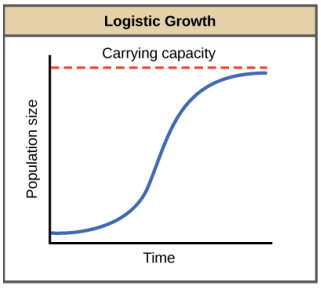
Week 11
Term 4
2023

HAWKER COLLEGE
Engage | Inspire | Achieve

Learning Brief
SM4

Goals



Source: https://goo.gl/KMmFbC

By the end of this unit, students:

- understand the concepts and techniques in applications of calculus and statistical inference
- apply reasoning skills and solve problems in applications of calculus and statistical inference
- communicate their arguments and strategies when solving problems
- construct proofs of results
- interpret mathematical and statistical information and ascertain the reasonableness of their solutions to problems.

This week:

- formulate differential equations including the logistic equation that will arise in, for example, chemistry, biology and economics, in situations where rates are involved.

Theoretical Components

Read the notes and study the examples.
(Classroom/ABOUT/Resources/ WK11)

Further notes/examples:

- https://shorturl.at/LXYZ8
- https://shorturl.at/bhHV2

Video Examples:

- https://shorturl.at/msyNX
- https://t.ly/VVaBo
- https://rb.gy/kt0mr
- https://rb.gy/orpvb

Further Reading (Optional):

Practical Components

Exercises: available in Google

Classroom/ABOUT/Resources/WK11

Investigation

See next page!

20 marks.

QFO

Quiz/Forum/Other

Keep checking G/Classroom for more resources.

Investigation:

Run the following code (as an example) here: https://pythonhow.com/python-shell

```
import numpy as np
import matplotlib.pyplot as plt
# Parameters
r = 0.1
K = 1000
N0 = 100

# Time values
t = np.linspace(0, 100, 500)  # Time from 0 to 100 hours

# Analytical solution
N = K / (1 + ((K - N0) / N0) * np.exp(-r * t))

# Plotting
plt.plot(t, N)
plt.xlabel('Time (hours)')
plt.ylabel('Population Size')
plt.title('Population Growth (Logistic Equation)')
plt.grid(True)
plt.show()
```

Study the code, try to understand the key information specific to this example. Describe the information presented by the chart produced. You could do this by focussing on the following:

- Identify the model used, the population size;
- the intrinsic growth rate (how fast the population can grow under ideal conditions);
- the carrying capacity (the maximum population size that the environment can sustain).

Now, make the necessary changes to the input information to produce a chart for the following scenario to figure how long will it take for the gorilla population to reach the carrying capacity of the preserve.

A certain wild animal preserve can support no more than 250 lowland gorillas. Twenty-eight gorillas were known to be in the preserve in 1970. Assume that the rate of growth of the population is

$$\frac{dN}{dt} = 0.1N\left(1 - \frac{N}{250}\right)$$

Take care with the units of measure.