Presentation 7

Lab 7

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RUDN

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Introduction

Goal

Build an advertising distribution schedule

Task

Construct a graph of the distribution of advertising, the mathematical model of which is described with the following equation: 1. dn/dt= (0.68 + 0.00018n(t))(N-n(t)) 2. dn/dt= (0.00001 + 0.35n(t))(N-n(t)) 3. dn/dt= (0.51sin(5t) + 0.31cos(3t)n(t))(N-n(t)) At the same time, the audience size is N=963, at the initial moment 12 people know about the product. For case 2, determine at what point in time the speed of advertising distribution will be have the maximum value.

Theory Aspects

An advertising campaign for a new product or service is being organized. Necessary, so that future sales profits more than cover advertising costs. At first, costs may exceed profits because only a small part potential buyers will be informed about the new product. Then, when As the number of sales increases, profits also increase, and finally the moment will come, when the market becomes saturated and advertising the product becomes useless.

Results

First Case

In [68]:
```
t0 = 0; #начальный момент времени
x0 = [12]; # количество людей, знающих о товаре в начальный момент
#времени
N = 963; # максимальное количество людей, которых может
#заинтересовать товар
tspan = (0, 30) # временной промежуток (длительность рекламной
#компании)
```

Out[68]:
```
(0, 30)
```

In [69]:
```
g(t) = 0.68 #функция, отвечающая за платную рекламу
v(t) = 0.00018 #функция, описывающая сарафанное радио
```

Out[69]:
```
v (generic function with 1 method)
```

In [70]:
```
function diff!(du, u, p, t)
    du[1] = ( g(t) + v(t)*u[1] )*( N - u[1] )
end
```

Out[70]:
```
diff! (generic function with 1 method)
```

In [71]:
```
using DifferentialEquations
using Plots
```

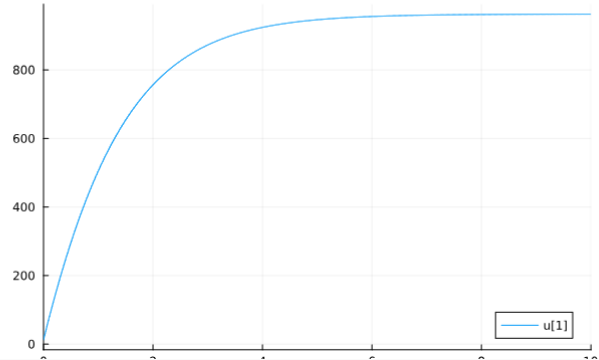

1. Parameters and different functions

Graph

In [71]:
```
using DifferentialEquations
using Plots
```

In [72]:
```
prob = ODEProblem(diff!, x0, (0, 10))
sol = solve(prob)
plot(sol)
```

Out[72]:



. **2:** First Graph

Second Case

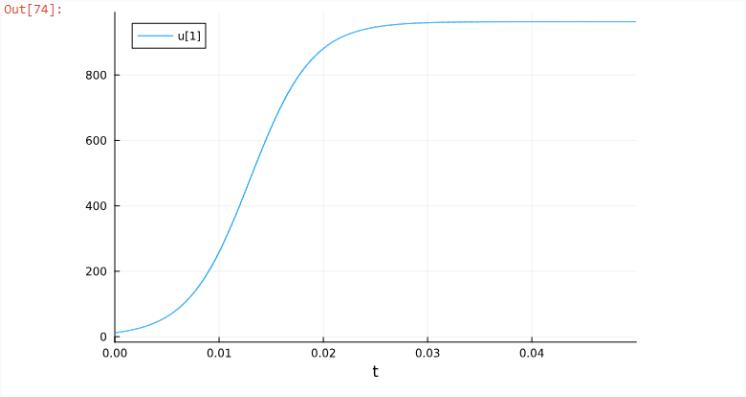
```
In [73]: g(t) = 0.00001 #функция, отвечающая за платную рекламу
         v(t) = 0.35 #функция, описывающая сарафанное радио
         diff!

Out[73]: diff! (generic function with 1 method)

In [74]: prob = ODEProblem(diff!, x0, (0, 0.05))
         sol2 = solve(prob)
         plot(sol2)
```

. **3:** Functions of the second case

Graph



. **4:** Second Graph

Third case

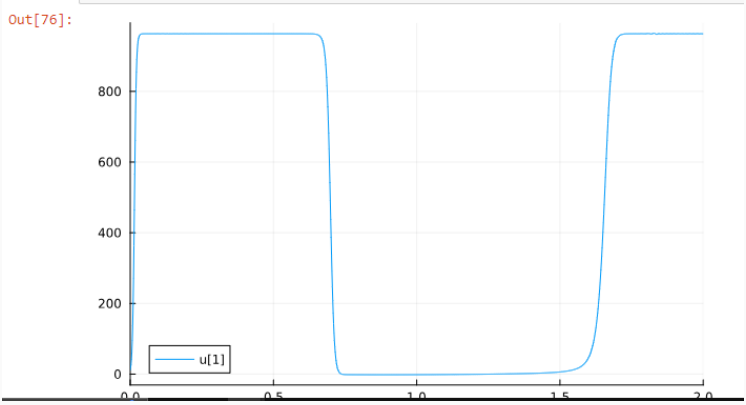
```
In [75]: g(t) = 0.51*sin(5*t) #функция, отвечающая за платную рекламу
         v(t) = 0.31*cos(3*t) #функция, описывающая сарафанное радио
         diff!

Out[75]: diff! (generic function with 1 method)

In [76]: prob = ODEProblem(diff!, x0, (0, 2))
         sol = solve(prob)
         plot(sol)
```

. **5:** Functions of the third case

Graph



. 6: Third graph

Max speed propagation and time

```
In [77]: arr = [(0.00001 + 0.35*n)*(N-n) for sub_arr in sol2.u for n in sub_arr]
         max_du, index = findmax(arr)
         max_du, index

Out[77]: (80726.42090184962, 6)

In [78]: t_maxdu = sol.t[index]#момент времени скорость распространения рекламы будет
         #иметь максимальное значение.

Out[78]: 0.01416569363692808
```

. **7:** Max Speed propagation and the time

Final Slide

When the function describing word of mouth is much larger than the function responsible for paid advertising, the number of people aware of the product increases quickly.