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LAMPIRAN

Lampiran 1. Titik kesetimbangan bebas kecanduan dan titik kesetimbangan kecanduan model matematika kecanduan media sosial.

```
> restart;
> with(linalg) :
> # p:=0.9; μ:=0.25; β:=0.6; δ:=0.25; σ:=0.2; ω:=0.5; α:=0.7;
> # U_P = E ; U_A = A ;
> P1 := p - (mu + beta·A)·S
```

$$P1 := p - (A\beta + \mu)\,S$$

```
> P2 := beta·A·S - (delta + mu)·E
```

$$P2 := \beta A S - (\delta + \mu)\,E$$

```
> P3 := delta·E - (mu + sigma + omega)·A
```

$$P3 := \delta E - (\mu + \sigma + \omega)\,A$$

```
> P4 := omega·A - (mu + alpha)·T
```

$$P4 := \omega A - (\mu + \alpha)\,T$$

```
> P5 := sigma·A + alpha·T - mu·R
```

$$P5 := A\sigma - R\mu + T\alpha$$

```
> solve({P1 = 0, P2 = 0, P3 = 0, P4 = 0, P5 = 0}, {S, E, A, T, R});
```

$$\left\{A = 0, E = 0, R = 0, S = \frac{p}{\mu}, T = 0\right\}, \left\{A = \frac{\beta\delta p - \delta\mu^2 - \delta\mu\omega - \delta\mu\sigma - \mu^3 - \mu^2\omega - \mu^2\sigma}{(\delta\mu + \delta\omega + \delta\sigma + \mu^2 + \mu\omega + \mu\sigma)\beta},\right.$$

$$E = \frac{\beta\delta p - \delta\mu^2 - \delta\mu\omega - \delta\mu\sigma - \mu^3 - \mu^2\omega - \mu^2\sigma}{\delta\beta(\delta + \mu)}, R = \left((\beta\delta p - \delta\mu^2 - \delta\mu\omega\right.$$

$$\left. - \delta\mu\sigma - \mu^3 - \mu^2\omega - \mu^2\sigma)(\alpha\omega + \alpha\sigma + \mu\sigma)\right) \Big/ \left(\beta(\alpha\delta\mu + \alpha\delta\omega + \alpha\delta\sigma + \alpha\mu^2\right.$$

$$\left. + \alpha\mu\omega + \alpha\mu\sigma + \delta\mu^2 + \delta\mu\omega + \delta\mu\sigma + \mu^3 + \mu^2\omega + \mu^2\sigma)\mu\right), S$$

$$= \frac{\delta\mu + \delta\omega + \delta\sigma + \mu^2 + \mu\omega + \mu\sigma}{\beta\delta}, T = \left(\omega(\beta\delta p - \delta\mu^2 - \delta\mu\omega - \delta\mu\sigma - \mu^3\right.$$

$$\left. - \mu^2\omega - \mu^2\sigma)\right) \Big/ \left(\beta(\alpha\delta\mu + \alpha\delta\omega + \alpha\delta\sigma + \alpha\mu^2 + \alpha\mu\omega + \alpha\mu\sigma + \delta\mu^2 + \delta\mu\omega\right.$$

$$\left. + \delta\mu\sigma + \mu^3 + \mu^2\omega + \mu^2\sigma)\right)\Big\}$$

Lampiran 2. Penentuan bilangan reproduksi dasar.

```
> restart;
> with(linalg) :
> T1 := matrix(3, 3, [0, beta·p/mu, 0, 0, 0, 0, 0, 0, 0]);
```

$$T1 := \begin{bmatrix} 0 & \frac{\beta p}{\mu} & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

> $K1 := matrix(3, 3, [\mathrm{mu} + \mathrm{delta}, 0, 0, -\mathrm{delta}, \mathrm{mu} + \mathrm{sigma} + \mathrm{omega}, 0, 0, -\mathrm{omega}, \mathrm{mu} + \mathrm{alpha}])$

$$K1 := \begin{bmatrix} \mu + \delta & 0 & 0 \\ -\delta & \mu + \sigma + \omega & 0 \\ 0 & -\omega & \mu + \alpha \end{bmatrix}$$

> $K2 := inverse(K1)$

$$K2 := \begin{bmatrix} \frac{1}{\mu + \delta} & 0 & 0 \\ \frac{\delta}{(\mu + \delta)(\mu + \sigma + \omega)} & \frac{1}{\mu + \sigma + \omega} & 0 \\ \frac{\delta \omega}{(\mu + \delta)(\mu + \sigma + \omega)(\mu + \alpha)} & \frac{\omega}{(\mu + \sigma + \omega)(\mu + \alpha)} & \frac{1}{\mu + \alpha} \end{bmatrix}$$

> $K3 := multiply(T1, K2)$

$$K3 := \begin{bmatrix} \frac{\beta p \delta}{\mu(\mu + \delta)(\mu + \sigma + \omega)} & \frac{\beta p}{\mu(\mu + \sigma + \omega)} & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

> $charpoly(K3, \mathrm{lambda})$

$$\left(\lambda - \frac{\beta p \delta}{\mu(\mu + \delta)(\mu + \sigma + \omega)}\right)\lambda^2$$

> $solve(\%, \mathrm{lambda})$

$$0, 0, \frac{\beta p \delta}{\mu(\delta\mu + \delta\omega + \delta\sigma + \mu^2 + \mu\omega + \mu\sigma)}$$

> $eigenvalues(K3)$

$$\frac{\beta p \delta}{\mu(\delta\mu + \delta\omega + \delta\sigma + \mu^2 + \mu\omega + \mu\sigma)}, 0, 0$$

> $R0 := \frac{\beta p \delta}{\mu(\delta + \mu)(\mu + \sigma + \omega)}$

$$R0 := \frac{\beta p \delta}{\mu(\mu + \delta)(\mu + \sigma + \omega)}$$

Lampiran 3. Analisis sensitivitas bilangan reproduksi dasar.

```
> restart :
> with(linalg) :
> R0 := β·Π·δ / (μ(δ+μ)(μ+σ+ω))
```

$$R0 := \frac{\beta \Pi \delta}{\mu (\delta + \mu) (\mu + \sigma + \omega)}$$

```
> diff(β·Π·δ / (μ(δ+μ)(μ+σ+ω)), β)
```

$$\frac{\Pi \delta}{\mu (\delta + \mu) (\mu + \sigma + \omega)}$$

```
> (Πδ / (μ(δ+μ)(μ+σ+ω))) · β / R0
```

$$1$$

```
> diff(β·Π·δ / (μ(δ+μ)(μ+σ+ω)), Π)
```

$$\frac{\beta \delta}{\mu (\delta + \mu) (\mu + \sigma + \omega)}$$

```
> (βδ / (μ(δ+μ)(μ+σ+ω))) · Π / R0
```

$$1$$

```
> diff(β·Π·δ / (μ(δ+μ)(μ+σ+ω)), δ)
```

$$\frac{\beta \Pi}{\mu (\delta + \mu) (\mu + \sigma + \omega)} - \frac{\beta \Pi \delta}{\mu (\delta + \mu)^2 (\mu + \sigma + \omega)}$$

```
> βΠ / (μ(δ+μ)(μ+σ+ω)) − (βΠδ / (μ(δ+μ)^2(μ+σ+ω))) · δ / R0
```

$$\frac{\beta \Pi}{\mu (\delta + \mu) (\mu + \sigma + \omega)} - \frac{\delta}{\delta + \mu}$$

```
> diff(β·Π·δ / (μ(δ+μ)(μ+σ+ω)), μ)
```

$$-\frac{\beta \Pi \delta}{\mu^2 (\delta + \mu) (\mu + \sigma + \omega)} - \frac{\beta \Pi \delta}{\mu (\delta + \mu)^2 (\mu + \sigma + \omega)} - \frac{\beta \Pi \delta}{\mu (\delta + \mu) (\mu + \sigma + \omega)^2}$$

```
> −βΠδ / (μ^2(δ+μ)(μ+σ+ω)) − βΠδ / (μ(δ+μ)^2(μ+σ+ω)) − (βΠδ / (μ(δ+μ)(μ+σ+ω)^2)) · μ / R0
```

$$-\frac{\beta \Pi \delta}{\mu^2 (\delta + \mu) (\mu + \sigma + \omega)} - \frac{\beta \Pi \delta}{\mu (\delta + \mu)^2 (\mu + \sigma + \omega)} - \frac{\mu}{\mu + \sigma + \omega}$$

```
> diff(β·Π·δ / (μ(δ+μ)(μ+σ+ω)), ω)
```

$$-\frac{\beta\,\Pi\,\delta}{\mu\,(\delta+\mu)\,(\mu+\sigma+\omega)^2}$$

```
> -(β*Π*δ)/(μ*(δ+μ)*(μ+σ+ω)^2)*ω/R0;
```

$$-\frac{\omega}{\mu+\sigma+\omega}$$

```
> diff(β·Π·δ/(μ*(δ+μ)*(μ+σ+ω)),σ);
```

$$-\frac{\beta\,\Pi\,\delta}{\mu\,(\delta+\mu)\,(\mu+\sigma+\omega)^2}$$

```
> -(β*Π*δ)/(μ*(δ+μ)*(μ+σ+ω)^2)*σ/R0;
```

$$-\frac{\sigma}{\mu+\sigma+\omega}$$

Lampiran 4. Sintax simulasi plot untuk setiap kelompok individu dengan pemberian nilai parameter β dan ω yang berbeda-beda.

```
clear all;
clc;
pi=0.9;
mu=0.25;
beta=0.6;
delta=0.25;
sigma=0.2;
w=0.5;
a=0.7;
S0=0.9523; E0=0.0476; I0=0; T0=0; R0=0;
h=0.1;
t=0:h:20;
N=length(t);
S=zeros(N,1); Sold=zeros(N,1);
E=zeros(N,1); Eold=zeros(N,1);
I=zeros(N,1); Iold=zeros(N,1);
T=zeros(N,1); Cold=zeros(N,1);
R=zeros(N,1); Rold=zeros(N,1);
S(1)=S0; E(1)=E0; I(1)=I0; T(1)=T0; R(1)=R0;
for i=1:N-1
y=[S(i) E(i) I(i) T(i) R(i)];
k1=h*SP(y,pi,mu,beta,delta,sigma,w,a);
k2=h*SP(y+0.5*k1,pi,mu,beta,delta,sigma,w,a);
k3=h*SP(y+0.5*k2,pi,mu,beta,delta,sigma,w,a);
k4=h*SP(y+k3,pi,mu,beta,delta,sigma,w,a);
y=y+(1/6)*(k1+2*k2+2*k3+k4);
 S(i+1)=y(1);
 E(i+1)=y(2);
 I(i+1)=y(3);
```

```
 T(i+1)=y(4);
 R(i+1)=y(5);
end
figure(1)
plot(t,S,'b-','linewidth',1.5);
xlabel('waktu (t)');
ylabel('Populasi Suspectible S(t)');
grid on;
hold on
figure(2)
plot(t,E,'b-','linewidth',1.5);
xlabel('waktu (t)');
ylabel('Populasi User Pasif U_P(t)');
grid on;
hold on
figure(3)
plot(t,I,'b-','linewidth',1.5);
xlabel('waktu (t)');
ylabel('Populasi User Aktif U_A(t)');
grid on;
hold on
figure(4)
plot(t,T,'b-','linewidth',1.5);
xlabel('waktu (t)');
ylabel('Populasi Treatment T(t)');
grid on;
hold on
figure(5)
plot(t,R,'b-','linewidth',1.5);
xlabel('waktu (t)');
ylabel('Populasi Recovered R(t)');
grid on;
hold on
```

Lampiran 5. Sintax simulasi plot menggunakan metode perturbasi homotopi.

```
clear
clc
pi = 0.9;% ini adalah pi
u = 0.25;% miu
B = 0.6;% Beta
d = 0.25;% delta
T = 0.2;% sigma
w = 0.5;% omega
a = 0.7;% alpa
n = 20; % ini N nya
V = zeros(5,n+1);
V(1,1) = 0.9523809524;
V(2,1) = 0.04761904762;
V(3,1) = 0;
V(4,1) = 0;
V(5,1) = 0;
```

```
av = 0;
bv = 0;
for i=2:n+1
    for j = 2:i
        av = av - B*V(1,j-1)*V(3,i+1-j);
    end
    if i==2
        V(1,i) = pi-u*V(1,i-1)+ av;
    else
        V(1,i) = -u*V(1,i-1) + av;
    end
    for j = 2:i
        bv = bv + B*V(1,j-1)*V(3,i+1-j);
    end
    V(2,i) = -u*V(2,i-1)-d*V(2,i-1)+ bv;
    V(3,i) = d*V(2,i-1)-u*V(3,i-1)-T*V(3,i-1)-w*V(3,i-1);
    V(4,i) = w*V(3,i-1)-u*V(4,i-1)-a*V(4,i-1);
    V(5,i) = T*V(3,i-1)+a*V(4,i-1)-u*V(5,i-1);
    av =0;
    bv=0;
end
disp (V)
% Gambar 1
t = 20;
dt = 0.001;
del_t = (t/dt)+1;
bt = zeros(del_t,1);
for i=1:del_t
    for k = 1:n+1
        j = (i-1)*dt;
        bt(i) = bt(i)+V(1,k)*j^(k-1);
    end
end
X = linspace(0,t,del_t);
figure (1)
%subplot (3,2,1)
plot (X,bt,'r--','LInewidth',3)
hold on
xlabel ('t','FontSize',20,'FontWeight','bold')
ylabel ('S(t)','FontSize',20,'FontWeight','bold')
ymin = min(bt);
ymax = max(bt);
axis ([0 16 ymin ymax])
% Gambar 2
t = 20;
dt = 0.001;
del_t = (t/dt)+1;
uv = zeros(del_t,1);
for i=1:del_t
    for k = 1:n+1
        j = (i-1)*dt;
        uv(i) = uv(i)+V(2,k)*j^(k-1);
    end
end
```

```
X = linspace(0,t,del_t);
figure (2)
%subplot (3,2,2)
plot (X,uv,'r--','LInewidth',3)
hold on
xlabel ('t','FontSize',20,'FontWeight','bold')
ylabel ('UV(t)','FontSize',20,'FontWeight','bold')
ymin = min(uv);
ymax = max(uv);
axis ([0 15 ymin ymax])
% Gambar 3
t = 20;
dt = 0.001;
del_t = (t/dt)+1;
ua = zeros(del_t,1);
for i=1:del_t
    for k = 1:n+1
        j = (i-1)*dt;
        ua(i) = ua(i)+V(3,k)*j^(k-1);
    end
end
X = linspace(0,t,del_t);
figure (3)
%subplot (3,2,3)
plot (X,ua,'r--','LInewidth',3)
hold on
xlabel ('t','FontSize',20,'FontWeight','bold')
ylabel ('UA(t)','FontSize',20,'FontWeight','bold')
ymin = min(ua);
ymax = max(ua);
axis ([0 16 ymin ymax])
% Gambar 4
t = 20;
dt = 0.001;
del_t = (t/dt)+1;
TT = zeros(del_t,1);
for i=1:del_t
    for k = 1:n+1
        j = (i-1)*dt;
        TT(i) = TT(i)+V(4,k)*j^(k-1);
    end
end
X = linspace(0,t,del_t);
figure (4)
%subplot (3,2,4)
plot (X,TT,'r--','LInewidth',3)
hold on
xlabel ('t','FontSize',20,'FontWeight','bold')
ylabel ('T(t)','FontSize',20,'FontWeight','bold')
ymin = min(TT);
ymax = max(TT);
axis ([0 15 ymin ymax])
% Gambar 5
t = 20;
```

```
dt = 0.001;
del_t = (t/dt)+1;
R = zeros(del_t,1);
for i=1:del_t
    for k = 1:n+1
        j = (i-1)*dt;
        R(i) = R(i)+V(5,k)*j^(k-1);
    end
end
X = linspace(0,t,del_t);
figure (5)
%subplot (3,2,5)
plot (X,R,'r--','LInewidth',3)
hold on
xlabel ('t','FontSize',20,'FontWeight','bold')
ylabel ('R(t)','FontSize',20,'FontWeight','bold')
ymin = min(R);
ymax = max(R);
axis ([0 16 ymin ymax])
```