



Exponential Decay

Understanding How Value Decreases Over Time



Decay vs. Growth

When looking at Exponential Growth and buying a home, we saw the total price we would pay over the life of the loan go up.

This time, we're going to consider purchasing a car. When looking at Exponential Decay and purchasing a car, should we expect the value of our car to go UP or DOWN over time?

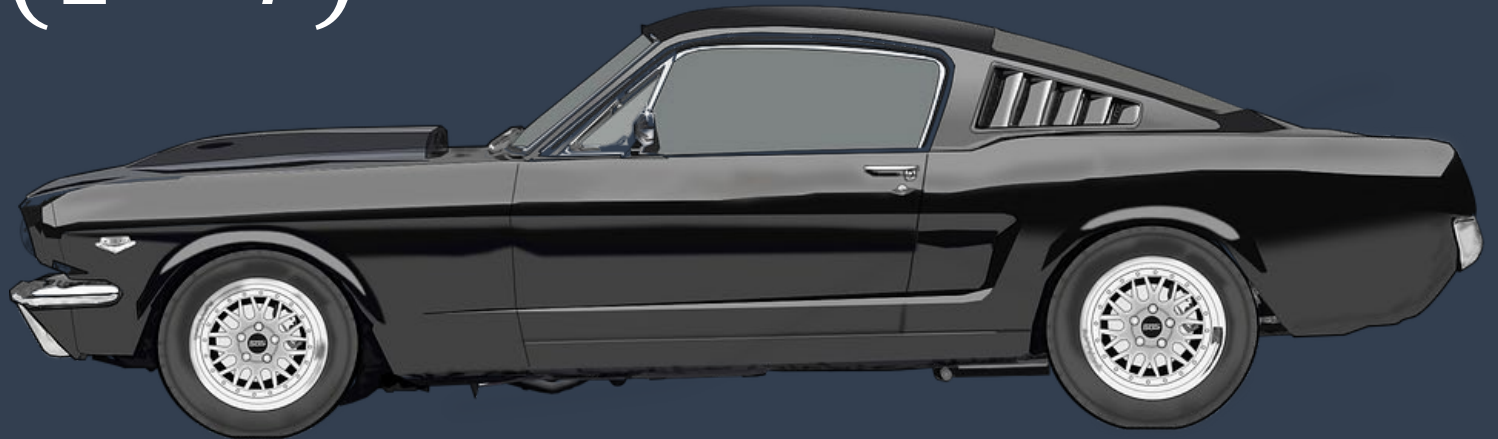
DOWN!

Exponential Decay

We learned about how Exponential Growth impacts the final price you pay for a home due to the amount of interest tacked on throughout the life of a loan.

Now, let's flip the equation to see the impact on your purchases – let's use buying a car as our first example of Decay.

$$y = P(1 - r)^t$$



Car Buying 101

Rule of thumb when buying a car:
Your purchase will decrease in
value the moment you drive your
car off the lot.

Why?



Your car decreases in value because...

The car you purchased is no longer new.

It can now only be sold as a USED car.

Now, let's buy a car!



P = Principal (the ticket price)

r = rate of depreciation

t = time since purchase

$$y = P(1 - r)^t$$

Notice: Change from + in growth to – when looking at decay

Scenario:

It's 2015 and you just graduated college and landed your dream job! To celebrate, you head to your local Honda dealer to buy a brand new 2010 Honda Civic!

Brand new 2015 Honda Civic LX-S = \$18,290

$P = \$18,290$



Time

Time will be represented by the number of years you own the car. In this case, you bought in 2015. It is now 2025 and you are ready to buy a car that fits your growing family! What will your 2015 Honda Civic sell for?

$$2025 - 2015 = 10$$

$$t = 10$$

Rate of Depreciation

When looking at growth we used the interest rate. This time, we will use the standard rate of depreciation for a typical car.

The standard rate of depreciation for a car is around 10%.

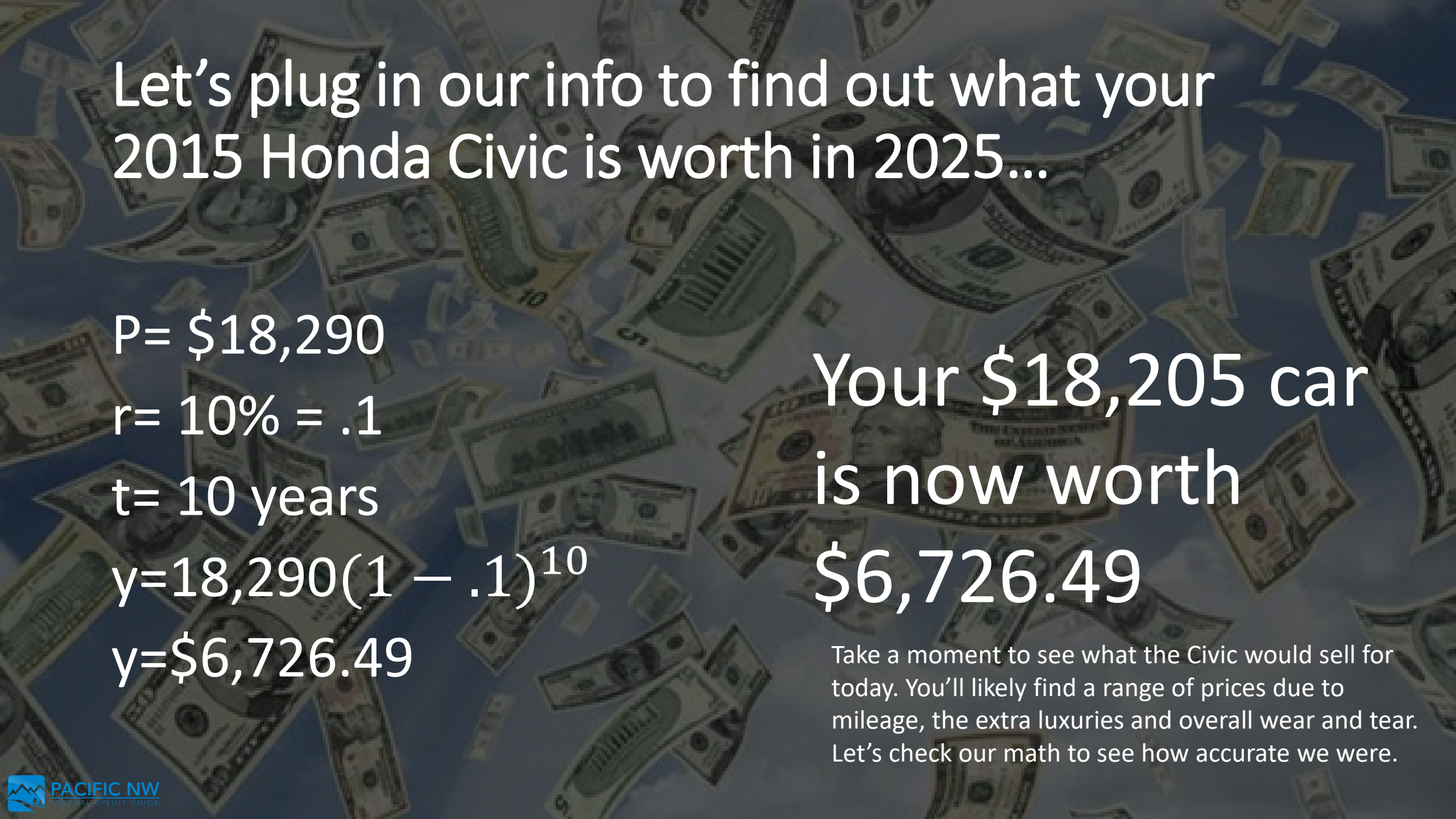
$r = .10$ or $.1$

Note: The rate changes for each car - especially luxury cars.

Side Note:

If we were to flip this to Exponential Growth, the typical car loan is offered over a 36, 48, or 60-month time period. Any longer than 60 months (5 years), and the car's depreciation will likely put you “underwater” in your investment.

“Underwater” means you'll owe more than your car is worth! A general rule of thumb is never purchase a vehicle you can't afford to pay off in 5 years or less.



Let's plug in our info to find out what your
2015 Honda Civic is worth in 2025...

$P = \$18,290$

$r = 10\% = .1$

$t = 10 \text{ years}$

$y = 18,290(1 - .1)^{10}$

$y = \$6,726.49$

Your \$18,205 car
is now worth
\$6,726.49

Take a moment to see what the Civic would sell for today. You'll likely find a range of prices due to mileage, the extra luxuries and overall wear and tear. Let's check our math to see how accurate we were.

Were we close?

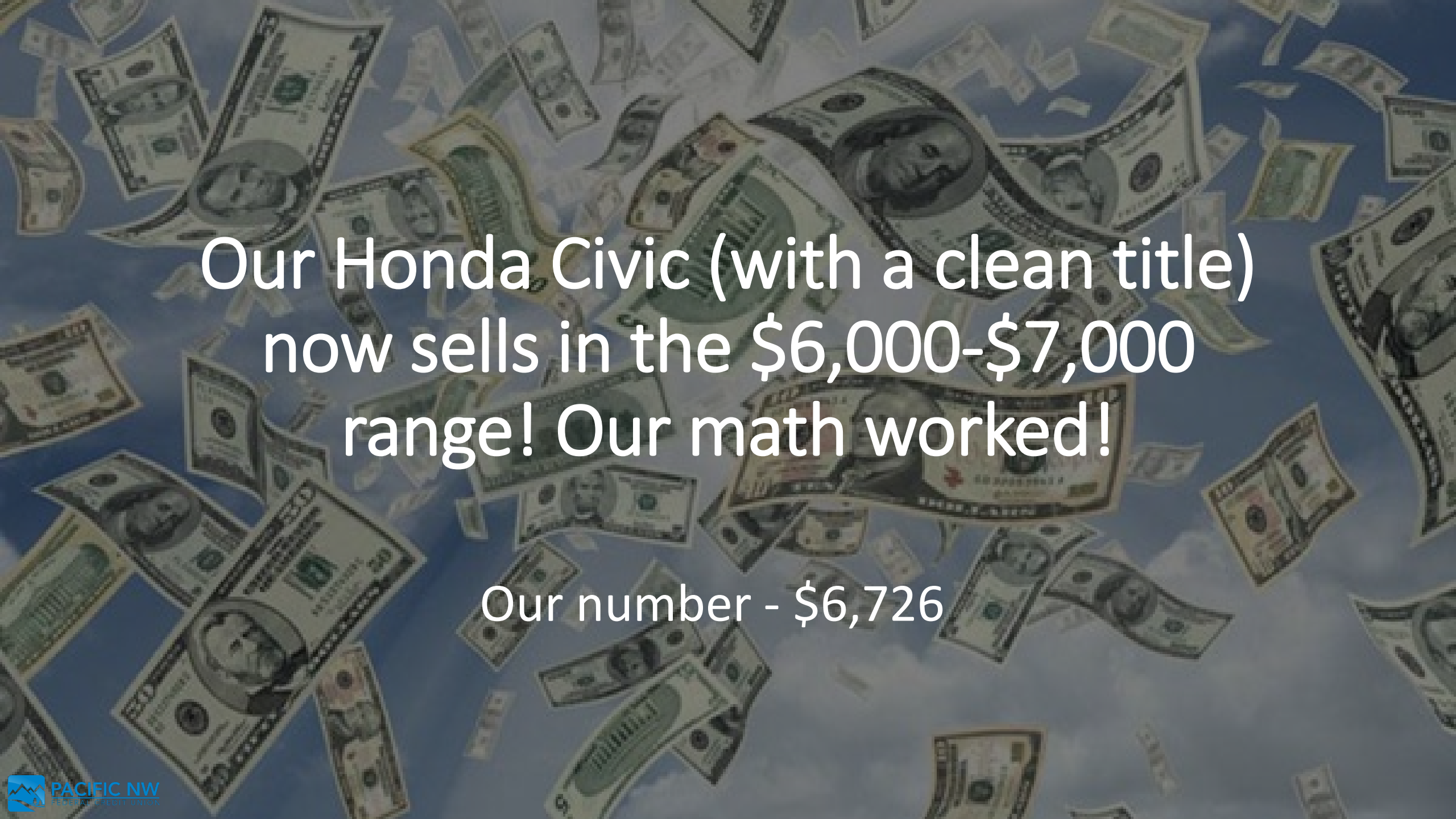
Look up what a 2015 Honda Civic sells for today.

Search Craigslist, Kelley Blue Book, or any other marketplace to see what the market is valuing this car at today.

Note: The price for a New 2015 Honda Civic was between \$18,290-\$29,390 depending on the model so there will be some variance.

The Craigslist logo, featuring the word "craigslist" in a purple, lowercase, sans-serif font, followed by a purple peace symbol.The AutoTrader.com logo, featuring the words "Auto" and "Trader" in a blue, italicized, serif font, with ".com" in a green oval to the right.The CARmax logo, featuring the word "CARmax" in a yellow, bold, sans-serif font, with a yellow dashed line to the left of the "max" part.

Kelley Blue Book
KBB.COM
The Trusted Resource

The background of the entire slide is a dense, dynamic pattern of US dollar bills of various denominations, including \$100, \$50, and \$20 bills, appearing to fall or float against a dark blue sky. The bills are oriented in various directions, creating a sense of movement and abundance.

Our Honda Civic (with a clean title)
now sells in the \$6,000-\$7,000
range! Our math worked!

Our number - \$6,726

Now, let's try the same equation for a 2010 BMW 7 Series -

P= \$88,900

r= 10% = .1

t= 10 years

$y = 88,900(1 - .1)^{10}$

y=\$30,997

Question: Does our equation work for this car? Is your car now worth \$30,900?

Let's look it up...

Do another web search for a 2010 BMW.

Did the math work?

Is your BMW still worth over \$30,000? The simple answer, NO!

The price range for a 2010 BMW 7 Series in 2020 is between \$11,000 and \$13,000 (Around 18% depreciation rate per year) – not even close to the \$30,997 our equation told us it should be.

Why does a luxury car, such as a BMW, depreciate at a much higher rate than a standard car?

Luxury Cars Depreciate at a higher rate because...

- Priced very high to begin with – so the only way is down in this case – the higher you buy the more you can fall.
- Repairs and maintenance are typically more expensive for luxury cars.
- The market tends to be inundated with older luxury cars due to the spending habits of people who can afford to buy luxury cars (always wanting the “Latest and the greatest!”) Luxury cars are also used as “fleet cars” for businesses. The turnover tends to be 2-3 years for fleet cars adding to the inundation of luxury cars.
- Hondas and Toyotas have a great reputation for reliability and long-term total cost of ownership – leading people who are buying a used car to lean toward reliability over luxury.



Exponential Decay

Now, use the provided worksheets to explore Exponential Decay and review Exponential Growth.