you toss a coin 4 times and X is the random variable whose value is the number of heads in an outcome. Recall we have the following probability distribution:

Value of X (number of heads)	0	1	2	3	4
Probability	$\frac{1}{16}$	$\frac{4}{16}$	$\frac{6}{16}$	$\frac{4}{16}$	$\frac{1}{16}$
μ_X					
σ_X^2					
$\sigma_X = \sqrt{\sigma_X^2}$					

- To fill in the third row, multiply each possible value of X by the respective probability.
- Add the values in the third row. This is the mean of the random variable X , written μ_X .
- To fill in the fourth row, for each possible random variable X , subtract the mean μ_X and square the result. Multiply the result by the respective probability. Enter the result in the fourth row.
- Add the values in the fourth row. This is the variance of the random variable X , written σ_X^2 .

As you might expect, the standard deviation of the random variable σ_X is the positive square root of the variance.

2. Repeat the same process to find the mean, variance and standard deviation when X is the number of heads that occur when you toss a coin six times.

Value of X (number of heads)	0	1	2	3	4	5	6
Probability	$\frac{1}{64}$	$\frac{6}{64}$	$\frac{15}{64}$	$\frac{20}{64}$	$\frac{15}{64}$	$\frac{6}{64}$	$\frac{1}{64}$
μ_X							
σ_X^2							
$\sigma_X = \sqrt{\sigma_X^2}$							

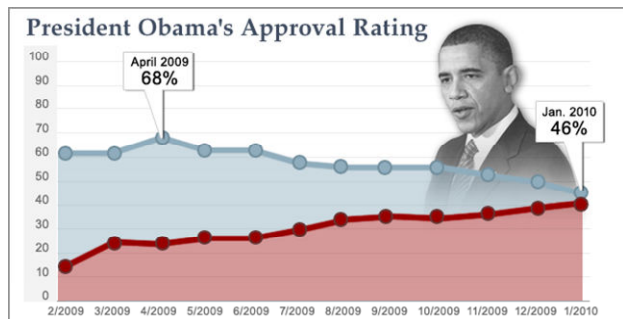
3. Repeat the same process to find the mean, variance and standard deviation when X is the number of heads that occur when you toss a coin six times.

Value of X (number of heads)	0	1	2	3	4	5	6
Probability	$\frac{1}{64}$	$\frac{6}{64}$	$\frac{15}{64}$	$\frac{20}{64}$	$\frac{15}{64}$	$\frac{6}{64}$	$\frac{1}{64}$
μ_X							
σ_X^2							
$\sigma_X = \sqrt{\sigma_X^2}$							

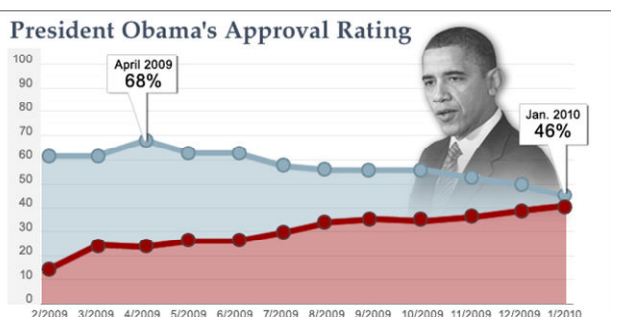
4. Can you make a conjecture (guess) about the mean, variance and standard deviation for the number of heads in n tosses? Show, in each of the examples above, write the mean as a fraction over 2, the variance as a fraction over 4, and the standard deviation as a fraction over 2.

A high point of a statistics class is learning to interpret statistics in the news. When we studied confidence intervals, we dissected a presidential approval poll.

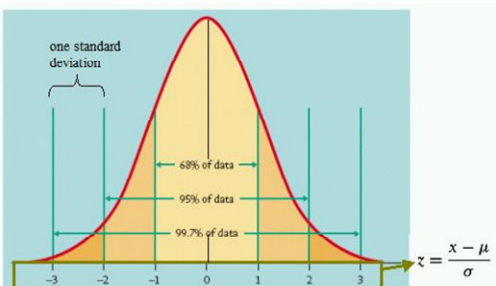
When we studied statistical significance, we dissected studies that claim pizza consumption reduces cancer risk.



CBS News Poll: January 11, 2010:
President Obama's Approval: 46%
Results Come From SRS of 1216 Adults.
Margin of Error: +/- 3%, Confidence Level: 96%



Goal: Estimate Percent of Adult Americans Who Approve of the President's Job Performance
Survey Results: 560 Adults Surveyed Approve
Estimate: $p = 560/1216 = 0.46$



Critical Values

For a given confidence level C , use the critical value z^* to determine how many standard deviations about the mean include $C\%$ of the distribution.

Confidence Intervals for a Proportion of a Population

Recall: the Confidence Interval is always:

Estimate $\pm$ Margin of Error

The Margin of Error for p is:

$\pm z^* SE$

The Confidence Interval is:

$p \pm z^* SE$

Compound Interest

December 2, 2009

1 Simple Interest

Simple interest is interest earned when the interest rate is only on the principal.

Suppose you deposit \$1000 in a savings account earning 5% simple interest per year. Fill in the following table:

End of Year	Account Balance
1	
2	
3	
4	
5	

Can you figure out a formula for the account balance as a function of time?

2 Compound Interest

Compound interest is interest earned when the interest rate is applied to the account balance including previous interest earned.

Suppose you deposit \$1000 in a savings account earning 5% interest compounded per year. Fill in the following table:

End of Year	Account Balance
1	
2	
3	
4	
5	

Can you figure out a formula for the account balance as a function of time?

Victor's background includes economics, law and physics. This allows him to bring several applications into the classroom.

Compound interest is arguably the most important application in the Algebra 5 curriculum.

Below, Victor and the students maximize a profit function for a firm facing a downward sloping, linear demand curve.



One of the challenges that Victor embraces is trying to help students develop the ability to "think mathematically" and solve unfamiliar problems, such as those in the third section of the handout to the right.

Inverse Functions

October 7, 2009

1 One-to-One Function

A one-to-one function is a function that satisfies the HORIZONTAL LINE TEST. For every output, there is exactly one input. In a function, f , no horizontal line intersects the graph of f more than once.

The following table represents a function whose inputs are x and whose outputs are y . For each table, answer the following questions: (i) Is f one-to-one, and if not give an example of an output that comes from more than one input, and (ii) How do the table determine x as a function of y if f is one-to-one? Is the answer function f^{-1} ?

2 Inverse Functions

For each of the following questions, solve for x . Does the result define x as a function of y ?

1. $y = \sqrt{x}$

2. $y = 3x - 8$

3. $y = 2x^2 - 1$

4. $y = \sqrt{x^2 + 1}$

5. $y = \sqrt{x^2 + 1}$

6. $y = \sqrt{x^2 + 1}$

7. $y = \sqrt{x^2 + 1}$

8. $y = \sqrt{x^2 + 1}$

9. $y = \sqrt{x^2 + 1}$

10. $y = \sqrt{x^2 + 1}$

11. $y = \sqrt{x^2 + 1}$

12. $y = \sqrt{x^2 + 1}$

13. $y = \sqrt{x^2 + 1}$

14. $y = \sqrt{x^2 + 1}$

15. $y = \sqrt{x^2 + 1}$

16. $y = \sqrt{x^2 + 1}$

17. $y = \sqrt{x^2 + 1}$

18. $y = \sqrt{x^2 + 1}$

19. $y = \sqrt{x^2 + 1}$

20. $y = \sqrt{x^2 + 1}$

21. $y = \sqrt{x^2 + 1}$

22. $y = \sqrt{x^2 + 1}$

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24. $y = \sqrt{x^2 + 1}$

25. $y = \sqrt{x^2 + 1}$

26. $y = \sqrt{x^2 + 1}$

27. $y = \sqrt{x^2 + 1}$

28. $y = \sqrt{x^2 + 1}$

29. $y = \sqrt{x^2 + 1}$

30. $y = \sqrt{x^2 + 1}$

