Interactive Teaching in Actuarial Science

Workshop 1: Opening and Orientation

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About Me

- Diana Skrzydlo, Continuing Lecturer at the University of Waterloo

- 12 years of teaching experience

- Won teaching awards at department, faculty, and university level

- Director of the MActSc program

- Spoken at many conferences about teaching practice, write about teaching on blog

- My first time in Indonesia!

Outline of Workshops – Day 1

1. Orientation – including survey of what you already know and do
2. Levels of learning – students can understand at different depths

Break

3. Motivating students – how to get students to care about your class

Lunch

4. Planning Interactive and Effective Teaching – plan for active learning

Break

5. Developing Interactive and Effective Teaching Strategies – let's try it

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Outline of Workshops – Day 2

6. Large Classes – strategies for engaging a large number of students

Break

7. Assessment Design for Learning – how you assess is how they'll learn

Lunch

8. Inclusive Education – making your course accessible to all students

Break

9. Getting Feedback from Students – how you can improve

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Outline of Workshops – Day 3

10. Getting Students to Think Like Actuaries – creating well-rounded students who understand context

Break

11. Sharing Session – Indonesian Lecturers who studied at UWaterloo will share their experience

Lunch and check out

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Survey

- Now I want to know more about you

- Please take the time to fill out the survey provided

- I want to make this workshop as useful as possible for you

- If you're not sure what something means, ask me

Survey Results (from Online)

- Years of teaching experience: 1 – 30

- Class sizes: 4 – 100

- Courses: Prob & Stats, Financial Math, Life Cons, Data Analysis

- Familiar teaching ideas: Active Learning, Rubrics, Aligning Goals

- Common practices: Lecturing, Questions, Problems

- Assessments: Assignments, Written Tests

- Question types: Calculation, Long Answer, Short Answer

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Survey Results (from Online)

- Your learning goals
  - Get students involved/engaged/motivated in class
  - Interactive techniques
  - Deliver material efficiently and effectively
  - Strategies for large classes
  - How to assess students
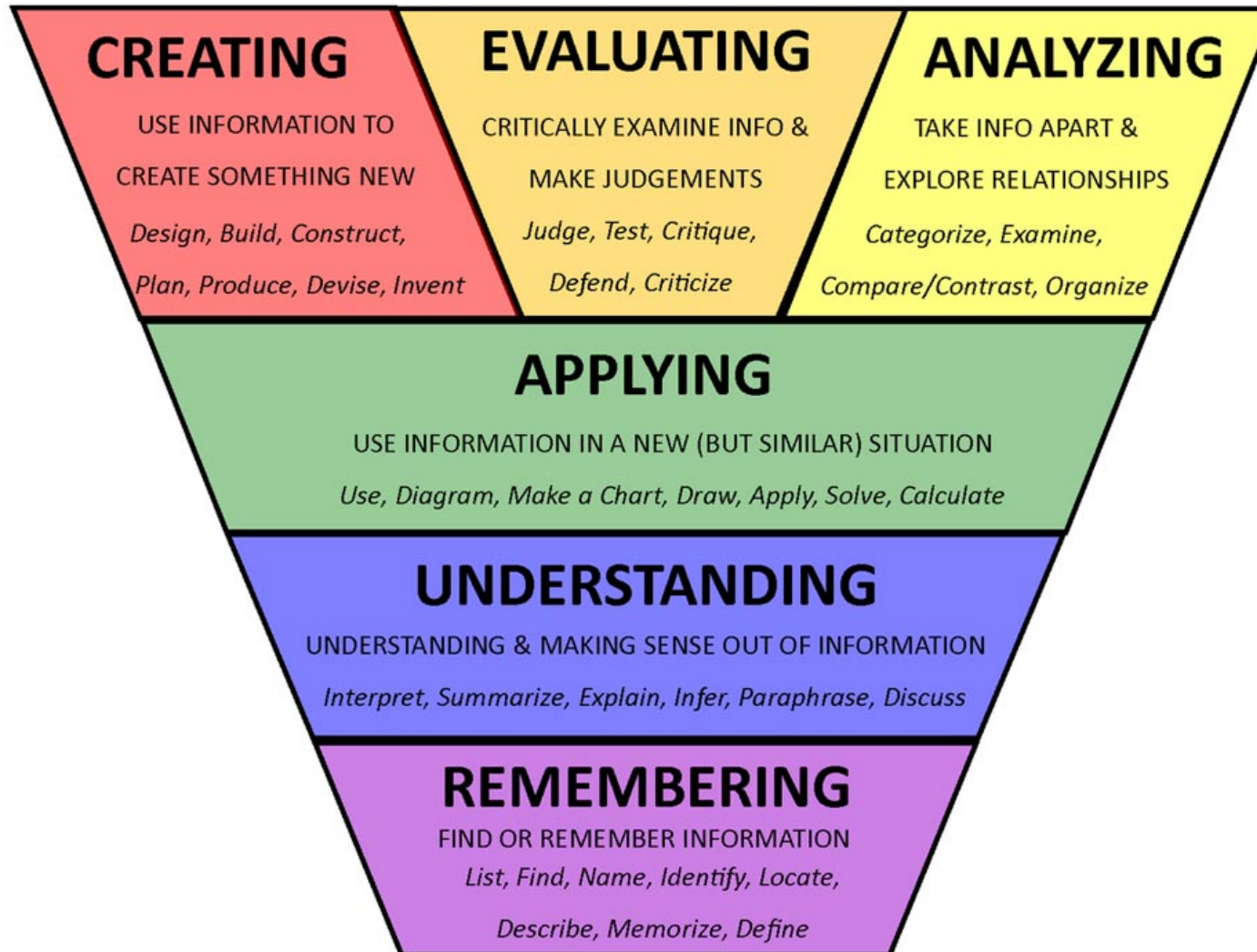 - Techniques for teaching younger generation
  - Learn from each other
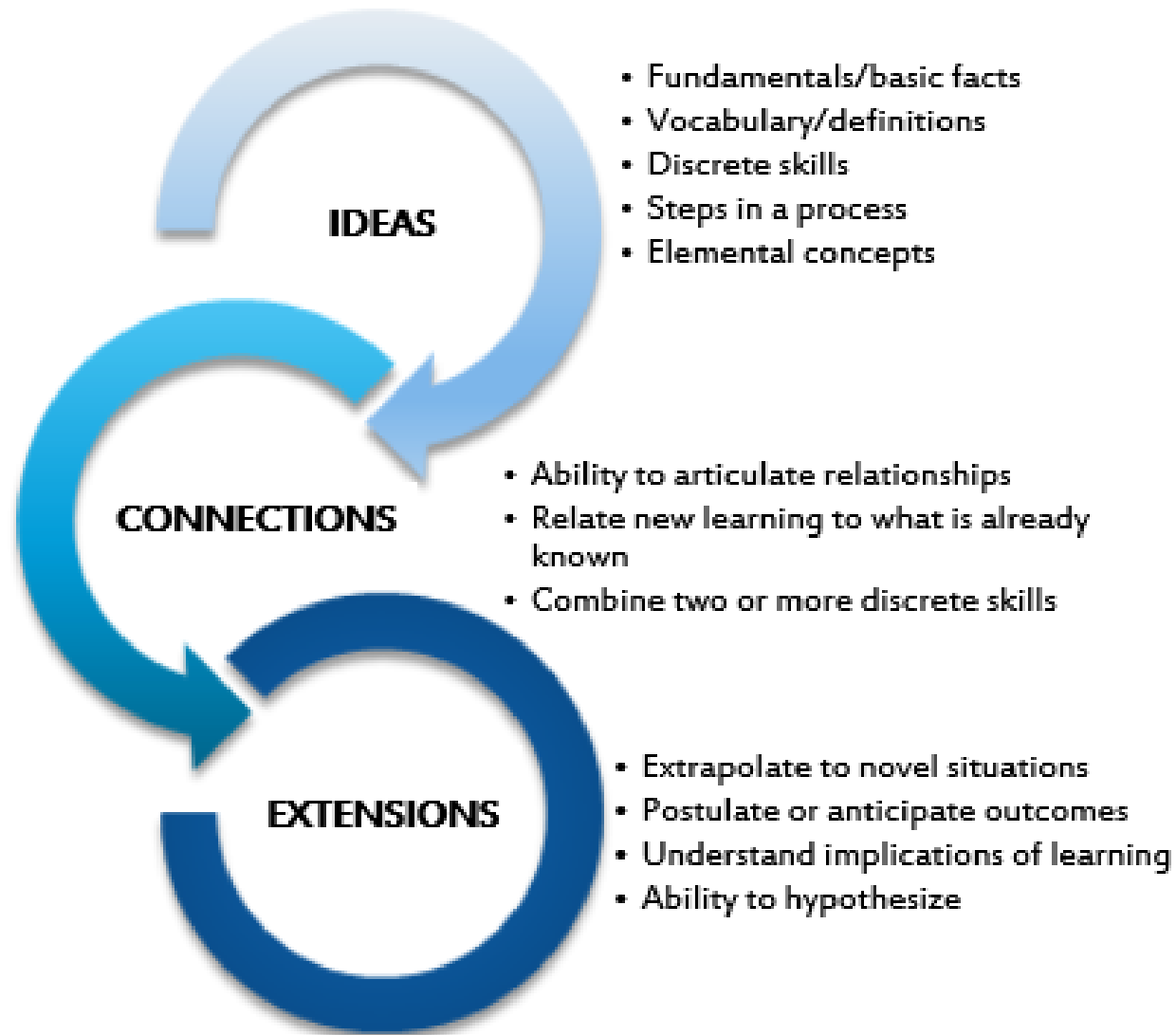
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Outline

- Learning Taxonomy/Framework

- Assessment is Curriculum

- Higher Level Question Examples

- Let's Try It

- Key Takeaways

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Learning Taxonomy – Bloom's

Learning Framework - ICE

IDEAS
- Fundamentals/basic facts
- Vocabulary/definitions
- Discrete skills
- Steps in a process
- Elemental concepts

CONNECTIONS
- Ability to articulate relationships
- Relate new learning to what is already known
- Combine two or more discrete skills

EXTENSIONS
- Extrapolate to novel situations
- Postulate or anticipate outcomes
- Understand implications of learning
- Ability to hypothesize

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The Knowledge Dimension

Factual	Conceptual	Procedural	Metacognitive
• knowledge of terminology • knowledge of specific details and elements	• knowledge of classifications and categories • knowledge of principles and generalizations • knowledge of theories, models, and structures	• knowledge of subject-specific skills and algorithms • knowledge of subject-specific techniques and methods • knowledge of criteria for determining when to use appropriate procedures	• strategic knowledge • knowledge about cognitive tasks, including appropriate contextual and conditional knowledge • self-knowledge

Assessment is Curriculum

- The way you assess your students is what they will learn to do

- Need **alignment** between your learning goals and assessments

- If you want your students to learn at a high level, you must test at a high level too

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Course Mapping

- What do you want your students to learn?

- What will you use to teach it?

- How will you test them on it?

- How does it relate to the overall course goals?

- Alignment – how much something is worth, how much time you spend on it, and how important it is should match

What Does a High Level Question Look Like?

- Remember the Bloom's verb lists

- Some examples and time for us to try it now

- We'll talk a lot more about this in session 7

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Examples

Low level – remember/understand	Mid level - apply	High level – create/evaluate/analyze
Define independence of random variables.	(give a joint pf) Are these two random variables independent?	If the joint range of two random variables is not a rectangle, what does that tell us?
Calculate the accumulated value of 1 invested for 5 years at 4% interest	If 1 is invested for 5 years at 4% interest, how much more is earned in the last year than the first?	What interest rate is used if the interest earned on 1 in the fifth year is xxx more than the interest earned in the first year?
List the conditions for a process to be considered a Discrete-Time Markov Chain	Prove that the conditions of a DTMC hold for a given process	Do you think the conditions of a DTMC would hold for this situation in real life?
Calculate the force of mortality for a given survival function	Find and graph the force of mortality for x > 0, labelling any key points	How does this force of mortality compare to the real mortality of human lives? Is this a good model?

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Let's Try It

- Write a question on a topic of your choice

- In pairs, identify the level it is testing at
  - What verbs does it use?
  - Does it bring multiple ideas together?
  - How would you improve it?

- Try to write a new question at a higher level
  - What can you remove from it?
  - Can you make it more general or more specific?

- Repeat

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Key Takeaways

- Learning happens at multiple levels and dimensions

- If you want students to learn deeply, ask deep questions

- How to teach and test at higher levels

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Workshop 3: Motivating Students

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Outline

- Motivation – Intrinsic and Extrinsic

- De-motivational Practices

- Examples of Motivation in Practice

  - Statistics for Computer Science

  - Actuarial Science Applications

  - Case Study Projects for Probability Models

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Motivation

- Motivation – *the general desire or willingness of someone to do something* – can be:

- **Intrinsic** (come from inside)

- **Extrinsic** (operate from the outside)

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Intrinsic Motivation

- *Students feel motivated to learn when:*

  1. They can make connections, building and scaffolding their knowledge
  2. They understand the importance of the material to their field of study
  3. They are curious about a subject or topic
  4. They feel they are contributing to the greater good or something bigger than themselves
  5. They feel they are capable of learning
  6. Goals seem obtainable but success isn't 100% guaranteed
  7. There is relationship between what they are learning and what is happening in their life

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Extrinsic Motivation

- *Students feel motivated to learn when:*

  1. They think they will be tested on the material

  2. They need to complete the course to move on with their degree

  3. They witness the intrinsic motivations of their teacher

  4. Rewards and punishments

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Teaching Behaviours that Decrease Motivation

Decreases Motivation	So Instead…
Repetitive lectures/class formats	Use a variety of techniques
"Busy work" assigned	Give meaningful assessments
No opportunity to participate	Include interaction in every class
Instructor is "disinterested" or inaccessible	Show your passion and knowledge for the subject and care for the students
Instructor is not respectful of students	Give and receive respect
Class is confusing	Review previous class, keep on track with learning goals

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Think About Your Course

- When you have trouble motivating some of your students

- Is the course…

  - Required, elective, or a mix?

  - Restricted to students in certain programs or open?

  - Relevant to the students' programs? Their careers? Their personal interests?

  - Related to their other courses, past or future?

Example 1 – Statistics for Computer Science

- STAT 230 is required for Math students (including Computer Science)

  - Relevance was not apparent to CS students

  - CS students significantly under-performed

- Proposed Solution: Create CS-focused section

  - Different lectures, more CS content

  - Same tests, quizzes, exams

  - Hope tailored course will improve performance

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Iterative Improvement

- Rather than making big changes at once, gradually added components

Step 1	Step 2	Step 3
• CS examples • CS-flavoured questions • Game of the Week • R workshop	• Restricted enrolment lifted • More examples • Add to course notes	• Machine Learning Idea of the Week • Stats in sci-fi • Ethical use of data

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Think About Your Course

- How can you gradually make additions to your course?

- Write down…

  - One change you can make in your course right away

  - One change you can think about making in the future

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Example 2 – Actuarial Science Applications

- Use what's in the news – external forces

- Real-world examples with no right answer

- Preparing for workplace challenges

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Inspiration for Ideas

- Partner and Friends

- Research on ActSci education

- Self-education (online course, Wikipedia)

- What's in the news

- Memes/reddit

- Popular books, games, movies

- Students themselves!

- Colleagues with expertise in the area

- Students' hobbies (ask!)

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Think About Your Course

- Who or what can you use for inspiration?

- Write down...

  - One person you can go to for ideas

  - One resource you can consult for ideas

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Example 3 - Case Study Competition

- Groups of 3 students

- Had to choose a topic and model it with a Markov Chain

- Presentations in class

- Cash prizes for winners chosen by panel of judges

- Reports due afterwards to incorporate feedback from presentations

- Personal reflection paper on learning from own and others' presentations

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Case Study Reflections

" The application of Markov Chains in our real life problems allowed us, as a class, to see the very appropriate application of one simple statistical concept in a kaleidoscope of areas in the world we live in today. The experience to me was one of the first, which I felt strengthened my conviction on the application of Math in everyday life. "

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Think About Your Course

- How will you know it is working?

- Write down…

  - One goal you have

  - One idea for measuring the success of your changes

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Let's Try It

- What techniques can you try?

- What demotivational practices do you sometimes use? How can you avoid them?

- Discuss at your table

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Key Takeaways

- Students are motivated in many different ways

- Take care not to unintentionally de-motivate

- Show relevance to their careers/interests

- Prepare for real-world problems

- Allow freedom to explore their own ideas

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Workshop 4: Planning Interactive and Effective Teaching

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Outline

- Strategies for Interactive Teaching Activities

  1. "Me, We, You" Structure

  2. Asking Questions

  3. Think-Pair-Share

  4. Polling Class

  5. In-Class Assignment

  6. Jigsaw Activity

  7. Exploratory Activities

  8. Facilitated Class Discussion

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1. Structure

- Active Learning

- Use a mix of practical and theoretical content

  - Discussion of background

  - Simplified practice

  - Larger more complex challenge

- Benefits students by scaffolding knowledge

- "Me, We, You" framework

- State learning goals every lecture

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2. Asking Questions

- Plan to ask at least 1 question every 5 minutes of class time

- They don't just happen, you must plan for it

- Best questions are high level, divergent, structured, single

- E.g. ask for:

  - The next step in a proof

  - The notation needed for an actuarial benefit

  - Which would be higher or lower

  - What information we're given means in a question

  - Why a result makes logical sense

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3. Think-Pair-Share

- Fantastic way to encourage more participation

- Keeps class engaged and interested

- Pose a question or ask for ideas, then:

  - Give time for students to think on their own and write down ideas

  - Pair with a partner and compare ideas

  - Share with the class

- Students are much more likely to share an idea someone else also has

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4. Polling Class

- Can do formally or informally

- Identify misconceptions, fix early

- How to do it:
  - Ask question
  - Vote
  - Discuss in pairs
  - Re-Vote

- Useful to get class going at start with review or warm-up question

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5. In-Class Assignment (Flipped Classroom)

- Questions focusing on topics from class

- Particular focus on confusing concepts

    - Threshold concept: something that transforms your understanding of a subject and once learned cannot be unlearned

- Instructor (and TAs) actively assisting

- Graded (mostly for effort) and returned

- Solutions posted promptly

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6. Jigsaw Activity

- Phase 1:
  - Divide into groups and assign each group a topic
  - They summarize the key points
- Phase 2:
  - Create cross-sectional groups
  - Students take turns presenting the summaries to their peers
- Benefits students by
  - Opportunity to learn through teaching
  - Providing additional perspectives on material

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7. Exploratory Activities

- When approaching a new topic or threshold concept

- Allow students to discover knowledge on their own

- Examples:
  - Multinomial distribution
  - Markov Chain communication
  - Brownian Motion derivation

- Reinforce in class later

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8. Facilitated Class Discussion

- Professor acts as facilitator instead of instructor

  - Unstructured student debate

  - Guidance and directed questions

  - Summarize and review

- Benefits students by

  - Allowing them to reach conclusions on their own

  - Increasing agency and ownership of the ideas

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Key Takeaways

1. Structure – use "me, we, you", combine theory & practice
2. Asking Questions – plan to engage your students
3. Think-Pair-Share – encourage participation from everyone
4. Polling Class – get instant feedback on student understanding
5. In-Class Assignments – give them a chance to try with help
6. Jigsaw Activity – enlist your students to help teach themselves
7. Exploratory Activities – let them discover things for themselves
8. Facilitated Class Discussion – let them explore hard ideas

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Bonus Idea – Communication Strategies

> " What on earth does Lego® have to do with communication strategies? "

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Bonus Idea – Communication Strategies

- Phase 1: Written only
  - Success rate: 3/18

- Phase 2: Verbal only
  - Success rate: 9/18

- Phase 3: Through an intermediary
  - Success rate: 15/18 (and the rest very close!)

- Discussion after each phase

- Reflective paper on what they learned from the experience

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Workshop 5: Developing Interactive and Effective Teaching Strategies

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Putting Workshop 4 Ideas into Practice

- Remember our list of possible activities:

  1. "Me, We, You" Structure

  2. Asking Questions

  3. Think-Pair-Share

  4. Polling Class

  5. In-Class Assignments

  6. Jigsaw Activity

  7. Exploratory Activities

  8. Facilitated Class Discussion

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Let's Try It

- Choose a topic in a course you have taught before

- Choose an activity you could use to make it more interactive

  - Plan what you would need

  - How much time would it take to explain and execute?

  - What are your goals with it?

- Share with a partner and give suggestions

  - Does it achieve the goals? How/whether to grade it? Will you need support from others?

- Repeat

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Guideline for Activity Usage

Activity	Best For	Time to Prepare	Time in Class
1. "Me, We, You"	Any topic	Low	Any
2. Asking Questions	Any topic	Low	Any
3. Think-Pair-Share	Where there are a large number of reasonable answers	Low	Short
4. Polling Class	When there is one right answer and common errors	Low	Short
5. In-Class Assignments	Questions students struggle with	Med	Med
6. Jigsaw	Material that divides nicely in sections, review, or introducing a new topic	Med	Long
7. Exploratory Activities	Important fundamental ideas	High	Long
8. Facilitated Discussion	Ideas with multiple perspectives e.g. ethics	Low	Med

You can also combine more than one activity!

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Workshop 6: Strategies for Large Class

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Outline

- What is a Large Class?

- Ideas for Large Classes

  1. Clickers

  2. Brainstorming

  3. Debate

  4. Ungraded Quiz/One-Minute Paper

  5. Blank Index Cards

  6. Discussion Board/Twitter

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Large Classes

- What do you consider a large class?

- How can we use interactive techniques that scale?
  - Many of the previous techniques scale well (e.g. asking questions, polling)
  - Some do not (e.g. jigsaw, exploratory activities)

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1. Clickers – Classroom Response Systems

- Options: iClicker, TopHat, Kahoot, Socrative, PollEverywhere, Acadly, etc

- Benefits:
  - Students try out techniques immediately
  - Feedback on student understanding
  - Collect data for examples
  - Increase student engagement
  - NOT a means to simply increase attendance

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1. Clickers – Drawbacks and Mitigation

Drawbacks	Possible Solutions
Creating questions	Question banks available
Time asking questions in class	Replace some examples
Administrative work	It gets easier!
Cost to students	Free options

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1. Clickers – Best Practices

- Assigning grades

- Allowing absences

- Administrative overhead

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1. Clickers – Impact on Grades
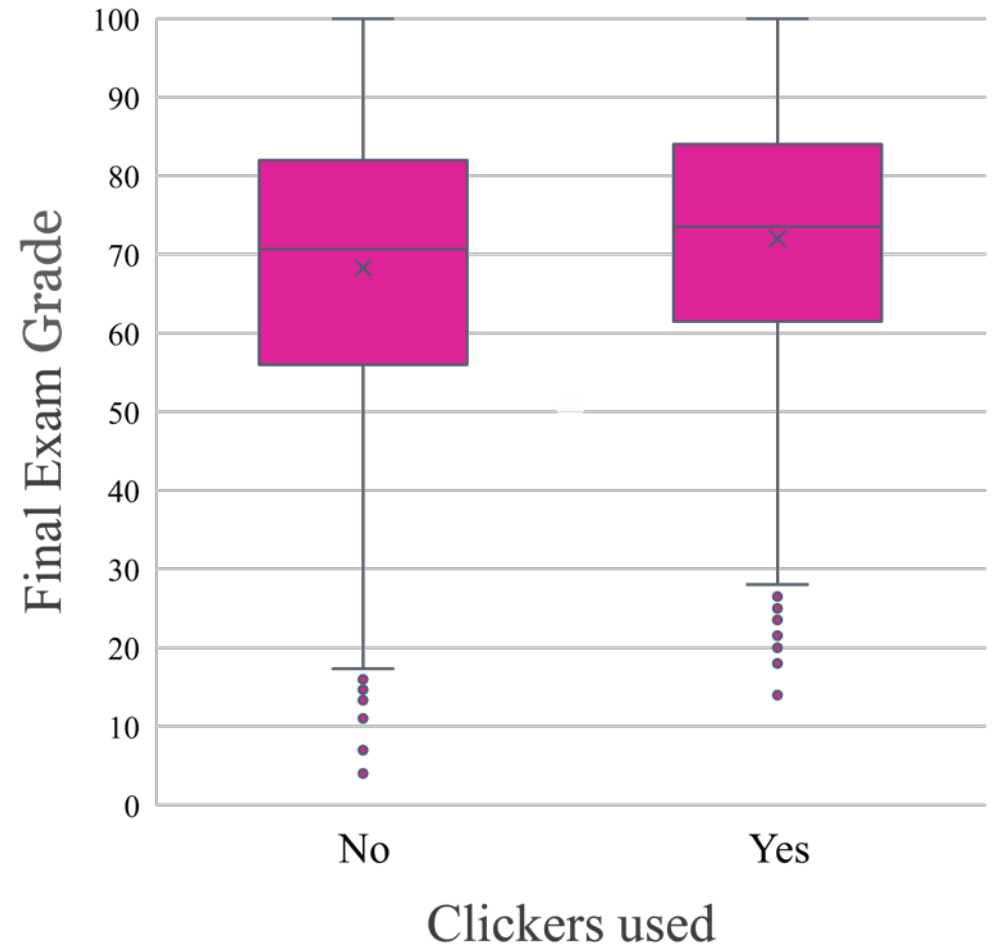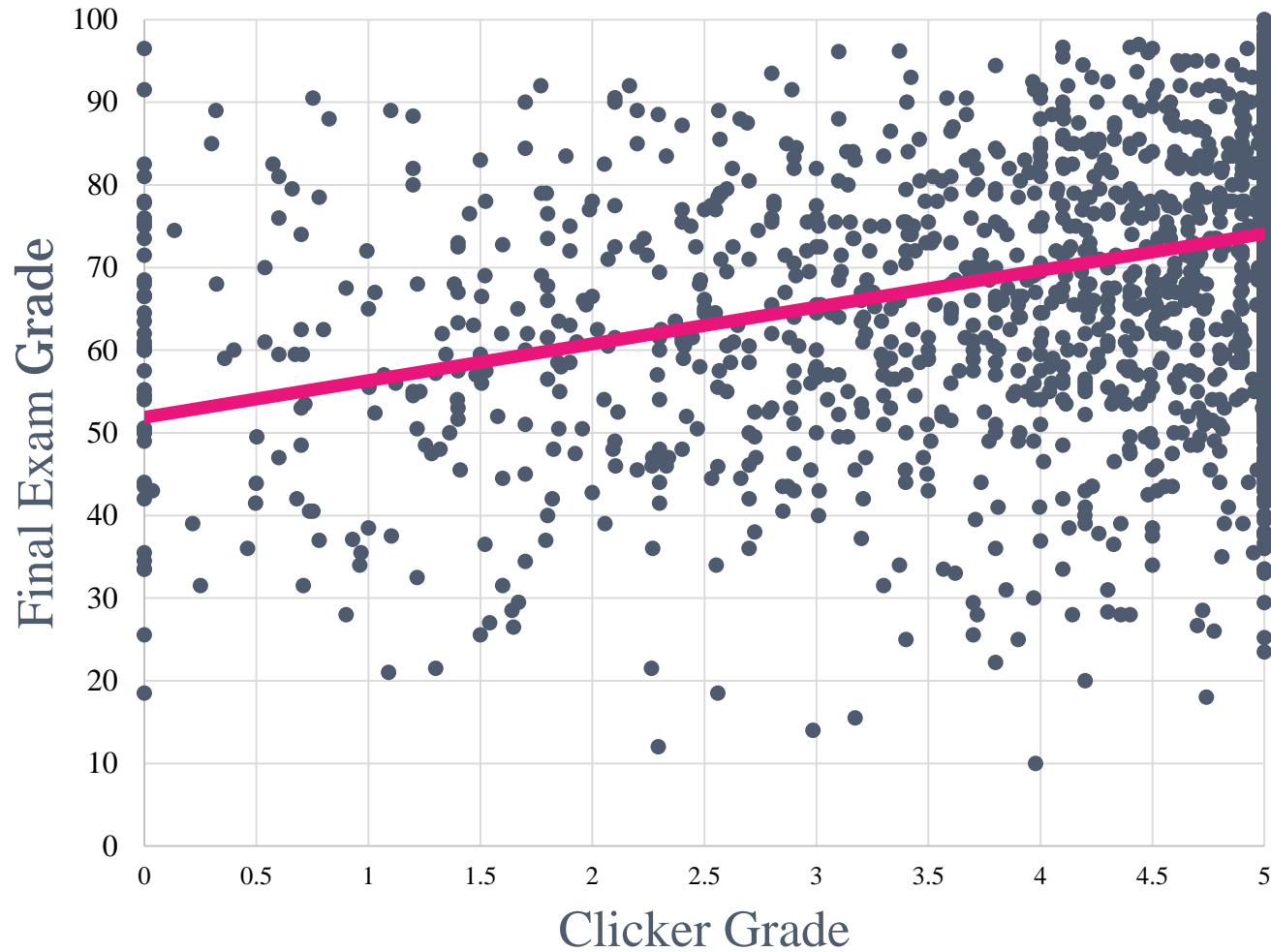
2. Brainstorming

- Choose a topic carefully – introducing a new idea or summarizing

- E.g. "tell me what you know, have heard, or have read about this topic."

- Give time to write individually

  - Can use Think-Pair-Share to get things going

- Don't reject anything, write everything down

- Categorize at the end

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3. Debate

- Describe background context

- Decide on two or more "sides" and physically group students

- Moderate as necessary but do not judge

- Summarize/reflect at end on what was said

4. Ungraded Quiz / One-Minute Paper

- Give a question or prompt

- Students answer it on a paper in a limited time

- Collect (anonymous or with names)

- Can have students swap and "grade" each other's informally

  - Variation: IF-AT cards

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5. Blank Index Cards

- Give all students a blank index card

- Ask them to write their answers, e.g.

    - The "muddiest point" – a lingering question or uncertainty

    - Most important ideas from that class

    - What people want to learn most from the course

- Collect and analyze, summarize next class

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6. Discussion Board / Twitter

- Continue the learning outside of class
  - Discussion questions
  - Challenge problems/extensions of in-class problems to work on
  - Get suggestions for topics
- Considerations:
  - Assign topics?
  - Required or optional?
  - Moderation?
  - Smaller groups or full class?

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Let's Try It

- Pick a course you teach that you consider large

- Choose one of the techniques you think might work for you

- How could you incorporate it into your large class?

- Swap with a partner and discuss

  - Does this idea scale well?

  - How will you handle classroom management?

- Repeat

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Key Takeaways

- Think about how your ideas will scale

- Use techniques that will engage everyone

- Planning is key

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Workshop 7: Assessment for Learning

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Outline

- What is assessment for?

- Some strategies for designing assessments:

  1. High Level Questions on Traditional Assessments

  2. Two-Stage Testing

  3. Projects & Reports

  4. Pre- and Post-Course Questionnaire

  5. Oral Exams

  6. Video Assignments

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Assessment Is Curriculum

- What do you want your students to learn?

 What skills do you want them to have?

- Test them on that!

- But how…

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1. High Level Questions

- Recall: Bloom's Taxonomy of Learning
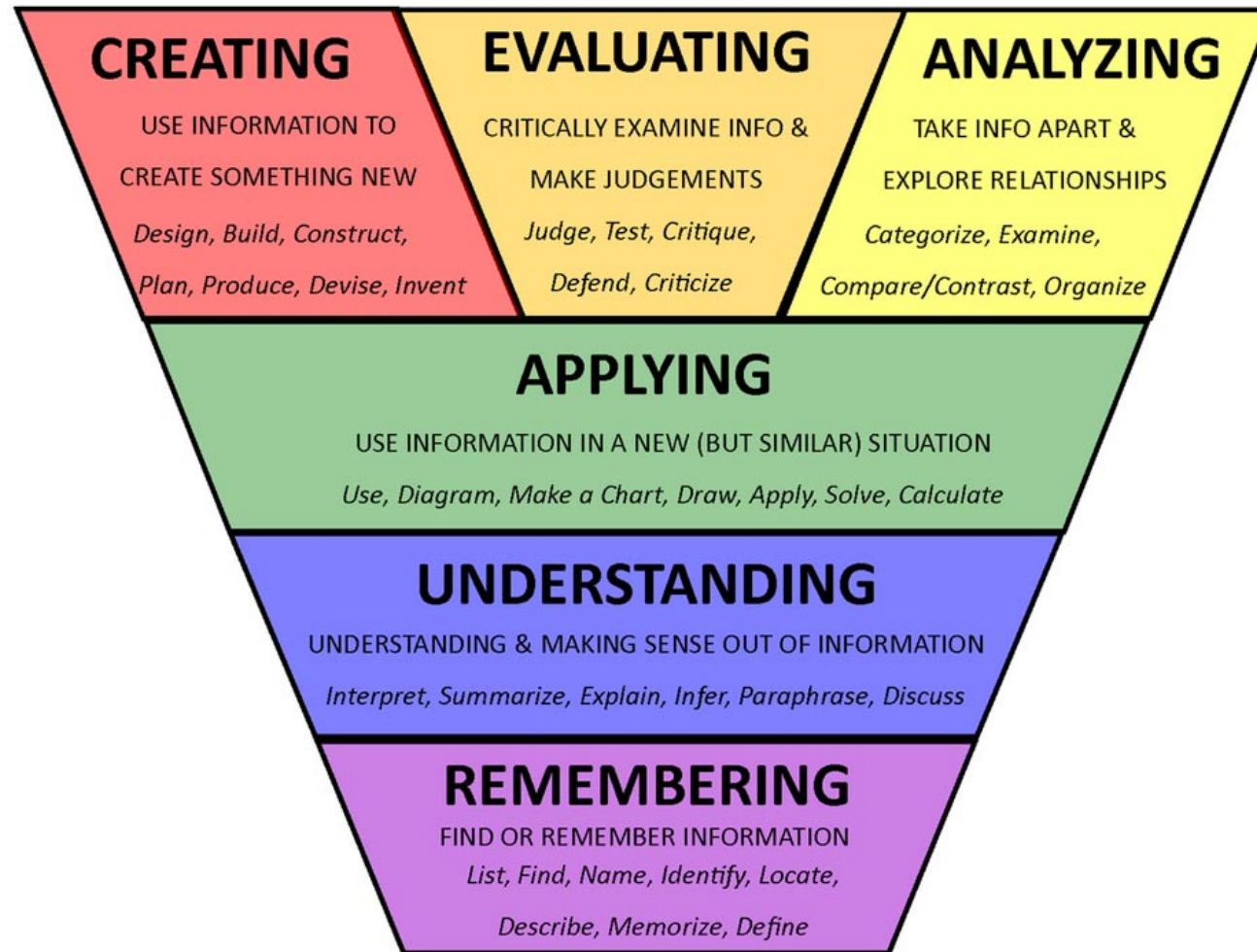
1. High Level Questions

- Start with a simple calculation
  - Can give the answer to less accuracy
- Then some more complex calculations
  - Using the first part or similar techniques
- Finally a conceptual question
  - Extending the material
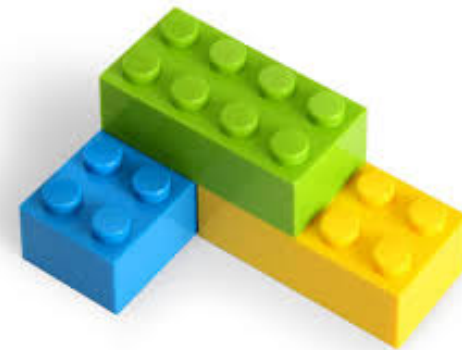
wiseGEEK

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1. High Level Questions

- Prove/Disprove instead of True/False

- Graph something

- Apply models to a completely new situation

- Translate between symbols and words

- Identify similarities and differences

- Discuss whether assumptions would hold, if model is appropriate

- Justify mathematical results logically, comment on interpretation

- State conclusions/recommendations in context

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1. High Level Questions – Probability

3. (10) Major data security breaches (where customer data or passwords are made public, either by accident or by hackers) can occur at any time. The probability that any month has no major data security breaches is 0.135.

   (a) (3) Do you think that the three conditions for a Poisson process would hold in this situation in real life? Discuss each one in 1-2 complete sentences.

   (b) (4) Assuming a Poisson process is appropriate, find the probability of observing at least 2 breaches in 1 month.

   (c) (3) Find the probability that you must wait 6 (non-overlapping) months until you observe 2 months with no breaches.

1. High Level Questions – Financial Math

5. [10 marks] The number of fruit flies in a lab grows at a constant daily force $\delta = 0.2$. There are 10,000 fruit flies in the lab at 9:00 am today.

   (a) [3 marks] What will be the increase in the number of flies between 9:00 pm and 10:00 pm tonight?

   (b) [3 marks] At what day and time (to the nearest hour) will there be 20,000 flies in the lab?

   (c) [4 marks] If at exactly 9:00 am each day, starting tomorrow, 1% of the normal fly population mutates, and mutated flies do not reproduce, how many mutated flies will there be in the lab just after 9:00 am in one week (7 mutations)?

1. High Level Questions – Life Cons 1

1. [16 marks] The survival function for a life age 0 is given by $S_0(x) = (\frac{\lambda}{\lambda+\beta x})^\alpha$, where α, β, and $\lambda > 0$.

   (a) [6 marks] Verify that $S_0(x)$ satisfies the three conditions to be a valid survival function, and briefly justify why each condition makes sense.

   (b) [3 marks] Show that the force of mortality $\mu_x = \frac{\alpha\beta}{\lambda+\beta x}$.

   (c) [3 marks] Show that for $x \geq 0$, $_tp_x = (\frac{\lambda^*}{\lambda^*+\beta t})^\alpha$, for some new λ^* that you should identify.

   (d) [2 marks] For $\alpha = 50$, $\beta = 0.001$, and $\lambda = 2$, calculate $\mathring{e}_0$, the average lifetime of an individual.

   (e) [2 marks] Roughly sketch a graph of the force of mortality for typical human lives.

2. A life age 50 buys a fully discrete 20 year term insurance policy with sum insured 100,000. The interest assumption for both premiums and policy values is 5% per year effective, and mortality follows the attached table.

   (a) [2] Show that the premium is $313 to the nearest $1.

   (b) [3] Calculate the policy value 15 years after the policy is issued.

   (c) [3] Using the recursive relationship, calculate the policy value 14 years after the policy is issued.

   (d) [4] Your boss needs the policy value at time 14.5. He suggests simply taking the average of the policy values at time 14 and 15. Explain briefly why this would give a poor approximation, and determine a more accurate estimate.

1. High Level Questions – Stochastic Processes

4. (a) [7] Check off whether each of the following statements hold for Markov Chains, Poisson Process, and/or Standard Brownian Motion.

	MC	PP	SBM
State space is discrete			
Process starts at 0 at time 0			
Process has the Markov property			
Equilibrium distribution exists			
Process is nowhere differentiable			
Process is stationary			
Process is non-decreasing			

(b) [6] Sketch a possible trajectory (sample path) for each of the following continuous-time stochastic processes, illustrating the differences between them:
i. Poisson Process ii. Standard Brownian Motion
iii. Geometric Brownian Motion with $\mu > 0$

6. ARCH/GARCH Models

   (a) [6] How can we tell that an ARCH/GARCH model might be appropriate for a set of data? Discuss 3 features that ARCH/GARCH models help capture, and how you would identify these features in your data from plots.

   (b) [2] Suppose you have fitted an $ARCH(1)$ model to some log stock returns, and the fitted parameters are $\mu = -0.0017$, $\alpha_0 = 0.462$, and $\alpha_1 = 0.085$. The most recent stock price is \$62.48. Predict what the stock price will be 3 business days later. No prediction interval is needed.

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2. Two-Stage Testing

- After writing test individually, students complete a blank copy of the test in small groups

- Allows students to revisit material

- Makes them accountable for the things they did poorly on

- Immediate feedback, correct misconceptions

- Variety of ways to grade

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2. Two-Stage Testing – Best Practices

- Group formation and dynamics
  - Use consistent groups, get buy-in
  - Can try to form groups so each question is covered
  - Groups must get consensus on answers
- How to grade
  - 80% individual, 20% group
  - Add half the difference between group average and group's score
- Time for deliberation and debrief afterwards

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3. Projects & Reports

- The best way to learn is to actually do!

- In-class presentation, report, peer evaluation

- Develops skills of communication, working with real data, research, teamwork

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3. Projects & Reports – Examples

- Life Contingencies: summarize papers on recent Actuarial research

  - E.g. pension plan documents, results of technical analysis, risk management

- Stochastic Processes: pick a topic and model it with a Markov chain

  - E.g. music, degree progress, disease progression, election results

- Experimental Design: design, conduct, and analyze an experiment

  - E.g. cookies, effect of caffeine/alcohol on math performance

- Forecasting: pick a topic, find data, and forecast using models

  - E.g. unemployment, university enrollment, tourism, temperature

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3. Projects & Reports – Other Types

- Persuasive presentations

- Summarizing reports

- Re-presenting material from a conference based on slides and audio recording

- Short presentations of news articles

- Final research project

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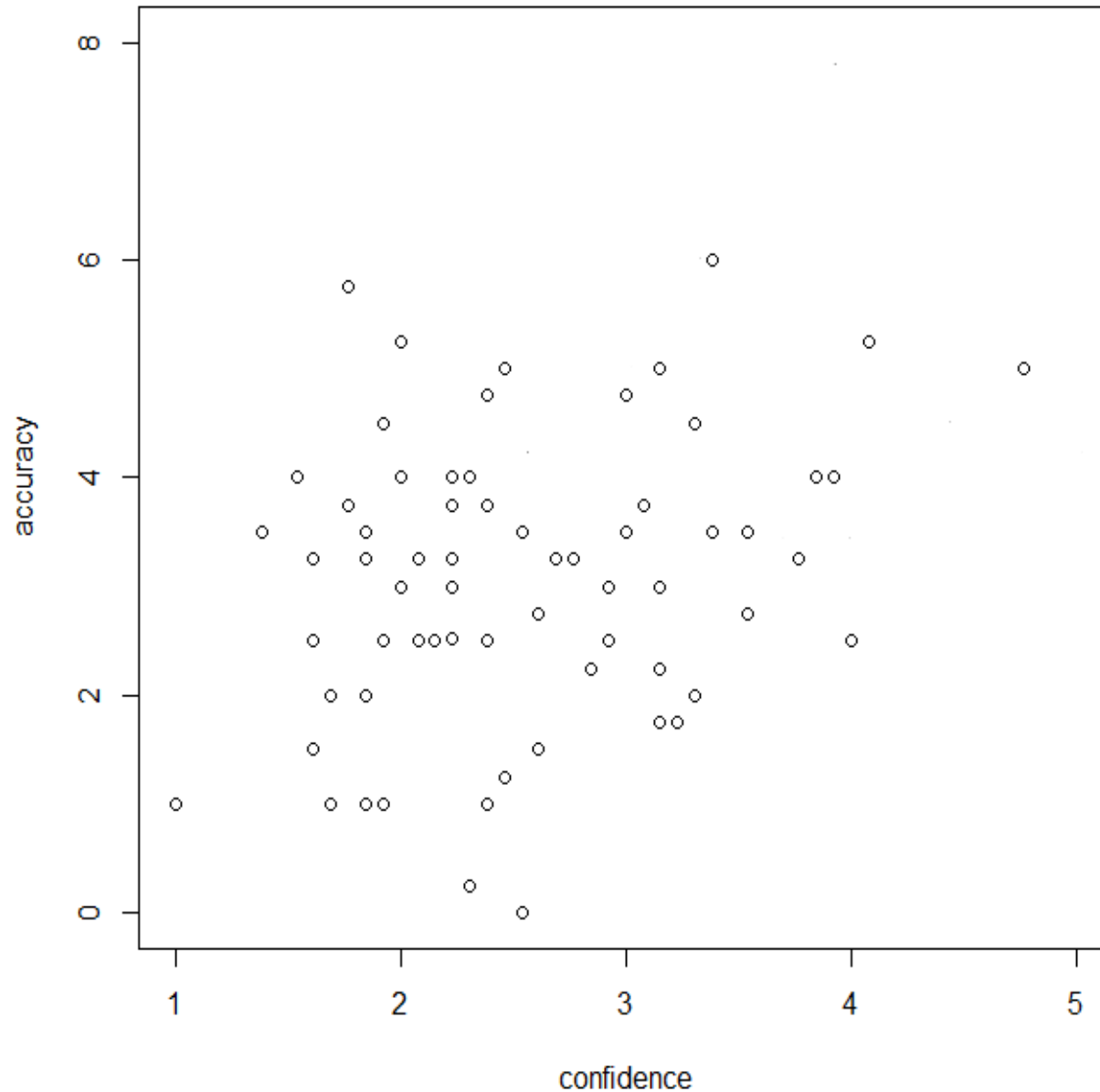**FACULTY OF MATHEMATICS**
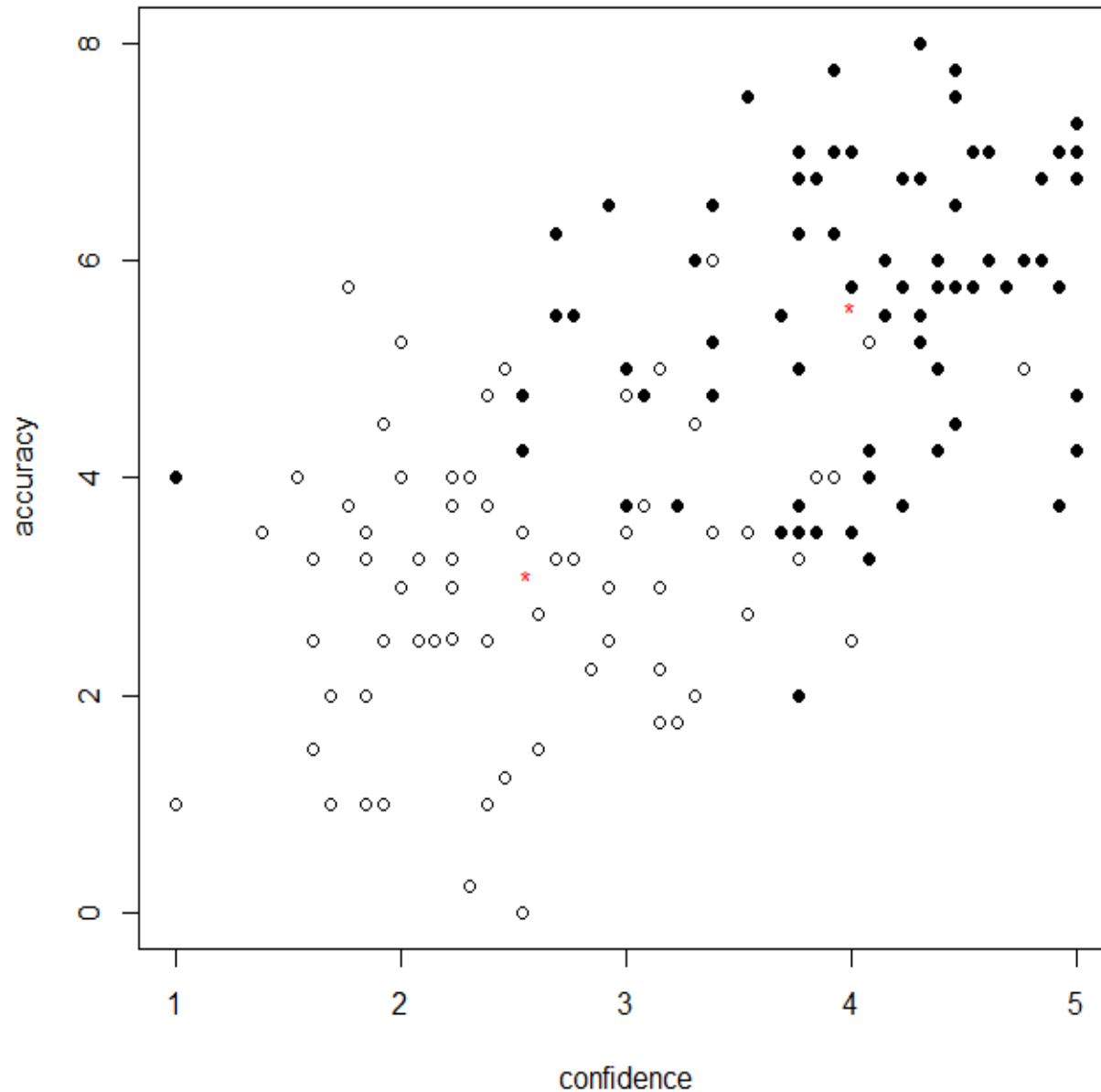
4. Pre- and Post-Course Questionnaire

- Answer questions about course material and rate confidence in answers

- After course, give the same questions

- Show students how their confidence and knowledge have grown

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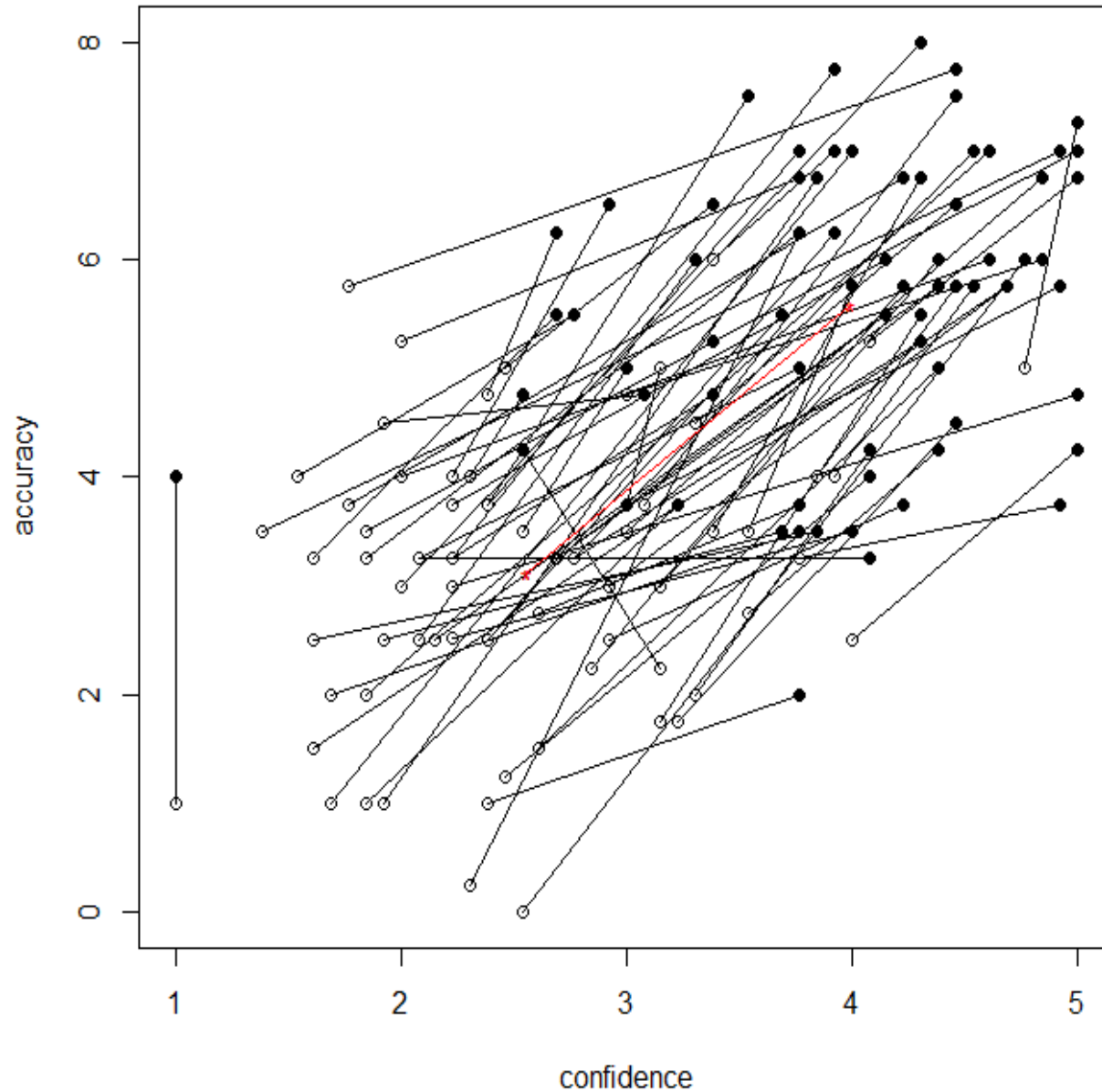# 4. Pre- and Post-Course Questionnaire - Pre

4. Pre- and Post-Course Questionnaire - Post

4. Pre- and Post-Course Questionnaire - Growth

4. Pre- and Post-Course Questionnaire Results

- Average accuracy improved

  2.45 pts out of 8 (31%)

- Each point gained → 1.5% higher final grade (significance level p=0.03)

- Average 51% of possible improvement

- Each 10% improvement → 1.2% higher final grade (significance level p=0.007)

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5. Oral Exam

- What?
  - Various formats used in different fields (Medicine, Thesis, Language course)
  - Essential point: two-way oral communication
- When?
  - Small classes for upper year students, sufficiently conceptual material
- Why?
  - Oral communication: desirable skill in and of itself!
  - Emphasize purpose/importance as a learning activity as well as an assessment
  - Get a much better sense of depth of knowledge
  - Can give help if question is misunderstood/missing some information

5. Oral Exam – Disadvantages

Disadvantages	How to Overcome
Language barrier	Give students clear expectations and lots of time/practice to prepare
Nerves	Have it not worth an extremely large % Allow students to bring in notes
Not as objective (the "halo" effect)	Have a clear marking scheme/rubric
Time	Only use when class size permits
Academic dishonesty	Have a bank of questions and randomize

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5. Oral Exam – My Format

- Exam is worth 5% overall, 15 minutes

- Open book (can bring in absolutely anything) – suggest preparing notes

- 5 questions, each out of 5 marks (define _, discuss advantages and disadvantages of _, compare _ vs _, describe the process for _, how would _ change if _)

- Can ask for clarification, or I may ask follow-up

- Randomized bank of questions ensuring I cover course topics equally

- After all exams but before written final, post point-form "ideal" answers

- Practice in class in pairs

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5. Oral Exam – Sample Questions – Actuarial

- Define: non-diversifiable risk, stress test, hybrid pension plan, credited interest rate

- Adv/Disadv: stochastic simulation, DC or DB pension plan, ILN model for interest rates

- Compare: UL vs Equity-Linked insurance, actuarial reserve vs dynamic hedge portfolio

- Describe process: MC simulation, calculating normal cost in DB pension, profit testing, calculating hedge portfolio, generating RSLN-2

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5. Oral Exam – Sample Questions – Statistics

- Define: independence, generating function, MLE, hypothesis test, Markov chain

- Adv/Disadv: CLT, paired comparison experiment, F-test in ANOVA table

- Compare: Binomial vs Poisson, MME vs MLE, CI vs PI, Type I vs Type II error

- Describe process: joint transformation, LSE estimation, Bayesian estimation, generating random walk/Brownian Motion

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6. YouTube Video Assignments

- Students create videos in groups, explaining a course concept in a fun, interesting way

- Learning through teaching

- Curated list made available for review

- Used in many courses:

  - Probability

  - Life Contingencies

  - Stochastic Processes

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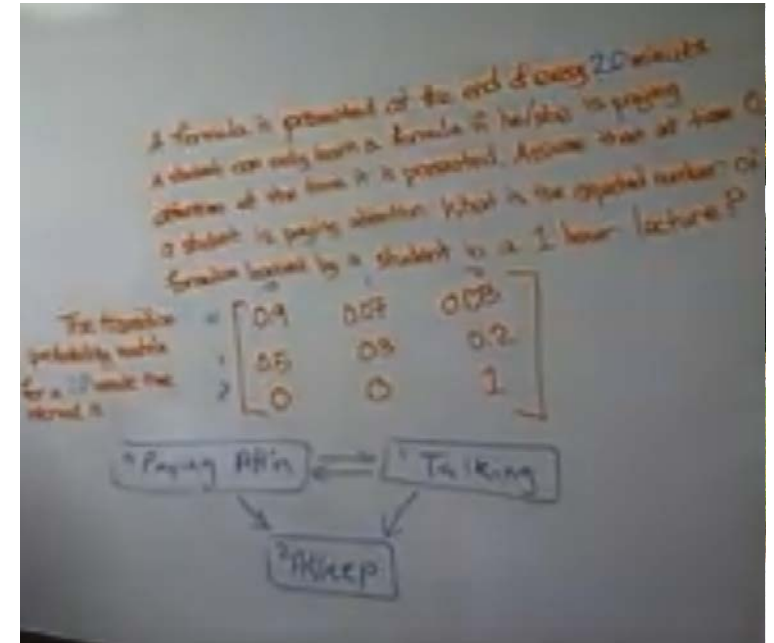# 6. YouTube Video Assignments – Examples

EXAMPLE 1

Harry Potter Petrification Insurance

EXAMPLE 2

Common Shock Model for Two Lives

EXAMPLE 3

Markov Chain for paying attention in class

And one more for good luck!

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6. YouTube Video Assignments – Grading

- Correctness / Accuracy

- Creativity / Passion

- Communication / Quality

- Uses:
  - Review material
  - Inspiring the next term

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Guidelines for Assessment Usage

Assessment	Best For	Time to Prepare	Time to Run & Grade
1. High Level Questions	Any material and course size	Low	Low
2. Two-Stage Testing	Any material and course size	Low	Med
3. Projects & Reports	Small-med course, practical material	Med	High
4. Pre- and Post-Course Questionnaire	Small-med course, material expanding on previous knowledge	Med	Med
5. Oral Exams	Small course, conceptual material	Med	High
6. Video Assignments	Any material and course size	Low	Low

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Let's Try It

- Think of a topic in your course and plan how you might assess it

- Share with a partner

  - Describe the assessment only

  - Have partner guess what skill you are testing

  - What do your assessments say about your learning objectives?

- Table discussion

  - What was most surprising?

Key Takeaways

- What do you want your students to learn?

  What skills do you want them to have?

- Design assessments to support these goals

- You can do it!

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Interactive Teaching in Actuarial Science

Workshop 8: Inclusive Teaching

Diana Skrzydlo

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Outline

- Universal Design for Learning

- Improving Access for Students

- Course Mapping

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Universal Design for Learning

- Universal Design = spaces/products designed to be used by as many people as possible

- Universal Design for Learning = course design/delivery/assessment so diverse students can participate to the best of their ability

- 4 areas of access:

  - Cognitive

  - Content

  - Communication

  - Physical

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Improving Cognitive Access

- Use a range of instructional techniques in class
  - Activities, small groups, peer learning
- Use different kinds of assessment
  - Take-home vs in-class
  - Multiple-choice vs short answer vs full solution vs writing
- Representative practice tests
- Study guide – clear expectations of what they should know
- Provide flexibility e.g. answer X of Y questions, choose a topic and…

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Improving Content Access

- Begin classes with learning goals, summarize key points

- Repeat questions before answering

- Clear grading criteria for assessments ahead of time

  - Rubric

  - Examples of good/poor work

  - Checklists

- Make notes of common errors and report back to students

- Allow re-writes, important to see growth over term

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Improving Communication Access

- Build a community of learners

- Explicitly state community values, introduce students to each other

- Promote interaction and group work

- Prepare for the workplace

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Improving Physical Access

- Includes both classroom and online

- Make resources easy to find

- Due dates on dropboxes

- Course calendar with all dates of tests/assignments

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Let's Try It

- Consider a course objective and how you currently assess it

- Is there only one way to assess it? Is every aspect of your assessment necessary?

    - Output format – consider giving a choice e.g. in-class presentation vs video

    - Amount of time needed – consider extended time for everyone or take-home

    - (If they are essential components of the task, keep it the way it is)

- Can it be adapted to be more inclusive? Think of different ways you can assess or provide choices

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Course Mapping

- What do you want your students to learn? – Learning Objectives

- What will you use to teach it? – Activities, Materials, Notes

- How will you test them on it? – Assessment

- How does it relate to the overall course goals? – Course Objectives

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Alignment

- For any learning objective:
  - How much it is worth
  - How much time you spend on it   Should all match!
  - How important it is

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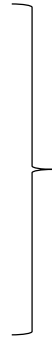
Let's Try It

- Consider a course you teach

- Identify the learning objectives

- Write the activities/materials and assessment for each

- Estimate the amount of time and % of grade for each

- Are these in line with the importance of the topic?

- Discuss with a partner

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Example

- Turning a Topic into a Goal ("I want my students to be able to...")

  - Topic: counting arguments
    Goal: understand and use counting arguments to solve problems

  - Topic: joint random variables
    Goal: calculate joint pf, find marginal pf, determine if independent, calculate and interpret covariance

- Estimating the % weight in final grade

  - Counting arguments – Assignment 1 (1.67%), 2/3$^{\text{rds}}$ of Quiz 1 (3.33%), 1/6$^{\text{th}}$ of Midterm 1 (2.5%), 1/50$^{\text{th}}$ of Final Exam (1%) = 8.5%

- Estimating the % of time spent

  - Counting arguments – 3 lectures out of 36 = 8.33%

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Key Takeaways

- Best Practices for Inclusive Teaching

  - Use a variety of ways to communicate course content

  - Use various types of assessment

  - Clear expectations and feedback

- Alignment/Course Mapping

  - Match the time and grades devoted to an objective to its importance

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Outline

- When & how to collect feedback

- What to ask

- How to respond

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When to Collect Feedback

For students:

Formative Assessment	Summative Assessment
Middle of term Assignments, Tests	End of term Final Exam
Used for evaluation and feedback	Used for evaluation of what students learned
Students will improve things they did poorly on for future assessments	Students will not likely work on improving things they did poorly on, since course is over

Similarly, for instructors:

Formative Feedback	Summative Feedback
Middle of term	End of term after course is over
Can make changes immediately	May make changes but students will not see
Used for personal growth	Used for evaluation

How to Collect Feedback

- Anonymous survey
  - Anonymity is important so students can be honest
- Suggestion box
  - Students can submit suggestions any time
- Class ambassador
  - A student the others can go to with concerns
- Observation by a peer
  - Talk about your goals for the class first, what you want them to watch out for
  - Meet afterwards to discuss how it went

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What to Ask

- What should the instructor stop doing?

- What should the instructor start doing?

- What should the instructor continue doing?

- Or give students a list of statements to rate and comment on (see handout)

- Don't ask anything you're not willing to change!

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Analysis

- Look for trends/patterns, not individual responses

- Look for the "why" – what is the source of the concern

- Consider having someone else summarize results for you

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How to Respond

- Summarize the results – transparency

- Most important is to respond to it as soon as possible

- Communicate what changes you will be making and what you won't

  - Things you can change right away

  - Things you will change next term

  - Things you will not change and why

- Will get more quality summative feedback at the end

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Let's Try It

- Give me feedback on this workshop

  - What should the instructor stop doing?

  - What should the instructor start doing?

  - What should the instructor continue doing?

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Key Takeaways

- Formative feedback from multiple sources

- Look for patterns

- Respond promptly and communicate results

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Feedback – Most Common Requests

- Stop:
  - Speaking so fast
  - Writing small or with red/blue marker
  - Waiting for everyone to start class
- Start:
  - More specific and practical examples
  - Giving slides ahead of time
  - Asking specific people to share experience
  - Talk about/show grading policy
  - Talk about balancing curriculum

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Interactive Teaching in Actuarial Science

Workshop 10: Getting Students to "Think Like an Actuary"

Diana Skrzydlo

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Outline

- Motivation

- "Think Like an Actuary" Integration

- Student Outcomes

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Motivation

- Recently completed Actuarial credential (ASA)

- Taught Life Contingencies again

- Gap between exam-prep calculation questions and nuance of actuarial work

- Communication of ideas as important as ideas

- Professionalism/ethical issues

- Goal: Prepare students earlier for these challenges

    Balance what they need for exams vs what they need for work

"Think Like an Actuary"

- In Lectures: brainstorming in many classes

- Tutorials (In-Class Assignments) each week: one question

- Assignments: one question each requiring a one-page report

- Tests: one part of one question each

- Final Exam: many parts of questions

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In Lectures

- Brainstorming
  - Insurance products that exist
  - Factors that affect mortality
  - Sources of expenses for insurer
- Explaining
  - Why variance/mean is higher/lower for different products
  - Why mathematical results make sense

- **What topics could you use in your lectures?**

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In Lectures – Your Ideas

- Theory of Interest – explain time value of money

  – compare annuity pvs for different frequencies

- Forecasting – discuss features of stock time series data

- Life Insurance – explain why we set $E[L_0] = 0$

  – explain relationships between p_x's and q_x's

- Probability – discuss how and when to use the Hypergeometric rv

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Tutorials/In-Class Assignments

- Guaranteed/simplified issue products

- Impact of self-driving cars

- Debate on genetic testing

- Relationships between values

- Covariance between PVRVs

- Charity as beneficiary

- Concerns with high commissions

- What topics could you use in your classes?

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Tutorials/In-Class Assignments – Your Ideas

- Theory of Interest – compare two investments

    – relationship between d, i, and δ

    – impact of changing i on the profitability of a project

- Financial Math – activity to determine prices of callable/puttable bonds (maybe a game where students in pairs are buyer/seller)

- General Insurance – reasons for/against having mandatory insurance

    – reasons for/against using gender in pricing

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Assignments

- Discuss advantages, disadvantages, and considerations of including certain rating factors in mortality models

- Compare choice of two different actual insurance policies for a theoretical client

- Reflect on all the "Think Like an Actuary" questions – what was most interesting?

- What topics could you use in your assignments?

Assignments – Your Ideas

- Recommend an investment mix for a particular set of liabilities

- Get a quote for insurance and calculate the theoretical premium using some assumptions; compare results

- Government-provided health insurance – should people buy additional insurance? Compare government-provided insurance in different countries

- Catastrophe modelling – what to measure ($ damage, lives lost, buildings destroyed, magnitude of earthquake, etc), what data sources?

- Get multiple quotes for car insurance from different companies and compare

Tests and Exams

- 20% of marks on all my assessments is for explaining results in words

- Insurable interest

- Recommendation for client

- Why certain relationships exist

- Effect of age on impaired mortality reduction

- What topics could you use in your tests? Anything mentioned before! More closed-ended since they don't have a lot of time to do research

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Student Outcomes

- Extremely impressed with depth of thought

- Quality of writing varied widely

- Insight into complexity of actuarial work

- Learned to consider external factors/context

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Student Outcomes - Beginning

"Do I have to actually write a sentence?"

"How many words? Double or single spaced? What margins should we use?"

"So... this is basically a writing course now?"

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Student Outcomes - End

"Actuarial work is **art - not just science**. One brings together their **actuarial judgement** and views, collects data, and then modifies their views."

"Actuaries have to make decisions **not only based on numbers** but also based on economical, social, and political factors."

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Key Takeaways

- You can always incorporate actuarial thinking into class, assignments, and tests

- Keep a list of ideas and add to it as you go
  - Start with your ideas from this workshop
  - Add ideas based on things that happen, questions students ask in class, etc
  - Then when you create your assignments/tests, you have lots of ideas ready

- Don't be afraid to ask hard questions – your students may surprise you!

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Interactive Teaching in Actuarial Science

Workshop 11: Sharing Session

Danang, Wawan, Ukur, Donny, Anisa

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