

# Using On-line Teaching As An Opportunity To Flip The Classroom, Gamify Course Content, and Build Infrastructure That Can Be Used Off-Line Too\*

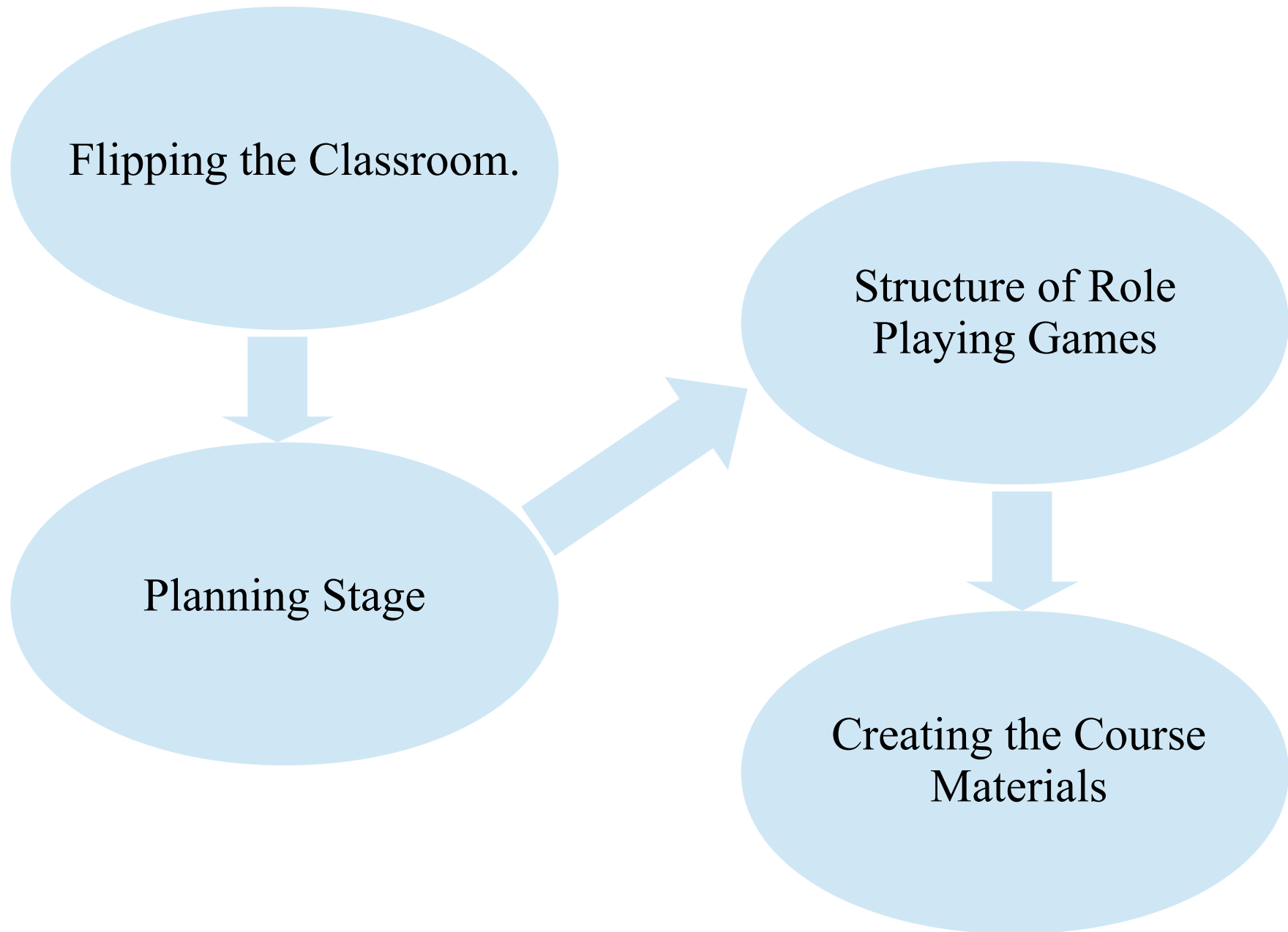
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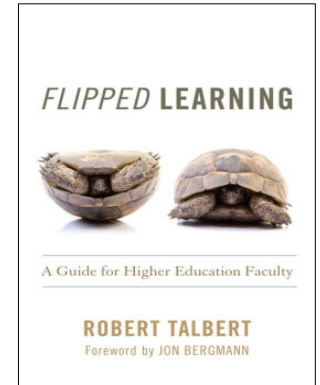
\* Submitted title

## Overview



# Flipping the Classroom

- Flipping the classroom:
  - Swap in-class and out-of-class activities.
  - Out of classroom:
    - Initial learning,
    - Lower order cognitive tasks (e.g., remembering, understanding).
  - Into classroom:
    - Practice, application, and skill building,
    - Higher order cognitive tasks (e.g., analyzing and evaluating).



# Flipping the Classroom

- My course:
  - For me this primarily meant "de-lecturing" the course.
  - More material than students can learn during class time alone.
  - Lectures dis-insentivize reading before class.
  - An increasing proportion of students came to the course with unrealistic expectations regarding graduate coursework.
- Your course:
  - What do you want to accomplish?
  - Is a flipped classroom likely to accomplish it?
  - What key features does your course require?
  - What other changes would a flipped classroom require?

## Planning Stage: Identifying Learning Objectives and KSAs

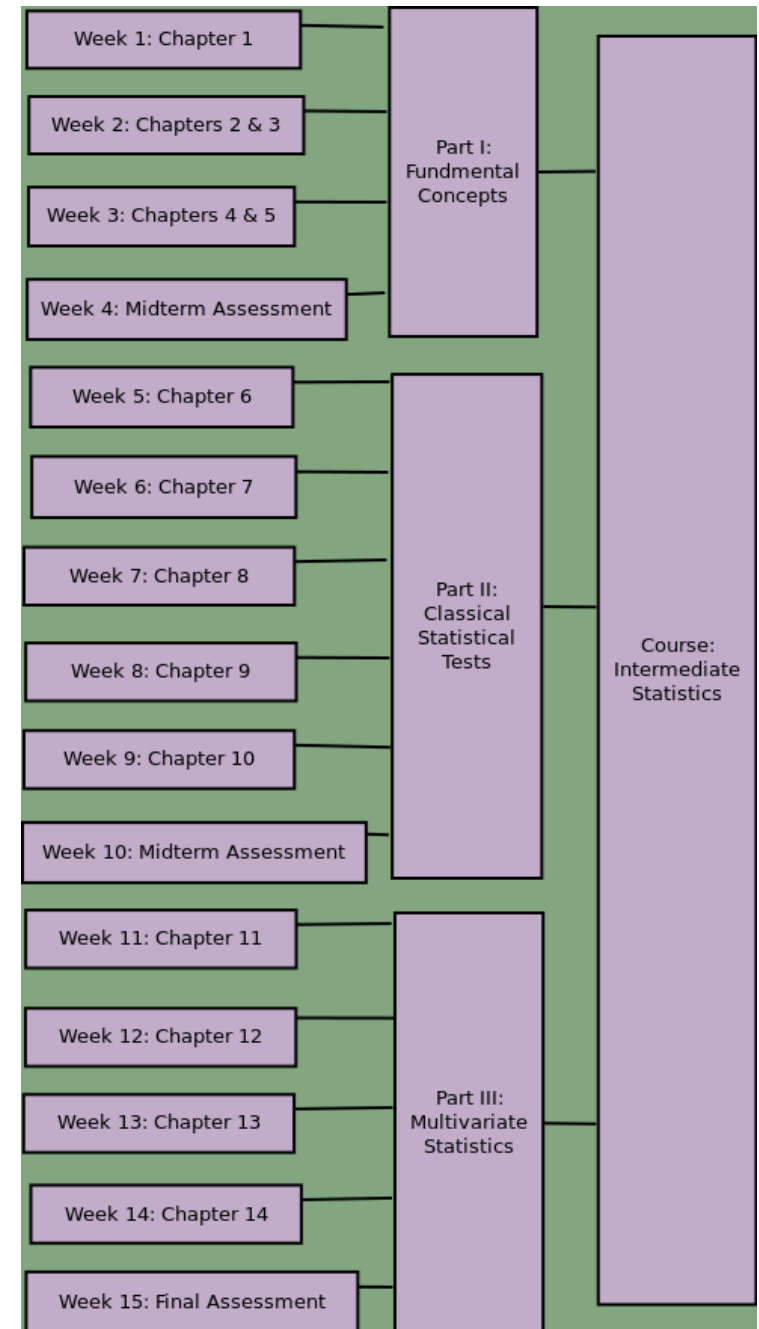
- Learning objectives can be very abstract.
  - However, learning is very specific and concrete.
  - So, it can be helpful to break down learning objectives into something more granular.
  - KSAs: knowledge, skills and abilities.
- It can also be useful to think explicitly about what is excluded.
  - You do not want to accidentally include things implicitly
  - Think about where your course fits in the broader curriculum.
  - What are students expected to bring to the course?

## Planning Stage: Identifying Learning Objectives and KSAs

- My course:
  - At every level of instruction, first statistics courses assume no prior knowledge of statistics.
  - There is a subsequent course on data analysis, so that does not belong in my course.
- Learning goals:
  - Students should understand fundamental concepts.
  - Students should have the foundation needed to learn new statistical methods.
  - Students should be able to apply statistical thinking to novel problems.
  - Students should be able to critically evaluate research reports.

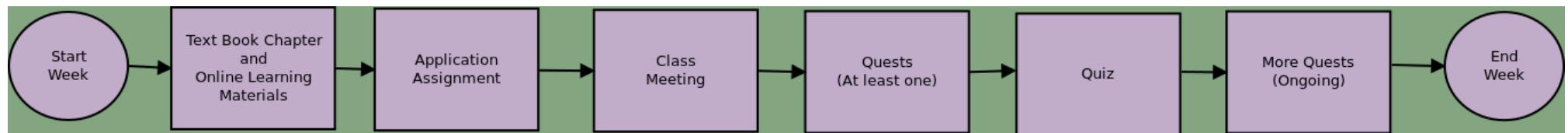
## Planning Stage: Mapping out the course

- An entire course is too big to work with.
- Mapping out the course helps in two ways.
  - It breaks the course into smaller pieces that can be revamped one at a time.
  - It provides a framework for considering each piece in the context of the rest of the course.
- My course:
  - Three parts
  - Grades returned after each part
  - Assessments are not cumulative



## Planning Stage: Mapping out learning process

- What is the sequence of tasks and work flow for student learning?
  - Is there sufficient time for each task?
  - Is there flexibility for scheduling tasks throughout the week?
  - How does each task build on the earlier ones?
- One goal of a flipped classroom is to motivate learning ahead of the class meeting.
- My course:
  - Application Assignments due before class.
  - These were graded very leniently, primarily on completeness.
  - However, they provided an early opportunity for feedback
    - Both for me and for students





# Planning Stage: Grading

- My course:
  - I treated each quest holistically (pass/fail)
  - Required 42 out of 56 (4 quests for each of 14 chapters)
  - Extra credit for extra quests
  - Also count Application Assignments and quizzes

- Text explanation of grading
- Table of letter grades
- Grade calculator

The screenshot shows a web browser window with the following content:

**Grading**

Our final grade comprises your Application grade, your Quiz grade, your Quest grade for each of the three parts of the course, and your Power Up. The Application grade counts each of the 12 application assignments as 1 point and equals the sum of these divided by 12. The Quiz grade counts each quiz as 1 point, drops the 2 lowest, and divides the sum by 10. The Quest grade for each part is the number of quests that you completed. You are required to complete 15 quests for Part 1 and for Part 2, and 12 quests for Part 3. Your final grade is based on the proportion of the required quests completed in each part. Specifically, I calculate  $\min(N, F) / N$  where  $N$  is the minimum required quests (15 or 12) and  $F$  the number of completed quests for that part of the course. The Power Up is calculated based on extra quests beyond those required. Here, I calculate  $\max(0, F - N)$  for each part of the course, add them together, and divide by 14. As such, you can never lose points with a negative Power Up, it will never fall below zero. The Power Up reflects the extra quests you complete beyond those required for each part of the course.

Your Numeric Course Grade is calculated from the above scores as follows:  $(.25 * \text{Application}) + (.25 * \text{Quiz}) + (.17 * \text{Part 1 Quests}) + (.17 * \text{Part 2 Quests}) + (.16 * \text{Part 3 Quests}) + (.05 * \text{Power Up})$ . In words, Applications and Quizzes both count 25% of your grade, required Quests count for 50%, and you can earn up to 5% extra credit by completing extra quests.

I will use the following chart to convert Numeric Course Grades to Letter Course Grades. On the proportion (not percent) scale, I will round .xx5 and above up and anything below .xx5 down.

Letter Grade	Numeric Course Grade
A	.95-1.00
A-	.90-.94
B+	.85-.89
B	.80-.84
B-	.75-.79
C+	.70-.74
C	.65-.69
C-	.60-.64
F	.00-.59

You can use the below grade calculator to estimate your course grade. This requires a web browser that supports JavaScript. For ease of use, I have expressed Applications Grade and Quizzes Grade as a percentage, so you need to multiply by 100. The Quest scores are counts of completed quests. So, for example, if you enter 100, 100, 15, 15 and 12, you get a grade of 100% with no Power Up.

**Grade Calculator**

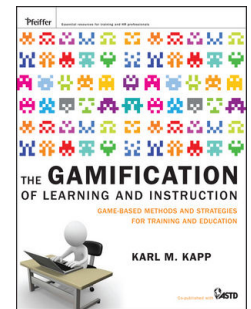
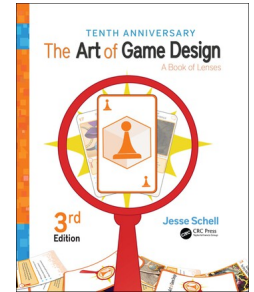
Applications Grade	100 %	Base Grade	73.82000000000001 %
Quizzes Grade	68.333333 %	Power Up	1.79 %
Part I Quests	20	Numeric Course Grade	75.60000000000001 %
Part II Quests	13	Letter Grade	B-
Part III Quests	0		
<input type="button" value="Clear"/>		<input type="button" value="Calculate"/>	

## Planning Stage: Grading

- Your course:
  - Many of the same considerations as grading an in-person lecture course.
  - Form follows function.
  - What purpose do the grades serve?
    - Motivation (consider that gamification may absorb some of this)
    - Selection (how does your course fit into the curriculum?)
    - Credentialing (levels of competence represented by each grade)
  - Find a balance between
    - Specificity: grades that optimally distinguish different levels of achievement.
    - Simplicity: grading system that is easy for students to grasp easily.
      - Students need to understand the grading system in order...
        - to be motivated by it
        - to make good choices
  - Students who feel in control of their grades will likely be less anxious about their grades.
  - Mechanical grading reduces adversarial relationship with students.
    - You do not give grades, students earn them.

# RPG game structure: Ontology

- Role Playing Games (RPGs) offer a shared reference point.
  - Vocabulary
  - Concepts
  - Expectations
- Ontology:
  - Avatar:
    - Player's role in game
    - Can be first-person or over-the-shoulder
  - Quest sponsors:
    - Typically non-player characters (NPCs)
    - Typically only offer one quest at a time
  - Quests
    - Medium sized tasks
    - Quests vary in difficulty
    - May involve sub-tasks
    - May divide between storyline quests and side quests
    - Appropriate terminology for any game setting (not just medieval fantasy)



## RPG game structure: Ontology

- My course:
  - Student is a statistical consultant.
  - 4 quest sponsors offer 1 quests per chapter:
    - Mayor,
    - Health Commissioner,
    - Police Chief,
    - Schools Chancellor
  - One quest typically involves answering 12 questions.
- Your course:
  - How long should a quest take?
  - How many quests should a student complete?
  - How long should a student have to complete a quest?

## RPG game structure: Metaphysics

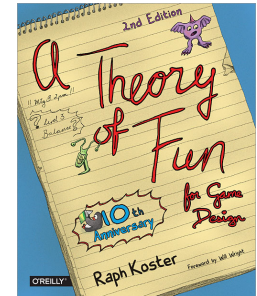
- Quest completion:
  - Quest status is typically incomplete or complete.
- Multiple attempts:
  - Avatars can accrue benefits even from failed attempts.
  - However, previous attempts do not alter the quest itself.
- Quest Independence:
  - Completion of one quest can unlock other quests.
  - Quests are fixed, game events do not change quests.

## RPG game structure: Metaphysics

- My course:
  - Quest completion requires 80% correct answers.
  - Students can turn in a quest workbook more than once.
  - Students are not required to complete earlier quests in order to access newer ones.
  - However, quests only become available week by week with other course materials.
  - Each part of the course requires a certain number of quests
  - Additional completed quests counts as extra credit (called "power ups")
- Your course:
  - What is required to complete a quest?
  - How much feedback should a quest provide?
  - When can students begin a quest?

# RPG game structure: Worldmaking

- Simplicity:
  - Select details can make the world more engaging.
  - In general, avoid irrelevant details.
  - Present the world as we understand it, not as it is.
- Coherence:
  - Take time to think holistically.
  - Maintain consistency of character and style.
- Narrative:
  - A clear simple storyline makes the constituent tasks more engaging.
- You do not have to create a world from scratch.
  - Play to your strengths, draw on your hobbies and skills.
  - You could situate quests in the real world.
    - Use photos instead of illustrations (as in demo).
    - Photograph your friends costumed as quest sponsors.
    - Or hire an art student.
- Nonetheless:
  - Present a simplified version of reality.
  - Seek coherence in how different quests and elements are presented.
  - Construct a narrative to tie people and places together.



# RPG game structure: Worldmaking

- My course:
  - Fictional city surrounded by cliffs on 3 sides and water on the fourth side.
  - Quests refer to specific locations in the city such as neighborhoods, hospitals, and schools.
  - Different key locations are represented in a quest workbook by different tabs.
  - Narrative: Student arrives by ferry, visits Statistician's Guild to get started, and repeatedly visits city offices for increasingly difficult statistics quests.





## Creating Course Materials: Libre Office

- Use whatever software you feel comfortable with.
  - I like free open-source software because all students have access.
  - Since giving up Windows, I have made an effort to remove myself from the Microsoft ecosystem.



- Libre Office is a popular fork of the Open Office office suite.
  - <https://www.libreoffice.org/>
  - Open document files formats (odt, ods, odp, etc.)
- Calc spreadsheet program.
  - Spreadsheets offer a platform for interactive documents.
  - Do not require a programming language.
  - Just code formulas that the worksheet will calculate.
  - Import images just like a word processor.

## Creating Course Materials: Libre Office

- My course:
  - Used Writer (word processor)
    - Converted my lectures from Impress (presentation software) to image-rich pdf files.
  - Used Calc
    - Interactive demonstrations in instructional materials.
    - Interactive quest workbooks.
      - Self-grading.
      - Included some open-ended responses (simply graded as not blank).
      - Students saved/printed to pdf and uploaded to Blackboard.

# Creating Course Materials: Libre Office

- Learning Materials
  - Converted from lectures
  - Typically:
    - 3-4 illustrated text documents,
    - 1 spreadsheet workbook
    - 1 video
- Images from spreadsheets included in text documents
  - Green cells where students can enter values
  - Red(ish) cells where spreadsheet reports calculations
- Graphical images
  - Dynamic in spreadsheet
  - Static in pdf document

## Single Group Hypothesis Tests for Population Means

This document assumes that you have read the introduction and overview document and also the text book chapter. This document will first look at the large sample approximation using the  $z$  distribution and then look at the more exact test using the  $t$  distribution. The document concludes with consideration of one-sided and two-sided tests.

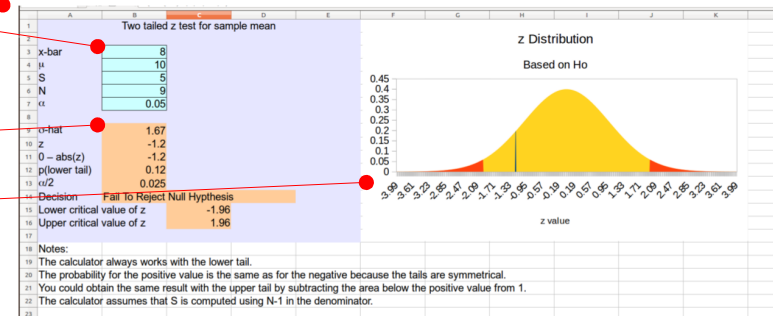


## Hypothesis Testing with the Standard Normal Distribution

The normal distribution offers a reasonable approximation of the sampling distribution of a sample mean when the sample size is sufficiently large that we can estimate the standard deviation very accurately. Our first step in testing a hypothesis involves stating the hypotheses. Here, the hypotheses involve the population mean (not the sample mean),  $\mu$ . The sampling distribution based on the null hypothesis tells us what we would expect from samples, if the null hypothesis were true. It offers a hypothetical analysis that you can think of as a conditional probability distribution, conditional on the null hypothesis being true.

Often times, researchers will test what is called a *nil null hypothesis* which states that  $\mu = 0$ . However, there is nothing about the statistics that requires a nil null hypothesis. You can use the same procedure to test other values as well.

You can obtain this probability from a table or from a spreadsheet using the NORMINV() function. You can see the same value obtained in the calculator below. We use .025 because we divide .05 evenly between the two tails.



# Creating Course Materials: Libre Office

## Comparison of Alternative Formats for Interactive Assignments

	Spreadsheet	Web Page	GUI
<b>Programming</b>	No programming. Just coding functions Much smaller learning curve (but visual basic available)	HTML & Javascript required, CSS a plus	TCL implemented through some other programming environment
<b>Saving work in progress</b>	Built in	Tricky (for security reasons)	Not built in but programmable
<b>Flexibility</b>	Have to be careful about row and column sizes	More flexible	Most flexible
<b>Multimedia</b>	Embed audio and video files	More flexible Standardized tools	Most flexible Platform dependent
<b>Distribution</b>	Users open files in compatible spreadsheet program	Any modern web browser	Either users must install same program environment or you must compile to an executable file

## Creating Course Materials: Libre Office

- Warning on compatibility between spreadsheet programs.
  - Most foolproof option:
    - Students install Libre Office
    - Available for all operating systems
    - Free
  - Microsoft Excel is largely compatible
    - Microsoft is breaking backward compatibility with some functions
    - Issues with both Microsoft Office and Microsoft Office 365.
  - Apple Numbers is not compatible
    - Far fewer functions than other spreadsheets

## Creating Course Materials: Libre Office

- Example: Self-grading question.
  - One cell for response.
  - One or more cells for prompt.
  - One cell for feedback
- Use if() function to print conditional feedback.
- Use cell references to refer to response cell.
  - e.g., B3
  - e.g., Sheet.B3
  - e.g., 'Sheet 1'.B3
- Caution: Single and double quotes are not interchangeable.

<b>Cell</b>	<b>Contents</b>
Prompt	How many boroughs does New York City have?
Response	(Empty)
Feedback	=if(B3=5,"Correct!","Try again.")

## Creating Course Materials: Libre Office

- Strategies & Tips
- Self-grading step-by-step:
  - Score each response
  - Sum scores
  - Format and present feedback
- Can debug in separate steps and then combine into one cell.
- Can hide intermediate computations in hidden columns or rows.
- If answer is zero: `=IF(AND(A1=0, A1 <> ""), 1, 0)`
  - This will avoid awarding point for no answer.
- For lenient grading:
  - `=IF(ABS(A1 - 10) < .1, 1, 0)`
  - `=IF(AND(A1 >= 9, A1 <= 11), 1, 0)`
  - Exercise caution if 0 falls within the acceptable range.
- Allow upper or lower case response.
  - `=IF(OR(A1="Y", A1="y"), 1, 0)`
- More examples in Workbook Demo.ods.

## Creating Course Materials: Libre Office

- Spreadsheet workbook design
- Plan the design to maintain consistency
  - But do not be afraid to experiment and change things
- Block out the space devoted to different things:
  - Title or other identifying information
  - Main text describing the task (instructions)
  - Main image
  - Supplementary information specific to this task
  - Questions and responses
  - Grading & Feedback (same worksheet? or separate?)
- Think about how it will look submitted
  - Spreadsheet file or pdf?
  - What information do you need to record a grade?
  - What do you want to be able to review easily?



# Creating Course Materials: Libre Office

- Vital info
- Overview and Instructions
- Sponsor illustration
- Table needed to answer questions
- Tabs for navigation

The screenshot shows a LibreOffice Writer document titled "Teaching 2020 I". The document contains a table with the following data:

Neighborhood	Day of Week	AM Calls	PM Calls
Cliffside	Weekday	17	25
	Weekend	42	57
Downtown	Weekday	75	14
	Weekend	21	6
The Shore	Weekday	9	26
	Weekend	16	33
Oldtowne	Weekday	13	38
	Weekend	23	56
<b>Total</b>			
Cliffside		141	
Downtown		116	
The Shore		84	
Oldtowne		130	
Weekday		217	

The document also includes an illustration of a woman sitting at a desk, and a navigation bar at the bottom with tabs for "Overview", "Quest 1", "Quest 2", "Quest 3", "Quest 4", and "Statistics Guild".

# Creating Course Materials: Libre Office

- Statistician's Guild
  - Name and illustration
  - Hints and tips
  - Grades and feedback
- Changes in Spring 2021
  - Student name
  - Verbal summary feedback to motivate and reward high-performing students

<b>Chapter:</b>	1	
<b>Name:</b>	A	Student
<b>Status:</b>	Quest Seeker	
<b>Quest</b>	<b>Status</b>	<b>Score</b>
1	Not complete	0
2	Not complete	0
3	Not complete	0
4	Not complete	0
<b>Total Complete:</b>		0

File Edit View Insert Format Sheet Data Tools Window Help

/media/keith/USB DISK/Teaching 2020 I

Liberation Sans 10 B I U T A B C D E F G

A1 Welcome to the Statisticians' Guild

Welcome to the Statisticians' Guild

Hints and Tips:

A statistic describes a sample and a parameter describes a population.

Samples can be random or non-random.

The categorization of studies as descriptive, explanatory or evaluation studies is useful but remember

Quest	Status	Score
1	Not complete	0
2	Not complete	0
3	Not complete	0
4	Not complete	0

Overview Quest 1 Quest 2 Quest 3 Quest 4 Statistics Guild

Find Find All Search Formatted Display String Match Case

Sheet 6 of 6 Default

- Total score

## Creating Course Materials: Libre Office

- Your course:
  - What do you want students to practice?
  - What do you want to assess?
  - Trade off:
    - Specific feedback
    - Making it too easy to work backwards from feedback to correct answer.

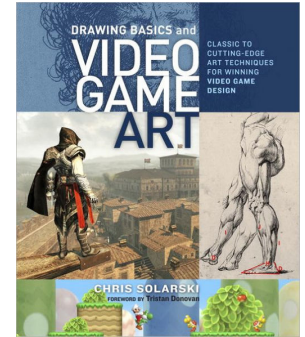
## Creating Course Materials: Krita, Gimp, Dia & R

- Krita: Digital painting program
  - <https://krita.org/en/>
  - I pair this with a Wacom tablet
  - For many uses a mouse can be sufficient.
- Gimp: Photo & image editor
  - <https://www.gimp.org/>
- Dia: Software for drawing diagrams
  - <http://dia-installer.de/index.html.en>
  - Diagrams in first part of presentation were created in Dia.
- R: Statistical computing environment
  - <https://cran.r-project.org/index.html>
  - Useful for drawing custom graphs.



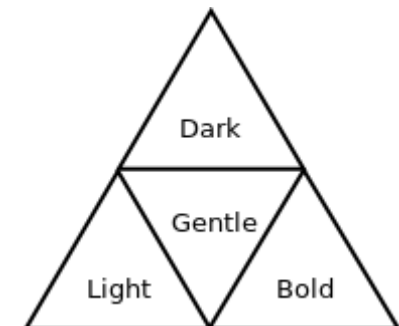
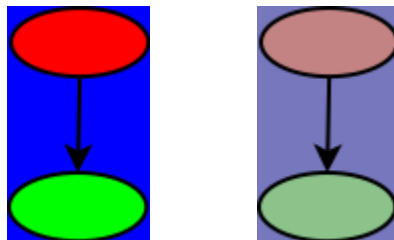
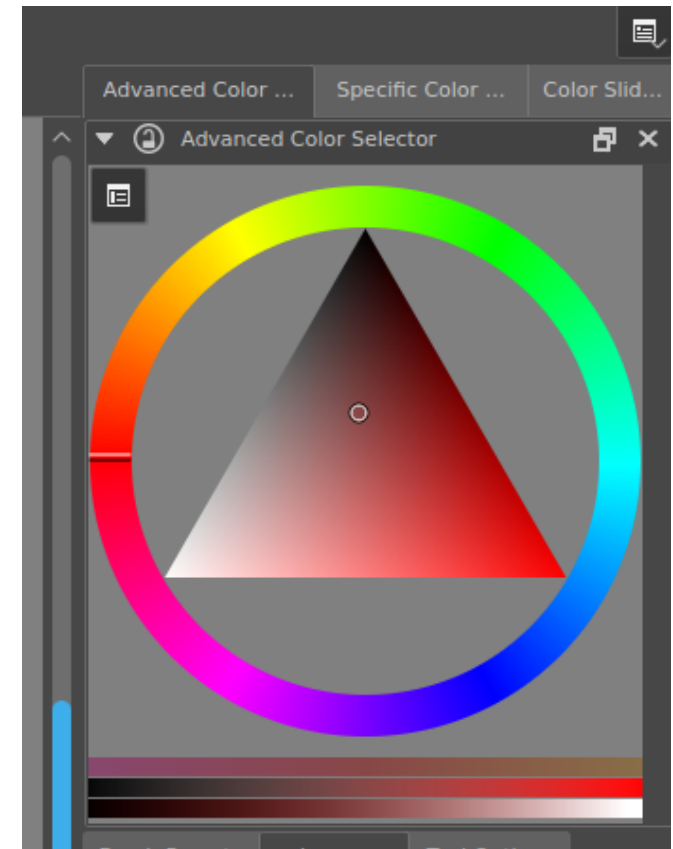
# Creating Course Materials: Krita, Gimp, Dia & R

- My course:
  - Krita:
    - concept art,
    - illustrations,
    - video backgrounds,
    - colors.
  - Gimp:
    - Writing on an image.
    - Image manipulation beyond what Libre Office supports.
  - Dia:
    - drawing diagrams (e.g., causal diagrams, flow charts).
  - R:
    - creating statistical graphs,
    - creating statistical output for quests.



# Creating Course Materials: Krita, Gimp, Dia & R

- Tip: Avoid garish saturated primary colors provided as defaults.
- Use color selector tool:
  - Dia (click More Colors)
  - Krita: Advanced Color Selector.
- Copy and Paste:
  - Dia: Copy or paste from text box.
  - Krita: Copy the hexadecimal color code from Specific Color Selector tab.
  - Then paste that color into Dia or R.
- Can be helpful to paste into Dia for consistency rather than trying to reproduce an exact color.



# Creating Course Materials: Audacity & Open Shot

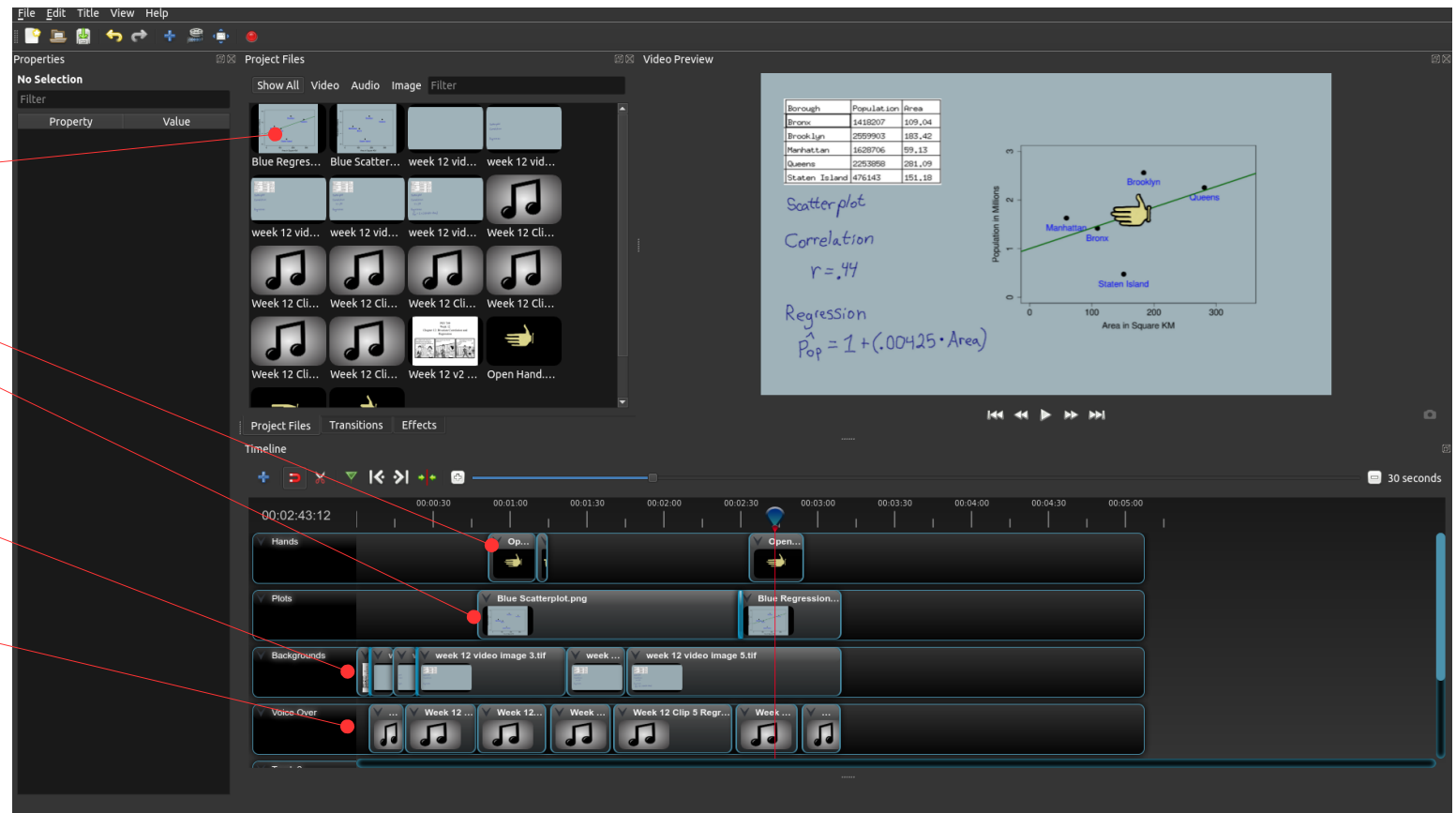
- Audacity audio recorder and editor
  - <https://www.audacityteam.org/>
- OpenShot video editor
  - <https://www.openshot.org/>
  - CUNY recently announced a cite license for another video editor.
  - Features:
    - Imports video, still images, and audio files.
    - Multiple tracks.
    - Fade and transition effects.
    - Titles
    - Easy export to multiple formats
- My course:
  - My workflow:
    - Prerecord audio
    - Edit audio into segments (e.g., 1 paragraph of script)
    - Edit video to sync to the audio.
  - Mostly short videos: Week overview or specific concept
  - White board videos using Krita images.
  - Scrolling/panning videos using Krita images
  - R images superimposed over Krita image background using same background color.



# Creating Course Materials: Audacity & Open Shot

- Video about scatterplots
  - Background color copied from Krita to R to match.
  - Whiteboard style writing and drawing in Krita.
  - Segments of voice over in separate audio files.

- Source files
- Hand animation
- Graph from R
- Background from Krita
- Voice over from Audacity (mp3)



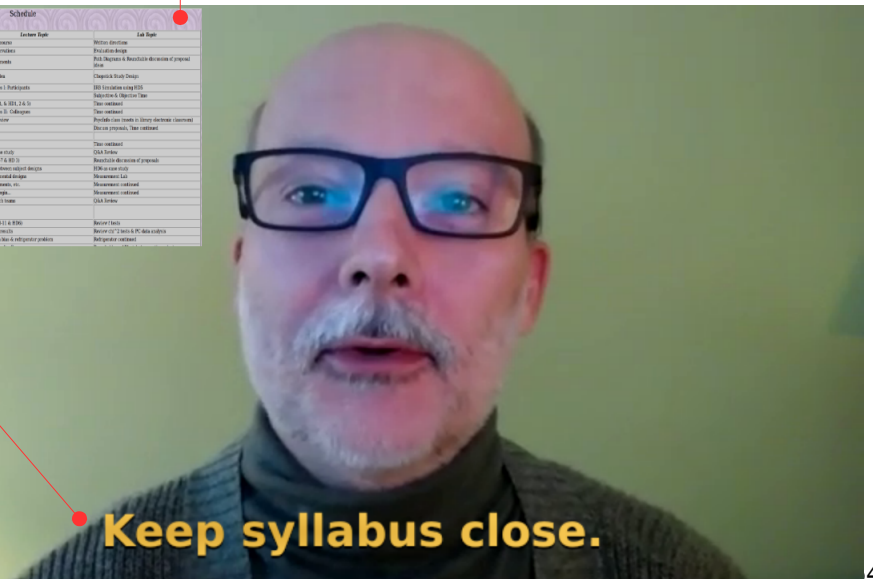


## Creating Course Materials: Audacity & Open Shot

- Your course:
  - Think about what function the videos serve in the course.
    - How do you expect students to use them?
    - When will they be watched?
    - Repeated viewings?
    - How do they fit with other instructional materials?
  - Look for examples to emulate.
    - Youtube
    - My personal inspiration: TLDR News
  - Time to create drops with experience.
    - By the end of the term, I could create a 5-10 minute video in half a day.
    - Early on, it took longer (e.g. 1.5 days)

# Creating Course Materials: Audacity & Open Shot

- Your course:
  - Start simple, you can always revise a video later.
  - Start small, you can always add more videos later.
  - Open Shot could also be used to edit talking-head videos and even long-form video lectures.
    - Easy to insert titles and graphics into video.
    - E.g, opening titles, info screen at end, news style inserts.

[illegible]

## Keep syllabus close.

## Student Survey Feedback

- N = 14
- Rated helpfulness on 5-point scale:
  - not, a little, somewhat, very, extremely

<i>Course Element</i>	<i>Percentage Responding Very Helpful or Extremely Helpful</i>
PDF Reading	57.1%
Spreadsheet Workbooks	71.4%
Course Videos	41.7%
Application Assignments	42.9%
Quest Assignments	92.9%
Quizzes	66.7%

## Student Survey Feedback

### Open ended responses:

- "I thought the worksheets and videos were sometimes more helpful than the book, but I liked the textbook as well."
- "I would say that it did not feel like a fully flipped classroom. I would have like[d] to have seen us able to ask questions on the quest about the parts that were confusing to us. Sometimes written explanations aren't as helpful for comprehending what is going on in a math problem."
- "Personally, my least favorite aspect of the course were the application assignments because often I felt like I did them wrong. But they definitely helped my understanding of the material and really got me thinking about the topic."

## Some Lessons Learned

- Course Planning:
  - Don't try to do too much all at once in terms of creating course materials.
- Course Mechanics:
  - Combine sections on Blackboard to avoid duplicate effort and allow students to interact across sections.
  - When deadlines pass, turn off submission portals. Do not rely on communication of the deadline.
  - Grade early and return feedback quickly to catch problems.
- Communication:
  - Do not be afraid to repeat yourself: Sometimes students need to hear things more than once.
  - Be prepared for a few students who do not get the concept.
- Producing Course Materials:
  - Beware of red shift software when taking screen shots.
  - Recording from a script greatly reduces paralinguistic vocalizations.

## Further Reading

Kapp, K. M. (2012). The gamification of learning and instruction: Game-based methods and strategies for training and education. New York: Wiley.

Koster, R. (2014). A theory of fun for game design (2nd ed.). Sebastopol, CA: O'Reilly Media.

Schell, J. (2000). The art of game design (3rd ed.). New York: CRC Press.

Solarski, C. (2012). Drawing basics and video game art: Classic to cutting-edge art techniques for winning video game design. New York: Watson-Guptill.

Talbert, R. (2017). Flipped Learning: A Guide for Higher Education Faculty. United States: Stylus Publishing.

## My Syllabus

<http://jjcweb.jjay.cuny.edu/kmarkus/psy769f2020.html>