```
Quit[];

(* Esercizio 5.2.11 *)
f[t_, y_] := r * b * (1 - y)
eq0 = p'[t] == f[t, p[t]];

α = 0.01; b0 = 0.02; d0 = 0.015; r0 = 0.1;
tA = 0.0; tB = 50.;
n = 50;
h = (tB - tA) / n;
t[0] = tA;
t[n] = tB;
Do[t[i + 1] = t[i] + h, {i, 0, n - 1}]
w[0] = α
Do[w[i + 1] = w[i] + h * (f[t[i], w[i]] /. {b → b0, d → d0, r → r0}), {i, 0, n - 1}]
```

```
0.01
```

```
sol = Table[{t[i], w[i]}, {i, 0, n}];

solnum = NDSolve[{eq0, p[tA] == α}, p[t], {t, tA, tB}, Method -> "ImplicitRungeKutta"][[1]];
```

```
NDSolve::ndnum : Encountered non−numerical value for a derivative at t == 0.`. ≫
```

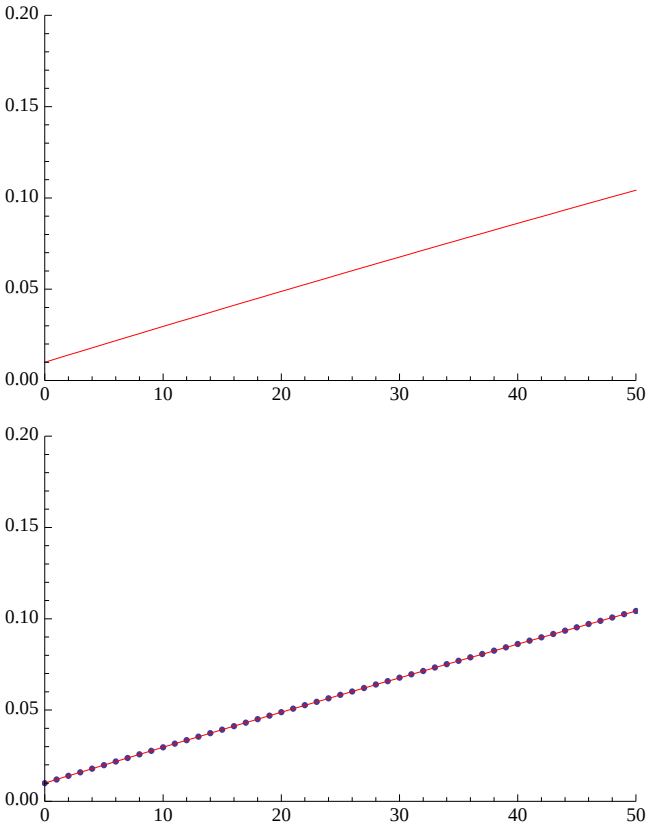
```
eq0
```

$$p'[t] == b\, r\, (1 - p[t])$$

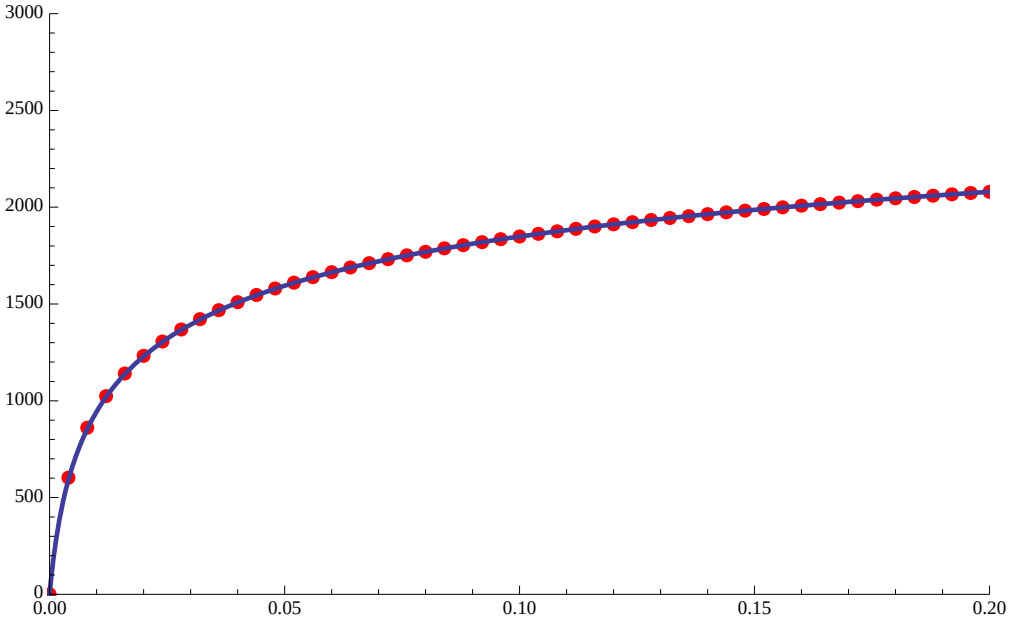
```
soltrue = DSolve[{eq0, p[tA] == α}, p[t], t][[1]]
```

$$\left\{p[t] \to e^{-b\,r\,t}\left(-0.99 + e^{b\,r\,t}\right)\right\}$$

```
trange = {tA, tB};
yrange = {0, 0.2};
pl1 = ListPlot[sol, PlotRange → {trange, yrange}];
(*pl2=Plot[y[t]/.solnum,{t,tA,tB},PlotRange→{trange,yrange}];*)
pl3 = Plot[p[t] /. soltrue /. {b → b0, d → d0, r → r0},
  {t, tA, tB}, PlotRange → {trange, yrange}, PlotStyle → RGBColor[1, 0, 0]]
Show[
 pl1,
 pl3]
```



```
(* Esercizio 5.4.15 con RK4 *)
α = 0.;
tA = 0.0; tB = 0.2;
n = 50;
h = (tB - tA) / n;
t[0] = tA;
t[n] = tB;
Do[t[i + 1] = t[i] + h, {i, 0, n - 1}]
w[0] = α;
k = 6.22 * 10^(-19);
n1 = n2 = 2000.;
n3 = 3000.;
f[t_, y_] := k * (n1 - y / 2)^2 * (n2 - y / 2)^2 * (n3 - 3 * y / 4)^3
Do[k1 = f[t[i], w[i]];
  k2 = f[t[i] + 0.5 * h, w[i] + 0.5 * h * k1];
  k3 = f[t[i] + 0.5 * h, w[i] + 0.5 * h * k2];
  k4 = f[t[i] + h, w[i] + h * k3];
  w[i + 1] = w[i] + h * (k1 + 2 * k2 + 2 * k3 + k4) / 6., {i, 0, n - 1}];
sol = Table[{t[i], w[i]}, {i, 0, n}];
solnum = NDSolve[{y'[t] == f[t, y[t]], y[tA] == α}, y[t], {t, tA, tB}][[1]];
(*soltrue=DSolve[{y'[t]==f[t,y[t]],y[tA]==α},y[t],t][[1]]*)
trange = {tA, tB};
yrange = {0, 3000.};
pl1 = ListPlot[sol, PlotRange → {trange, yrange},
   PlotStyle → {PointSize[0.015], RGBColor[1, 0, 0]}];
pl3 = Plot[y[t] /. solnum, {t, tA, tB}, PlotRange → {trange, yrange},
   PlotStyle → Thickness[0.005]];
(*pl3=Plot[y[t]/.soltrue,{t,tA,tB},PlotRange→{trange,yrange},
   PlotStyle→RGBColor[1,0,0]];*)
Show[
 pl1,
 pl3]
```



```
(* Esercizio 6.2.16 *)
Clear[a, α];
n = 3;
a = {{2, 1, 3}, {4, 6, 8}, {6, α, 10}};
b = {1, 5, 5};
MatrixForm[a]
MatrixForm[b]
```

$$\begin{pmatrix} 2 & 1 & 3 \\ 4 & 6 & 8 \\ 6 & \alpha & 10 \end{pmatrix}$$

$$\begin{pmatrix} 1 \\ 5 \\ 5 \end{pmatrix}$$

```
s[1]
s[2]
s[3]
```

```
3

8

10
```

```
r[1]
r[2]
r[3]
```

$$\frac{2}{3}$$

$$\frac{1}{2}$$

$$\frac{3}{5}$$

```
a0 = a /. α → -3;
MatrixForm[a0]
Do[s[i] = Max[Table[Abs[a0[[i]][[j]]] // N, {j, 1, n}]], {i, 1, n}];
Do[r[i] = Abs[a0[[i]][[1]]] / s[i] // N, {i, 1, n}];
Do[Print["i = ", i, "    s[i] = ", s[i], "   r[i] = ", r[i]], {i, 1, n}]
aa = {Join[a0[[1]], {b[[1]]}], Join[a0[[2]], {b[[2]]}], Join[a0[[3]], {b[[3]]}]};
MatrixForm[aa]
```

$$\begin{pmatrix} 2 & 1 & 3 \\ 4 & 6 & 8 \\ 6 & -3 & 10 \end{pmatrix}$$

```
i = 1    s[i] = 3.   r[i] = 0.666667

i = 2    s[i] = 8.   r[i] = 0.5

i = 3    s[i] = 10.   r[i] = 0.6
```

$$\begin{pmatrix} 2 & 1 & 3 & 1 \\ 4 & 6 & 8 & 5 \\ 6 & -3 & 10 & 5 \end{pmatrix}$$

```
a1 = {aa[[1]], aa[[2]] - (aa[[2]][[1]] / aa[[1]][[1]]) * aa[[1]],
   aa[[3]] - (aa[[3]][[1]] / aa[[1]][[1]]) * aa[[1]]};
MatrixForm[a1]
Do[s[i] = Max[Table[Abs[a1[[i]][[j]]] // N, {j, 2, n}]], {i, 2, n}];
Do[r[i] = Abs[a1[[i]][[2]]] / s[i] // N, {i, 2, n}];
Do[Print["i = ", i, "    s[i] = ", s[i], "   r[i] = ", r[i]], {i, 2, n}]
```

$$\begin{pmatrix} 2 & 1 & 3 & 1 \\ 0 & 4 & 2 & 3 \\ 0 & -6 & 1 & 2 \end{pmatrix}$$

```
i = 2    s[i] = 4.   r[i] = 1.

i = 3    s[i] = 6.   r[i] = 1.
```

```
a2 = {a1[[1]], a1[[2]], a1[[3]] - (a1[[3]][[2]] / a1[[2]][[2]]) * a1[[2]]};
MatrixForm[a2]
```

$$\begin{pmatrix} 2 & 1 & 3 & 1 \\ 0 & 4 & 2 & 3 \\ 0 & 0 & 4 & \frac{13}{2} \end{pmatrix}$$

```
Clear[a];
a = {{2, -1, 3}, {4, 2, 2}, {-2, α, 3}};
MatrixForm[a]
```

$$\begin{pmatrix} 2 & -1 & 3 \\ 4 & 2 & 2 \\ -2 & \alpha & 3 \end{pmatrix}$$

```
Det[a]
```

$$40 + 8\,\alpha$$