#1. discrete

\[ P = \text{principal in dollars} \]
\[ t = \text{time in years} \]
\[ P_0 = 500 \quad \text{initial principal} \]
\[ r = 0.05 \quad \text{interest rate, (annual).} \]

\[ P(t+1) = 1.05 \times P(t) \] is the recursion relation.

Solution \[ P(t) = 500 \times (1.05)^t \]

<table>
<thead>
<tr>
<th>( t )</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>500</td>
</tr>
<tr>
<td>1</td>
<td>500 \times (1.05)</td>
</tr>
<tr>
<td>2</td>
<td>500 \times (1.05)^2</td>
</tr>
<tr>
<td></td>
<td>\vdots</td>
</tr>
</tbody>
</table>

#2. continuous

Same variables & parameters.

Equation: \[ \frac{dP}{dt} = 0.05 \times P \]
\[ P(0) = 500 \]

Solution \[ P = 500 \times e^{0.05t} \]

#3. discrete

\[ W = \text{number of whales (could be in thousands)} \]
\[ t = \text{time in years} \]
\[ W_0 = 20,000 \]
\[ r = 0.02 \quad \text{annual population growth.} \]

\[ W(t+1) = W(t) \times (1.02) \]

Solution \[ W = 20,000 \times (1.02)^t \]

<table>
<thead>
<tr>
<th>( t )</th>
<th>( W )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>20,000</td>
</tr>
<tr>
<td>1</td>
<td>20,000 \times (1.02)</td>
</tr>
<tr>
<td>2</td>
<td>20,000 \times (1.02)^2</td>
</tr>
<tr>
<td></td>
<td>\vdots</td>
</tr>
</tbody>
</table>
# 4. Continuous

\[ R = \text{number of rabbits} \]
\[ t = \text{time in years} \]
\[ r = 0.10 \text{ annual growth rate} \]
\[ R_0 = 200 \text{ initial population} \]
\[ \frac{dR}{dt} = 0.1 R \]

Solution: \[ R = 200 e^{0.1t} \]

# 5. Discrete

\[ S = \text{your probability of surviving to time } t \]
\[ t = \text{time in years} \]
\[ m = 0.95 \text{ annual survival probability} \]
\[ S_0 = 1 \]
\[ S(t+1) = 0.95 S(t) \]

Solution:

\[
\begin{array}{c|c|c}
\text{t} & S(t) & S(t+1) \\
0 & 1 & 0.95 \\
1 & 0.95 & 0.95 \times 0.95 \\
2 & (0.95)^2 & \vdots \\
\end{array}
\]

# 6. Continuous

\[ S(t) = \text{probability of surviving to time } t \]
\[ t = \text{time in years} \]
\[ m = 0.005 \times 365 = \text{annual death rate} \]
\[ S_0 = 1 \]
\[ \frac{dS}{dt} = -1.825 S \]
\[ S = \text{e}^{1.825 t} \]
\[ S(1/2) = \text{1.402} \]