Solve differential equations of population growth

Set constants

In[707]:=
```
ClearAll[S0, R0, K, S, R, s, r, t, α, μ1, μ2]
S0 = 1*^3;
R0 = 1*^3;
K = 1*^5;
```

Population growth equations - simple

In[437]:=
```
(*solution = DSolve[{
     S'[t]==μ1*S[t]-α*S[t],
     R'[t]==μ2*R[t]+α*S[t]
    },{S[t],R[t]},t];*)
```

Population growth equations - logistic growth

In[711]:=
```
solution = ParametricNDSolve[{
    S'[t] == μ1 * (1 - (S[t] + R[t]) / K) * S[t] - α * S[t],
    R'[t] == μ2 * (1 - (S[t] + R[t]) / K) * R[t] + α * S[t],
    S[0] == S0, R[0] == R0},
   {S, R},
   {t, 0, 25},
   {μ1, μ2, α}]
```

Out[711]=
```
{S → ParametricFunction[ ⊞ Expression: S
                         Parameters: {μ1, μ2, α} ],
 R → ParametricFunction[ ⊞ Expression: R
                         Parameters: {μ1, μ2, α} ]}
```

Assign equations to functions

In[712]:=
```
s[t_] = S[t] /. solution;
r[t_] = R[t] /. solution;
```

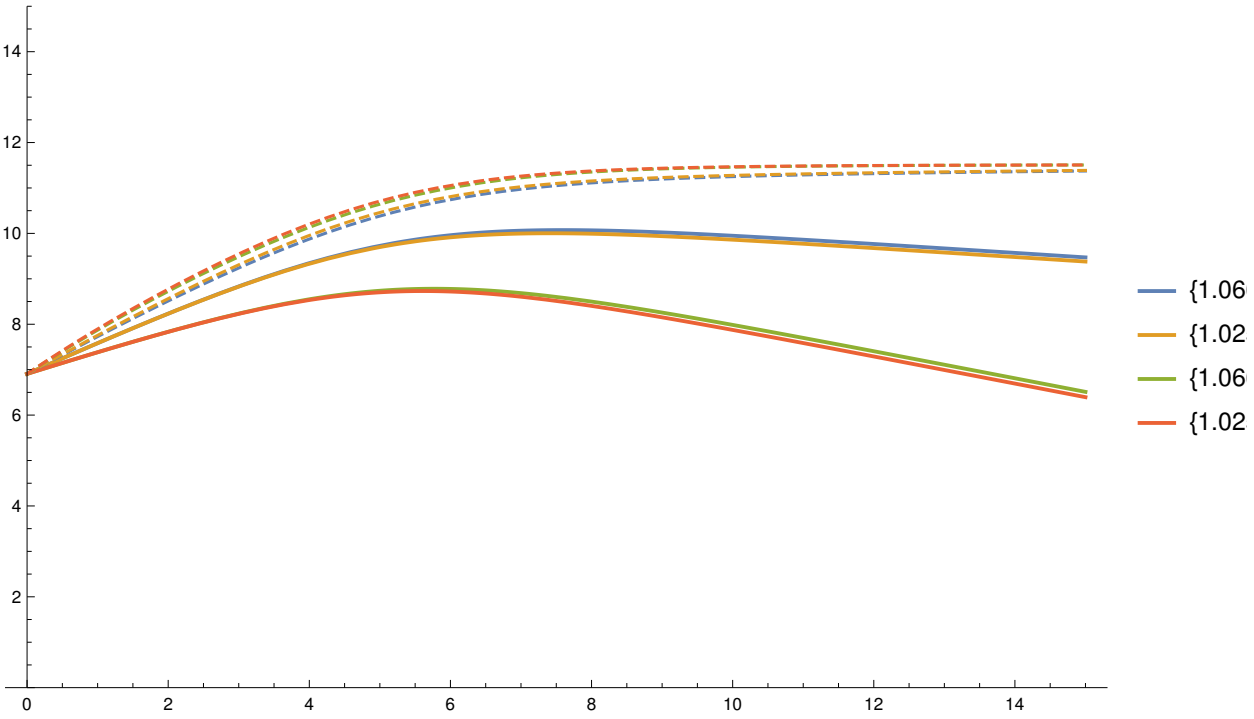
Plot

In[714]:=
```
mu1 = {.8};
mu2 = {.75, .78};
alp = {.1, .3};
tmax = 15;

params = Join @@@ Table[{m1 / m2, α}, {m1, mu1}, {α, alp}, {m2, mu2}];

Show[Plot[
  Evaluate@Table[Log[S[μ1, μ2, α][t]] /. solution,
    {μ1, mu1}, {α, alp}, {μ2, mu2}],
  {t, 0, tmax},
  PlotStyle → Thick,
  PlotLegends → {params},
  PlotRange → {All, {0, 15}}
 ],
 Plot[
  Evaluate@Table[Log[R[μ1, μ2, α][t]] /. solution,
    {μ1, mu1}, {α, alp}, {μ2, mu2}],
  {t, 0, tmax},
  PlotStyle → Dashed,
  PlotRange → All],
 ImageSize → Large]
```

Out[719]=



In[445]:=
```
(*Show[Plot[Evaluate@Table[{
     Log[s[t,.8,μ2,α]],
     Log[r[t,.8,μ2,α]]},
    {μ2,{.75,.78}},{α,{.1,.3}}],
  {t,1,20},
  PlotLegends→{"S","R"},
  AxesLabel→{{"t"},"Population"},
  PlotStyle→Thick],ImageSize->Large]*)
```