

# Stochastic birth-death process by C

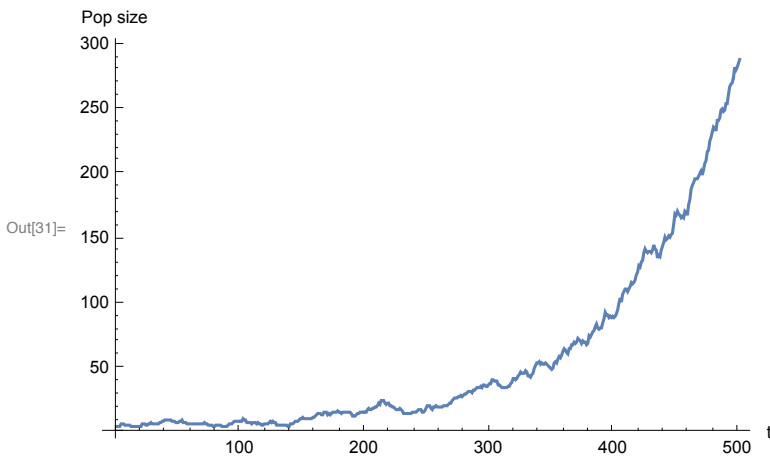
```
In[19]:= SetDirectory[  
  "/Users/takasu/home/情報科学科の仕事/講義/平成29年度/H29 大学院講義/Birth-death  
  model/birth-death/DerivedData/birth-death/Build/Products/Development/"]
```

```
Out[19]= /Users/takasu/home/情報科学科の仕事/講義/平成29年度/H29 大学院講義/Birth-death  
  model/birth-death/DerivedData/birth-death/Build/Products/Development
```

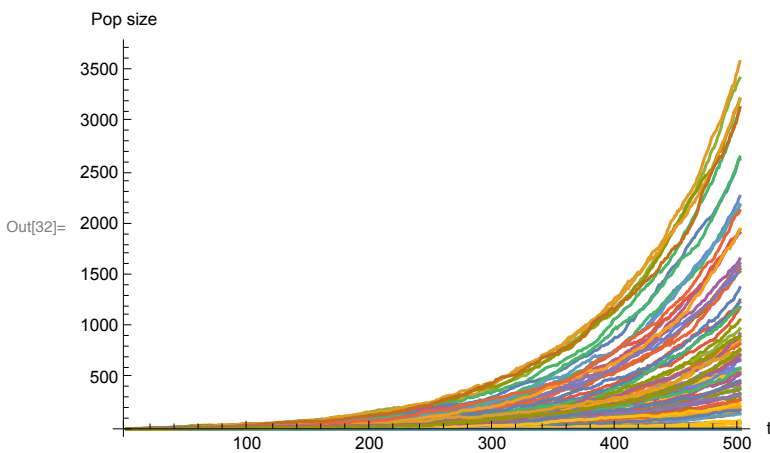
```
In[29]:= data = ReadList["data_eq_intv", Real, RecordLists -> True];  
  Length[data]
```

```
Out[30]= 100
```

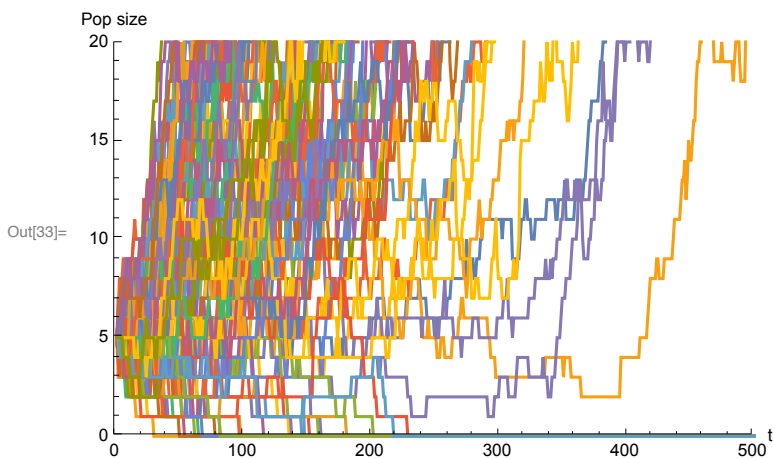
```
In[31]:= ListPlot[data[[1]], Joined -> True, AxesLabel -> {"t", "Pop size"}]
```



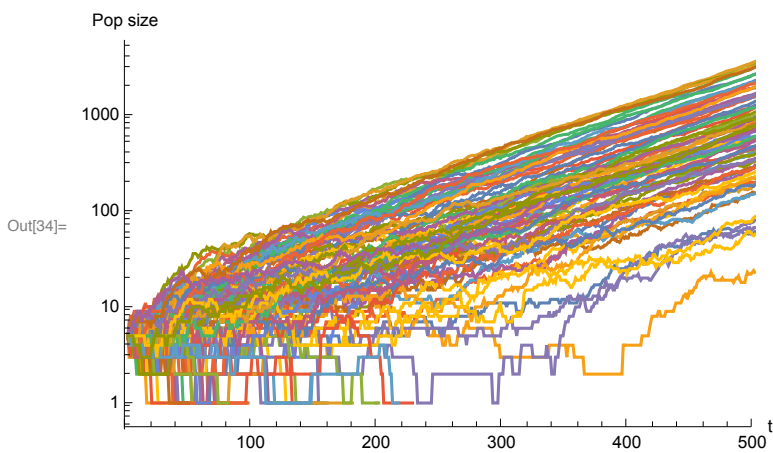
```
In[32]:= ListPlot[Take[data, 100], Joined -> True,  
  PlotRange -> All, AxesLabel -> {"t", "Pop size"}]
```



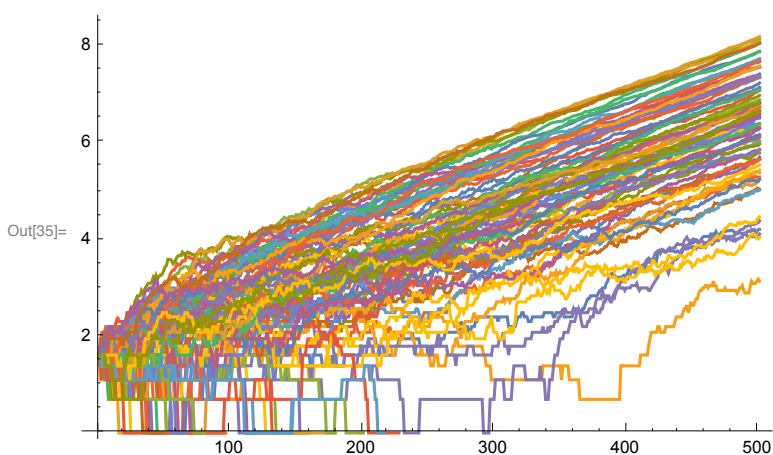
```
In[33]:= ListPlot[Take[data, 100], Joined → True,
  PlotRange → {{0, 500}, {0, 20}}, AxesLabel → {"t", "Pop size"}]
```



```
In[34]:= ListLogPlot[Take[data, 100], Joined → True,
  PlotRange → {{0, 500}, All}, AxesLabel → {"t", "Pop size"}]
```



```
In[35]:= ListPlot[Log[Take[data, 100]], Joined → True, PlotRange → {All, All}]
```



```
In[36]:= Fit[Take[Log[data[[1]]], -100], {1, t}, t]
```

Out[36]= 4.60146 + 0.0104712 t

```

In[37]:= Do[
  tmp = Take[Log[data[[i]]], -20];
  regress = Fit[tmp, {1, t}, t];
  Print[regress], {i, 1, Length[data]}
]
5.4486 + 0.0108486 t
Fit::fitm: フィットパラメータについて解くことができませんでした。 デザイン行列は非矩形または非数值的であるか、
あるいは逆行列が存在しません。 >>
Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
  Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
  Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
  Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]
7.94249 + 0.0104175 t
7.12459 + 0.0113091 t
Fit::fitm: フィットパラメータについて解くことができませんでした。 デザイン行列は非矩形または非数值的であるか、
あるいは逆行列が存在しません。 >>
Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
  Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
  Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
  Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]
7.18271 + 0.0076646 t
Fit::fitm: フィットパラメータについて解くことができませんでした。 デザイン行列は非矩形または非数值的であるか、
あるいは逆行列が存在しません。 >>
General::stop: この計算中に、 Fit::fitmのこれ以上の出力は表示されません。 >>
Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
  Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
  Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
  Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]
6.09511 + 0.0120035 t
7.24274 + 0.00830155 t
5.66854 + 0.00389393 t
6.92525 + 0.00972091 t
7.16351 + 0.00937006 t
6.32667 + 0.0138271 t
Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
  Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
  Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
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Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
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  Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
  Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]
4.14146 - 0.00462522 t
7.96513 + 0.0107153 t

```

```
Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
      Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
      Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
      Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]
```

5.18953 + 0.0051499 t

7.3752 + 0.00946493 t

6.615 + 0.0092643 t

6.56036 + 0.0106865 t

```
Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
      Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
      Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
      Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]
```

5.34661 + 0.0158236 t

7.8666 + 0.0104392 t

6.79189 + 0.0138425 t

7.50866 + 0.0108498 t

2.88028 + 0.0122012 t

```
Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
      Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
      Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
      Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]
```

7.81571 + 0.011459 t

7.65943 + 0.0106583 t

5.05229 + 0.00697183 t

5.93355 + 0.00581933 t

7.16589 + 0.0110544 t

```
Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
      Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
      Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
      Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]
```

4.80138 + 0.0129086 t

4.84892 + 0.00793152 t

5.19637 + 0.0119961 t

5.64804 + 0.010514 t

6.7315 + 0.011957 t

7.38962 + 0.00921745 t

6.23574 + 0.00820816 t

```
Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
      Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
      Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,
      Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]
```

7.36848 + 0.010164 t

7.66054 + 0.0109036 t

6.90964 + 0.0102166 t

6.51116 + 0.0118234 t

6.69301 + 0.00947141 t

6.58173 + 0.0067196 t

3.98393 + 0.0123444 t

5.4874 + 0.00835436 t

5.80668 + 0.00949593 t

6.19994 + 0.00778779 t

6.05408 + 0.0104092 t

5.83545 + 0.00631573 t

Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
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Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]

6.43115 + 0.00855605 t

5.19158 + 0.0103317 t

6.33469 + 0.0116617 t

6.87773 + 0.0108195 t

6.98514 + 0.0117111 t

Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
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Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]

5.50564 + 0.00535837 t

4.11039 + 0.0133957 t

Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
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Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]

3.71392 + 0.0214518 t

Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
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Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]

6.40723 + 0.0113668 t

5.95455 + 0.00982476 t

6.23953 + 0.0135618 t

6.57074 + 0.0103043 t

5.92057 + 0.0096458 t

7.5112 + 0.00905322 t

5.09834 + 0.00726978 t

7.87084 + 0.010437 t

Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
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Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
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Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]

7.1742 + 0.0109718 t

Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
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Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]

7.4939 + 0.010041 t

4.29037 + 0.00573587 t

6.53237 + 0.0149251 t

6.64847 + 0.00848602 t

Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
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Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
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Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]

7.36633 + 0.0101922 t

6.07992 + 0.0124734 t

6.12625 + 0.0128635 t

5.93937 + 0.0113221 t

6.51128 + 0.00708836 t

Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
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Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]

7.44252 + 0.0117256 t

5.69479 + 0.00600248 t

7.8426 + 0.00972526 t

Fit[{{Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate,  
Indeterminate, Indeterminate, Indeterminate, Indeterminate, Indeterminate}}, {1, t}, t]

5.30623 + 0.0112897 t

$$6.31162 + 0.0111102 t$$

$$6.41698 + 0.0121914 t$$