

```
In[55]:= Needs["IdentifiabilityAnalysis`"]
        startTime = AbsoluteTime[]
```

```
Out[56]= 3.7143127095913888  $\times 10^9$ 
```

```
In[57]:= vars = {x1, x2, x3, x4}
```

```
Out[57]= {x1, x2, x3, x4}
```

```
In[58]:= params = {d1, d2, d3, b, kTL, m0, e0}
```

```
Out[58]= {d1, d2, d3, b, kTL, m0, e0}
```

```
In[59]:= sys = {x1'[t] == -d * x1[t] - d2 * x1[t] * x3[t],
               x2'[t] == kTL * x1[t] - b * x2[t],
               x3'[t] == d3 * x4[t] - d2 * x1[t] * x3[t],
               x4'[t] == -d3 * x4[t] + d2 * x1[t] * x3[t],
               x1[0] == m0, x2[0] == 0, x3[0] == e0, x4[0] == 0}
```

```
Out[59]= {x1'[t] == -d x1[t] - d2 x1[t] x3[t], x2'[t] == kTL x1[t] - b x2[t],
          x3'[t] == -d2 x1[t] x3[t] + d3 x4[t], x4'[t] == d2 x1[t] x3[t] - d3 x4[t],
          x1[0] == m0, x2[0] == 0, x3[0] == e0, x4[0] == 0}
```

```
In[60]:= output = {x2[t]}
```

```
Out[60]= {x2[t]}
```

```
In[61]:= iad = IdentifiabilityAnalysis[{sys, output}, vars, params, t]
```

```
MatrixRank::nmod :
```

```
{0,0,0,0,0,0,0,0,1,0,0},{0,0,0,0,1358158970,0,0,311676514 + 1835807115 d,1610432727,0,0}} is not valid  
modulo 2147483629. >>
```

```
MatrixRank::nmod :
```

```
{0,0,0,0,0,0,0,0,1,0,0},{0,0,0,0,1358158970,0,0,311676514 + 1524130601 d,1610432727,0,0},{0,1204721082,0,  
972145393, <<3>>,432407064 + 1594346015 d + 623353028 d2,588508773,340106561,0},{0,627551479 +  
1885525094 d,0,1189840539 + 1175338236 d,55067104 + 616024789 d + 1358158970 d2,0,0,183081669 +  
1866091235 d + 1801547468 d2 + 1524130601 d3,2046111463,1348922464 + 1467270507 d,313795259}}  
is not valid modulo 2147483629. >>
```

```
MatrixRank::nmod :
```

```
{0,0,0,0,0,0,0,0,1,0,0},{0,0,0,0,1358158970,0,0,311676514 + 1212454087 d,1610432727,0,0}, <<5>>,{0,738162205 +  
2084211904 d + 1700161549 d2 + 412472409 d3 + 661565600 d4 + 1361608024 d5,1205026758 + 1819024125 d +  
642240198 d2 + 1722830683 d3, <<5>>,1899826236,1734191209 + 511316814 d + 1023578827 d2 + 67706457 d3 +  
1577884849 d4 + 106844263 d5,812111100 + 2049016504 d + 507625799 d2 + 1107172809 d3 + 411961627 d4}}  
is not valid modulo 2147483629. >>
```

```
General::stop : Further output of MatrixRank::nmod will be suppressed during this calculation. >>
```

```
RowReduce::nmod :
```

```
{0,0,0,0,0,0,0,0,1,0,0}, <<9>>,{0,1216356917 + 1461167345 d + 598684078 d2 + 1031139942 d3 + 895937528 d4 +  
166983657 d5 + 1706372156 d6 + 993175182 d7 + 105071593 d8, <<7>>,2087300481 + 1738388257 d + 503746821  
d2 + 1365168199 d3 + 1412293484 d4 + 617290169 d5 + 812499857 d6 + 426859651 d7 + 913475420 d8,  
1423785579 + 1759607543 d + 786258779 d2 + 964408865 d3 + 1318244575 d4 + 1475521986 d5 + 805072898 d6 +  
1588272450 d7}} is not valid modulo 2147483629. >>
```

```
Transpose::nmtx : The first two levels of the one-dimensional list
```

```
{NullSpace[RowReduce[{{0,0,0,0,0,0,0,0,1,0,0},{0,0,0,0,1358158970,311676514 + 900777573 d,0,311676514 +  
900777573 d,1610432727,0,0}, <<7>>,{0, <<1>>, <<7>>, <<1>>,1896029611 + 1998813256 d + <<3>> +  
802961958 Power[<<2>>] + 196332736 Power[<<2>>]],{0, <<9>>,1423785579 + 1759607543 d + 786258779  
Power[<<2>>] + 964408865 Power[<<2>>] + 1318244575 Power[<<2>>] + 1475521986 Power[<<2>>] +  
805072898 Power[<<2>>] + 1588272450 Power[<<2>>]]}, <<1>>], <<1>>]]  
cannot be transposed. >>
```

```
Part::take : Cannot take positions 1 through 7 in
```

```
NullSpace[{{0,0,0,0,0,-1,0,1,0,0,0},{0,0,0,0,0,0,0,0,1,0,0},{0,0,0,0,0,0,-1,0,0,1,0},{0,0,0,0,0,0,0,0,0,0,1}}.  
Transpose[{{NullSpace[RowReduce[{{<<11>>}, Rule[<<2>>]], Modulus → 2147483629]], Modulus → 2147483629}.  
NullSpace[RowReduce[{{0,0,0,0,0,0,0,0,1,0,0}, <<10>>}, Modulus → 2147483629], Modulus → 2147483629}.  
>>
```

```
Out[61]= IdentifiabilityAnalysisData[False, <>]
```

```
In[62]:= iad["IdentifiableQ"]
```

```
Out[62]= False
```

```
In[63]:= iad["DegreesOfFreedom"]
```

```
Out[63]= 2
```

```
In[64]:= iad["NonIdentifiableParameters"]
```

```
Out[64]= {b, d1, d2, d3, e0, kTL, m0}
```

```
In[65]:= endTime = AbsoluteTime[]
```

```
      N[endTime - startTime]
```

```
Out[65]= 3.7143127117249377  $\times 10^9$ 
```

```
Out[66]= 2.13355
```

```
In[67]:=
```