

## Template for Chapter 2

Generating the stochastic data in Table 2.3

```

> A := Matrix(9,10): # open a 9x10 matrix to store the data table
for i from 1 to 10 do # simulation i from 1 to 10
  x := Vector(9): # vector to store data for this
simulation
  x[1] := 100: # starting from 100 squirrels
  for k from 1 to 8 do # year k from 1 to 8
    m := x[k]: # the number of squirrels at the start
of the year
    s := 0: # the squirrel counter, initialize as
zero
    for j from 1 to m do # each squirrel goes through a coin
flip
      t := RandomTools:-Generate(integer(range=0..1)): #
flip a coin
      if t=1 then # if getting a head ...
        s := s + 1 # this squirrel survives, count it
      end if:
    end do:
    x[k+1] := s # at the year end, store the number of
surviving squirrels
  end do:
  A[1..-1,i] := x: # the i-th column of A stores this
simulation data
end do:

```

```

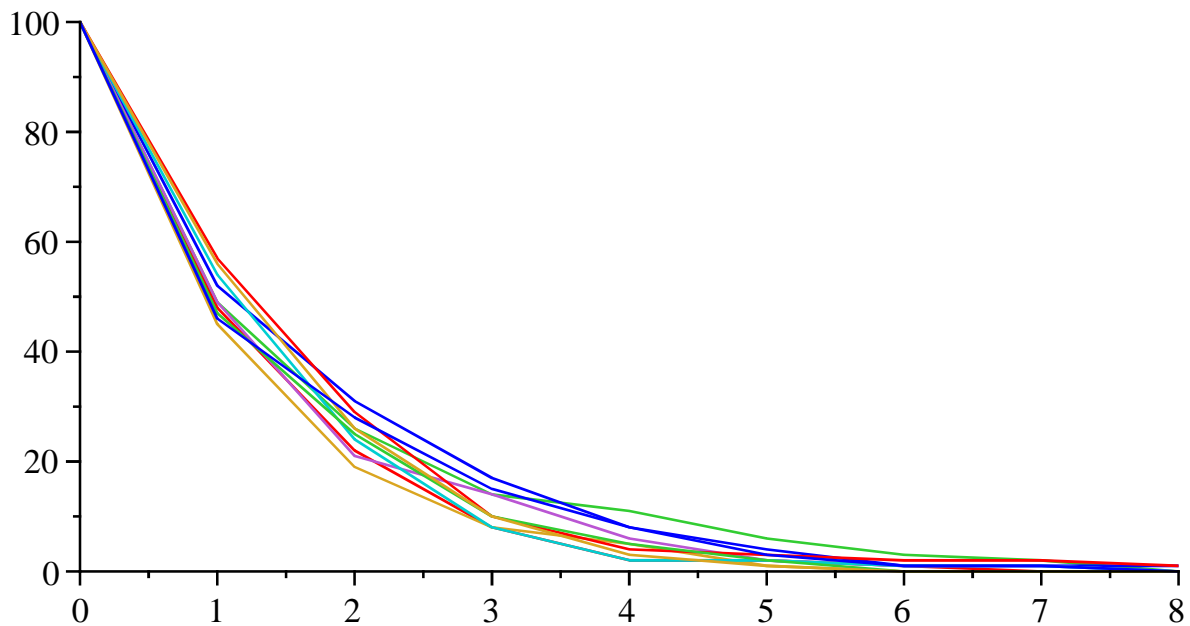
> A;

```

100	100	100	100	100	100	100	100	100	100	100
48	49	45	52	49	54	57	47	56	46	
22	26	19	31	21	24	29	25	26	28	
8	14	8	17	14	8	10	10	10	15	
2	11	5	8	6	2	4	5	3	8	
2	6	1	4	2	2	3	2	1	3	
1	3	0	1	1	1	2	0	0	1	
0	2	0	1	1	1	2	0	0	1	
0	0	0	1	0	0	1	0	0	0	

(1)

```
> # generating Figure 2.2
plot([seq([seq([j-1,A[j,i]],j=1..9)],i=1..10)]);
```



Generate a histogram.

Example on page 53, AST test scores

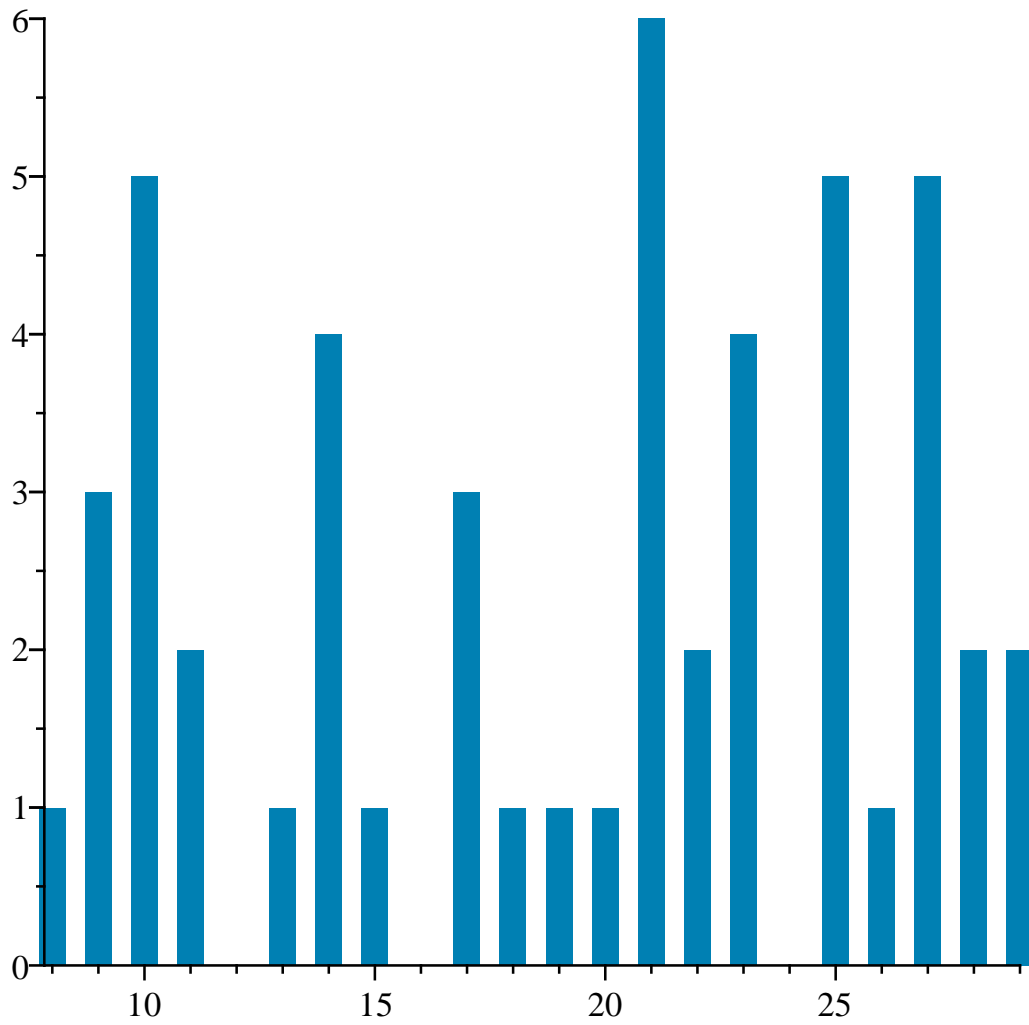
Generate 50 AST test scores ranging from 7 to 29

```
> s := LinearAlgebra:-RandomVector(50, generator = 7..29):
> seq(s[i],i=1..50); # view the scores in a sequence
29, 11, 17, 29, 20, 21, 21, 23, 10, 9, 27, 23, 10, 23, 19, 11, 14, 10, 21, 22, 21, 9, 13, 14, 28, 10,
18, 27, 9, 21, 17, 27, 25, 25, 23, 17, 15, 10, 25, 28, 22, 27, 14, 25, 25, 27, 21, 26, 14, 8
```

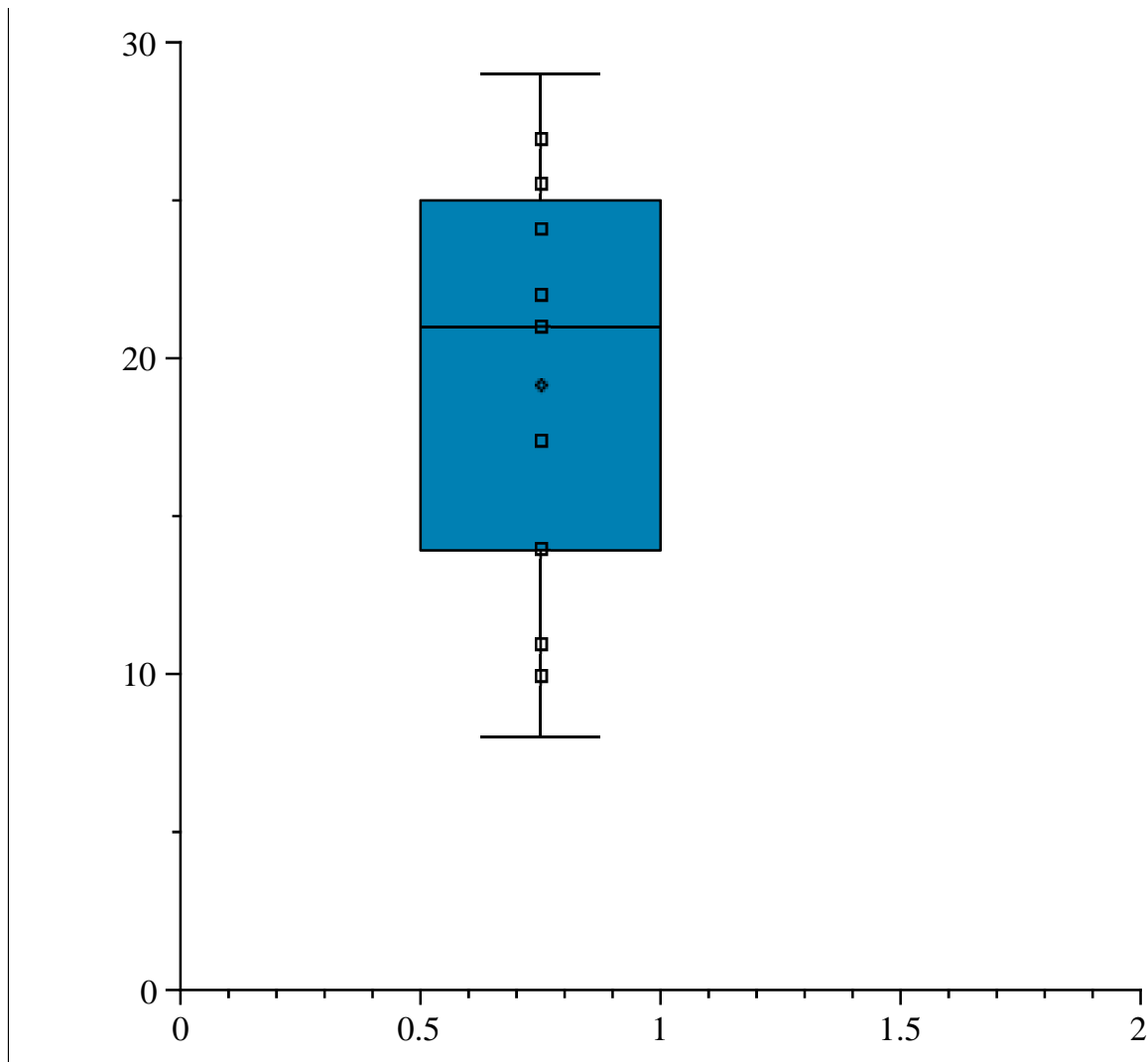
(2)

The histogram

```
> Statistics:-Histogram(s, discrete = true, thickness = 10,
frequencyscale = absolute);
```



```
> Statistics:-BoxPlot(s,width=0.5,view=[0..2,0..30]);
```



```
[ > Statistics:-FivePointSummary(s);
  [minimum = 8., lowerhinge = 14., median = 21., upperhinge = 25., maximum = 29.] (3)
```

```
[ > Statistics:-StandardDeviation(s);
  6.6002 (4)
```

### Section 2.3.3

#### Stochasticity and the Sandhill Crane

Generating Table 2.10:

```
[ > Digits := 5:
  m, n := 20,6:
  B := Matrix(m, n): # a 20x6 matrix
  br, dr := 0.5, 0.1: # normal birth rate and death rate
```

```

for k from 1 to m do # simulation runs (1 to 20)
  x := Vector[row](n): # vector to store data for this run
  x[1] := 100: # starts with 100 cranes
  for j from 1 to n-1 do # year 1 to 5
    # generate a uniform random floating-point number from 0
to 1
    t := RandomTools:-Generate(float(range=0..1,method=
uniform)):
    if t < 0.04 then
      x[j+1] := (1 + 0.6*br-1.25*dr)*x[j] # catastrophic
year
    else
      x[j+1] := (1+br-dr)*x[j] # normal year
growth
    end if;
  end do;
  B[k,1..-1] := x:
end do:
> B[1..10,1..-1]; B[11..20,1..-1];

```

100	140.0	196.00	274.40	384.16	537.82
100	117.50	164.50	230.30	322.42	451.39
100	140.0	196.00	274.40	384.16	537.82
100	140.0	196.00	274.40	384.16	537.82
100	140.0	196.00	274.40	384.16	537.82
100	140.0	196.00	274.40	384.16	451.39
100	140.0	196.00	274.40	384.16	537.82
100	140.0	196.00	274.40	384.16	537.82
100	140.0	196.00	274.40	384.16	537.82
100	140.0	196.00	274.40	384.16	537.82
100	140.0	196.00	274.40	384.16	537.82

```

100 117.50 164.50 230.30 322.42 451.39
100 140.0 196.00 230.30 322.42 451.39
100 140.0 196.00 274.40 384.16 537.82
100 140.0 196.00 274.40 384.16 537.82
100 140.0 196.00 274.40 384.16 537.82
100 140.0 196.00 274.40 384.16 537.82
100 140.0 196.00 274.40 384.16 537.82
100 140.0 196.00 274.40 384.16 537.82
100 140.0 196.00 274.40 384.16 537.82
100 140.0 196.00 274.40 384.16 537.82

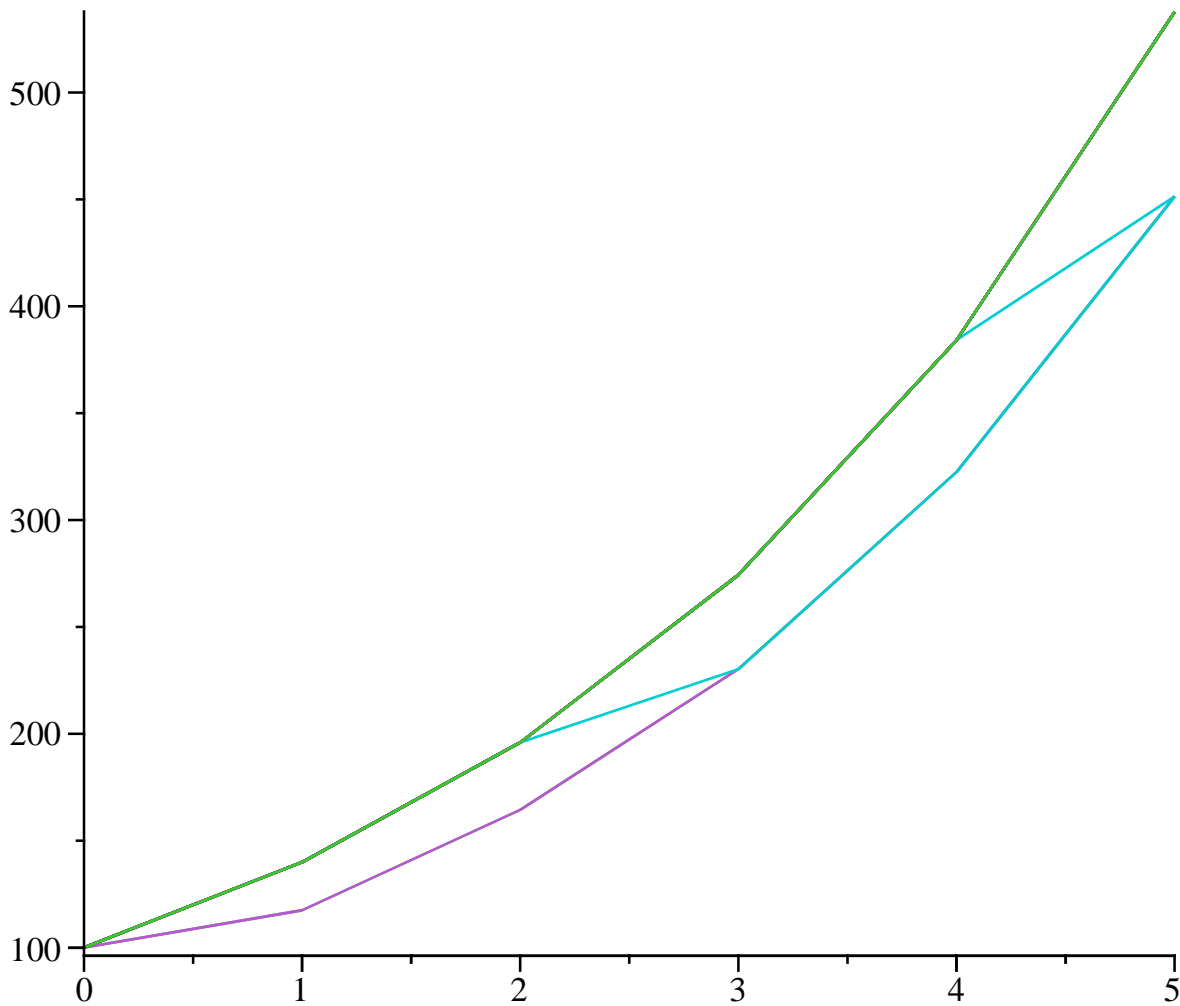
```

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```

> # generate Figure 2.12
plot([seq([seq([j-1,B[k,j]],j=1..n)],k=1..m)]);

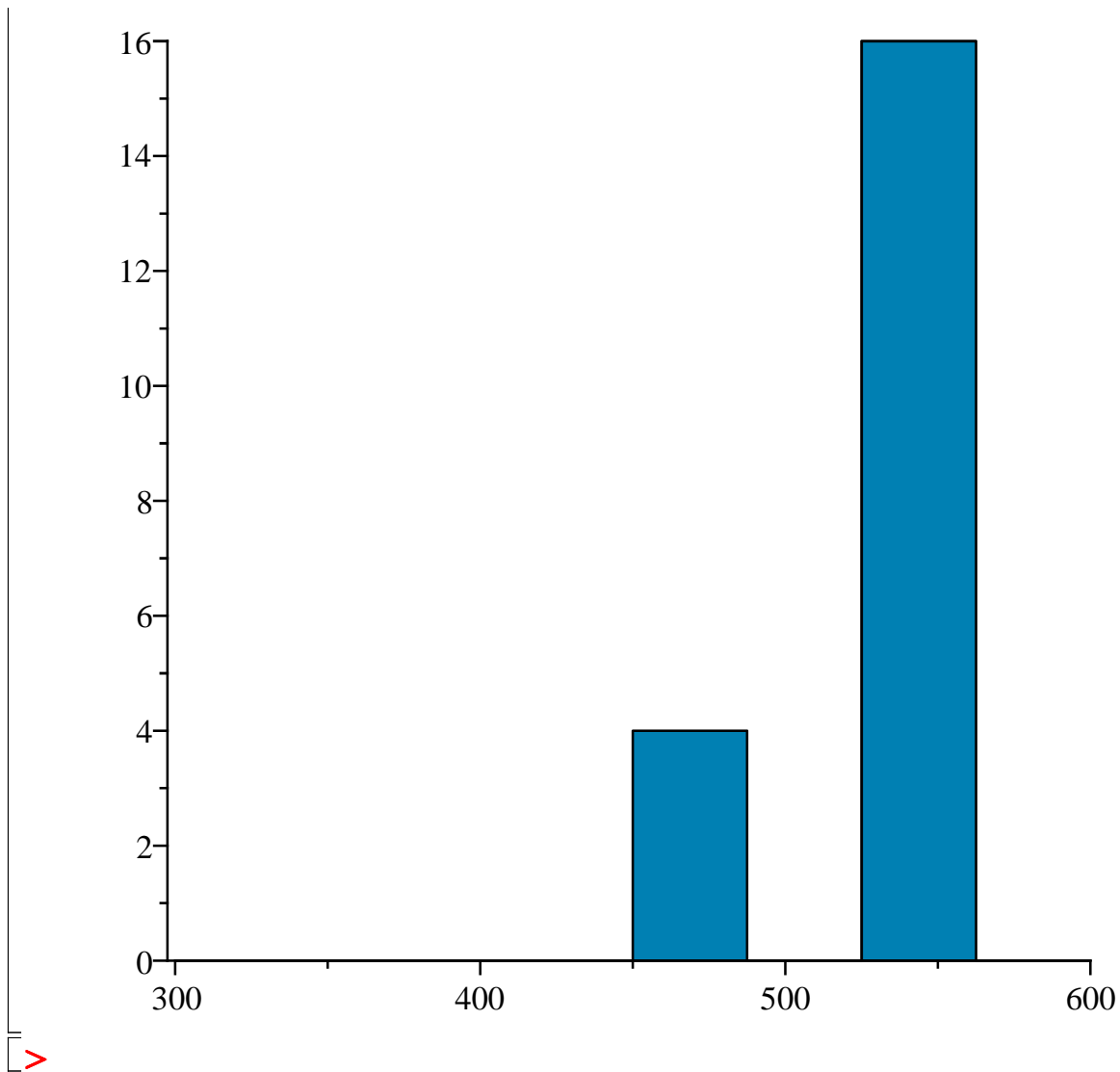
```



```

> Statistics:-Histogram(B[1..-1,6], binwidth = 40, range = 300 ..
600, frequencyscale=absolute);

```



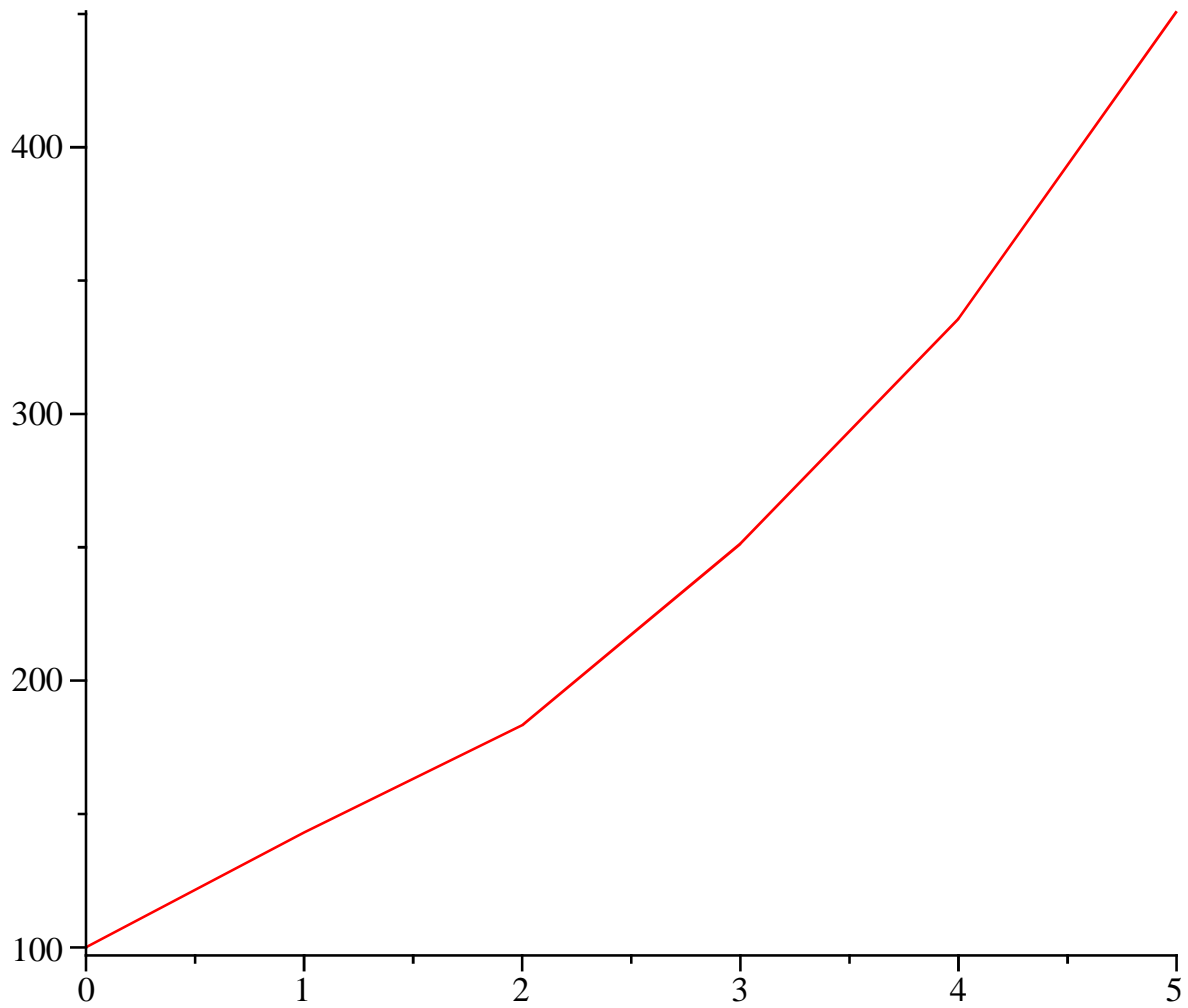
Demographic Stochasticity

```

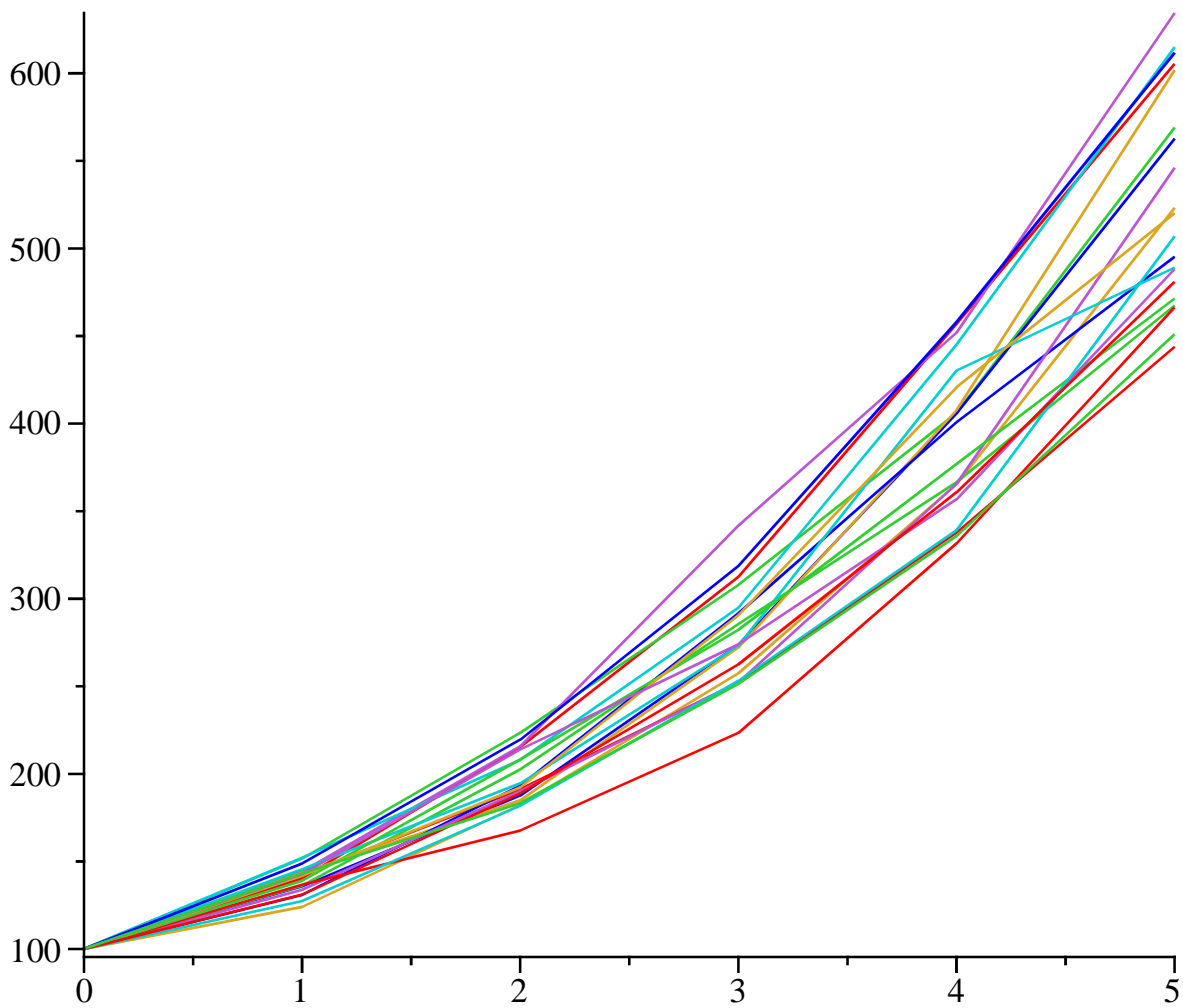
> C := Matrix(20,6):
  for k from 1 to 20 do      # simulation runs (1 to 20)
    x := Vector[row](6):    # vector to store data for this run
    x[1] := 100:           # starts with 100 cranes
    for j from 1 to 5 do   # year 1 to 5
      br := RandomTools:-Generate(distribution(Normal(0.5,0.03))
    ): # random birth rate
      dr := RandomTools:-Generate(distribution(Normal(0.1,0.08))
    ): # random birth rate
      x[j+1] := (1+br-dr)*x[j]
    end do;
    C[k,1..-1] := x:
  end do:

```

```
> # generate Figure 2.14  
plot([seq([j-1,x[j]],j=1..6)]);
```



```
> # generate Figure 2.15  
plot([seq([seq([j-1,C[k,j]],j=1..6)],k=1..20)]);
```



> # Table 2.12

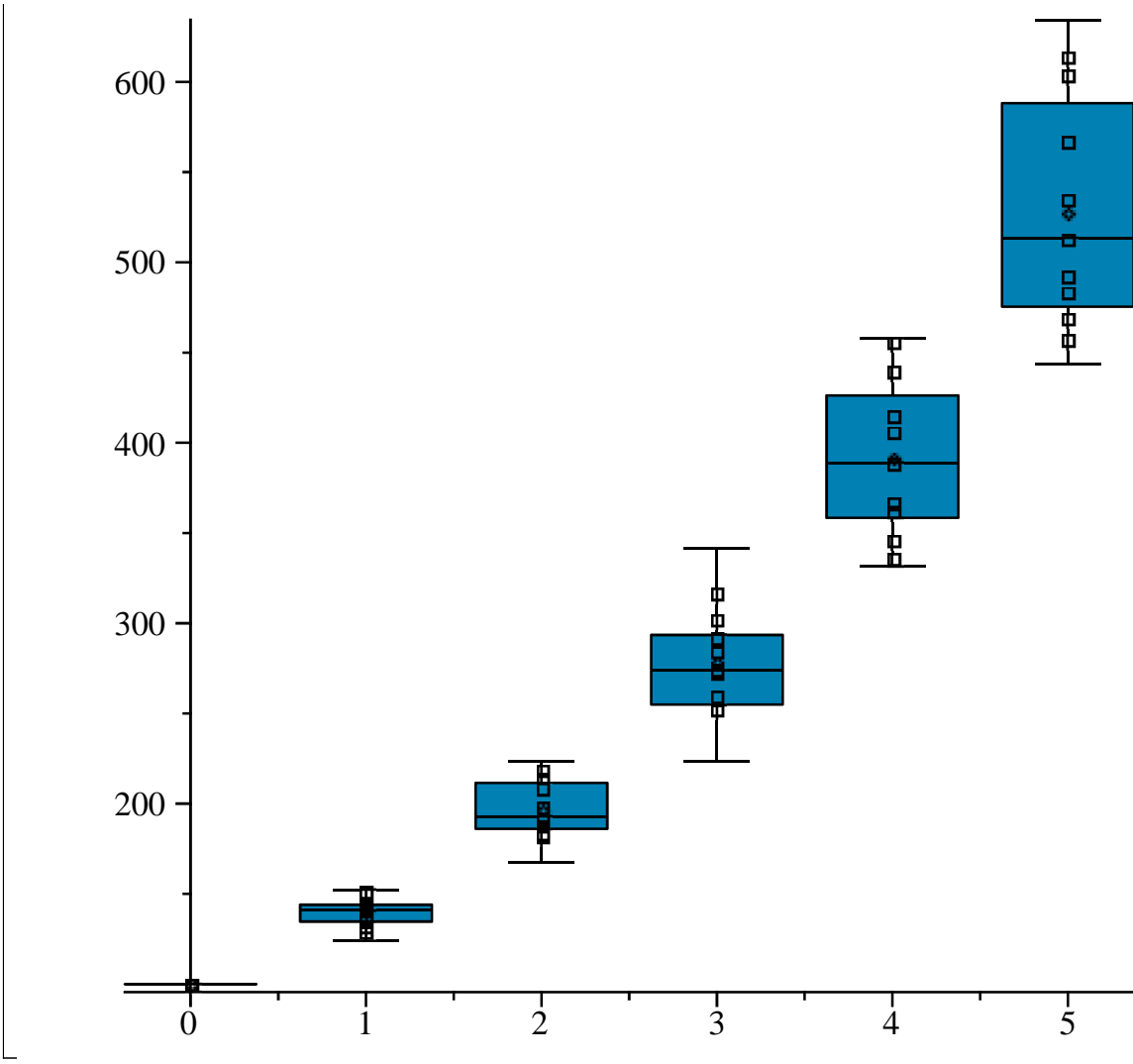
`C[1..10,1..-1]; C[11..20,1..-1];`

100	140.44	215.35	312.47	457.05	605.36
100	151.60	223.46	307.91	405.98	569.18
100	124.04	182.29	257.43	365.24	523.24
100	135.73	187.66	273.65	405.80	562.72
100	144.20	215.72	341.74	451.85	634.44
100	152.10	208.01	294.83	445.10	615.04
100	142.18	191.19	252.06	337.71	443.82
100	136.22	202.53	285.55	366.45	467.41
100	143.55	184.92	272.17	407.57	601.82
100	130.95	193.31	291.61	400.70	495.27

```
100 133.84 190.12 252.27 365.54 546.04
100 145.55 194.60 273.20 430.26 489.08
100 136.72 167.66 223.39 331.58 466.33
100 138.99 208.18 282.23 376.95 471.49
100 141.79 192.25 290.61 420.72 520.18
100 148.82 219.52 318.68 457.98 611.77
100 142.81 213.86 273.98 356.78 488.18
100 127.40 181.75 253.12 339.03 507.02
100 131.01 188.93 262.56 360.78 480.99
100 143.08 183.29 251.35 335.75 450.98
```

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```
> # generate Figure 2.16
for k from 1 to 6 do
  p[k] := Statistics:-BoxPlot(C[1..-1,k],offset=k-2,width=0.75)
:
end do:
plots[display]({seq(p[k],k=1..6)});
```



[>