Some helpful equations:

\[ A(t) = P(b)^t \quad A(t) = P(1 + r)^t \quad A(t) = P_{old} \left( \frac{P_{new}}{P_{old}} \right)^{\frac{t}{n}} \quad A(t) = P(h)^{\frac{t}{L}} \]

- \( A \): amount after some time
- \( P \): "principle", or the initial amount
- \( b \): growth/decay factor
- \( t \): time
- \( n \): number of times compounded per year
- \( L \): how long something took
- \( r \): growth/decay rate

1. Is this a linear function, exponential function, some other type of function, or not a function?

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>3.500</td>
<td>0.350</td>
<td>-0.954</td>
<td>-1.956</td>
<td>-2.80</td>
<td>-3.54</td>
</tr>
</tbody>
</table>

2. Is this a linear function, exponential function, some other type of function, or not a function?

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</thead>
<tbody>
<tr>
<td>y</td>
<td>7.100</td>
<td>3.950</td>
<td>0.800</td>
<td>-2.350</td>
<td>-5.500</td>
<td>-8.650</td>
</tr>
</tbody>
</table>

3. Is this a linear function, exponential function, some other type of function, or not a function?

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<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>3.100</td>
<td>3.720</td>
<td>4.464</td>
<td>5.357</td>
<td>6.428</td>
<td>7.7137</td>
</tr>
</tbody>
</table>

4. Is this a linear function, exponential function, some other type of function, or not a function?

\[ y = 934(1 + 0.39)^x \]

5. Is this a linear function, exponential function, some other type of function, or not a function?

\[ y = 27(1 + 3x)^2 \]

6. Makebelievia Inc. is making automatic homework doers, they can make 2000 the first year, increasing by 5% per year.

   (a) What is the growth rate?
   (b) What is the growth factor?
   (c) Find a model, \( D(t) \) for the production level, as a function of the number of years after the first production.
   (d) Find the amount produced 7 years later.
   (e) Find the time when they first produce over 3000. (Watch your rounding)
   (f) Find the decadal growth rate (growth rate over a decade).

7. You invest $1700 in a ponzi scheme paying 3.7% compounded annually.

   (a) Find a model \( A(t) \) that gives the amount you believe you have, in dollars, as a function of years after initial deposit.
   (b) Find the amount in the account after 27 years.
   (c) Find the doubling time.
   (d) Find the monthly growth rate.

8. A colony of ants has moved into your roommate’s sock drawer, on Feb. 17 the population was 1200, by Feb. 20 the population had grown to 2300. Assume exponential growth.

   (a) Find a model \( P(t) \) that gives the number of ants as a function of days after Feb. 17th.
   (b) Find the amount of ants on Feb 29.
   (c) Find the day when the number of ants is exactly 3000. (Extra credit: find the hour in the day)
   (d) Find the daily growth factor.
   (e) Find the daily growth rate.
9. Makebelievia’s national reserves, in billions, can be modeled by the function $D(t) = 273(0.8432)^t$ where $t$ is the number of years after January 1, 2000.

(a) Find the country’s annual percent growth/decay rate.
(b) The country’s reserves [increase / decrease] by _____ each ______.
(c) Find the per-decade growth/decay factor, round to four decimal places (extra credit, why four places?)
(d) Find the average rate of change during President Phakie’s term, (2002 to 2009)
(e) The country’s actual reserves in 2009 were $54.71$ billion, find the model’s error.
(f) Predict the reserves in 2018.
(g) In what year will the reserves reach 4,380 million? (watch your units)

10. My laptop battery loses 4% of its runtime every month, find the time when it’s down to half of it’s initial runtime.

11. The following data represents the number of points scored in the Makebelievia national championship mud-slinging match for several years.

<table>
<thead>
<tr>
<th>Year</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points</td>
<td>103</td>
<td>131</td>
<td>143</td>
<td>172</td>
<td>184</td>
<td>219</td>
</tr>
</tbody>
</table>

(a) Find the linear model $M(t) = at + b$ that best fits these data where $t$ is the number of years after 2003.
(b) Find the SSE of your model
(c) Find the AE (average error)
(d) Find the correlation coefficient
(e) Can you be 95% confident that there’s correlation between year and points? (Pretend you know $r_5 = 0.878$)
(f) The model [under-predicts / over-predicts / exactly predicts] the points in 2006
(g) Predict the number of points in 2011

12. A group of bacteria doubles in size in 8 hours, if there are 1600 at noon, how many are there at 5:00 pm.

13. Find the effective annual yield for each of these accounts:

(a) $1000$ invested at 5% compounded annually
(b) $2172$ invested at 4.5% compounded daily
(c) $829$ invested at 3.2% compounded monthly
Answers:

1. Some other type of function

2. Linear function

3. Exponential function

4. Exponential function

5. Some other type of function

6. (a) 5%
   (b) 1.05
   (c) $D(t) = 2000(1 + .05)^t$
   (d) 2814
   (e) $t = 8.31$, but round up to $t = 9$
   (f) 62.88%

7. (a) $A(t) = 1700(1 + .037)^t$
   (b) $4533.96$
   (c) $t = 19.08$
   (d) 0.30%

8. (a) $P(t) = 1200(2300/1200)^{t/3}$ or $P(t) = 1200(1.2422)^t$
   (b) 16195
   (c) $t = 4.23$ or Feb 21, 5:24 am
   (d) 1.2422
   (e) 24.22%

9. (a) -15.68%
   (b) The country’s reserves decrease by 15.68% each year.
   (c) factor: .1631, rate: -83.86%
   (d) -19.33 billion/year
   (e) -4.12 billion
   (f) 12.67 billion
   (g) $t = 24.23$ or 2024

10. $t = 16.98$ or about 17 months

11. (a) $M(t) = 21.94t + 103.81$
    (b) 143.28
    (c) 4.89
    (d) 0.9916
    (e) Yes
    (f) The model under-predicts the points in 2006
    (g) 279.35

12. 2468 (round to a whole number)

13. (a) 5%
    (b) 4.60%
    (c) 3.25%