Lab 01: Guidelines for Evaluating Student Work

General Grading Criteria

1. **Documentation:** Ensure that the code is well-documented with comments explaining key sections of the code, including equations and important steps.
2. **Organization:** Write clean and well-organized code. Follow a logical structure that is easy to follow. Use functions appropriately for modular code design.
3. **Clarity:** Ensure that your plots are clear, labeled, and easy to interpret. Use appropriate titles and axis labels. Include legends where necessary.

Specific Grading Criteria

Exploring chaos with the discrete logistic equation

1. **Function Implementation (`R` function):** Properly implement the `R` function for the logistic equation:
$$x_{n+1} = \lambda \cdot x_n \cdot (1 - x_n) \tag{1}$$
2. **Simulation and Plotting:** Correctly simulate population size changes over time for different values of λ. Plot x as a function of time with 4×4 panels, each corresponding to a different value of λ.
3. **Discussion:** Provide a clear discussion of the effect of λ on the dynamics based on the panel plot. Discuss bifurcations, chaos, and stability.

Fitting a logistic equation to data

1. **Function Implementation (`logistic_model` function):** Properly implement the `logistic_model` function for the logistic growth equation:
$$x_{n+1} = r \cdot x_n \cdot \left(1 - \frac{x_n}{K}\right) \tag{2}$$
2. **Simulation and SSE Calculation:** Correctly simulate population size changes over time using the logistic equation. Calculate the sum of squared errors (SSE) for each combination of parameters and initial conditions.
3. **Optimal Parameter Finding:** Find the combination of parameters (r, K) and initial conditions (x_1) that minimize the SSE. Use array indexing to extract optimal parameter values.
4. **Plots:** Create clear plots showing SSE as a function of each model parameter (r, K) and initial condition x_1. Include visualizations of the fitted model against the observed data.
5. **Conclusion:** Provide a clear conclusion about the best-fit parameter values based on the analysis of SSE plots. Discuss the biological interpretation of the parameters.