Practice 6

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- **Definition equation model**

<u>Model SIR</u>

$$\frac{dS(t)}{dt} = -r \cdot S(t) \cdot I(t)$$

$$\frac{dI(t)}{dt} = r \cdot S(t) \cdot I(t) - a \cdot I(t)$$

$$\frac{dR(t)}{dt} = a \cdot I(t)$$

$$S(t) + I(t) + R(t) = S_0 + I_0 + R_0 = const.$$

<u>Model SIR with Vaccination</u>

$$\frac{dS(t)}{dt} = -r \cdot S(t) \cdot I(t) - \delta$$

$$\frac{dI(t)}{dt} = r \cdot S(t) \cdot I(t) - a \cdot I(t)$$

$$\frac{dR(t)}{dt} = a \cdot I(t)$$

$$\frac{dV(t)}{dt} = \delta$$

$$S(t) + I(t) + R(t) + V(t) = S_0 + I_0 + R_0 + V_0 = N = const.$$

- **Table of all state variables of the model with columns**

$S(t)$	$I(t)$	$R(t)$	$V(t)$
Healthy population	**Sick-Infectious population**	**Resistant population**	**Vaccinated population**
$S(0) = 99$	$I(0) = 1$	$R(0) = 0$	$V(0) = 0$
individuals	**individuals**	**individuals**	**individuals**

- **Table of all model parameters:**

r	a	δ	N
Rate of spread infection	**Rate of treatment**	**Vaccinate rate**	**The whole number of population**
0.01018	**0.5**	**5**	**100**
\\.	**\\.**	**\\.**	**individuals**

- **Practice 6_1**

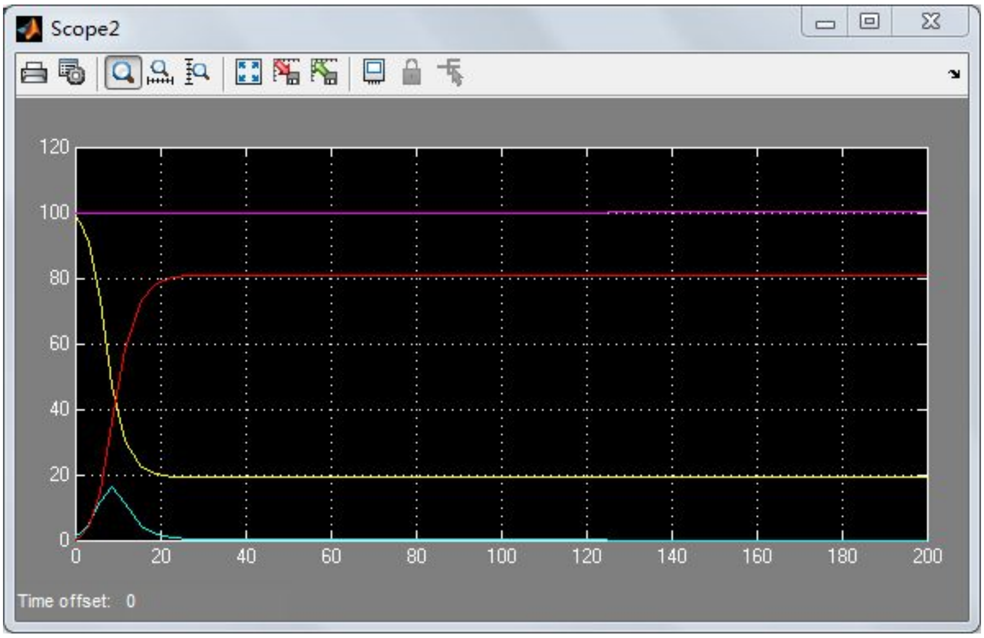
<u>Analytical Determination</u>

1)whether an epidemic breaks out or doesn't break out

$$\rho = \frac{a}{r} = \frac{0.5}{0.01018} = 49.12 < S(0)$$

Epidemic is spreading.

2)Inhabitants remain capable of working



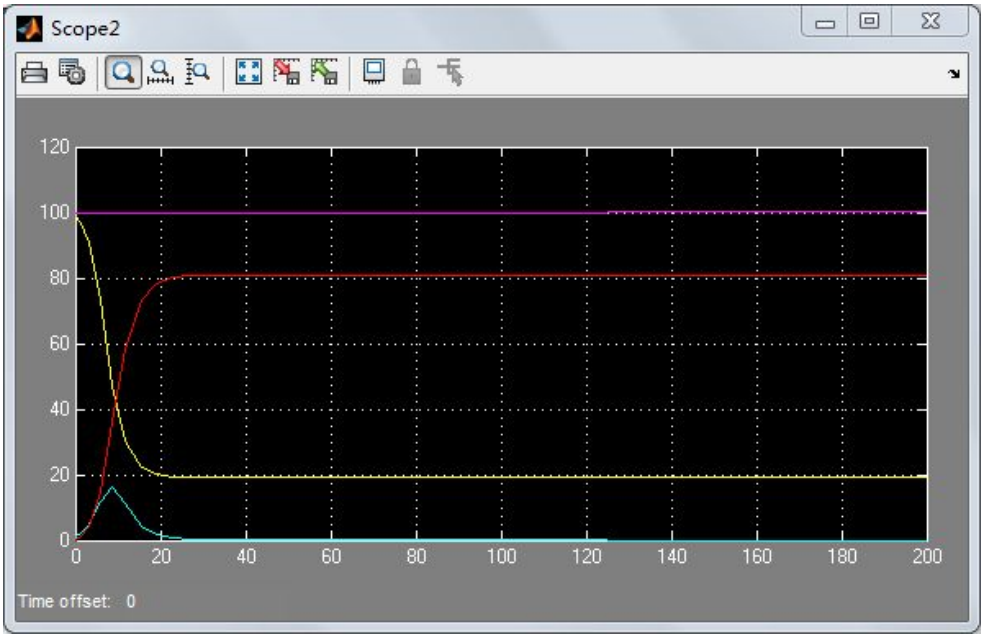
According to the graph,the number of population remain healthy is <u>19.</u>

3)the speed of treatment while the size population of patients is constant.

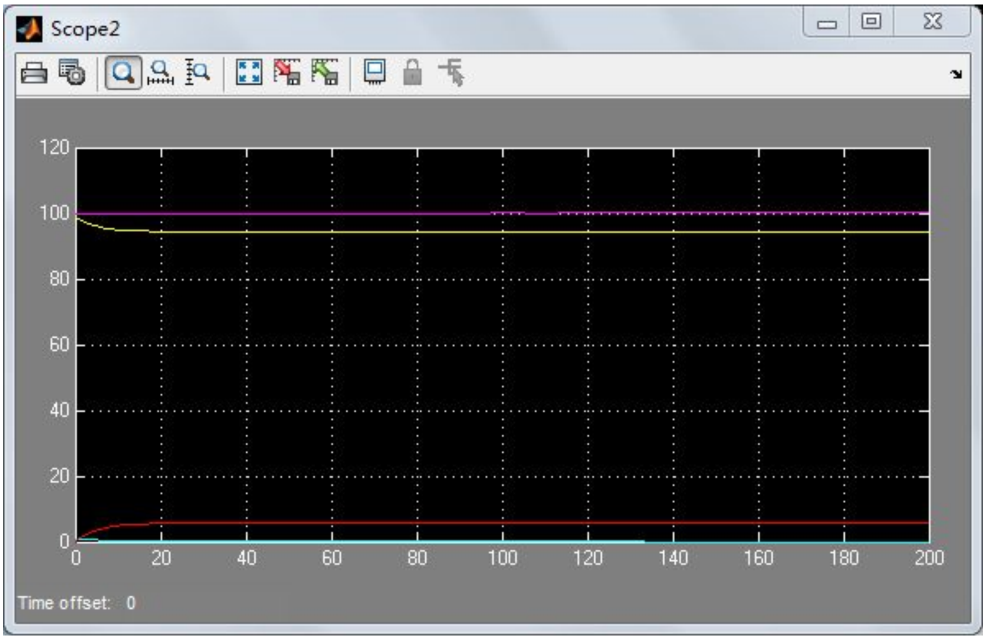
$$r \cdot S \cdot I - a \cdot I = 0$$
$$a = 1.00782$$

<u>Graphical Representation</u>

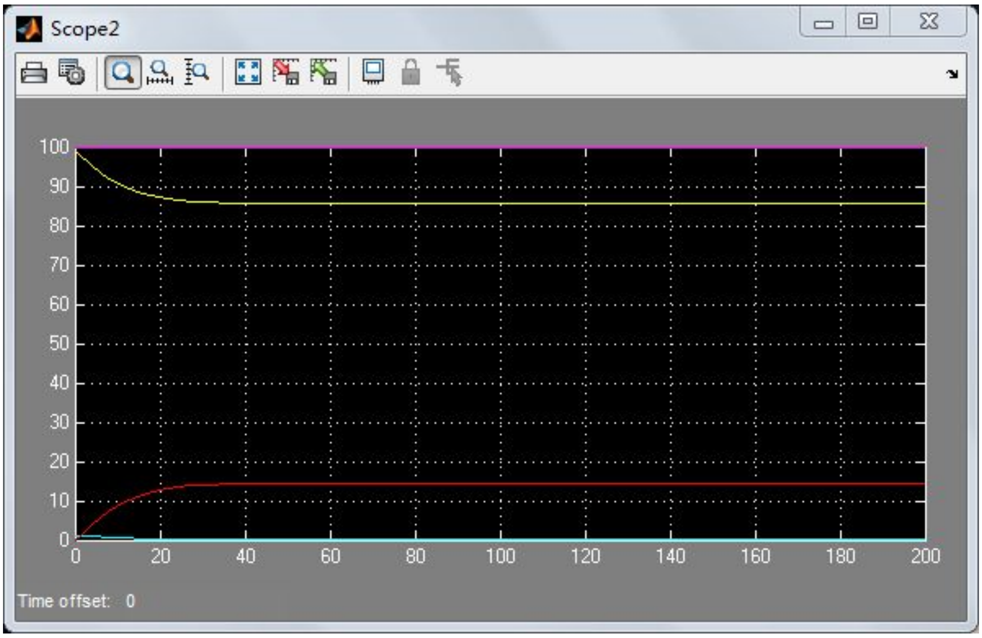
Epidemic is spreading.



Epidemical is not spreading.



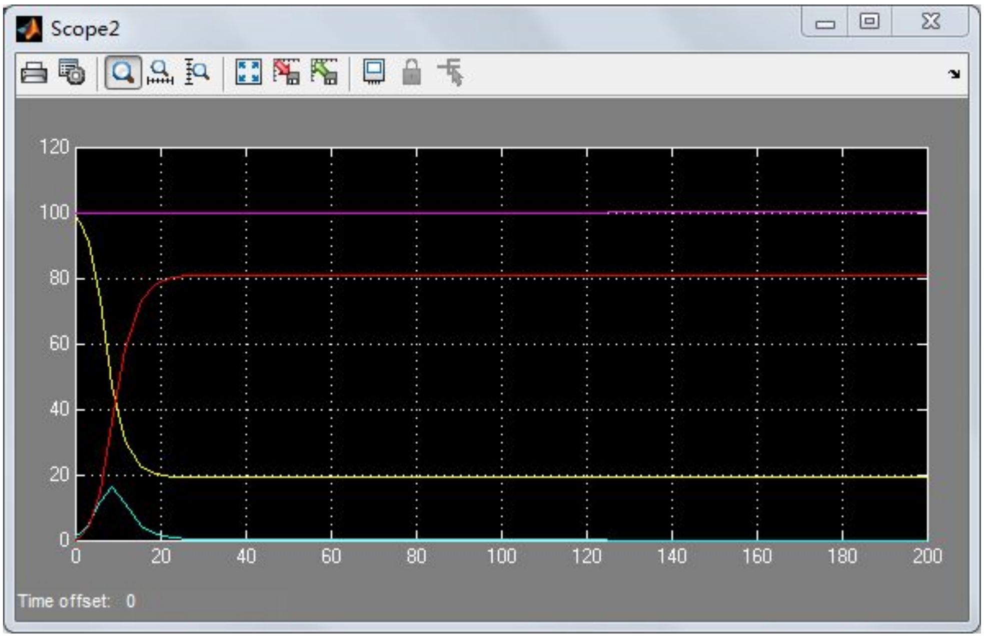
Patient population is constant.



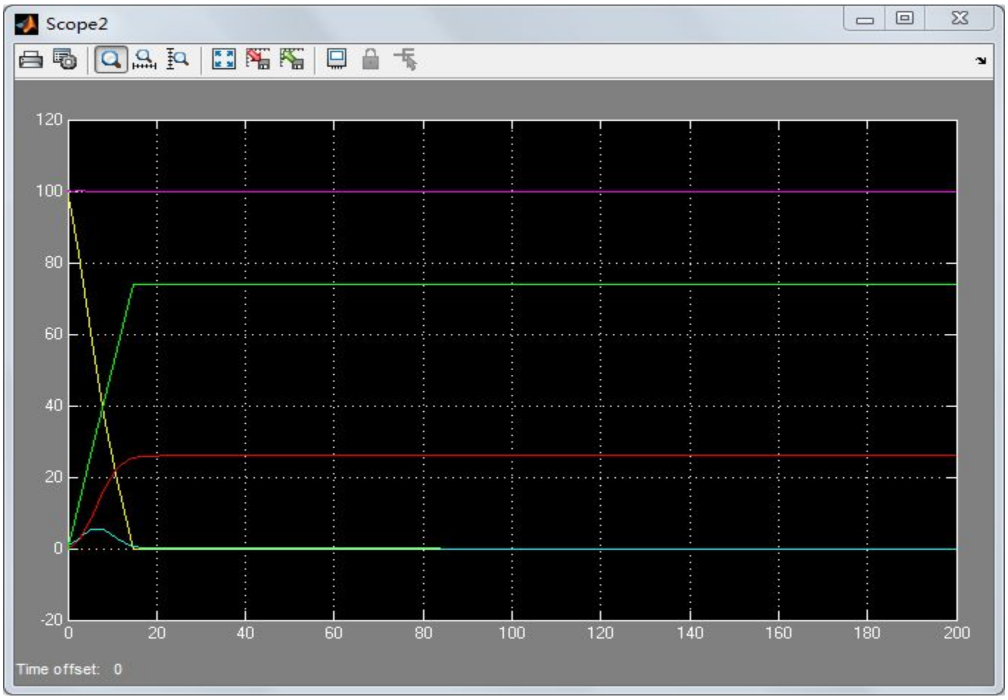
- **Practice 6_2**

<u>Graphical representation of the simulation results</u>

Without Vaccination



With Vaccination



<u>**A Brief Conclusion Summarize the Value**</u>

1)How many cows survive epidemic if we do not vaccinate?

19

2)How many cows will survive the epidemic when a farmer starts vaccination?

5

3)How much will vaccination cost in total?

The cost:74*840=62 160 CZK