

Personal Finance

Mike Pierce • Math113 College Algebra • April 2024

High-Interest Checking Account

I have an *Impact Money Market* account through National Cooperative Bank (NCB). Within the account disclosure document are these critical details of that account:

- “If your daily balance is \$10,000, but less than \$49,999, the interest rate paid on the entire balance will be 2.50% with an annual percentage yield of 2.53%.”
- “Interest will be compounded daily. Interest will be credited to your account monthly.”
- “We use the daily balance method to calculate the interest on your account. This method applies a daily periodic rate to the principal in the account each day.”

This all means that NCB compounds the interest daily at a 2.5% APR, even though interest payments only appear in the account at the end of each month. They claim that this 2.5% APR corresponds to a 2.53% APY, but we can verify this ourselves:

$$\left(1 + \frac{0.025}{365}\right)^{365} \approx 1.02531424 \approx 1 + 2.53\%$$

From this it appears the figure for the APY in the disclosure was rounded. More importantly, let's verify that NCB is correctly calculating the account interest. My account was credited \$30.83 in interest for March. According to that last disclosure item above, the interest is calculated daily and credited monthly. Luckily my account statement lists an average daily balance for my account during the month of March as \$14,507.22, which saves me from performing an interest calculation for the period between each pair of transactions in March. Recalling that there are 31 days in March, my interest should be calculated as:

$$\$14507 \left(1 + \frac{0.025}{365}\right)^{31} - \$14507 \approx \$30.83466925$$

Conventionally in the US, banks will round interest payments down to the nearest cent, so the result of this calculation rounds to \$30.83 as expected.

Mortgage

My girlfriend and I recently bought a house. After making a down payment, we took out a 15-year mortgage on the remaining \$251,200 balance at a fixed 5.99% rate. Looking at our statement from April, we were charged \$2,375.12 as a payment. Let's verify that this is the correct amount:

$$\$251,200 = P \left(\frac{1 - \left(1 + \frac{0.0599}{12}\right)^{-12 \times 15}}{\frac{0.0599}{12}} \right) \rightarrow P = \$2118.41$$

This is notably *less than* the amount we were charged. However, after looking over the statement more carefully, this is because this amount does not include escrow, taxes and insurance on the property. According to the statement our escrow payment in May was \$256.71, and

$$\$2,118.41 = \$2,375.12 - \$256.71$$

which checks out. The mortgage statement even breaks down how much of that payment is going towards the interest (\$12,00.68) versus going towards the principle (\$917.73).

Retirement Investments

Upon starting my job here at CMU in September 2021, I was enrolled in a retirement account through TIAA (Teachers Insurance and Annuity Association). Browsing that account details on their website, it appears that TIAA invests the balance of this account into a fund titled *American Funds 2055 Target Date Retirement Fund Class R6 (RFKTX)*. The returns on this account appear to fluctuate, so I presume this fund is tied to the stock market. I don't recall the details of this retirement benefit of my employment, so I'll try to reverse engineer the details and do some calculations based on the average rate of return that TIAA lists as 12.7% for the 2.5 years I've been working. Note this rate corresponding to an *annual* average rate of return of 5.08%.

My last contribution in mid-April was \$180.82 while CMU's contribution was \$280.27, for a total of \$461.09. These contributions are deposited into the account twice-per-month. Noting that

$$\frac{\$280.27}{\$180.82} \approx 1.54999$$

it appears that CMU matches my contribution 155%. Running an annuity calculation for the thirty months (2.5 years) I've worked here:

$$\$461.09 \left(\frac{\left(1 + \frac{0.0508}{24}\right)^{24(2.5)} - 1}{\frac{0.0508}{24}} \right) \approx \$29,465.75$$

This figure is only about \$2,000 higher than my current account balance. Looking through my contribution history though, the size of my (and CMU's) contributions have changed occasionally, and the stock market has improved since I got my job here, so it makes sense that this figure would be a little off. Anyways, based on the name of the account fund, I'm supposed to retire in 2055, which is thirty-four years after I started this job. Using the same 5.08% average annual rate of return, and running that same calculation using $t = 34$ years we get that the account balance will be \$1,005,239.51 in 2055, which is rather low, but as a teacher, I did understand going in that I wouldn't be paid that well, and may have to wait until after 2055 to retire.

To be more thorough, I could do a more sophisticated calculation that accounts for (1) cost-of-living adjustments (COLA) to my income and how those affect my retirement contributions, (2) inflation, and (3) the actual details of the TIAA fund and historic behavior of the stock market, and compare this result to experts' suggestion for a reasonable retirement account balance. But, with the goal of limiting this report to a single page, I do not have the room to do so.