

STATCRUNCH GROUPS: EMBEDDING ACTIVITIES FOR EXPLORATION AND ASSESSMENT

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Abstract

Engaging students in the learning process is essential to deep conceptual understanding of statistical topics. This paper illustrates a way to incorporate active learning in an online environment using activities that involve a student worksheet, a video lesson, an applet, and an assignment.

Introduction

Although I have been teaching statistics for over a decade, teaching statistics online was a completely new challenge that I took on during the summer semester 2011. In the classroom, my strength is my ability to actively involve students in the learning process. Over the years, I have developed countless lessons and activities designed around inquiry based learning. In the online environment, I was completely at a loss on how to effectively incorporate these same activities.

The activities that I design for my traditional classes follow the guidelines set forth by the *Guidelines for Assessment and Instruction in Statistics Education (GAISE) College Report* [1]. In particular, they incorporate active learning, conceptual understanding of statistical ideas, real data, and technology. The students in the classroom are assessed on their understanding of the material by verbal and written response to the underlying concept being considered. For a course delivered through distance learning, assessing the understanding of statistical concepts that are presented and reinforced using an applet was more difficult. Therefore, I have developed applet activities that are delivered through MyStatLab [2] and use a StatCrunch [3] group page that involve a student worksheet, a video lesson, an applet, and an assignment that mimic the activities in class.

For each activity, the students are asked to print a worksheet that is a blueprint of the lesson. Students then watch a short video explanation of the objectives of the lesson and write the answers to the questions that are addressed in the video on the worksheet for their personal notes. Next, they are directed to the applet activity that uses StatCrunch and possibly data posted on the StatCrunch group page. There are detailed steps on the worksheet that walk the student through the applet. While running the applet, students are asked to answer questions on the worksheet related to their experience. Again, these worksheets serve as written notes for the students to reference later when studying the concept. Finally, the students are asked to complete an assignment presented through MyStatLab to receive credit for completing and understanding the activity.

In this paper, I present the format of the lessons created, an example of lecture notes that follow the video, an activity, and an assessment of the activity.

Format

Each of the lessons is designed based on a section in the textbook. Some sections are covered as a whole while others are divided into parts. The reason for dividing the section into parts is to keep the time needed to complete any one task between 30 minutes to one hour. The textbook used is the 12th Edition of *Elementary Statistics* [4]. I have integrated my lessons with the publisher's links so that the students are required to go through my directions and lessons prior to attempting any assignment. Each of the lessons includes the objectives and requirements. Links to the class lecture notes and worksheets are given in the outline of the lesson while the video is embedded. *Figure 1* is an example of the outline of a section that incorporates two parts; the first part involves a video lesson and the second part has the student continue on their own to discover other properties of the binomial distribution.

Figure 1: Outline of an online lesson with links to documents.

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Section 5.4: Parameters for Binomial Distributions

Part 1

Objectives:

- Find the mean and standard deviation of a binomial probability distribution.
- Find the range of usual values for a binomial probability distribution.
- Determine if a given value is unusual.
- Interpret a usual/unusual value.

Requirements:

- Print the lecture notes: [Section 5.4](#)
- Open a blank workbook in StatCrunch, go Applets > Simulations > Coin Flipping. Let the Probability of Heads = 0.5 (this means that we have a fair coin where we expect to have 50% head and 50% tails in the long run). Let the Number of Coins = 50. We will be simulating tossing 50 fair coins. Please leave the Number of Heads ≥ 1 . We will change this on the second part of this lesson. Please note that the video illustrates an older version of this applet. There is very little difference in the old and new applets. Also, the old applet was able to be saved and shared on the group page. This is no longer the case; you now need to open it in a workbook in StatCrunch.
- Watch the video lesson available below. Are your lecture notes in hand and applet open?
- Watch the short homework video (less than 5 minutes) available below. This illustrates how to work an exercise.

Part 2

Objectives:

- Understand the relationship between the value p and the shape of the distribution of a binomial distribution.
- Determine what happens when the sample size increases and the value p remains the same.
- Understand the Law of Large Numbers.

Requirements:

- Print the lesson: [Chapter 5 Binomial Simulations 2014](#)
- Open a blank workbook in StatCrunch, go Applets > Simulations > Coin Flipping. All the directions for the four activities on this part of the lesson for section 5.4 are outlined on the lesson.
- Do the homework for Section 5.4 after completing both Parts 1 and 2 of this lesson. This homework is available in the link for Chapter 5. Please note that the first assessment is based on the video lesson in Part 1 and the activities in Part 2. **Please do this first! You can take this assessment only once, please do not attempt this assessment until you have watched the video, completed the activities, and taken personal notes.**

The videos are embedded into the lesson plan at the bottom of the page. Therefore the students simply have to press play and the video plays. In the past, I had links to the videos, but I have found that embedding the videos is a better choice for total student involvement. *Figure 2* is an example of what a student will find in their lessons.

Figure 2: Embedded video



Lecture Notes

The lecture notes are designed as a worksheet so the students can follow along with the video and add their own personal notes. The students are expected to be creating a personal book of notes by three whole punching the notes and putting them in a three-ring binder for reference later. The notes are very detailed and include explicit directions on how to use StatCrunch. Any data that is used in the video lessons is available on the StatCrunch group site. Students are instructed to open the provided data and work along with the lesson. The notes also include definitions, theorems, tables, important facts, etc. Any concept that is important for success in the course and future courses are included in the notes.

Video

The videos were created using Smart Technology or Jing. Both of these software packages do screen captures which allows the user to capture anything that can be pulled up onto the computer monitor. Using screen capture opens the door to teaching the software interactively and illustrating how to use an applet. Once the videos are created they are uploaded to YouTube, set on an unlisted setting, and then embedded into the MyStatLab lesson for the section. The students will watch the lesson and add notes to the lecture notes while the concepts are explained. *Figure 3* presents an example of some notes from a video that are being completed as the students work along.

Figure 3: Lecture notes being presented in a video.

Name: _____

Recall the requirements for a binomial distribution are:

- The procedure has a **fixed** number of trials (this is denoted by n).
- The trials are **independent** (meaning the outcome on one trial does not affect the outcome on the next).
- Each trial must have all outcomes classified into **two** categories (commonly referred to as **success** and **failure**).
- The probability of a success is the **same** in all trials (this is denoted by p).

1. Suppose you flip a fair coin 50 times and record the number of heads on each flip. Please open the shared applet: Flipping a Fair Coin 50 Times

a. What is the fixed number of trials?

$$n = 50$$

b. How many outcomes are possible on any one trial?

2 head / tail

c. What is the probability of head on any one trial?

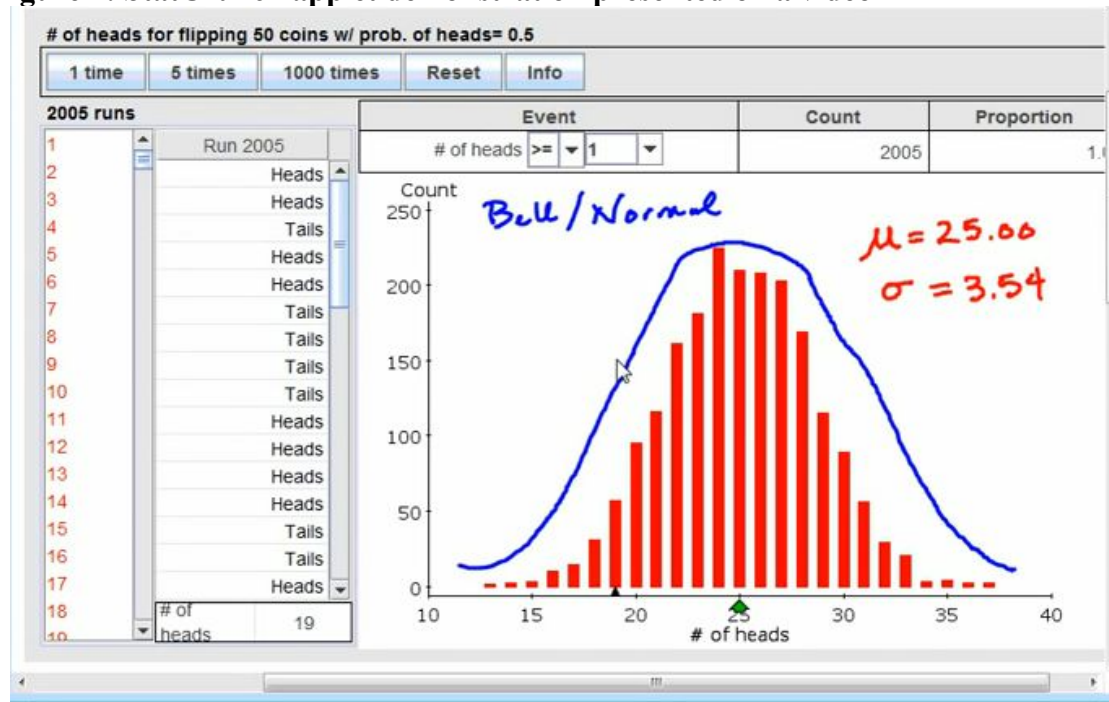
$$p = 0.5$$

d. Are the trials independent of one another?

Yes!

The applet used in *Figure 4* can be found on StatCrunch and is in the video lesson illustrated in *Figure 3*. The students are directed on how to use the applet prior to investigating ideas by themselves in the activity that follows.

Figure 4: StatCrunch applet demonstration presented on a video



Activity

The activities are an extension of the lesson that is typically completed in a classroom setting under my direction in a traditional course. In the online environment, students are completing these activities independently, so it is necessary that the instructions on the video are clear and concise and the written instructions on the extension activity are perfect. Students need to feel success in these activities. This motivates them to perform at their own personal best. A student works harder when they are sent down a path of discovery that they know they will be successful at as long as they follow the directions. The satisfaction expressed by my students when they comprehend these activities is positive. *Figure 5* illustrates a part of one of the outlined activities on the extension for binomial distributions. This is not the entire activity, but demonstrates the details given in the instructions.

Figure 5: Activity example

3. In this activity, you are going to simulation flipping a weighted coin (a coin that results in 30% heads in the long run) for n times. As you increase the sample size, n , you will investigate how this increase affects the shape center and spread of the distribution. Furthermore, you will determine what this change has on the proportion of samples that result in 20% or more heads.
 - a. Using the Coin Flipping Applet again, let the Probability of Heads = 0.3, the Number of Coins = 5, and the Number ≥ 1 . Select Compute! Select 1000 runs at least twice to get 2000 samples of 5 coin flips. Select the **green** arrow on the x-axis to show the mean and standard deviation of the binomial distribution. Then complete the first row in the table below.
 - b. Keep the Probability of Heads = 0.3, but change the Number of Coins = 50, and the Number ≥ 10 . Select Compute! Select 1000 runs at least twice to get 2000 samples of 50 coin flips. Select the **green** arrow on the x-axis to show the mean and standard deviation of the binomial distribution. Then complete the second row in the table below.
 - c. Keep the Probability of Heads = 0.3, but change the Number of Coins = 500, and the Number ≥ 100 . Select Compute! Select 1000 runs at least twice to get 2000 samples of 500 coin flips. Select the **green** arrow on the x-axis to show the mean and standard deviation of the binomial distribution. Finally complete the third row in the table below.

p = 0.3	Shape	Mean	Standard Deviation	Proportion of samples with at least 20% heads.
n = 5				
n = 50				
n = 500				

- d. When the probability of heads is 0.3, what happens to the shape of the distribution as the sample size increases?
- e. For each of this situations, did the mean approximately equal the expected number of heads = mean of the binomial distribution = np ?
- f. For each of this situations, did the standard deviation approximately equal the standard deviation of the binomial distribution = \sqrt{npq} ?

Assessment

With proper assessment of these activities and video lessons, students strengthen their understanding of the material and built confidence in their ability to discover other statistical concepts on their own. Without assessment, students typically decide to discontinue participation. Therefore, an assignment covering these activities and the video lessons is created that is based on two types of questions; questions specific to the lesson and conceptually based questions. The questions are presented in the lesson so the students can record their answers and comments while working through the activity prior to completing the assignment. If a student needs to revisit the activity while engaged in the assessment, they can certainly reopen it. The assessments are presented through MyStatLab while the applets and data are shared on StatCrunch. *Figure 6* gives two examples of questions that are specific to the video lesson. To answer these questions correctly, a student must watch the video and take notes. The questions in *Figure 7* address the concepts presented in the extension activity. These questions were given in the directions for the activity.

Figure 6: Questions specific to the video lesson

1) For the unprepared student who took the 75 question multiple choice midterm, how many answers would we expect the student to get correct?

- A. 8
- B. 22
- C. 45
- D. 15

2) What is the range of usual values for the number of questions correct for the unprepared student?

- A. Between 15 and 45 correct.
- B. Between 8 and 22 correct.
- C. Between 12 and 18 correct
- D. Between 45 and 75 correct.

Figure 7: Conceptually based questions

8) When the probability of heads is 0.3, does the sample size change the overall shape of the distribution?

- A. No, the distribution is bell shaped regardless of the sample size.
- B. Yes, as the sample size increases, the distribution is less skewed and more bell shaped.
- C. No, the distribution remains skewed regardless of sample size.
- D. Yes, as the sample size increases, the distribution becomes more skewed and less bell shaped.

9) As the sample size increased when $p = 0.3$, what happened to the proportion of samples with at least 20% heads? Was it easier or more challenging to get a sample with at least 20% heads?

- A. The proportion increased; it was easier to get a sample with at least 20% heads.
- B. The proportion decreased; it was easier to get a sample with at least 20% heads.
- C. The proportion increased; it was more challenging to get a sample with at least 20% heads.
- D. The proportion decreased; it was more challenging to get a sample with at least 20% heads.

Conclusion

Many students are opting to take statistics through the distance learning format. These students are missing the in-class discussions and activities that focus on simulations and active learning. To foster this deeper conceptual understanding of statistical ideas in the online environment, activities that involve the student must be designed in such a way that students can easily access the materials, understand the objectives, and be assessed on the conceptual understanding. The assessments should give immediate feedback so the student is clear on his/her misunderstanding as necessary. These lessons have proven to be essential to student understanding and involvement. Having this systematic format of printed notes, video, student involvement, and assessment forces the student to truly participate in the online community and receive an enriched educational experience. The success rate of my online course has increased since I began incorporating these lessons and organizing them in a structured manner. In the future, I plan to continue to expand and improve these lessons as well as create more lessons to address students' misunderstandings of statistical concepts.

References

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