

# Teaching Portfolio

Brenden Eum

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## Teaching Statement

When I started my PhD, my advisor asked me “What is the biggest impact you can make in science?” I replied with something along the lines of research. He told me that while research will be an important part of my contribution, my biggest impact will come from teaching. It’s simple economics: I can contribute one scholar’s worth of work, or I can invest in my students’ futures and potentially birth the contributions of many. I hold this lesson dear to my heart and hope to inspire passion in future generations of young scientists.

Central to my teaching philosophy is getting students to actively participate in discussions and learn from each other. This philosophy is important to me because I believe it can spark creativity and nurture passion for a subject. To achieve this, I employ a variety of pedagogical practices – from building an open classroom where students feel free to speak their minds, to incorporating active learning techniques, to restructuring lectures on the fly based on student understanding. From the very first class, I use ice breakers and active learning activities to encourage students to feel comfortable with me and with each other. Among my favorite active learning activities are (1) sketch-and-show, where I pose a question to students and have everyone present their answer at the same time with a piece of paper; (2) scenario-predictions, where I pose a question, suggest a few potential answers, have students vote and discuss, then reveal the correct answer; and (3) think-pair-share, where I pose a question, give students time to critically think on their own, then split students into groups to discuss and present. These activities help me gauge student understanding during a lecture, hinting whether I should continue, slow down, or review some material again.

My teaching goal is for students to walk away from my class with an understanding of how to apply the material to their own interests and careers. I believe one of the most effective ways to get students to apply what they’ve learned to their own lives is to replace their final exam with a research project and presentation. I ask students to develop their own hypothesis, conduct a literature review, design their own test of their hypothesis, and report their anticipated results in the form of a short presentation. This final assessment helps students engage with the research process and practice reporting their results.

When it comes to homework, I believe practice makes perfect. Homework should be low-stakes *practice* for the final assessment. My goal for practicing is to provide ex-ante explanations for questions on the homework and ex-post feedback, thus preparing students for the final project. In my experience, a cover letter for every homework that explains why each question is asked helps students understand how to pose these questions to themselves in the future, building a foundation for critical and creative thinking. I try to answer these three questions with every cover letter: (1. The Hypothesis) Why am I asking you to do this? (2. The Methods) What information/data/tools are you starting with? and (3. The Results) What is the final product going to look like? I also find that repeated practice in the form of homework helps to reduce anxiety related to final assessment.

Last but not least, feedback is vital for me to continue to grow as a teacher. I believe teaching reviews that only come at the end of the semester are insufficient for building an open classroom *during* that semester. I like to leave post-it notes outside of the classroom for students to write anonymous feedback on. They can post it on the door after class. This allows me to quickly adapt my classroom to the

needs of my *current* students, not just my past ones. In the past, students have used these post-it notes to ask for extra help with coding, suggest certain material they would like me to review, and to request for more lecture time and less discussion time during recitations. In each case, I was able to take this feedback and use it to adjust the structure of my following recitations to suit the needs of my students.

## Teaching Activities, by Relevance

Co-Founder, Student Leader, and Lecturer: Social and Decision Neuroscience Graduate Bootcamp  
2020-2021, 2023

- I created the introductory summer school for incoming graduate students at Caltech entering the Social and Decision Neuroscience program.
- As a founder and student leader, I organized the series of classes that students would take over the course of 4 weeks and gathered instructors willing to teach those classes.
- As a lecturer, I designed the syllabus, homework, and lecture for 3 classes on microeconomics, behavioral economics, and statistics.

Teaching Assistant for Prof. Antonio Rangel: Bayesian Statistics  
2021-2023

- Advanced undergraduate and early graduate course with a class size of roughly 90 students from a variety of majors.
- My primary role was to host office hours (6 hours a week), manage discussion boards, and provide detailed feedback on homework.
- Course topics included: (1) discrete models, (2) regression models, (3) hierarchical models, (4) MCMC methods, and (5) model comparison. The course combined theory with hands-on experience so that students could apply the material to their own research.

Teaching Assistant for Prof. Charlie Plott: Introduction to Economics  
2020

- Undergraduate course with a class size of roughly 40 students from a variety of majors.
- My primary role was to teach a 1-hour recitation each week. I would spend some time reviewing the answers to problem sets, then I would review topics from the previous week that students seemed to struggle with. Finally, I would open the class up to more discussions and questions.
- I was also in charge of drafting the midterm and final, grading weekly problem sets, holding office hours, and providing feedback on weekly short essays.
- Course topics included: (1) law of supply and demand, (2) preferences and choice, (3) consumer theory, (4) production and cost, (5) [imperfect] competition, (7) wages, and (8) some macroeconomics [employment, capital and growth, money markets].

Co-Mentor: Caltech Summer Undergraduate Research Fellowship (SURF)  
2023

- Caltech accepts a cohort of undergraduate students in science and engineering that are seeking to collaborate with a mentor and develop their own research project. I helped to mentor one student.
- My role was to (1) help guide this student through the research process, (2) help them understand the theory or concepts related to their research project, and (3) resolve any issues they had with programming in R or Python.

Co-Mentor: Caltech WAVE Fellows Program

2021

- Caltech accepts a small cohort of underrepresented students in science and engineering looking to apply for PhD programs each summer. I helped to mentor one student.
- My role was to (1) help guide this student through the research process, (2) help them understand the theory or concepts related to their research project, and (3) resolve any issues they had with programming in R or Python.

## Evidence of Teaching Effectiveness

### Results

So far, my approach to teaching seems to be working well. Based on feedback from students after each course is complete, I've consistently scored high on teaching assistant ratings (see "Teaching Assistant Ratings" in Appendix 1 and 2). Furthermore, student comments have been consistently positive (see "Comments" in Appendix 1 and 2). For example, "Brenden really took time to answer my questions... He showed great conceptual understanding..." and "He frequently went above and beyond the requirements of a TA... When I was struggling with a concept, I found his explanations to be exceptionally clear and helpful." After taking courses on educational methods and practices, I applied what I learned to multiple courses in order to earn my Certificate of Practice in University Teaching from the Caltech Project for Effective Teaching (see Appendix 3). The combination of all my student feedback scores and comments eventually led to me receiving the 2021 Brass Division Award for excellence in teaching and mentoring (see Appendix 4).

### Materials

For recitations, I open with a review of the lecture material from the past week. I usually put more focus on topics that students seem to struggle with (or topics that I anticipate they will struggle with). Then I use this opportunity to tie one of those recent topics to a real-world scenario, usually something in the news. I also take this time to highlight exceptional responses from students (who were also tasked with providing a real-world example every week). I end by going over the answers to the previous week's homework. See Appendix 5 for a set of example slides that I created for incoming teaching assistants in social sciences at Caltech.

As for homework rubrics, I usually split each question into multiple parts and assign points for those parts. I try to be as clear as possible about what the points are for in as few words as possible. If students still have questions, they can send me a message through Canvas, and it is easy to reference a specific part of a question using the rubric. In brackets are the correct answers, in case students want to see the correct answer and work backwards on their own. I use itemized notes to provide feedback to the students. In the rubric in Appendix 6, I've included a common explanation for why someone might've lost points on Step 4 of Question 2. I delete this comment if the student did not make that mistake.

## Appendix

### 1. Student ratings and feedback for Introduction to Economics (ratings out of 5)

2020

#### Teaching Assistant Section: Brenden Eum

##### Teaching Assistant Ratings

|   |  | Score       | Dept. | Div. | Caltech |
|---|--|-------------|-------|------|---------|
| Provided helpful comments on assignments, papers, exams |  | 4.67 ± 0.75 | 4.42  | 4.60 | 4.49    |
| Answered questions clearly and concisely                |  | 4.33 ± 1.03 | 4.48  | 4.57 | 4.51    |
| Was well prepared for section, office hours or lab      |  | 4.75 ± 0.60 | 4.70  | 4.66 | 4.60    |
| Presented material clearly in section or lab            |  | 4.75 ± 0.60 | 4.70  | 4.67 | 4.59    |
| Overall teaching effectiveness                          |  | 4.58 ± 0.64 | 4.60  | 4.63 | 4.54    |

##### Comments

##### Please provide any comments you may have regarding the teaching assistant: Brenden Eum

|  |
|--|
| Brenden was exceptionally helpful and willing to take time to re-explain confusing topics and showed great patience and control over the rec sessions. |
| This guy was awesome and was the sole reason I was able to do remotely well in this course!!!  |
| I could tell that he cared about whether students were doing well in the class, which was nice.  |
| Amazing TA, very helpful and responsive to my emails.  |
| Fantastic TA! Great job Brenden, you made this class work. I enjoyed hearing your perspectives and interpretations for this material.                  |
| Thank you for all of your detailed responses! I think you're the most helpful TA I've had yet. I hope to have you in future courses. 5/5               |
| You were a great TA! Thank you!  |
| Brenden did a great job  |

2. Student ratings and feedback for Bayesian Statistics (ratings out of 5)

2021

**Teaching Assistant Section: Brenden Eum**

**Teaching Assistant Ratings**

|   |  | Score       | Dept. | Div. | Caltech |
|---|--|-------------|-------|------|---------|
| Provided helpful comments on assignments, papers, exams |  | 4.82 ± 0.57 | 4.63  | 4.73 | 4.73    |
| Answered questions clearly and concisely                |  | 4.82 ± 0.57 | 4.69  | 4.72 | 4.71    |
| Was well prepared for section, office hours or lab      |  | 4.82 ± 0.57 | 4.74  | 4.79 | 4.74    |
| Presented material clearly in section or lab            |  | 4.80 ± 0.60 | 4.79  | 4.82 | 4.77    |
| Overall teaching effectiveness                          |  | 4.82 ± 0.57 | 4.68  | 4.72 | 4.73    |

**Comments**

Please provide any comments you may have regarding the teaching assistant: Brenden Eum

|   |
|---|
| thank you!  |
| Thanks for being well-prepared and always fun to chat with during the weekend HW sessions. Keep it up!  |
| Brenden really took time to answer my questions and talk through my code. He showed a great conceptual understanding but was also very helpful resolving detailed coding problems.  |
| Thank you for being a great TA! I appreciated the in-depth explanations on the discussion board.  |
| He frequently went above and beyond the requirements of a TA, helping students thoroughly debug their code and answering questions over email after office hours were over. When I was struggling with a concept, I found his explanations to be exceptionally clear and helpful. |
| Brenden was an amazing TA! He helped me debug my stan code, which saved me a lot of time in running and re-running models.  |

2022

**Teaching Assistant Section: Brenden Eum**

**Teaching Assistant Ratings**

|   |  | Score       | Dept. | Div. | Caltech |
|---|--|-------------|-------|------|---------|
| Provided helpful comments on assignments, papers, exams |  | 4.71 ± 0.70 | 4.83  | 4.77 | 4.62    |
| Answered questions clearly and concisely                |  | 4.50 ± 0.87 | 4.76  | 4.72 | 4.60    |
| Was well prepared for section, office hours or lab      |  | 4.57 ± 0.73 | 4.79  | 4.77 | 4.65    |
| Presented material clearly in section or lab            |  | 4.71 ± 0.70 | 4.82  | 4.83 | 4.67    |
| Overall teaching effectiveness                          |  | 4.71 ± 0.70 | 4.82  | 4.84 | 4.62    |

**Comments**

Please provide any comments you may have regarding the teaching assistant: Brenden Eum

|                            |
|----------------------------|
| Brenden is a good teacher. |
| Wonderful TA!              |
| Brendan was helpful at OH! |



2023

### Teaching Assistant Section: Brenden Eum

#### Teaching Assistant Ratings

|   |  | Score       | Dept. | Div. | Caltech |
|---|--|-------------|-------|------|---------|
| Provided helpful comments on assignments, papers, exams |  | 5.00 ± 0.00 | 4.17  | 4.46 | 4.59    |
| Answered questions clearly and concisely                |  | 4.90 ± 0.30 | 4.12  | 4.43 | 4.57    |
| Was well prepared for section, office hours or lab      |  | 5.00 ± 0.00 | 4.33  | 4.57 | 4.61    |
| Presented material clearly in section or lab            |  | 5.00 ± 0.00 | 4.54  | 4.70 | 4.61    |
| Overall teaching effectiveness                          |  | 4.90 ± 0.30 | 4.31  | 4.56 | 4.62    |

#### Comments

##### Please provide any comments you may have regarding the teaching assistant: Brenden Eum

Brenden was an amazing TA. He was always extremely helpful during office hours and was very understanding whenever there was any issue with the sets.

Brenden spent 3.5 hours with me helping me to install a working version of Stan on my computer the day before my set was due (for some reason Stan wouldn't load onto my version of R, and was not resolved by any of the simple fixes we tried). Without Brenden I would have gotten a B instead of an A in this class. He went above and beyond what any TA would be reasonably expected to do.

I was honestly very emotionally moved by his helpfulness. I can't express how grateful I am to him, because I've never had anyone help me like that in my entire life. He stayed positive the whole time, never gave up, and was very quickly coming with up potential ideas to fix the issue the whole time. He has made me reevaluate what I am willing to do for others, and what it means to be a good person generally. I literally start crying everytime I think about it - I never realized how meaningful it is to me to be genuinely helped by another person when I am in a crisis.

Brenden is without a doubt the greatest TA I have ever worked with over my last 4 years at Caltech, and he definitely has left an impact on me.

Brenden is probably one of the best TAs I've had at Caltech. His office hours are welcoming and engaging, and he's really responsive outside of dedicated class hours, too.

You're so helpful and knowledgeable thank you

3. Certificate of Practice in University Teaching from the Caltech Project for Effective Teaching

**Caltech****CTLO**

June 9, 2023


To Whom It May Concern,

It is our pleasure to affirm that Brenden Eum has completed the 2022-2023 requirements for a **Certificate of Practice in University Teaching** from the Caltech Project for Effective Teaching (CPET). He has spent over 150 hours formally learning about educational research, methods, and best practices, and applying his knowledge as a teaching assistant, a workshop leader, and as the co-founder and leader of a summer program for incoming graduate students. Through this program, Brenden met with the Associate Director of University Teaching and the Program Manager for Graduate Teaching at the Center for Teaching, Learning and Outreach (CTLO) to plan and implement evidence-based practices into several teaching experiences. Brenden built a background in educational pedagogy by taking the course *E110: Principles of University Teaching and Learning in STEM*. He then thoughtfully applied this knowledge in multiple teaching experiences: as a teaching assistant for EC112 and EC122, as a workshop leader for training new teaching assistants for Humanities and Social Sciences, and as a co-founder, leader, and lecturer for the Social and Decision Neuroscience Graduate Bootcamp to prepare incoming graduate students. Brenden has reflected upon his teaching and learning experiences throughout this program and has constructed a teaching portfolio and teaching statement to help him in his future role as an educator. In addition to this letter, Brenden will receive a transcript notation indicating his successful completion of the Certificate of Practice in University Teaching.


CPET, advised by the CTLO at the California Institute of Technology, is led by advanced graduate students and seeks to support graduate students and post-doctoral fellows in their preparation for academic and other professional teaching positions. Individuals choose from a variety of learning and teaching experiences to fulfill the requirements for this letter and transcript notation, including required elements of synthesis and application of effective methods for teaching and learning, assessment and implementation of a teaching philosophy, and refinement of pedagogy through feedback and self-evaluation.

For more information, please see <https://ctlo.caltech.edu/universityteaching/programs/certificates/practice>.

Sincerely,



Dr. David C. Chan  
*Professor of Biology;  
Dean of Graduate Studies*



Dr. Jasmine Bryant  
*Interim Director, CTLO*

4. Brass Division Teaching Award Letter



Jean-Laurent Rosenthal  
Rea A. and Lela G. Axline Professor of Business Economics;  
Ronald and Maxine Linde Leadership Chair, Division of the Humanities and Social Sciences  
1200 E. California Blvd.  
MC 228-77  
Pasadena, CA 91125  
(626) 395-4058  
jlr@hss.caltech.edu

December 03, 2021

Brenden Eum  
California Institute of Technology  
MC 228-77  
Pasadena, CA 91125

Dear Brenden,

Congratulations! As you know, based on the recommendations of the faculty committee, you were selected as one of the recipients of the HSS Brass Division Award for 2021. The award recognizes teaching, mentoring, and other activities that enhance learning among Caltech students, and it comes with a monetary prize of \$1500 (before taxes), which will be included in your December paycheck.

Again, congratulations! We are fortunate to have you in HSS.

Sincerely,

A handwritten signature in black ink, appearing to read "J. Rosenthal".

Jean-Laurent Rosenthal

## 5. Example Recitation Slides for Introduction to Economics

**Caltech**

**Ec 11**  
**Example Recitation**

Brenden Eum

Except for clarification questions, please hold your questions until the end of class.

June 1, 2020

1

**Lecture Review**

Go over confusing topics from class. Hints for what topics are confusing:

- Poorly formatted slides.
- Questions during office hours or email.
- Homework questions that most people answered incorrectly.

3

2

**Preferences**

Source of individual demand and individual supply : preferences and purposeful (optimizing) behavior.  
Preferences are "rationalized" choice ... a binary relation over options (bets), reflexive, transitive).

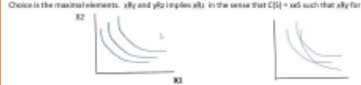
Let  $S$  be the feasible/available set and let  $C(S)$  be the observed choice.

Suppose  $x = C(S_1)$  and  $y = C(S_2)$  then  $x \succ C(S_2)$  and  $x \succ C(S_1)$   
If  $x$  and  $y$  then  $x \succ y$  (preference is transitive)

Suppose  $(x, y) = C(S_1)$  and  $(y, z) = C(S_2)$  then  $(x, z) = C(S_3)$  and  $(x, z) = C(S_1)$   
If  $x$  and  $y$  then  $x \succ z$  (indifference is transitive)

Suppose  $(x, y) = C(S_1)$  and  $y = C(S_2)$  then  $x \succ C(S_2)$  and  $(y, z) = C(S_3)$   
If  $x$  and  $y$  then  $x \succ z$  (preference orders indifference classes)

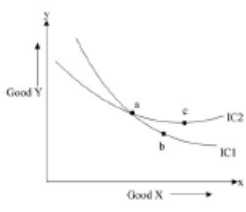
Choice is the maximal elements.  $x$  and  $y$  implies  $x \succ y$  in the sense that  $C(S) = x$  such that  $x \succ y$  for all  $y \in S$



3

3

**Why can't indifference curves cross?**



3

4

**Weekly Report**

Give an example of something we learned this week.

Give my own report first as an example.  
Go over a few exceptional responses:

- Shows that you are reading their responses every week.
- Reward students for high quality work (even if the reports are just participation points).

3

5

**MY BOOKIE** Operations User Settings Casino Betting

Customer Support: Contact, Help, Account, Terms, About, Site, Our Mission, About, Contact

Home | 100% Bonus | International Casino Odds

Who will win the 2020 Presidential Election?  
The odds are 100% in favor of Trump.

The values above are from 10/2/2020 @ 10:35 a.m.  
\*\*Don't bet the odds too high. You'll lose the example point!

Positive American odds reflect your profit should you bet \$100.

Negative American odds reflect the amount of money you would have to bet in order to win \$100.

3

6

### Eve Blank

- Seeking proximity
- Profit maximization
- Cost of rent

Weekly Report

7

### (anonymous)

- Preference
- Optimization over subjective preference

Weekly Report

8

### Adam Abbas

- Effects of a demand shock on price

Weekly Report

9

### Homework

Active engagement.  
 Different approaches to the same question.  
 Go over questions that most people answered incorrectly.  
 Introduce new concepts that the students haven't seen before.

Weekly Report

10

### Q2(a) Sketch and Show

Little Anne consumes candy and fruit juice. Candy costs \$5 per pound and fruit juice costs \$1 per bottle. Anne receives \$50 per month (from her mother) to spend on these items.

Show Anne's consumption opportunities (budget constraint), a set of preferences (indifference curve), and a choice on a graph (nonzero amount).

X axis is quantity of candy, Y axis is quantity of fruit juice. [1 minute]

Homework

11

### Q2(a)

Homework

12

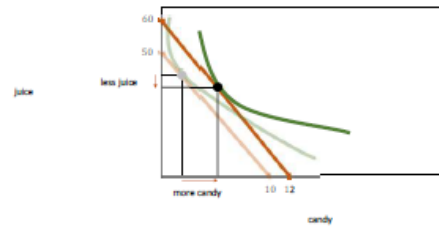
### Q2(b)

Anne's mother has read that fruit juice is good for health and she wants to encourage Anne. She gives Anne an additional \$10 per month.

Show the new budget constraint and draw preferences for Anne that would lead Anne to consume less fruit juice as a result of her mother's encouragement.

13

### Q2(a)



14

### Q3

The utility function is  $U(X_1, X_2) = 2X_1X_2 + X_2$ .  
Income is  $M$ .

Find the demand function for  $X_1$  and  $X_2$  as a function of  $P_1$ ,  $P_2$ , and  $M$ .

15

### Q3 by substitution

$$U = 2X_1X_2 + X_2$$

$$M \geq P_1X_1 + P_2X_2$$

Assumption 1 (A1): Anne will spend everything she has.  
 $M = P_1X_1 + P_2X_2$

Assumption 2 (A2): Anne is an optimizer.

$$\frac{\partial U}{\partial X_j} = 0$$

Using A1,  $X_2 = \frac{M - P_1X_1}{P_2}$

Plug into utility function,  $U = 2X_1 \left( \frac{M - P_1X_1}{P_2} \right) + \left( \frac{M - P_1X_1}{P_2} \right) = \frac{2M}{P_2}X_1 - \frac{2P_1}{P_2}X_1^2 + \frac{M}{P_2} - \frac{P_1}{P_2}X_1$ .

Using A2,  $\frac{\partial U}{\partial X_1} = 0 = \frac{2M}{P_2} - \frac{4P_1}{P_2}X_1 - \frac{P_1}{P_2}$

Solve for  $X_1$ .

16

### Q3 by Lagrangian

$$U = 2X_1X_2 + X_2$$

$$M \geq P_1X_1 + P_2X_2$$

$$L = U + \lambda BC$$

$$L = (2X_1X_2 + X_2) + \lambda(M - P_1X_1 - P_2X_2)$$

$$1. \frac{\partial L}{\partial X_1} = 2X_2 - \lambda P_1 = 0$$

$$2. \frac{\partial L}{\partial X_2} = 2X_1 - \lambda P_2 = 0$$

$$3. \frac{\partial L}{\partial \lambda} = M - P_1X_1 - P_2X_2 = 0 \quad (A1)$$

Solve for  $(X_1, X_2)$  using Eq 1 and 2.

Plug these into Eq 3 and solve for  $\lambda$ .

Plug  $\lambda$  back into Eq 1 and 2 to solve for  $X_1(P_1, P_2, M)$  and  $X_2(P_1, P_2, M)$ .

17

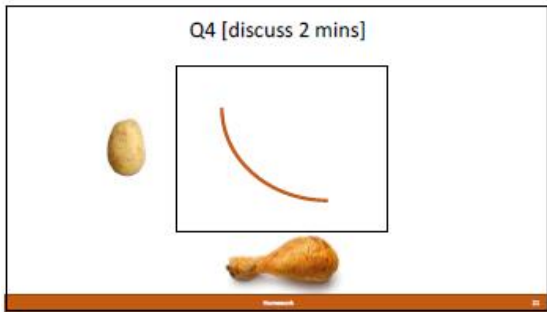
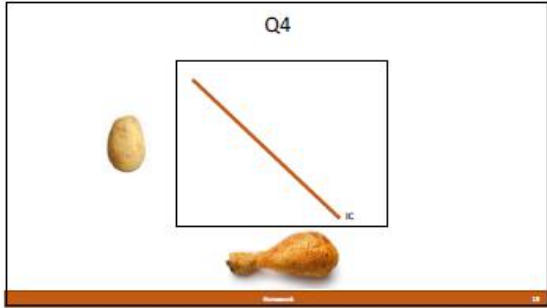
### Q4

Use of Miller's table for your decision on how to allocate your budget. Each of the market baskets gives the equal satisfaction.

| Market Basket | Meat (pounds) | Potatoes (pounds) |
|---------------|---------------|-------------------|
| 1             | 1             | 9                 |
| 2             | 2             | 8                 |
| 3             | 3             | 7                 |
| 4             | 4             | 6                 |
| 5             | 5             | 5                 |
| 6             | 6             | 4                 |
| 7             | 7             | 3                 |
| 8             | 8             | 2                 |

From an economic perspective, there is something troubling about the above information. If Miller ate the cook to your home, with a fixed budget to spend, would you expect Miller to use the five items in descending form for food budget would be allocated?

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6. Example Homework Rubric for Bayesian Statistics

| Q1.   | Q2.  |
|---|--|
| Step 1 +.5/.5   | Step 1 +.5/.5  |
| Correct parameters +.25<br>[w0 .23, k0 59.25, t1 .13]<br>[t500 .24, t948 .27]<br>Correct quantiles +.25 | Sufficient iter +.5<br>[20000, 4 chains]   |
| Step 2 +2/2   | Step 2 +1/1  |
| Rhats $\approx$ one +.5<br>ESS high (mostly >1000) +.5<br>Worst param fits +.5<br>Trace plots +.5       | Omega(_c) posteriors +1  |
| Step 3 +1/1   | Step 3 +.5/.5  |
| Posterior difference +.75<br>[.11, .3]<br>HDI +.25<br>[.10, .13]  | PPC for all c +.5  |
| Step 4 +1/1   | Step 4 +1/1  |
| Posterior difference +.75<br>[-.015, .03]<br>HDI +.25<br>[-.03, 0]                                      | Intuition +1<br>- didn't discuss why the PPC for pitcher still doesn't match data (the same data is available for modeling the individual groups, so modeling individual groups doesn't see much benefit from separating pitchers from others) |
| Step 5 +1/1   |  |
| Omega(_c) posteriors +.5<br>Intuition +.5   |  |
| Step 6 +.5/.5   |  |
| PPC for all c +.5   |  |
| Step 7 +1/1   |  |
| Intuition +1<br>[not exchangeable]  |  |