U5D6_T Exponential Growth _ Decay

November 21, 2019 12:16 PM

U5D6_T Exponenti...

UNIT 5 Day 6:

Exponential Growth and Doubling Time

Doubling time refers to the amount of time for a quantity to double in value. For exponential relations, this doubling time is a constant value.

Draw in the first few rows of a First Difference column and a ratio column.

Then calculate the appropriate values.

NOTE:

This is an Exponential of the form $y=ab^x$ --

So, for this ratio column calculate the ratio of consecutive y-values.

Date	Principle ($)	First Diff	Ratio
2010	$5,000		
2011	$5,359		
2012	$5,743		
2013	$6,156		
2014	$6,598		
2015	$7,071		
2016	$7,579		
2017	$8,123		
2018	$8,706		
2019	$9,330		
2020	$10,000		
2021	$10,718		
2022	$11,487		
2023	$12,311		
2024	$13,195		
2025	$14,142		
2026	$15,157		
2027	$16,245		
2028	$17,411		
2029	$18,661		
2030	$20,000		
2031	$21,435		
2032	$22,974		
2033	$24,623		
2034	$26,390		
2035	$28,284		
2036	$30,314		
2037	$32,490		
2038	$34,822		
2039	$37,321		
2040	$40,000		

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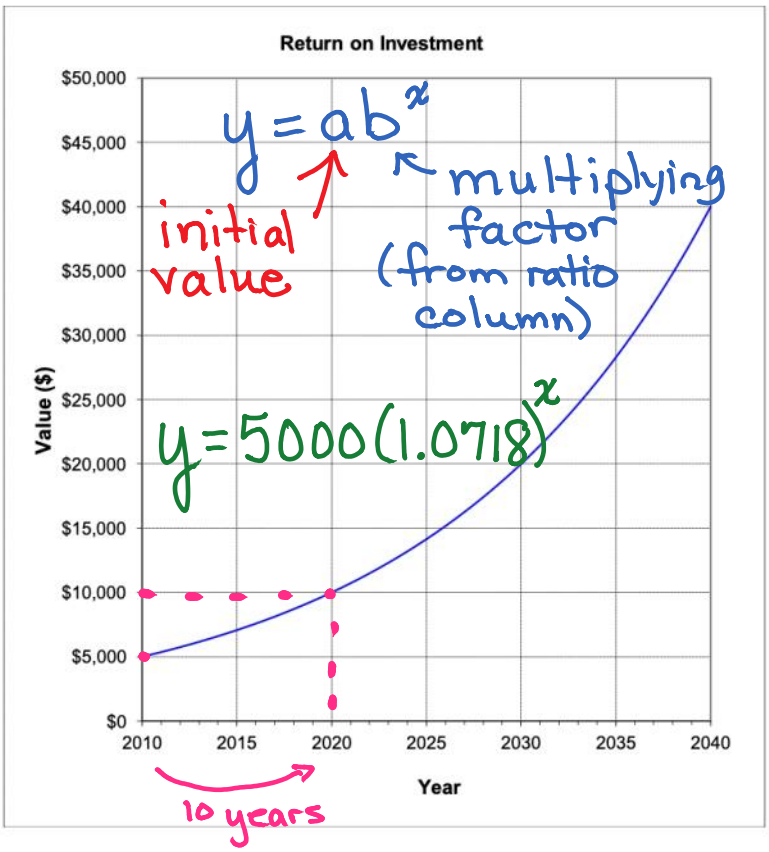
Date	Principle ($)	First Diff ($)	Ratio
2010	$5,000	5359 – 5000 = $359	5359/5000 = 1.0718
2011	$5,359	5743 – 5359 = $384	5743/5359 = 1.0717
2012	$5,743	6156 – 5743 = $413	6156/5743 = 1.0719
2013	$6,156	$442	1.0718
2014	$6,598	$473	1.0717
2015	$7,071	$508	1.0718
2016	$7,579	$544	1.0718
2017	$8,123	$583	1.0718
2018	$8,706	$624	1.0717
2019	$9,330	$670	1.0718
2020	$10,000	$718	1.0718
2021	$10,718	$769	1.0717
2022	$11,487	$824	1.0717
2023	$12,311	$884	1.0718
2024	$13,195	$947	1.0718
2025	$14,142	$1,015	1.0718
2026	$15,157	$1,088	1.0718
2027	$16,245	$1,166	1.0718
2028	$17,411	$1,250	1.0718
2029	$18,661	$1,339	1.0718
2030	$20,000	$1,435	1.0718
2031	$21,435	$1,539	1.0718
2032	$22,974	$1,649	1.0718
2033	$24,623	$1,767	1.0718
2034	$26,390	$1,894	1.0718
2035	$28,284	$2,030	1.0718
2036	$30,314	$2,176	1.0718
2037	$32,490	$2,332	1.0718
2038	$34,822	$2,499	1.0718
2039	$37,321	$2,679	
2040	$40,000		

no need to do all of these (I used a spreadsheet)


Return on Investment
$50,000
$45,000
$40,000
$35,000
$30,000
$25,000
$20,000
$15,000
$10,000
$5,000
$0
Value ($)
2010
2015
2020
2025
2030
2035
2040
Year
y = ab^x
initial value
multiplying factor (from ratio column)
y = 5000(1.0718)^x
10 years

1. What is the doubling time for this investment? 10 years

2. What is the multiplying factor for this investment?

From ratio column around 1.0718

3. What is the annual rate of return (percentage)?

The "multiplying factor" 1.0718 means we are multiplying by 107.18%

That means the "growth rate" is 107.18% − 100% = 7.18%

OR

$$\text{percent change} = \frac{\text{New} - \text{Old}}{\text{Old}} \times 100\%$$

percent increase is the same as growth rate

$$\frac{5359 - 5000}{5000} \times 100\% = 7.18\%$$

Exponential Decay and Half Life Time

Half-Life time refers to the amount of time for a quantity to divide in half (multiply by 0.5).

For exponential relations, the half-life is a constant value.

Draw in the first few rows of a First Difference column and a ratio column.

Then calculate the appropriate values.

Time (hrs)	Caffeine (mg)	First Differences	Ratio
0	200.00		
1	174.11		
2	151.57		
3	131.95		
4	114.87		
5	100.00		
6	87.06		
7	75.79		
8	65.98		
9	57.43		
10	50.00		
11	43.53		
12	37.89		
13	32.99		
14	28.72		
15	25.00		
16	21.76		
17	18.95		
18	16.49		
19	14.36		
20	12.50		
21	10.88		
22	9.47		
23	8.25		
24	7.18		
25	6.25		
26	5.44		
27	4.74		
28	4.12		
29	3.59		
30	3.12		

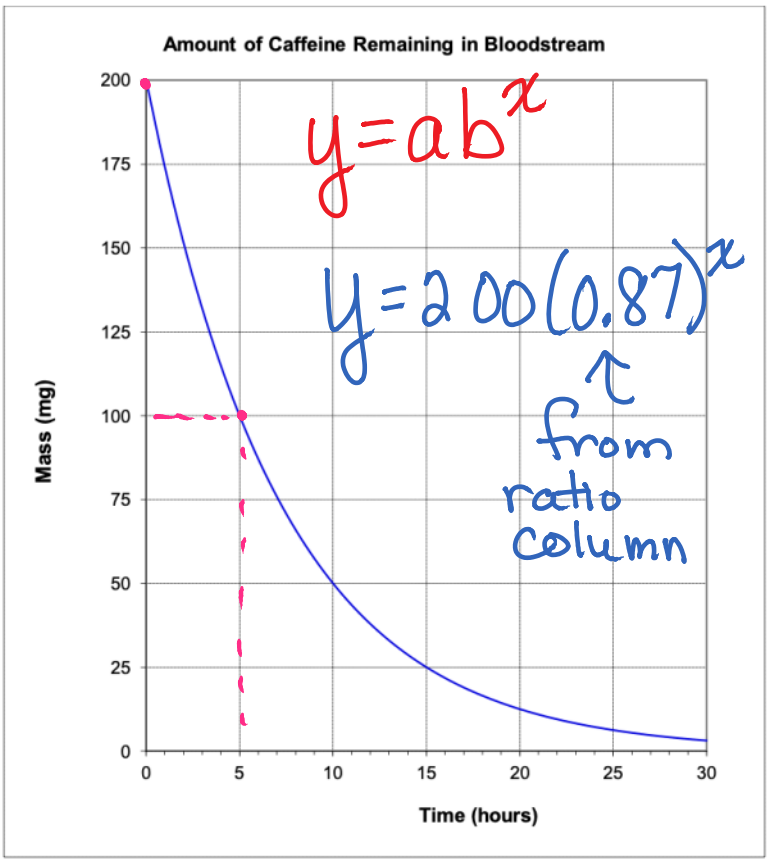
Exponential Decay and Half Life Time

Half-Life time refers to the amount of time for a quantity to divide in half (multiply by 0.5).

For exponential relations, the half-life is a constant value.

Time (hrs)	Caffeine (mg)	First Differences	Ratio
0	200.00	-25.89	0.8706
1	174.11	-22.54	0.8705
2	151.57	-19.62	0.8706
3	131.95	-17.08	0.8706
4	114.87	-14.87	0.8705
5	100.00	-12.94	0.8706
6	87.06	-11.27	0.8705
7	75.79	-9.81	0.8706
8	65.98	-8.55	0.8704
9	57.43	-7.43	0.8706
10	50.00	-6.47	0.8706
11	43.53	-5.64	0.8704
12	37.89	-4.90	0.8707
13	32.99	-4.27	0.8706
14	28.72	-3.72	0.8705
15	25.00	-3.24	0.8704
16	21.76	-2.81	0.8709
17	18.95	-2.46	0.8702
18	16.49	-2.13	0.8708
19	14.36	-1.86	0.8705
20	12.50	-1.62	0.8704
21	10.88	-1.41	0.8704
22	9.47	-1.22	0.8712
23	8.25	-1.07	0.8703
24	7.18	-0.93	0.8705
25	6.25	-0.81	0.8704
26	5.44	-0.70	0.8713
27	4.74	-0.62	0.8692
28	4.12	-0.53	0.8714
29	3.59	-0.47	
30	3.12		

no need to do all of these!



Note : 1 small cup of coffee contains approx 100 mg of caffeine

1. What is the half-life for caffeine in the bloodstream? 5 hours

2. What is the decay factor for caffeine in the bloodstream? 0.87

When you see the words multiplying factor or decay factor for growth for decay means the number from ratio column

3. What is the percent decrease per hour for caffeine?

$87\% - 100\% = -13\%$

decrease of 13%

OR

$$\frac{\text{New} - \text{Old}}{\text{Old}} \times 100\%$$

$$= \frac{174.11 - 200}{200} \times 100\%$$

$$= -12.945$$

$$\doteq -13\%$$ ← decrease of 13%

so the decay rate is 13%.