Online Supplement to
"Running Online Experiments Using Web-conferencing Software"
by Jiawei Li, Stephen Leider, Damian Beil, Izak Duenyas

This online supplement offers a general introduction of ZTu setup and experiment process (part A), instructions for both conditions of the dynamic resource allocation task (part B), and instructions for the three diagnostic tasks (part C). If you have any questions, please contact Jiawei Li through jiawli@umich.edu.

Online Supplement A: ZTree Unleashed (ZTu) General Introduction and Online Experiment Procedure

Figure 1: ZTu Network Setup

ZTREE Unleashed (ZTu) was developed by a group of experimental economists at the University of Cologne. In a nutshell, it allows researchers to stream ZTREE experiment programs to subjects who can then access it as a tab in their browsers. ZTu can be deployed in a local server; in our case, it is deployed on a virtual machine running on a server rented from our university; see Figure 1 above for a visual illustration. Once loaded, ZTu essentially runs like an operating system but is designed explicitly for conducting ZTREE experiments (see Figure 2). Researchers can simply load the ZTREE experiment file to ZTu, and then order ZTu to generate web links to be shared with subjects. For the deployment of ZTu on a local server and the initial setup for it, please refer to the developers and their Google group.

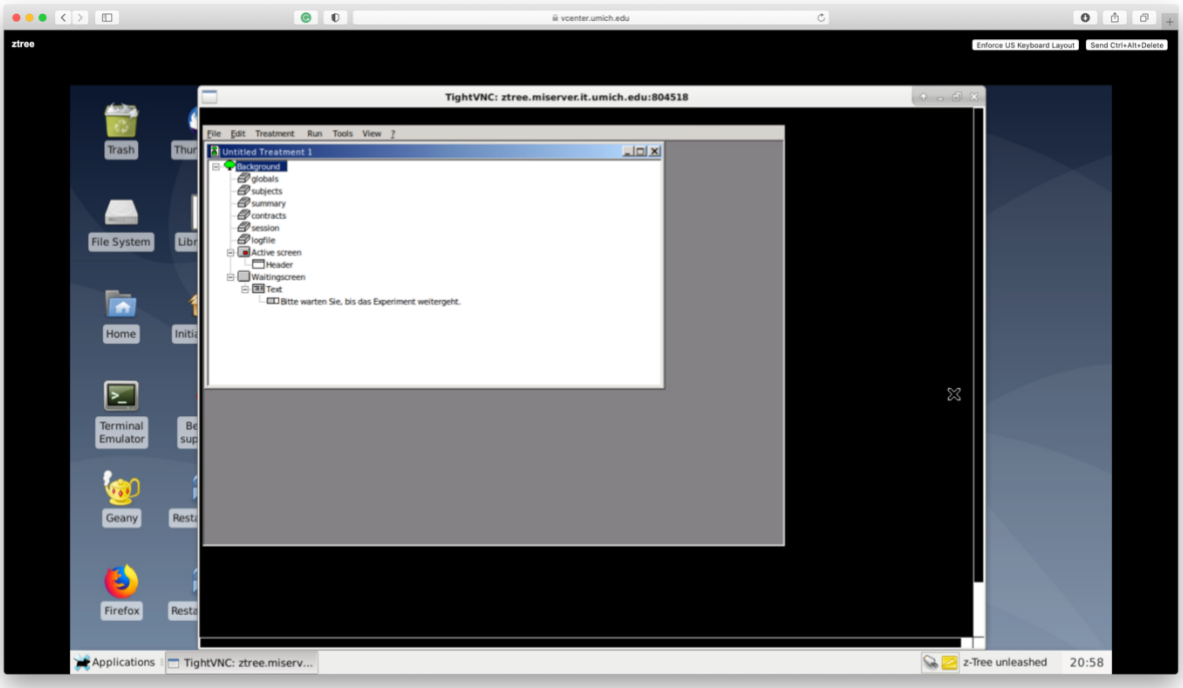

Figure 2: ZTu Experimenter Interface

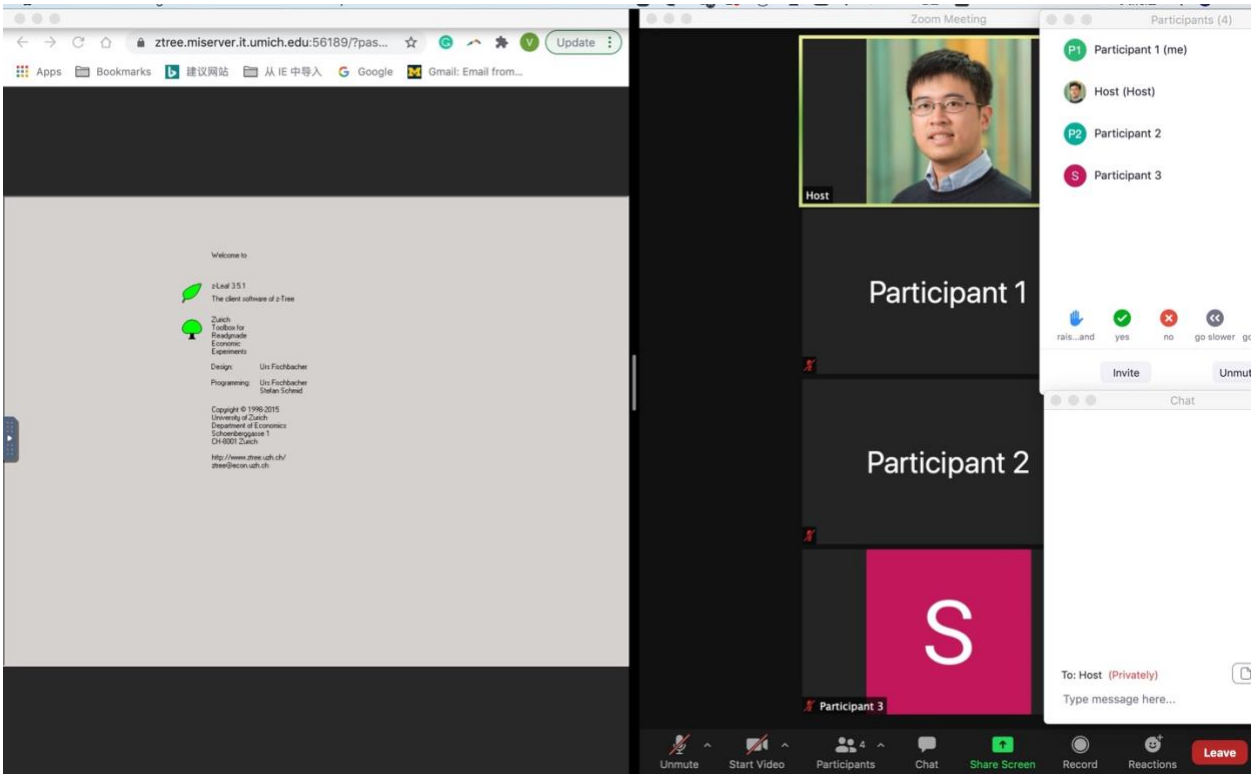

Figure 3: ZTu User Interface Illustration – No Webcam Protocol

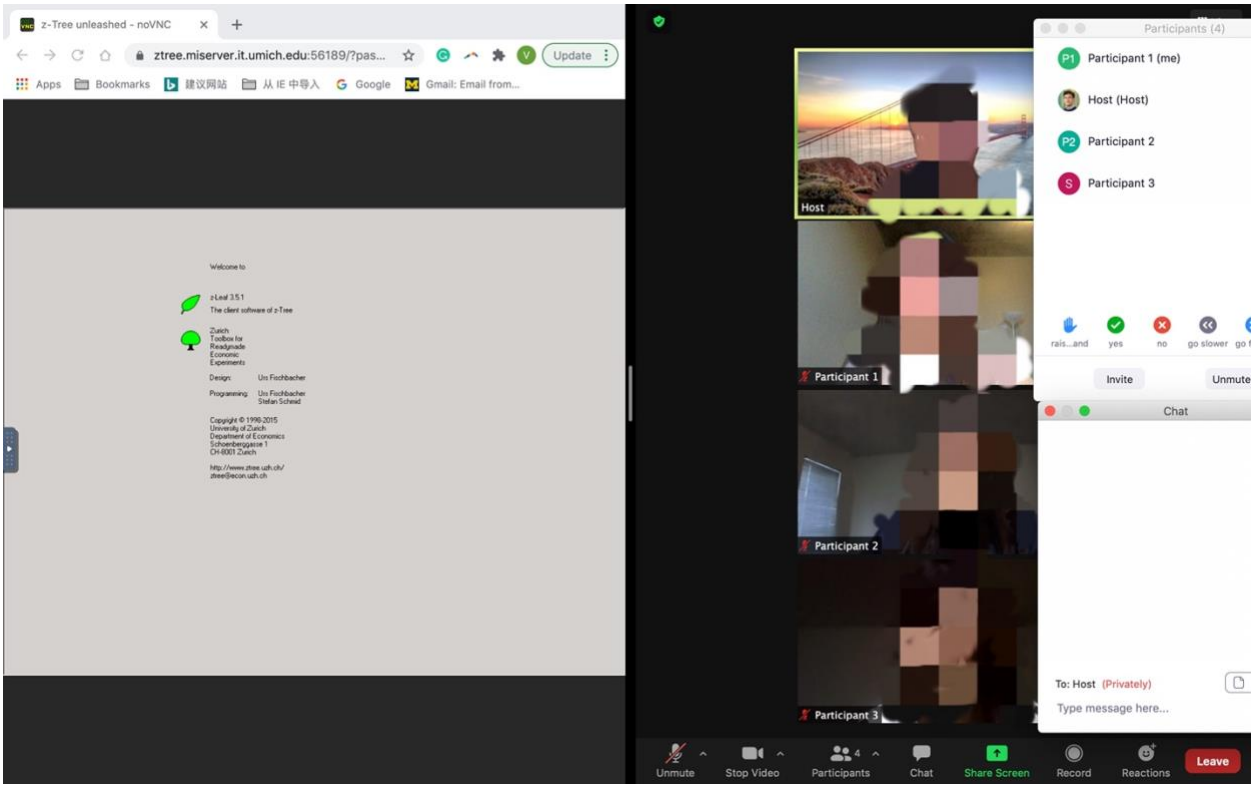

Figure 4: ZTu User Interface Illustration – Webcam Protocol (Subject Image Blurred by the Authors)

After receiving the links, subjects can copy the link to their browser, which will bring them to the pre-experiment webpage. The experimenter can then start the program after making sure all the subjects are connected. At that point, we are ready to conduct experiments using the platform.

Having a proper protocol is essential for the successful implementation of the online experiment. In our study, we employ a general protocol modified from Zhao et al. (2020), with important changes made to address the two online experiment protocols in our study: Webcam versus No Webcam. We also want to note that one essential element of this protocol is having a Zoom room that runs in parallel to the experiment program. See Figures 3 and 4 for illustrations from subjects' viewpoint regarding the two protocols (No Webcam protocol or Webcam protocol).[1]

In our online experiment, the Zoom room mimics the physical (lab) experiment experience of having all the subjects gather, check-in, be monitored by the experimenters, and check out. The Zoom room, therefore, helps with maintaining the general attention level of subjects as they know that we (the experimenters) are always there and monitoring the whole process.

In general, the online experiment procedure can be divided into five steps:

1. **Subject Recruitment.** In order to generate comparable results with the offline (lab) experiments, it is critical to use the same recruitment method and subjects pool in the online experiments. In our study, for both online and offline experiments, we use ORSEE to recruit subjects from the same subject pool; subjects are undergraduate and graduate students from a large public university in the Midwest of the United States. In sending out recruitment emails, we clearly point out that the experiments will be conducted online. In the Webcam protocol, the webcam-on requirement is clearly stated in the recruitment email; we also note that the video will NOT be recorded.
2. **Reminder email and check-in information sent out.** The ORSEE recruitment platform will automatically send out a reminder email 12 hours prior to the start of the experiment. In addition to this, one hour before the experiment, we send out another email to all the registered subjects. This email serves as another reminder and, more importantly, contains the detailed instruction for them to join the experiment. Specifically, we: (1) provide them with the link to the Zoom room set up by us (the experimenter); (2) share the informed consent form with them. Guided by the IRB of our university, subjects in our experiment do not send back the e-signed informed consent form to us. They simply read it before coming to the experiment. On the first page of the experiment program, we have a check box for them to express their consent for the informed consent form.
3. **Experiment check-in and start.** At the scheduled time of the experiment session, subjects join the Zoom room. We rename subjects as soon as they join and check them in using the private message function. All subjects are muted upon entry and are not allowed to unmute themselves during the experiment. We also only enable the private message function between each subject and the researcher; this prevents unintended cross-subject communication. Once we finish the check-in process, we ask if subjects have any questions before we start; in the Webcam protocol, we restate the webcam-on requirement once more. We then start the experiment program.

[1] Figure 3 and 4 are simulated illustrations conducted by the authors. In reality, this is a between subject study, so subjects only experience one of the two protocols. Also, subjects in actual sessions may have different ways of organizing the windows, such as minimizing the Zoom window and only having the experiment window open.

4. **Starting the Experiment.** Once the experiment starts, we use the audio function and the private message function in Zoom to communicate with the subjects. (If desired, we can also read the instruction out loud to all the subjects using the audio function of Zoom. This ensures the "public information" required by some experiments, although it is not crucial for our particular study which is an individual decision-making experiment.) We also want to note two extremely useful features of ZTu in helping researchers monitor the experiment progress. First, in the ZTREE program run on ZTu, we can monitor the experiment progress by making use of the client table (which lists all the connected subjects and which experimental stage they are in), just like in the offline (lab) experiment. Second, ZTu allows us to observe what each subject is doing in the program. For example, we can observe the mouse movement, subjects entering and deleting answers, and so on; of course, we will not be able to observe their actions on their personal computer beyond the usage of the experiment program.
5. **Finishing the Experiment.** After we finish the experiment, we clarify the payment method to subjects and answer any of their final questions. We offer two payment options for subjects: physical paycheck or Amazon e-gift card. The subjects can then leave the Zoom room and close the program.

As we can see from above, the online experiment procedure is comparable to the offline experiment procedure. The recruitment part (step 1) is identical except for the contents of the email. The implementation part (steps 2-5) is adjusted accordingly to enable remote execution of the experiment and continuous monitoring of participants throughout the experiment.

Online Supplement B: Instructions for Dynamic Resource Allocation Task

This section includes the instructions for the two conditions of the dynamic resource allocation task. To save space, below, we include the instructions for online experiments only. The instructions for offline (lab) experiments are identical, except that the paragraph related to Zoom information is removed.

Online Supplement B.1: Instructions the Constant Cost (Simple) Condition

Welcome. Thank you for joining the experiment.

Starting from this point, please don't talk to other participants or look at their screens. Please do not use other electronic devices during the whole experiment.

During the experiment, you will be muted in the Zoom room. However, if you have any questions, please feel free to use your Zoom to text the host (experimenter). If you accidentally close the web tab for the experiment, simply click the link on your Zoom again to get reconnected.

Please make sure that you have reviewed the informed consent form shared to you earlier. By checking the box on the screen, you will certify that you have read and agreed with the informed consent form.

Today's session is a study of product development management.

There are two stages of the main experiment. The first stage, which is the main part of the experiment, consists of managing 5 product development projects. The second stage consists of several decision tasks that are not directly related to the first stage; the instruction for the second stage will be given after we finish the first stage. There will be a short survey after the main experiment.

In the first stage, the 5 projects are **independen**t of each other. For each product development project, you will be asked to make a series of decisions that will affect your payoff. The payoff is expressed in Experimental Currency Units (ECUs), with an exchange rate of 2000 ECU to 1 dollar.

At the end of the experiment, we will randomly select **one** product development project and use your earned ECU in that project, plus payoff from stage 2 and 5 dollars show-up fee, to determine your final payoff. At the end of the experiment, you will also need to complete a survey that collects your payment-related information.

Stage 1: Making Sequential Decisions for One Product Development Project

The following instruction demonstrates how decisions will be made in managing **one** product development project.

The project will last for 10 periods, and you have a total budget of 5000 ECU. At the beginning of each period, you will be presented with a design opportunity to improve the design of your product. Each design opportunity costs you 1000 ECU. In other words, you can implement at most 5 design opportunities.

Each design opportunity, if implemented, will bring you certain benefits. In particular, the benefit takes three possible values: 6000 ECU, 4000 ECU, or 2000 ECU. You will not be able to see the benefit of each design opportunity until you have reached the beginning of the period.

For example, if you are at the beginning of period 1, you will observe the benefit of the design opportunity for period 1, but you do **not** observe the benefit of the design opportunity for period 2, period 3, … , period 10. However, you do know that the **three possible values happen with equal probability** for each design opportunity.

There is no correlation between the benefits of these 10 design opportunities. That is, you **cannot** make inference for future benefits based on historical benefits. Also, you **cannot** reinvest the benefit you have collected for future design opportunities. In other words, the 5000 ECU is the **only** financial resource you can use to implement design opportunities.

Your payoff for each product development project is determined by the **total amount** of benefits you collect, plus any unspent budget.

In summary, the sequence of events is as follows:

1. You enter a new period. You are presented with the information regarding your remaining budget and the history of your decision-making.

2. If you still have an unspent budget, you will be asked to think carefully about your investment strategy **for this period**. Specifically, you will choose the minimum value of design benefit you are willing to accept.

    For example, if you choose 4000 ECU, then this means you are willing to implement the design opportunity **only if** its benefit is 4000 ECU or 6000 ECU **in this period**, and you will **not** want to implement it if its benefit is 2000 ECU. You have 1 minute to make this decision.

3. The actual benefit for the design opportunity of this period is shown to you. There are two possible outcomes:

    a. If the benefit is within what you have chosen to implement in step 2, then you will implement the design opportunity and earn the corresponding benefit, and your budget will be deducted by 1000 ECU.

    b. If not, then the design opportunity is not implemented; no benefit is collected, and your remaining budget is unchanged.

4. You proceed to the next period.

At the end of the product development project (10th period), if you still have a remaining budget, it will be added to your total benefit collected. You will also see a final summary screen for this product development project. You will then proceed to a new product development project. All projects share the same decision sequence outlined above.

In the history table, you will be able to see your decisions from previous projects as well, but please be noted that projects are independent of each other. In other words, the sequence of realized benefits you observe in one project **does not** predict the sequence of realized benefits for another product

development project. **Finally, please be sure to make decisions in every period**; skipping decision periods will make you lose valuable opportunities to earn payoffs.

Online Supplement B.2: Instructions for the Increasing Cost (Complex) Condition

Welcome. Thank you for joining the experiment.

Starting from this point, please don't talk to other participants or look at their screens. Please do not use other electronic devices during the whole experiment.

During the experiment, you will be muted in the Zoom room. However, if you have any questions, please feel free to use your Zoom to text the host (experimenter). If you accidentally close the web tab for the experiment, simply click the link on your Zoom again to get reconnected.

Please make sure that you have reviewed the informed consent form shared to you earlier. By checking the box on the screen, you will certify that you have read and agreed with the informed consent form.

Today's session is a study of product development management.

There are two stages of the main experiment. The first stage, which is the main part of the experiment, consists of managing 5 product development projects. The second stage consists of several decision tasks that are not directly related to the first stage; the instruction for the second stage will be given after we finish the first stage. There will be a short survey after the main experiment.

In the first stage, the 5 projects are **independen**t of each other. For each product development project, you will be asked to make a series of decisions that will affect your payoff. The payoff is expressed in Experimental Currency Units (ECUs), with an exchange rate of 2000 ECU to 1 dollar.

At the end of the experiment, we will randomly select **one** product development project and use your earned ECU in that project, plus payoff from stage 2 and 5 dollars show-up fee, to determine your final payoff. At the end of the experiment, you will also need to complete a survey that collects your payment-related information.

Stage 1: Making Sequential Decisions for One Product Development Project

The following instruction demonstrates how decisions will be made in managing **one** product development project.

You are the program manager of a product development project. Your team is now developing a new product under a given financial budget. Your responsibility is to monitor the development process and allocate financial resources wisely.

The project will last for 10 periods. At the beginning of each period, you will be presented with a design opportunity to improve the design of your product. Each design opportunity, if implemented, will bring you certain benefits. In particular, the benefit takes three possible values: 7000 ECU, 5000 ECU, or 3000 ECU. You will not be able to see the benefit of each design opportunity until you have reached the beginning of the period.

For example, if you are at the beginning of period 1, you will observe the benefit of the design opportunity for period 1, but you do **not** observe the benefit of the design opportunity for period 2, period 3, …, period 10. However, you do know that the **three possible values happen with equal probability** for each design opportunity.

Meanwhile, implementing design opportunities will incur financial costs, and you must decide how to spend your money wisely. For each project, you have a total budget of **6000 ECU**. In period 1 to 5 (phase 1), each design opportunity costs you **1000 ECU**. In period 6 to 10 (phase 2), it becomes more expensive to implement each design opportunity: Each design opportunity costs you **2000 ECU**.

Note that the increase in cost means that you need to have **at least** 2000 ECU in your budget to be able to handle any design change in period 6-10. In addition, suppose you enter period 6 with a remaining budget of 3000 ECU, then you can only implement **one** design opportunity in period 6-10.

There is no correlation between the benefits of these 10 design opportunities. That is, you **cannot** make inference for future benefits based on historical benefits. Also, you **cannot** reinvest the benefit you have collected for future design opportunities. In other words, the 6000 ECU is the **only** financial resource you can use to implement design opportunities.

Your payoff for each product development project is determined by the **total amount** of benefits you collect, plus any remaining budget.

In summary, the sequence of events is as follows:

1. You enter a new period. You are presented with the information regarding your remaining budget and the history of your decision-making.

2. If you still have a remaining budget greater than or equal to the cost to implement a design change (**1000 ECU in period 1-5, 2000 ECU in period 6-10)**, you will be asked to think carefully about your investment strategy **for this period**. Specifically, you will choose the minimum value of design benefit you are willing to accept.

    For example, if you choose 5000 ECU, then this means you are willing to implement the design opportunity **only if** its benefit is 5000 ECU or 7000 ECU **in this period**, and you will **not** want to implement it if its benefit is 3000 ECU. You have 1 minute to make this decision.

3. The actual benefit for the design opportunity of this period is shown to you. There are two possible outcomes:

    a. If the benefit is within what you have chosen to implement in step 2, then you will implement the design opportunity and earn the corresponding benefit, and your budget will be deducted by **1000 ECU** if in period **1-5**, or **2000 ECU** if in period **6-10**.

    b. If not, then the design opportunity is not implemented; no benefit is collected, and your remaining budget is unchanged.

4. You proceed to the next period.

At the end of the product development project (10th period), if you still have a remaining budget, it will be added to your total benefit collected. You will also see a final summary screen for this product development project. You will then proceed to a new product development project. All projects share the same decision sequence outlined above.

In the history table, you will be able to see your decisions from previous projects as well, but please be noted that projects are independent of each other. In other words, the sequence of realized benefits

you observe in one project **does not** predict the sequence of realized benefits for another product development project. **Finally, please be sure to make decisions in every period**; skipping decision periods

Online Supplement C: Instructions for The Three Diagnostic Tasks

The same set of instructions are applied across all three experiment formats, with the only exception that the numbers in the questions of the CRT are modified to be different from the version in Frederick (2005) to prevent directly searchable results from the internet. The CRT instruction below shows the modified questions. The original questions in Frederick (2005) are used in the offline (lab) experiments.

General Information

In this stage, you will answer three simple decision tasks. The three tasks are not related to each other. Successfully answering each question will bring you extra monetary payoffs. Again, the reward is expressed in terms of Experimental Currency Units (ECUs), and the exchange rate is 2000 ECU to 1 dollar. You have 5 minutes to finish each decision task. Their payoff will be added to your total payoff, which will be shown at the end of the experiment.

Decision Task 1: Lottery Decision-Making

On the screen, you will see 10 decisions. For each decision, please select either the fixed amount, or the lottery.
At the end, one out of the ten decisions will be randomly selected for payment. For that decision, you will be paid the outcome for the fixed amount or the lottery you chose.

Decision #	Fixed Amount	Lottery	Your Choice (Fixed Amount or Lottery)
1	1000 ECU	50% of 6000 ECU, 50% of 1000 ECU	
2	1500 ECU	50% of 6000 ECU, 50% of 1000 ECU	
3	2000 ECU	50% of 6000 ECU, 50% of 1000 ECU	
4	2500 ECU	50% of 6000 ECU, 50% of 1000 ECU	
5	3000 ECU	50% of 6000 ECU, 50% of 1000 ECU	
6	3500 ECU	50% of 6000 ECU, 50% of 1000 ECU	
7	4000 ECU	50% of 6000 ECU, 50% of 1000 ECU	
8	4500 ECU	50% of 6000 ECU, 50% of 1000 ECU	

9	5000 ECU	50% of 6000 ECU, 50% of 1000 ECU	
10	5500 ECU	50% of 6000 ECU, 50% of 1000 ECU	

Decision Task 2: Answering Three Calculation Questions

Please answer the three questions shown on your screen. You will receive 1000 ECU for each question you get correct.

- **Question 1.** A bat and a ball cost $2.05 in total. The bat costs $1.85 more than the ball. How much does the ball cost? (answer in number of cents)
- **Question 2.** If it takes 7 machines 7 minutes to make 7 widgets, how long would it take 50 machines to make 50 widgets? (answer in number of minutes)
- **Question 3.** In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 26 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake? (answer in number of days)

Decision Task 3: Hit-15

Consider the following two-person game: There is a basket in which people place points. The two players take turns placing 1, 2, or 3 points in the basket. The person who places the 15th point in the basket wins a prize. Say you are playing and want to win the prize. You will answer two questions regarding the actions you will take in this decision task.

Please answer the following two questions. You will receive 1000 ECU for each question you get correct.

- **Question 1.** If you go first, how many points will you place in the basket? Please pick one of the answers below (1, 2, or 3).
- **Question 2.** If you go second and the other player has already put 2 points in the basket on her first turn, how many would you put in? Please pick one of the answers below (1, 2, or 3).

Reference:

Frederick, S. (2005). Cognitive reflection and decision making. Journal of Economic perspectives, 19(4), 25-42.

Zhao, S., López Vargas, K., Friedman, D., & Gutierrez, M. (2020). UCSC LEEPS Lab Protocol for Online Economics Experiments. Available at SSRN 3594027.