# Load necessary libraries

library(deSolve) # for ode solving

library(ggplot2) # for plotting

# Define SEIR model function with seasonal transmission rate

SEIR\_model <- function(time, state, parameters) {

with(as.list(c(state, parameters)), {

beta\_t <- beta\_0 \* (1 + A \* cos(2 \* pi \* time / T))

dS\_dt <- nu \* (1 - p) - (beta\_t \* I + mu) \* S

dE\_dt <- beta\_t \* S \* I - (sigma + mu) \* E

dI\_dt <- sigma \* E - (gamma + mu) \* I

dR\_dt <- nu \* p + gamma \* I - mu \* R

return(list(c(dS\_dt, dE\_dt, dI\_dt, dR\_dt)))

})

}

# Initial conditions

initial\_state <- c(S = 0.99, E = 0.01, I = 0, R = 0)

# Parameters

parameters <- list(

beta\_0 = 0.5,

A = 0.2,

T = 365, # Period of one year in days

sigma = 1/8,

gamma = 1/5,

nu = 0.02,

mu = 0.02,

p = 0.5

)

# Time points (in days)

t <- seq(0, 3 \* parameters$T, length.out = 3 \* parameters$T)

# Solve the SEIR equations

output <- ode(y = initial\_state, times = t, func = SEIR\_model, parms = parameters)

# Convert output to data frame for plotting

output\_df <- as.data.frame(output)

# Plotting using ggplot2

ggplot(output\_df, aes(x = time)) +

geom\_line(aes(y = S, color = "Susceptible")) +

geom\_line(aes(y = E, color = "Exposed")) +

geom\_line(aes(y = I, color = "Infectious")) +

geom\_line(aes(y = R, color = "Recovered")) +

labs(x = "Time (days)", y = "Fraction of population", color = "Compartment") +

ggtitle("SEIR Model with Seasonal Transmission Rate") +

theme\_minimal() +

scale\_color\_manual(values = c("Susceptible" = "blue", "Exposed" = "yellow", "Infectious" = "red", "Recovered" = "green"))

Code in R