**Biosecurity Game Instructions  
Base Version**

**Author: Mark Hurlstone**

**Editors: Benedict White, Joel Dunstan**

**Table of Contents**

[Part 2: The Biosecurity Game 2](#_Toc483512513)

[Your Anonymity 2](#_Toc483512514)

[Background Context 2](#_Toc483512515)

[The Game 2](#_Toc483512516)

[The Stages 3](#_Toc483512517)

[Protection Decision Stage 3](#_Toc483512518)

[Outcome Feedback Stage 4](#_Toc483512519)

[Your Payout 4](#_Toc483512520)

# **Part 2: The Biosecurity Game**

Please read through these instructions carefully. If you have any questions please contact one of the experimenters. You are about to take part in an experiment about collective decision-making related to risky choices. This experiment gives you an opportunity to earn money. How much you earn depends partly on your decisions, partly on the decisions of others, and partly on chance.

## **Your Anonymity**

All decisions you make in the game are anonymous. To ensure this, a pseudonym is assigned to you by the computer. The anonymous name you have been assigned is Neptune.

## **Background Context**

In this experiment, you are a farmer in a region with three other farmers (viz. your co-players in the game). Each season, your crop will generate revenue. You will receive this revenue in the seasons where there is no pest outbreak. When a pest outbreak occurs, the pest spreads quickly and infects all neighbouring farms, resulting in the loss of that season’s crop. You will generate no revenue in a season where a pest outbreak occurs.

At the start of each season, you must decide how much effort you will invest in protecting your crops against a pest outbreak. There is a financial cost associated with this effort—as the amount of effort you invest increases, so too does the cost of protection. You do not have to pay any cost if you choose to invest zero effort in protection.

The probability of a pest outbreak occurring is variable and depends on the amount of effort both you and your co-players invest in protection.

## **The Game**

The game consists of 15 playing rounds, with each round corresponding to a growing season. Each player starts the game with a $50.0 operating fund. On each round, your crop will generate your potential revenue of $25.0. You must also pay a $5.0 production cost. This is the labour cost of producing your crop, which you have no control over. You can also choose the amount of effort and money that you wish to invest in protecting your crops against a pest outbreak. The amount of effort you may invest in protection varies between 0% (with a cost of $0) and 100% (with a cost of $10.0).

If there is no pest outbreak you will receive your revenue of $25.0, minus the $5.0 cost of production and the cost of protection. For example, if you chose to invest 100% effort in protecting your crops then your cost of protection would be $10.0. Accordingly, your income for the round would be $10.0—viz.

$25.0 (revenue from crop) - $5.0 (cost of production) - $10.0 (cost of protection) = $10.0.

If there is a pest outbreak each player’s crop revenue will be lost. Based on the above example, your income for the round would be -$15—viz.

$0 (revenue from crop) - $5.0 (cost of production) - $10.0 (cost of protection) = -$15.0.

If you had contributed 0% effort in protecting your crops, with an associated cost of $0, then your income for the round would be -$5.0—viz.

$0 (revenue from crops) - $5.0 (cost of production) - $0 (cost of protection) = -$5.0.

As you can see, when there is a pest outbreak your income for the round will necessarily be negative, with the extent of your losses increasing with the amount of effort you invested in protection.

Whether or not there is a pest outbreak on a round is based on a joint probability calculated on the amount of protection you and each of your group members decide to provide. How the joint probability is calculated is illustrated in the following two examples:

Example 1: Imagine a round where there are 4 players and each player contributes an effort of 90% towards protection to give a 90% chance that each player is not the source of a pest outbreak. The joint probability of an outbreak is:

Probability of Outbreak = 1 - Player 1's Probability × Player 2's Probability × Player 3’s Probability × Player 4’s Probability

Probability of Outbreak = 1 - (0.9) × (0.9) × (0.9) × (0.9)

Probability of Outbreak = 1 - 0.66

Probability of Outbreak = 0.34 or 34%

Example 2: Imagine another round, again with 4 players, where players 1, 2, and 3 contribute 90% and player 4 contributes 10%. The joint probability of an outbreak is:

Probability of Outbreak = 1 - Player 1's Probability × Player 2's Probability × Player 3’s Probability × Player 4’s Probability

Probability of Outbreak = 1 - (0.9) × (0.9) × (0.9) × (0.1)

Probability of Outbreak = 1 – 0.07

Probability of Outbreak = 0.93 or 93%

As can be seen from these examples, the chance of a pest outbreak is determined based upon the amount of protection each group member provides. Even if all players provide a relatively high amount of effort toward protection, there is still a relatively high risk of a pest outbreak (e.g., Example 1). If most players provide a relatively high amount of effort toward protection, but just a single player provides a relatively low amount of effort toward protection, then there is a very high risk of a pest outbreak (e.g., Example 2). The chance of a pest outbreak is completely determined by you and your group's actions.

# **The Stages**

## **Protection Decision Stage**

In this stage, you will use a slider to indicate how much effort you want to invest in protecting your crops. For a given effort level, indicated by the position of the slider, you will be able to see the cost of protection and the associated probability that you will not be the source of a pest outbreak. Remember, this game is based on joint probability—your individual probability is not an indicator of the group's probability of a pest outbreak, even if other players provide the same amount of protection. The maximum amount of protection you can provide per round will be $10.0, the cost of production will be $5.0 and the amount of revenue to gain in the event no incursion occurs is $25.0.

## **Outcome Feedback Stage**

In this stage you will receive feedback about whether or not there was an outbreak of pests, and your income for the round. You will not receive feedback on how much protection other players provided, only whether there was an outbreak of pests or not.

## **Your Payout**

At the end of the experiment, you will be paid any revenue generated during the biosecurity game, subject to a conversion rate. The conversion rate is your revenue earned × 0.1. For example, if your revenue earned was $300 then you would be paid 300 × 0.1 = $30.