**Summary of reflection of previous Statistics RPGs**

Below is an excerpt from the valuable insights shared by Statistics RPG after completing the training programme. We recommend considering their experiences as you improve your teaching and develop your course materials.

**Changes in Understanding Students' Difficulties/Key Barriers to Learning Statistics**

1. Students' prior knowledge of statistics
   - The students' prior knowledge of statistics is much **more variable than expected.**

   - Contrary to my initial belief that a lack of resources with appropriate difficulty level was a significant barrier, I have come to realize that the primary difficulty lies in **the absence of foundational knowledge**. Insufficient understanding of fundamental statistical concepts or terminology can impede students' ability to comprehend and apply statistical methods effectively. Also, students may **struggle to connect statistical concepts to real-life scenarios**, leading to a lack of motivation.

2. Students' prior knowledge of programming R
   - Some students found it more difficult to follow the coding exercises than other students. And the key barrier for those students is that they have **no previous coding experience**, consequently, they kept making typos (which is not statistical but rather about syntax) in the codes and cannot proceed as planned.

   - I **underestimated the programming aspect, assuming it would be straightforward as long as I provided step-by-step instructions.** However, during the teaching process, a significant amount of time was devoted to installing and debugging. It became apparent that students without prior coding training struggled to comprehend the code and practical exercises. Additionally, **those who primarily used SPSS (or other languages) in the past exhibited less motivation to engage with the R exercises.** One student in my class was unaware that R is case-sensitive, which resulted in significant time being spent trying to understand the error messages they received.

   - I know most of them **do not have programming experience before and lack confidence in handling statistical procedures**. I provided some sample codes and thought students can run these codes successfully. However, they encounter different problems since **they are new to R Studio**, and I should give more explicit instructions.

3. Learning needs for students without a statistics background
   - I have a clearer and deeper feeling and comprehension of **what raises difficulties in their study and what their underlying demand of learning statistics** is. Statistics can be very hard and abstract. But it can **also be explained in very plain language**. Obviously, students without statistical backgrounds want the latter.

During the workshop, sometimes, I skipped part of the interpretation of some figures or numbers. **Something straightforward in my point of view may be vague for them**.

4. Math anxiety
    - After the training, it is found that students' key difficulty in learning statistics is **math anxiety**. Statistics can be inaccessible if the speaker cannot avoid including formulas. Even though the ideas behind the mathematical formulas are simple, **presenting formulas may still trigger anxiety in students who are not good at math and thus make it difficult for them to think**. This finding has guided me in preparing accessible teaching materials.

**Changes in strategies for designing learning materials for students without a statistical background.**

- Prioritize the teaching focus
  - During the workshop, I observed that the attendees **showed little interest in the settings and backgrounds of the models**; their primary concern was **learning how to utilize them effectively**.

  - I will further **shorten the length of the introduction** to the methods and **focus more on how to apply the methods to real-world scenarios**.

  - Furthermore, I gained knowledge on how to carefully select and **prioritize the essential components to include in the learning materials**. Given the limited duration of the workshop (3 hours), it is crucial to **avoid overwhelming students with excessive information and ensure they have clear takeaways**.

  - And for the coding part, they **focus more on what will be produced and what should I modify if I want something else**. The syntax is not that important.

- Prioritize presenting statistical concepts graphically and verbally, rather than relying solely on mathematical language.
  - I try to **minimize the mathematical details**, put **more effort into the interpretation**, and **give graphical demonstrations as much as possible**. Also, the design learning materials helped me select the proper topic and techniques to be introduced in the workshop.

  - I realized that **careful adjustment** is needed when designing so that the statistical methods **can be easy enough for everyone to understand**. If I have the chance to design another workshop for the general audience in the future, I will definitely refer to what I have learned through this training program. For example, I will include **more graphical illustrations of the ideas behind statistical methods without showing the mathematical formulas**.

  - Instead of the conventional approach of presenting all notations and technical details at the beginning of the workshop, I learned that it is **more effective to start with an intuitive explanation of the concept and introduce the notations gradually as they become relevant**. This approach helps to maintain students' attention from the start.

  - Since most of them have difficulties in understanding the formula or some complex mathematical notation, **I added graphical interpretation and verbal expression next to the equation**. **Introduce each statistical method with an example**. Try to give students some exercises to work out in the middle of the workshop.

**Key challenges or difficulties actually faced during teaching**

1. Accommodating the teaching of students with diverse backgrounds in coding.

    - During the workshop, I encountered a **challenge in accommodating the diverse coding backgrounds of the students**, particularly when it came to the examples and hands-on coding exercises using R. While some students had prior experience with R and were able to engage with the coding activities seamlessly, others **who were unfamiliar with R found the coding tasks to be demanding and challenging**.

    - Some students **got lost in the middle of the workshop**. Some students **encounter some unexpected difficulties in programming**, and I should give them more explicit instructions.

2. Fostering active engagement of students with diverse background

    - The main difficulties I actually faced during the teaching were **how to express in words that they could easily understand, how to keep them interested in the whole study**, and **whether the techniques I introduced could help them solve the problems in their research**. I think I partially found a way to overcome the first two difficulties in the second workshop. However, I am still poor at the third point. It is hard to understand the barriers they face in their field. The topic is unfamiliar to me, and the terminologies in their research are hard to understand. Therefore, I can only give some uncertain feedback to their questions.

    - The main challenge I encountered was **fostering active engagement and encouraging students to ask questions during the class**. For instance, there were students who **didn't complete the coding exercises because R wasn't their programming language of choice**. As a result, they only grasped less than half of the course materials. Additionally, some students **exhibited shyness when it came to asking questions; they would sit through one hour or so and quietly leave afterward**. Despite the manageable class size of approximately eight students, it proved difficult to involve everyone and create a participatory learning environment.

    - The key challenge I actually faced was to **take care of all students and adjust teaching based on their timely feedback**. There was a student who interacted frequently with me during the workshop and showed a good understanding of the materials. However, there also turned out to be a high degree of disparity in students' knowledge of the materials according to the feedback after the workshop. Focusing on the timely positive feedback from the majority of students during the workshop made me **overlook a student who was struggling with Math**. I should have realized earlier the importance of being **more concerned about the silent minority** instead of believing in my own prediction.

**If you had one more chance to teach your workshop again, what would you do differently?**

1. Reduce the time spent on teaching materials/ Narrow down the scope of the materials to allow more time for hands-on activities and examples.

- I would **reserve more time for coding exercises and cut down on some assumption explanations**.

- I should **trim some topics and give them more examples**. A better explanation and instructions on R Studios can be given. The **time control** can be improved. **Do not cover too much material. Just focus on a few topics and provide more examples.**

- I think I will further **narrow down the scope of the materials to be taught** and **give more examples of each technique, especially real-data examples**. I may also change the structure of the PPT slides to give students a clearer understanding of what will be taught and what they will gain from the workshop at the very beginning.

- To ensure adequate time allocation for each section, I plan to **implement stricter time management during future teaching sessions**. This will help me maintain a balanced pace throughout the session and **avoid the need to rush through any parts of the teaching materials**.

2. Adapt teaching materials for students without prior knowledge to encourage their active participation in class.

- I will adapt the teaching materials based on the specific needs of students with math anxiety and **make statistics more accessible and engaging for them**. When explaining statistical concepts, I will **regularly assess students' understanding through quizzes**, which allows me to identify areas where students may be struggling and provide targeted support. I will also **ensure their comprehension by encouraging them to ask more questions**.

3. Offer two workshops on the same topic, customized to accommodate students with varying levels of statistical knowledge.

- I would prepare two different workshops with one **introducing starter level coding** and the **other introducing more sophisticated coding**.

- I became aware of the large variance of students' prior knowledge, and I will **prepare two sets of materials targeting different level of previous exposure to coding for future workshops**. And the workshop may be designed to provide Basic's and Advanced's.