

# How Did Teaching Introductory Statistics Get To Be So Complicated?!?

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## Experienced Reflections of an ~~Old~~ Statistics Teacher

- Teaching statistics used to be EASY
  - I lectured, they listened (or not...)
  - Took about 45 minutes to prepare for a one hour class—consisted mainly of concocting an example with simple numbers to illustrate the calculations
  - On exams, as long as I asked questions like “Calculate the...” or “What is the value of...” and let students use a calculator and a formula sheet, most did fine
  - Fondly referred to as “Lecturing at the Bored”

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Sure, we made some assumptions...

Such as

If students can

- construct a histogram of sample data
- do a t test
- compute the equation of the regression line

then SURELY they must understand

- the concepts of variability and distribution
- what statistical significance means
- what least squares means

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## Life was Beautiful

Until the **TROUBLEMAKERS** came along!



And others!

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## What did the troublemakers do??

They had the nerve to suggest

**CHECK YOUR ASSUMPTIONS**

The response: **NO PROBLEM.**  
We can do that ...

Well, nothing has been the same since!

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This talk is an attempt to share three lessons learned after being shocked by the troublemakers out of a state of complacency and denial!

First Lesson Learned:

- Check your assumptions.
- Assess conceptual understanding, and do it in a timely manner—not just at exam time.

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### Illustrating the point...

- Please read the short passage on traxoline and then take the short three question quiz.

From "Clickers in the Classroom" by Douglas Duncan, attributed to Judy Lanier

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### What is traxoline?

- A chemical byproduct of combustion
- A gasoline additive
- A new form of zionter

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### Where is traxoline monotilled?

- San Luis Obispo
- Ceristanna
- West Wyomia
- France

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### How is traxoline quaselled?

Traxoline is quaselled by gristerlating large amounts of fevon and then bractering it.

3 out of 3! Feeling pretty smart, aren't you!

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### Mid-talk exam

In your own words, describe why traxoline will be important to our future.

How is traxoline like common table salt?

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### Side Note on Clicker Technology

- Keeps students interested and engaged, but...
- Need to ask the right kind of questions and at the right time
- Great for immediate feedback and assessment of understanding

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### Assess for understanding

- Old style: What is the value of  $r^2$ ?
  - 100% correct
- New improved: What is the value of  $r^2$ ? Interpret this value.
  - 95% correct
- Oops: What proportion of the variability in house price is explained by the relationship between price and house size?
  - 20% correct

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### Lesson 1 Modified: Do-overs!

- Playing games with my nephews when they were young taught me about do-overs. "That was a mess-up—it's a do-over."
- If you do classroom assessment, you have to be willing to react.
- Lesson 1 Modified:
  - Check your assumptions.
  - Assess conceptual understanding, and do it in a timely manner—not just at exam time.
  - Don't be afraid to declare a classroom do-over!

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### Second Lesson: Basketball

- Statistics students are like the people at a basketball game...



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### Spectators

- Some are interested and appreciative
- Some are bored and disinterested



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### Referees

- May not be expert players, but they
  - Know the rules
  - Recognize bad behavior and can call a foul when they see it



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### Players

- Varying skill levels
  - Recreational to professional
  - Have to know the rules, but also have to be able to handle the ball



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We can characterize introductory statistics courses by whether they are attempting to prepare

- Statistics “spectators”
- Statistics “referees”
- Statistics “players”

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### Statistics Spectators

- Goal: someone who is interested and excited and who enjoys “watching”

Statistics appreciation type course—appreciate the “beauty of statistics” or at least the usefulness of statistics

But, if unsuccessful ...



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### Statistics Referees

- Need to know the rules
- Need to be able to critically evaluate the work of others
- Don’t necessarily need the skills of a player

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### Statistics Players

- Need to know the rules in order to recognize good and bad behavior
- Also need to be able to produce good behavior
- Skill levels will vary, but some “ball-handling” skills needed

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### How would you characterize the intro stat course you teach most often?

1. Preparing statistics spectators
2. Preparing statistics referees
3. Preparing statistics players

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1 2 3

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### Lecturing—Making a Free Throw

From [www.tutorials.com](http://www.tutorials.com)

The objective is to find your most comfortable way of holding and shooting the ball by following some guidelines. Take it slow, avoid the temptation to move back and fling the ball up. It’s even a good idea to start halfway to the free throw line (about 10 feet out) to get the feeling down first, then step back. A free throw doesn’t require that you jump. Hold the ball in your fingers, not your palm, and take a few dribbles to get the rhythm of the ball.



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### Step 1: Position the ball

- Shooting a basketball is all in the fingertips and wrist snap.
- With the dominant hand:** take the ball and pull your wrist to a cocked back position until it shows wrinkles. Next, bring in your dominant elbow as far under the ball as feels comfortable and lift the ball to a comfortable place at a height around your shoulders.
- With the nondominant hand:** hold the ball with your fingertips on the nondominant side like a bookmark. Bring your nondominant elbow up about 8 inches (20 centimeters) from your body.

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### Step 2: Bend your legs

- Crunch down and bend your legs, as if you are ready to jump.
- Your feet should be shoulder's width apart--if you drew an imaginary line from your shoulder joint to the ground, your feet would be directly in that line. Then point your dominant foot at your target and about four inches in front of the other foot.

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### Step 3: Extend and shoot

- Just before you shoot, bend your knees a little more, then extend. Shooting involves bringing the ball up at the same time as the legs extend, and then releasing the ball just before the top of the motion. To propel the ball, snap the right wrist, and point your fingers (called a "follow through") where you want the ball to go. Try to get the ball to spin backwards on its way.

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### Is this an effective way to prepare

- Spectators?
- Referees?
- Players?
- Is this how a basketball coach would train a novice player???
- Can't prepare statistics players this way either...

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### Lesson 2 Modified

You can't prepare a spectator and then expect them to play!

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### Accumulating evidence (its those troublemakers again!)

- Students need to be
  - Active
  - Engaged
  - Focused

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### So let's do an activity

In keeping with the basketball theme, I will show you a brief video clip of students passing a basketball. Some students are wearing white shirts and some are wearing black shirts.

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Your task: Count the number of times a player in a white shirt passes the ball to another player in a white shirt.

This requires concentration, so please don't disturb others while the video is playing. Please be quiet and don't discuss your answer with others when the video is finished.

Your cooperation is appreciated.

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### Video

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### How many times did a player wearing a white shirt pass the ball to another player wearing a white shirt?

1. 15
2. 16
3. 17
4. 18
5. 19
6. 20
7. 21

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1 2 3 4 5 6 7

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### And by the way, how many gorillas did you see in this video?

1. 1
2. 2
3. 3
4. I didn't see any gorillas

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1 2 3 4

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### But it was SO obvious I didn't think I needed to point it out...

- How could this happen???
- You were active
- You seemed engaged
- You were focused
- You were trying
- Well, you were all those things, but you weren't focused on what was important

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### Which is how I learned Lesson 3

Don't let your students miss the gorilla!



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### Gorilla Wisdom

- It is really important for students to be active and engaged, but that isn't enough!
- Need to help students focus on what is important.

This is one of the biggest challenges that we face as statistics teachers

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### Lessons Learned (with the help of those troublemakers)

- You can't prepare a spectator and then expect them to play: facilitate discovery and engagement if you want to prepare players
- Assess understanding and don't be afraid to declare a classroom "do-over"
- Don't let students miss the gorilla—help students to focus on what is important through what you ask them to do, what you assess, and what you value

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