

ESTONIAN UNIVERSITY OF LIFE SCIENCES

Institute of Forestry and Engineering

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**TARKVARARAKENDUS „BirdfeedersForest“**

CONSOLE APPLICATION “BirdfeedersForest”

Software application

Curriculum in Software design, programming and Data Management

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Tartu 2024

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**Application “BirdfeedersForest”**

**Purpose of the Application.**

The purpose of the console application “Birdfeeders” is to determine the impact of presence of humanmade birdfeeders in the forest subject of study on the ecosystem health which would be expressed in survival rate of birds in the forest and on the increased attractiveness of such a forest in the eyes of human visitors with children, who would be attracted by birds chirping and would enjoy bird feeding as a form of entertainment and as a way to experience outdoors.



Figure 1

As scientific studies by Millikin University in six forested sites in Illinois, US showed, “the individual health of birds improved with the presence of humanmade feeders with supplemental feeding, including increased antioxidant levels, reduced stress (heterophil-to-lymphocyte ratio) and more rapid feather growth. In some species, there was improved body condition index scores and innate immune defence” **(Wilcoxen E, et al 2015**). In general, with the presence of birdfeeders with grains, there were observed consistent patterns of birds being in greater overall health . “The simple act of putting out a bird feeder and keeping it clean and full can greatly improve the chances that birds and their offspring will survive. Survival rates for birds and their offspring were 38 percent higher in areas where bird feeders were present, and places with bird feeders have a higher percentage of young birds recruited into the breeding population than places without” (The Benefits of Bird Feeding - <https://www.perkypet.com/articles/the-benefits-of-bird-feeding> ).

I incorporated the data above in one of the functions designed to determine at the end the degree of attractiveness of a theoretical forest of an area of 5000 hectares in the visitors eyes.

Besides, bird feeders provide food during cold, barren months, give birds energy for migration, supplement natural food resources. As for humans, they offer relaxation and decrease stress. “In a world overwhelmed with technology, the joyful chirping of wild birds provides for visitors a nice escape to unwind from daily stressors.” (The Benefits of Bird Feeding”).

**Figure 2:**



**Short guide for using the program**

To run this program, you need a Python version at least 3.12.

To test my application, go to my Github (https://github.com/Makintosh24/SoftwareApplicationBirdfeeders), download the file:

Go to the repository, click the green button “CODE”, Download Zip.

Download repository as a zip file and unpack in in the folder of your choice.

I take this ZIP to my desktop. Extract it from zip, “Birdfeeders”.

We go to the source . Download Python 3.12 or higher on the computer.

Open the folder, run the command src\main.py

In the shell –

A computer screen with white text

Description automatically generated

Open the shell- find the folder with **the source**.

I go to the source, I open the main.py and I run it in Python and test it.

I have a fully open license.

**The source.**

# BirdfeedersForest app

#

# to start go to folder birdfeeders and type

# python.exe .\src\main.py

#

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import math

# Variable declarations

birdfeeders: int = 0 # Number of bird feeders in the forest of 5000 ha

# Calculated final survival rate based on diminishing returns formula

calculated\_survival\_rate: float = 0.0

# Forest attractiveness description

forestattractiveness: str = "The forest is considered more attractive due to the increased healthier bird population."

# Function to classify bird feeders

def classify\_bird\_feeders(feeders: int) -> tuple:

if feeders < 1:

return 'O', (0.0, 0.0)

elif 1 <= feeders <= 3:

return 'A', (0.1, 0.3)

elif 4 <= feeders <= 6:

return 'B', (0.3, 0.6)

elif feeders >= 7:

return 'C', (0.6, 0.99)

# Function to calculate survival rate

def calculate\_survival\_rate\_with\_diminishing\_returns(feeders: int, initial\_rate: float) -> float:

k = 0.38

survival\_rate = initial\_rate + math.log10(1 + k \* feeders)

return min(max(survival\_rate, 0.1), 0.99)

# Function to determine forest attractiveness

def calculate\_attractiveness\_with\_diminishing\_returns(feeders: int, survival\_rate: float) -> str:

if feeders == 0 or survival\_rate < 0.2:

return "Not very attractive"

elif 1 <= feeders <= 3:

if survival\_rate < 0.4:

return "Moderately Attractive"

elif 0.4 <= survival\_rate < 0.7:

return "Quite Attractive"

elif survival\_rate >= 0.7:

return "Highly Attractive"

elif 4 <= feeders <= 6:

if survival\_rate < 0.5:

return "Moderately Attractive"

elif 0.5 <= survival\_rate < 0.8:

return "Quite Attractive"

elif survival\_rate >= 0.8:

return "Highly Attractive"

elif 7 <= feeders <= 10:

if survival\_rate < 0.7:

return "Moderately Attractive"

elif 0.7 <= survival\_rate < 0.9:

return "Quite Attractive"

elif survival\_rate >= 0.9:

return "Highly Attractive"

elif feeders > 10:

return "Saturated Attractiveness"

else:

return "Undefined"

# Main function

def main():

print("Welcome to the Forest Attractiveness Calculator!")

while True: # Main loop to keep the program running until the user exits

try:

# Input number of feeders

birdfeeders = int(input("Enter the number of bird feeders (or -1 to exit): "))

if birdfeeders == -1:

print("Thank you for using the Forest Attractiveness Calculator. Goodbye!")

break # Exit the loop after printing the goodbye message

if birdfeeders < 0:

print("Number of feeders cannot be negative.")

continue

if birdfeeders > 20:

print("Allowed number of feeders is between 0 and 20. Please try again.")

continue

# Input for initial survival rate

initial\_survival\_rate = float(input("Enter the initial survival rate of birds (between 0.0 and 1.0): "))

if not (0.0 <= initial\_survival\_rate <= 1.0):

print("Invalid input. Survival rate must be between 0.0 and 1.0.")

continue

# Process results

feeders\_segment, survival\_rate\_range = classify\_bird\_feeders(birdfeeders)

final\_survival\_rate = calculate\_survival\_rate\_with\_diminishing\_returns(birdfeeders, initial\_survival\_rate)

attractiveness = calculate\_attractiveness\_with\_diminishing\_returns(birdfeeders, final\_survival\_rate)

# Display results

print("\nAnalysis Result:")

print(f"Number of Bird Feeders: {birdfeeders}")

print(f"Feeders Segment: {feeders\_segment}")

print(f"Initial Survival Rate: {initial\_survival\_rate:.2f}")

print(f"Final Survival Rate with Diminished Returns: {final\_survival\_rate:.2f}")

print(f"Forest Attractiveness: {attractiveness}")

print(f"\n{forestattractiveness}")

print("-" \* 40)

# Prompt for new calculation

new\_calc = input("New calculation (y or n)? ").strip().lower()

if new\_calc in ["n", "no"]:

print("Thank you for using the Forest Attractiveness Calculator. Goodbye!")

break # Exit the program after printing the goodbye message

elif new\_calc in ["y", "yes"]:

continue # Continue the loop and start the next calculation

else:

print("Invalid input. Please enter 'y' or 'n'.")

except ValueError:

print("Invalid input. Please enter a valid number.")

# Keep the terminal open (if running in some environments)

input("Press Enter to exit...") # This ensures the terminal window stays open if needed

# Run the program

if \_\_name\_\_ == "\_\_main\_\_":

main()

**Rules for input**

The application at the final output determines the extent of attractiveness of the forest in the eyes of the human visitors as a function of the number of birdfeeders, implying that a greater amount of birdfeeders attracts more birds, who have more healthy offspring, who attract more human visitors as a result by solving orderly the following two problems:

**1)**Function to classify bird feeder segments:

This function categorizes the number of bird feeders into segments such as "A" (few feeders), "B" (moderate feeders), and "C" (many feeders).

**Outputs**:

* The function returns a segment label (e.g., "A", "B", "C").
* It also returns the **range of survival rates** based on the number of feeders (for example, "A" corresponds to survival rates between 0.1 and 0.3).

For that, we input the number of the supposed birdfeeders in a theoretical forest with area of 5000 hectares. The maximum number of birdfeeders for such a forest is 20.

The function assigns feeder segments (A, B, C) directly to corresponding survival rate ranges (0.1-0.3, 0.3-0.6, 0.6-0.9). The reasoning is that as the number of feeders increases, the potential bird survival rate increases naturally.

This implementation uses a natural logic where:

* Fewer feeders lead to lower survival rates (Segment A).
* Moderate number of feeders correspond to medium survival rates (Segment B).
* Many feeders correspond to high survival rates (Segment C).

The survival rates are assigned based on the segments to reflect a realistic ecological relationship: more feeders result in higher potential survival rates thus the model reflects the idea that feeder quantity and survival are closely correlated.

2) The second function is **calculate\_survival\_rate\_with\_diminishing\_returns**: This function is designed to calculate the **bird survival rate** using a logarithmic formula to model the **diminishing returns effect** based on the number of feeders. It takes **feeders** and a user-provided **initial\_rate** as inputs and adjusts the survival rate according to a scaling factor k.

Calculate the survival rate of birds in a forest containing birdfeeders based on diminishing returns formula using a logarithmic function to model diminishing returns

survival\_rate = initial\_rate + math.log10(1 + k \* feeders)

implying that the survivalrate increases as the number of feeders, but at a diminishing rate. This approach reflects the reality that once a certain level of feeders is reached, adding more feeders has less impact on survival, as food is no longer the only limiting factor. This is a realistic model of how resources affect bird survival rates in nature.

If it has been observed that survival rates for birds and their offspring increase by **38%** in areas with bird feeders, this impacts the **scaling factor** (commonly represented as k) in the logarithmic function used to model diminishing returns.

The formula for the **survival rate with diminishing returns** is:

survival\_rate = initial\_rate + math.log10(1 + k \* feeders)

In this formula:

* k is a scaling factor that influences how much the number of feeders impacts the survival rate.
* The survival rate increment is modeled to grow at a diminishing rate as the number of feeders increases (logarithmic growth).

**Output**: It calculates the **final survival rate** using a logarithmic function to represent diminishing returns.

Inside the application, I declared the following three variables of different types:

BIRDFEEDERS: **int** = 0 – for number of birdfeeders in the forest

CALCULATED SURVIVAL RATE: **float** = 0.0 - the calculated final survival rate as a function of the number of birdfeeders based on diminishing returns formula

FOREST ATTRACTIVENESS DESCRIPTION : **str = "The forest is considered more attractive due to the increased healthier bird population.**" – a statement which describes the extent of attractiveness of the forest as a recreation site for visitors as a function of the number of the feeders. Attractiveness of the forest as a descriptive string. This specific message will automatically appear as part of the output regardless of the attractiveness levels determined by feeders.

As for the first function, To activate the Forest Attractiveness calculator, we insert the number of birdfeeders in the forest subject of study and determine the extent of its attractiveness in the eyes of the visitors, if a number under 0 is inserted, the system gives an error, the forest is not considered attractive, the threshold is 20. Then function assigns feeder segments (A, B, C) directly to corresponding survival rate ranges (0.1-0.3, 0.3-0.6, 0.6-0.9).

As for the second problem that the application is solving - This function models shows how the survival rate of birds improves with the number of bird feeders but with diminishing returns (i.e., the effect becomes less pronounced as more feeders are added).

Here, The user must insert only the input of initial\_rate manually.

The number of bird feeders (feeders) is **not directly input** by the user into this specific function. Instead, it is provided earlier when the user specifies the number of feeders in the general script workflow.

Input Structure looks like this:

**User inputs**:

  **feeders**: Entered first by the user and stored as a variable in the main script.

 **initial\_survival\_rate**: Manually entered by the user when prompted.

If upon those two procedures and subsequent solutions we desire to continue with our calculations, aca inserting new input, to the question that follows “ new calculation yes or no?” we should insert y for yes, and then the cycle continues, otherwise we answer n for “NO”, and the process halts and we get eventually to the end.

In conclusion, in this application users are prompted to enter the number of bird feeders and an initial survival rate. The program then validates inputs and performs calculations. Results are displayed, and the user is prompted to continue or exit. Invalid inputs trigger error messages without exiting the program abruptly.

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**References:**

**The Benefits of Bird Feeding** - https://www.perkypet.com/articles/the-benefits-of-bird-feeding

**Wilcoxen E. (Biology dep., Millikin University) Horn D. et al** (2015) Effects of Birdfeeding activities on the population of wild birds - *Conservation Psychology.* Vol 3. [www.ncbi.nlm.nih.gov/pmc/articles/PMC4778448/pdf/cov058.pdf](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4778448/pdf/cov058.pdf)

**Illustrations: Figure 1, Figure 2 -from “The Benefits of Birds Feeding*”***