Aligning Assessment for Aspiring Actuaries

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Alignment

- Assessment is Curriculum
- Authentic Assessment
- Backwards Design:

  - First, what do we want actuarial students to be able to do?
  - Then, how will we assess them on these skills?
  - Finally, how will our instructional practices prepare them?

Learning Outcomes for Actuaries

Professional Skills

- Teamwork
- Technical writing
- Oral presentations
- Give/receive feedback
- Reflection

Technical Skills

- Data validation
- Build/document models
- Justifying assumptions
- Actuarial judgement
- Use data ethically

Anything else?

Assignments/Tests/Exams

- Explain whether a model is appropriate for a situation
- Logically justify why mathematical results make sense
- Describe how results obtained, justifying assumptions
- State conclusions in context
- Clean data and build/document model
- Answer hypothetical client emails
- Best practices
  - Ask these kinds of questions consistently

Group Projects

- Design and pitch a P&C Insurance product
  - E.g. rideshare, social media liability, satellite, e-device
- Build stochastic model to simulate VA gtee risk
  - Incorporating different interest rate models, policy designs
- Pick a topic, find data, and forecast using models
  - E.g. unemployment, university enrollment, tourism, temp
- Best practices for group work
  - Accountability – within- and between-group peer evals
  - Guidance on effective team work, meetings

Reports

- Choice of articles to read and summarize
- Discussing pros and cons of using rating factors
- Memo presenting findings and recommendations of technical analysis
- Summarizing product and making recommendation
- Best practices for writing assignments
  - Early-bird deadline to get feedback and resubmit
  - Exemplars

Presentations

- Regular in-class questions
- Persuasive
- Individual research project
- Summarizing material from other sources
- Debates (genetic tests, vendor vs in-house models)
- Best practices for presentations
  - Make material part of curriculum
  - Guidance on effective structure, slide design, delivery

Reflective Writing

- Reflect on goals and/or what they have learned
  - Summarize important course concepts in plain language
  - Describe a problem you struggled with but now understand
  - Discuss what made you want to study this topic
  - Explain whether you achieved your goals for the course
  - What did you learn from an in-class activity or project
- Best practices for reflections
  - Give a framework: “What? So What? Now What?”
  - Respond authentically

Oral Exams

- Focus on explaining conceptual ideas in words
- Able to ask for clarification
- My format: 15-minutes, 5 questions
  - Definition, Advantages/Disadvantages, Compare/Contrast, Describe a Process, Predict the Impact
- Best practices for oral exams
  - Clear expectations, rubric for fair grading
  - Give students time to practice

How Can You Use These Ideas?

- What are the skills future actuaries will need?
- Design assessments that test those skills
- Use instructional practices to help students succeed
- Inspiration tips:
  - Use what is happening locally and globally
  - Keep a list of ideas and use when needed
  - Let students drive the curriculum with their interests

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Appendix - Additional examples and assessment types

Example 1 – Probability (STAT 230)

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.

Example 2 – Financial Math (ACTSC 231)

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)?

Example 3 – Life Cons 1 (ACTSC 232)

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.

Example 4 – Life Cons 2 (ACTSC 331)

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.

Example 5 – Probability Models (STAT 334)

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 $\mu > 0$

Example 6 – Time Series (STAT 443)

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.