

CMC South 2016

5 Fantastic Activities for Stats

Jared Derksen

There is a secret activity in this packet. You will be part of an experiment soon! Please do **NOT** read ahead in the packet or you will be excluded from the experiment. That would spoil the fun!

If you do not have a laptop with you, you will enjoy our first experiment more if you download Google Sheets onto your smartphone or tablet.

Handouts from today's session can be downloaded at: mrmathman.com/talks

If you have any further questions, feel free to send me an email at:
jared@mrmathman.com

Rolling Down the River

Name: _____ Date: _____

A farmer has just cleared a new field for corn. It is a unique plot of land in that a river runs along one side. The corn looks good in some areas of the field but not others. The farmer is not sure that harvesting the field is worth the expense. He has decided to harvest 10 plots and use this information to estimate the total yield. Based on this estimate, he will have a projection for how big his paycheck will be this harvest.

A. Method Number One: Convenience Sample

The farmer began by choosing 10 plots that would be easy to harvest. His house was on the west side, so he sampled plots 1 through 10. Go to bit.ly/rollingriver and find the yields in bushels per acre of these 10 plots. Find the mean of the 10 plots.

Mean of the convenience sample: _____

1	11	21	31	41	51	61	71	81	91
2	12	22	32	42	52	62	72	82	92
3	13	23	33	43	53	63	73	83	93
4	14	24	34	44	54	64	74	84	94
5	15	25	35	45	55	65	75	85	95
6	16	26	36	46	56	66	76	86	96
7	17	27	37	47	57	67	77	87	97
8	18	28	38	48	58	68	78	88	98
9	19	29	39	49	59	69	79	89	99
10	20	30	40	50	60	70	80	90	100



Since then, the farmer has had second thoughts about this selection and has decided to come to you (knowing that you are an AP statistics student, somewhat knowledgeable, but far cheaper than a professional statistician) to determine the approximate yield of the field.

You will still be allowed to pick 10 plots to harvest early. Your job is to determine which of the following methods is the best one to use – and to decide if this is an improvement over the farmer's original plan.

Rolling Down the River

B. Method Number Two: Simple Random Sample

Use your calculator or random.org to choose 10 plots to harvest. Continue to use bit.ly/rollingriver to find the yields.

Mean of the simple random sample: _____

C. Method Number Three: Stratified Sample

Consider the field as grouped in vertical columns (called strata). Using your calculator or a random.org, randomly choose one plot from each vertical column and continue using bit.ly/rollingriver to find the yields.

Mean of the stratified random sample: _____

D. Conclusions

1. Place your means from the simple random sample and the stratified random sample on the class graphs.
2. Compare the two distributions. (Center, shape, spread)
3. Did both methods estimate the true mean accurately? How does this compare to the convenience sample? Describe the importance of randomization to reduce bias.
4. How does the variability of the methods differ? What does this difference tell you about choosing a sampling method?

Rolling Down the River

Teacher notes:

- After the class makes the class graphs, you need to control the pace. Have students complete question two. Then discuss. Mark the population mean on both graphs (the population mean is 170.5 bushels/acre with a standard deviation of 17.7 bushels/acre). An alternate to physical class graphs is having students enter their data points into software and analyzing the data in a more sophisticated setting.
- These data were based on realistic corn yields in bushels per acre. The data was generated using a random normal generator with a standard deviation of 10. The first two columns used a mean of 150, followed by 160, 170, 180, 190 in groups of two columns.
- You can access the original Google Sheet that was used to create the student sheet at bit.ly/rollingriverteacher . On the student sheet, the data is hidden in columns W & X where most students will not notice that they have access to a complete census.
- These links to the Google sheets are created so that the user is forced to create a new copy of the sheet in their Google account. This is necessary because an entire group of people cannot edit a sheet simultaneously. If you want to save a version of these sheets for yourself, feel free. If you want to share a modified version with your students that will force them to open a new copy simply create a Google share link (with editing privileges) and then remove the end of the URL that includes the word “edit” and replace with the word “copy”. A handy trick!
- Many thanks to Carolyn Doetsch, Peter Flanagan-Hyde, Mary Harrison, Josh Tabor, and Chuck Tiberio. They created this activity in the summer of 2000 at NCSSM. I modified their idea in only small ways.

1	11	21	31	41	51	61	71	81	91
2	12	22	32	42	52	62	72	82	92
3	13	23	33	43	53	63	73	83	93
4	14	24	34	44	54	64	74	84	94
5	15	25	35	45	55	65	75	85	95
6	16	26	36	46	56	66	76	86	96
7	17	27	37	47	57	67	77	87	97
8	18	28	38	48	58	68	78	88	98
9	19	29	39	49	59	69	79	89	99
10	20	30	40	50	60	70	80	90	100

144.8	152.9	154.4	178.6	178.5	183.1	198.1	189.7	186.6	186.5
151.1	133.1	164.3	155.8	155.4	163.8	192.4	203.6	188.9	204.9
156.9	156.6	166.5	153.5	169.3	168.2	177.7	165.1	189.7	175.2
143.1	153.5	174.8	162.9	163.7	164.8	186.4	175.4	192.4	194.1
156.2	135.4	157.2	160.3	181.8	156.2	185.5	164.6	182.1	187.6
132.4	165.1	145.3	172.4	171.9	179.4	197.3	176.7	190.1	195.7
161.9	163.2	161.6	164.2	170.3	166.5	186.9	167.7	192.6	202.4
127.1	159.7	171.3	165.9	173.7	151.9	186.4	153.4	184.6	180.7
142.2	136.2	162.9	161.5	176.4	183.1	186.4	185.3	191.1	178.6
154.8	150.2	146.1	176.2	154.3	167.9	172.8	205.6	195.1	185.9

Matching Boxplots, Histograms, & Summary Statistics

(By Sandi Takis, adapted from *Activity Based Statistics*)

Revised and reformatted by Kathy Fritz, Plano West Senior High School

- Copy the following pages on cardstock. They can be laminated to preserve them for future use.
- Have students work with a partner to match the boxplot, histogram, & summary statistics
- Provide each pair with a page to record the matches

Answers:

Histograms	Boxplots	Summary Statistics
I	A	5
II	C	1
III	D	8
IV	G	3
V	E	2
VI	F	6
VII	B	4
VIII	H	7

To try an electronic version of this activity, go to student.desmos.com and enter class code PZ4PJ.

To use this activity with your students, you can access the teacher version at bit.ly/statmatch



Mean

50.08

Median

50

Standard Deviation

33.625



Mean

40.76

Median

38

Standard Deviation

21.171



Mean

67.8

Median

74

Standard Deviation

17.049



Mean

49.4

Median

50

Standard Deviation

20.265



Mean

68.72

Median

71

Standard Deviation

30.019



Mean

47.88

Median

41

Standard Deviation

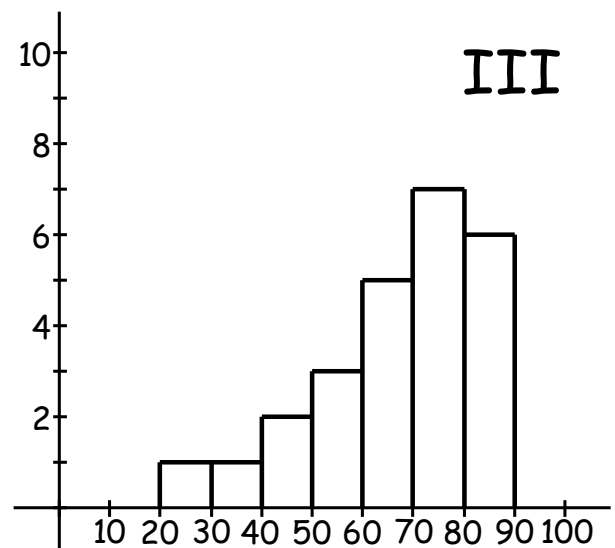
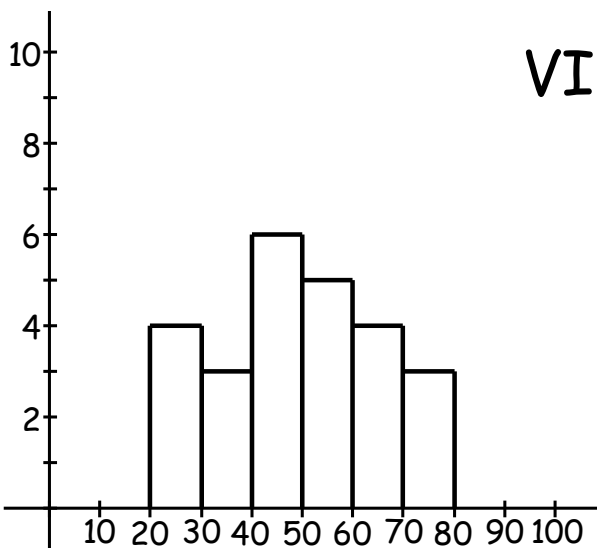
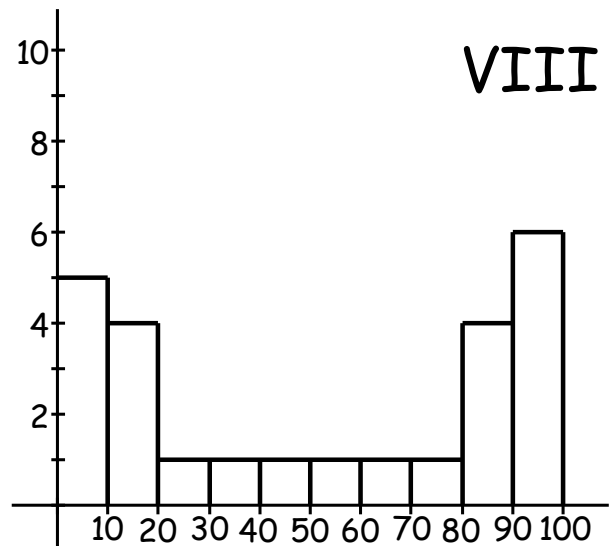
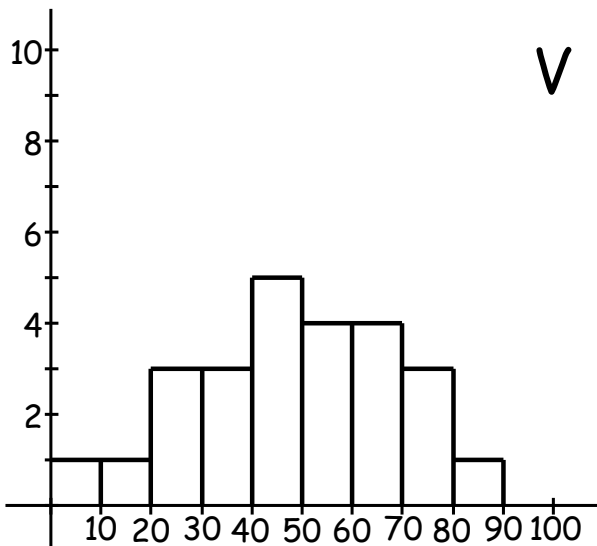
19.020

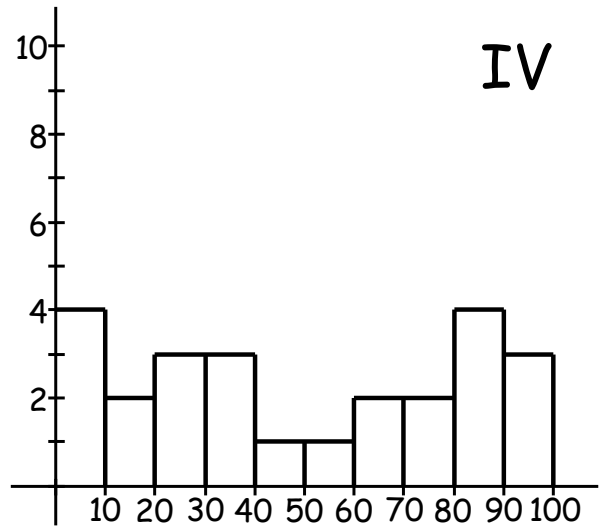
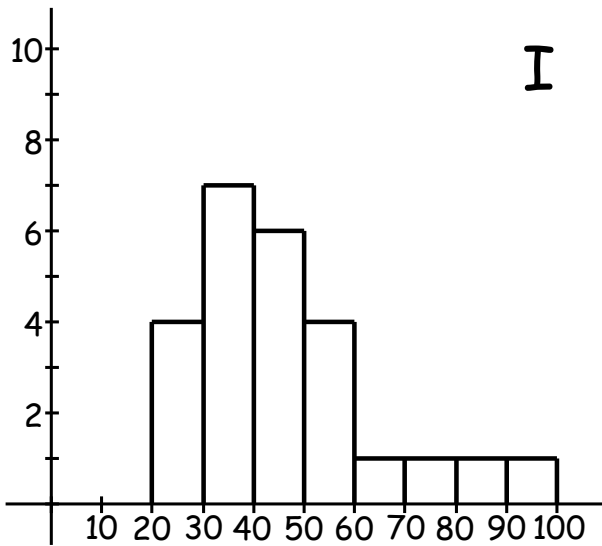
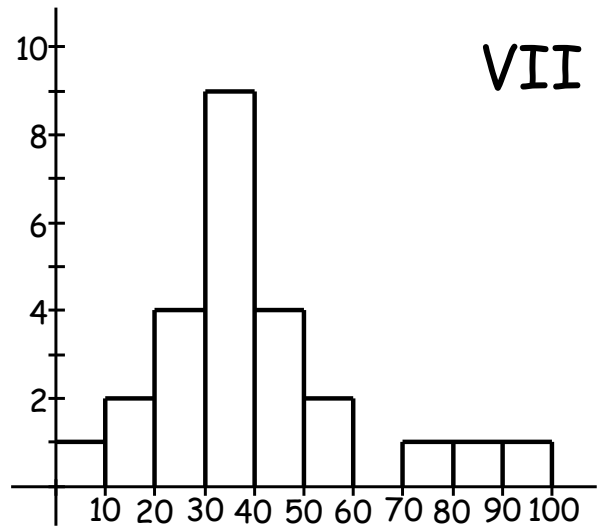
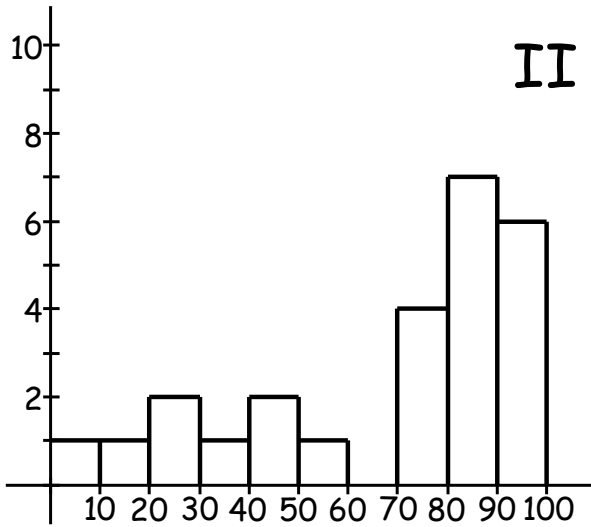


Mean
52.32
Median
53
Standard Deviation
38.297

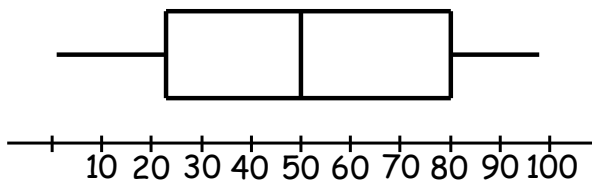


Mean
50.32
Median
50
Standard Deviation
16.163

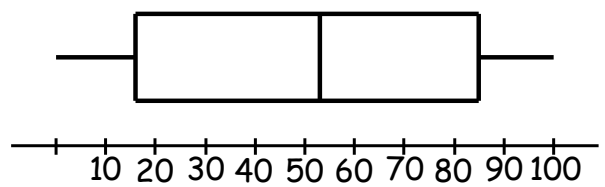




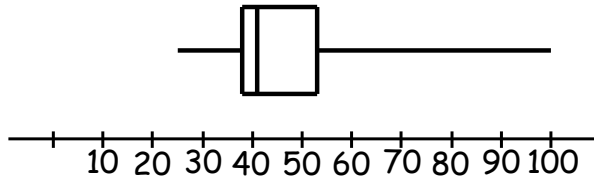
G



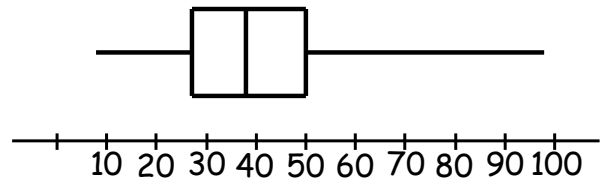
H



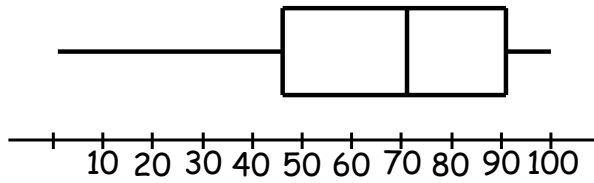
A



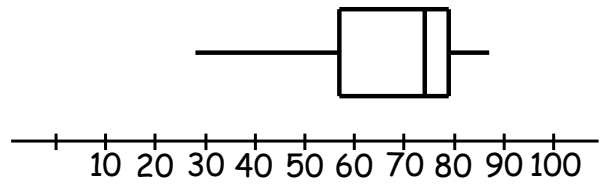
B



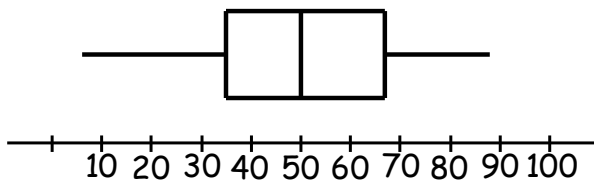
C



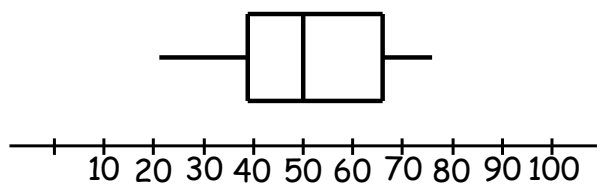
D



E



F



Answer as many questions as you can in 3 minutes based upon what you remember. Your results are anonymous. All answers are exactly one or two words. You may abbreviate, as long as it is clear what you are writing.

1. What color was the truck that crashed into the mailbox? _____
2. How many hikers were lost in the blizzard? _____
3. Where were the two ducks? _____
4. How many arrows did Benjamin shoot before hitting the bullseye? _____
5. Where did Gary wear a plaid flannel shirt? _____
6. What color was the bench on which the orange kitten slept on? _____
7. The stamp was omitted from an envelope containing what? _____
8. How many tulips remain? _____
9. What direction are the storm clouds drifting? _____
10. What did the chocolate candy have in it besides peanuts? _____
11. Where is it 6 o'clock? _____
12. What toilet is clogged up again? _____
13. What color was the candle wax that got all over the kitchen counter? _____
14. In what part of the house were the five shirts hanging? _____
15. What card were there five of in the deck? _____
16. Who was surfing porn on the internet at school? _____
17. Where did two planes collide on the runway? _____
18. What is quite expensive to produce? _____
19. Whose favorite holiday is Easter? _____
20. The dead body of what animal was full of maggots? _____

The Memory Game

Directions

Over the next few minutes, we will test your memory. This is NOT an IQ test. When the game is over, you will have an opportunity to compare your memory with others in the room, however, it is not a competition among individual students.

The teacher will read the class a list of statements. You may not write anything down and you may not talk or communicate with anyone. After the list of statements is complete, everyone in the class will silently attempt to answer a series of questions regarding the statements you just heard. Answers will be marked either right or wrong, and your answer sheet will be anonymous.

You will be handed the list of questions as soon as the teacher finishes reading the statements. For the next few minutes, your task is to **LISTEN** quietly and **TRY NOT TO FORGET** what you hear.

The Memory Game

Directions

Over the next few minutes, we will test your memory. This is NOT an IQ test. When the game is over, you will have an opportunity to compare your memory with others in the room, however, it is not a competition among individual students.

The teacher will read the class a list of statements. You may not write anything down and you may not talk or communicate with anyone. After the list of statements is complete, everyone in the class will silently attempt to answer a series of questions regarding the statements you just heard. Answers will be marked either right or wrong, and your answer sheet will be anonymous.

You will be handed the list of questions as soon as the teacher finishes reading the statements. For the next few minutes, your task is to **LISTEN** quietly. The **BEST TECHNIQUE** for short term memory recall is to **VISUALIZE** whatever you hear. For example, if the teacher says “the red motorcycle was in the barn,” you might picture a red motorcycle in a barn. **ATTEMPT TO VISUALIZE IN YOUR MIND all of the statements the teacher reads!**

Teacher Instructions for The Memory Game An in-class experiment and hypothesis test

What you'll need in advance: Copies of both sets of directions, enough of each for $\frac{1}{2}$ of the group. Also, enough copies of the questions for the entire group. You'll need one set of "statements." Students will only need a pen or pencil, and a couple will need calculators to compile results at the end of the game.

1. Using a recognizable method of random assignment, break the class down into two "teams" of equal size. Physically separate the two groups so that, ideally, they can not see the other team's papers. Remember, if they realize early that they are receiving different directions, the experiment is blown.

2. Inform the class that in order for the game to "work," they must be absolutely silent for the next five minutes. Tell them that they are playing a competitive memory game and we'll see at the end which team "wins." This also serves that in case someone realizes the two sets of directions are different, they are forced to remain silent about it.

3. Distribute the directions to "team 1" and "team 2." Randomly determine which group receives which set of instructions: control (no training) and treatment (memory training). You need to be subtle about the distribution of papers so they don't notice that there are two different sets of directions. I usually have the two stacks on top of each other, and deal them out, first from the top of the pile, then from the bottom.

If possible, you can get a third party to distribute the directions. As long as you don't see which group has which set of directions, then you can create a double-blind situation, though this is often hard to pull off in a high school classroom.

4. Read the 25 statements. I usually stand in the center of the front of the room and stare straight ahead, making certain not to make eye contact with any one student or group. DO WHAT IT TAKES TO KEEP THEM QUIET, HOWEVER!

5. Distribute the questions. Everyone gets the same questions, so this distribution is accomplished by whatever method is efficient. Keep the question sheets face down until everyone receives them.

6. Say start. They have 3 minutes to answer as many as possible.

7. Stop the writing. Now they can talk. Have them exchange papers with a member of their own team, and read off the answers. All answers are marked either correct or incorrect, there is no partial credit or middle ground (e.g. the answer is "Korea," answers of North or South Korea are simply marked wrong). Have them count the number correct and write that score (0-20) on the top of the page.

8. Have a couple of members of each team grab calculators and calculate sample mean, standard deviation, and n for each group. Have them put these statistics on the board. There will be some exuberance when the “winning team” is realized. In 16 trials of this game at four different schools with three different teachers, (as of 5/30/2009), the treatment group have always won.

9. **NOW** – inform the class that they have just been the subjects of a controlled experiment (maybe double blind). See if they can identify the treatment (the different directions). Have them come up with a null, alternative, etc.... At this point, there’s a lot you can do pedagogically depending on the outcome, and what you want to stress (experimental design, inference testing, etc.) and how much time you have.

10. Have them run the two-sample t-test to compare the means and write a conclusion in context.... Again, this is left to your own pedagogy.

My history: Though I have only had a statistically significant (at $\alpha = .05$) result a handful of times, the treatment group has never failed to “win” the game. I have 16 trials of data, and growing. I briefly used this result to mention the sign test to my classes this year (2009), though it’s not part of the curriculum, so I didn’t dwell on it.

Send me your results and your feedback!!! If it’s ever published, you’ll get a mention, I promise. THANKS & GOOD LUCK WITH THE MEMORY GAME!

Adam Shrager:
ashrager@hvrnsd.org

AP Statistics Instructor
Hopewell Valley Central High School, Pennington NJ

Lecturer of Public & International Affairs
Woodrow Wilson School of Public & International Affairs
Princeton University, Princeton NJ

Statements for *The Memory Game*:

1. The orange kitten was asleep on the green bench.
2. Business cards are quite expensive to produce.
3. In the park there were two ducks.
4. The brown truck crashed into the mailbox.
5. Five shirts hung from the exercise bicycle in the basement.
6. She mailed him a birthday card, but she forgot to put a stamp on the envelope.
7. The dead body of the sheep was full of maggots.
8. It is 6 o'clock in Korea.
9. Easter is Rebecca's favorite holiday
10. The deck of cards had five nines in it.
11. Gary prefers shrimp to steak.
12. 10 of my tulip bulbs flowered, but the deer ate 8 of them
13. The upstairs toilet is clogged up again
14. His television set did not receive channel 7
15. At church last week, I got a splinter from the pew.
16. 4 hikers were lost in the blizzard. They are presumed dead.
17. The web sites Brad was surfing at school contained pornographic images.
18. After shooting 3 arrows, Benjamin hit the bull's-eye of the target.
19. The chocolate candy has walnuts and peanuts in it.
20. Gary wore a plaid flannel shirt to the store.
21. Two planes collided on the runway in the Canary Islands.
22. The storm clouds overhead seem to be drifting Southwest.
23. Yellow candle wax got all over the kitchen counter.
24. The evil super villain threatened to release death spores in the city's water supply
25. Michele's foot was bleeding because she cut it on a piece of sharp coral.

Answer as many questions as you can in 3 minutes based upon what you remember. Your results are anonymous. All answers are exactly one or two words. You may abbreviate, as long as it is clear what you are writing.

1. What color was the truck that crashed into the mailbox? brown
2. How many hikers were lost in the blizzard? 4
3. Where were the two ducks? In the park
4. How many arrows did Benjamin shoot before hitting the bullseye? 3
5. Where did Gary wear a plaid flannel shirt? to the store
6. What color was the bench on which the orange kitten slept on? green
7. The stamp was omitted from an envelope containing what? birthday card
8. How many tulips remain? 2
9. What direction are the storm clouds drifting? southwest
10. What did the chocolate candy have in it besides peanuts? walnuts
11. Where is it 6 o'clock? Korea
12. What toilet is clogged up again? upstairs
13. What color was the candle wax that got all over the kitchen counter? yellow
14. In what part of the house were the five shirts hanging? basement
15. What card were there five of in the deck? 9's
16. Who was surfing porn on the internet at school? Brad
17. Where did two planes collide on the runway? Canary Islands
18. What is quite expensive to produce? business cards
19. Whose favorite holiday is Easter? Rebecca
20. The dead body of what animal was full of maggots? sheep

Russian Egg Roulette

Materials

- YouTube video (search: Jimmy Fallon egg roulette)
- 12 eggs
 - 8 hard-boiled (or empty)
 - 4 raw (or filled with confetti)

The Plan

Students watch Jimmy Fallon video.

Ask students about probability of getting a raw egg. Students should note that choosing eggs without replacement results in changing probabilities.

Display eggs and find a challenger! Play game, stopping to ask probabilities at each draw. Or have a recorder keep tallies on the game and find probabilities after game is concluded.

Adventurous teachers can consider getting messy!

- Go outside to a grassy area (so your janitor doesn't hate you).
- Bring a trash bag to cover student clothing.
- Wear an old t-shirt.
- Make sure school journalism is alerted so you can share your sacrifice in the school newspaper/yearbook!

Snapping Experiment A Matched Pairs Experiment

- All students raise their dominant hand in the air.
- Teacher asks for all students with their birthday on an even day to switch hands.
- Students snap as fast as they can for 10 seconds.
- Switch hands and repeat.
- Data is placed on the board.
- Discussion points:
 - Why not just split the class in half for each treatment?
 - Why is it important to randomize the order of the treatments?
 - Why examine the differences instead of the speeds of each hand?
 - What value should we compare the differences to? Why?
 - What is the appropriate summary statistic?
 - What would be an appropriate graph?
 - How would you be able to tell if the differences were more than chance variation?