

Always read the fine print!
A few observations on APR in Canada

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Updated May 12, 2021

In class, we've taken a fairly simple view of APR (Annual Percentage Rate). If an APR is X , compounded m times a year, this means that the corresponding interest rate is X/m per time period, where the time period is $(1/m)$ years. APR of 24%, compounded yearly? That's an interest rate of 24% a year. APR of 24%, compounded monthly? That's an interest rate of 2% per month.

In practice, things are more complicated. Advertised APRs may not clearly state the compounding period, there may be fees that are omitted or included, and different, non-obvious rules will apply that mean that what you eventually have to pay on a loan is not exactly what you *thought* you had to pay.

In this handout we will look at four common cases in Canada: credit cards offered by the Toronto Dominion Bank and the Royal Bank of Canada, Canadian fixed rate mortgages, and an example of a variable rate mortgage. In all these cases we will assume that you borrow \$100 on January 1, at an advertised APR of 24%, and pay it back a year later.

A Toronto Dominion (TD) Credit Card

From March, 2020, TD credit cards charge compound interest¹. Just as we covered in class, that means that interest is charged on interest. If you borrow \$100 at an interest rate of i per month, after two months you will owe $\$100(1+i)^2$. What makes a TD card (and credit cards in general) worth covering is how that monthly interest is calculated.

Different months have different numbers of days. TD and other credit card issuers take this into account, and charge different interest rates in different months. They calculate the interest to be charged as follows:

First, they take the APR and divide it by 365 (or 366 in a leap year) to determine the interest rate per day². Then, they multiply this daily interest rate by the numbers of days in the month, to determine how much interest is charged that month.

Note the difference to how we did things in class: interest is *calculated* on a daily basis, but it is not *compounded* daily: it is compounded *monthly*. Interest is

¹ See Alini, E. (2020, January 24). TD to start charging compound interest on all personal credit cards. In *Global News* [Web Site]. Retrieved from <https://globalnews.ca/news/6451352/td-credit-cards-compound-interest/> Thanks to one of your fellow students, anonymous by request, who brought it to my attention.

² For our example of 24% APR and a non-leap year, this is about 0.06575% per day.

charged only twelve times a year. This interest is applied³ to the card holder's *average daily balance*⁴ for the month.

The table below shows what happens if a TD cardholder borrows \$100 for a year, at an advertised APR of 24%. Note that the interest charge for one period gets added to the outstanding balance, on which interest is charged, for the next one.

Month	Days	%	TD Credit Cards (from March 2020) APR = 24%		
			Average Daily Balance	Interest	Total Owed (End of Month)
January	31	2.04%	\$100.00	\$2.04	\$102.04
February	28	1.84%	\$102.04	\$1.88	\$103.92
March	31	2.04%	\$103.92	\$2.12	\$106.04
April	30	1.97%	\$106.04	\$2.09	\$108.13
May	30	1.97%	\$108.13	\$2.13	\$110.26
June	31	2.04%	\$110.26	\$2.25	\$112.51
July	31	2.04%	\$112.51	\$2.29	\$114.80
August	31	2.04%	\$114.80	\$2.34	\$117.14
September	30	1.97%	\$117.14	\$2.31	\$119.45
October	31	2.04%	\$119.45	\$2.43	\$121.89
November	30	1.97%	\$121.89	\$2.40	\$124.29
December	31	2.04%	\$124.29	\$2.53	\$126.82
Yearly Interest Rate					26.82%

At the end of the year, you owe \$126.82, which is the \$100 of principal, plus an additional \$26.82 in interest. Therefore, the annual interest rate is 26.82%.

A Royal Bank (RBC) Credit Card

According to the November, 2019 version of the RBC Royal Bank Credit Card Agreement, RBC does not charge interest on interest (though it does charge interest on unpaid fees). This interest is applied once a month, on the average daily balance⁵.

As shown in the table below, this has the effect of making the APR equal to the annual interest rate.

³ There is a minimum 21-day 'grace period' during which you can pay off new fees and purchases, and no interest will be charged. The same is true for the RBC credit card, below. Since in our example we are borrowing \$100 for a year, the grace period does not apply.

⁴ To find this, TD will "add the amount you owe each day [...] and divide that by the number of days in your statement period". TD Cash Back *Visa Infinite* Cardholder Agreement and Benefit Coverages Guide, accessed on May 19, 2020. Unlike RBC (below), TD "add[s] your unpaid interest charges to your balance at the end of each statement period. As a result, [they] charge interest on unpaid interest."

⁵ "We multiply the average daily balance by the applicable daily interest rate(s) (obtained by taking the annual interest rate(s) [APR] and dividing it by the number of days in the year). We then multiply this value by the total number of days in the statement period to determine the interest we charge you." Royal Bank. (2019). RBC Royal Bank Credit Card Agreement.

Month	Days	%	RBC Credit Cards APR = 24%		
			Average Daily Balance	Interest	Total Owed (End of Month)
January	31	2.04%	\$100.00	\$2.04	\$102.04
February	28	1.84%	\$100.00	\$1.84	\$103.88
March	31	2.04%	\$100.00	\$2.04	\$105.92
April	30	1.97%	\$100.00	\$1.97	\$107.89
May	30	1.97%	\$100.00	\$1.97	\$109.86
June	31	2.04%	\$100.00	\$2.04	\$111.90
July	31	2.04%	\$100.00	\$2.04	\$113.94
August	31	2.04%	\$100.00	\$2.04	\$115.98
September	30	1.97%	\$100.00	\$1.97	\$117.95
October	31	2.04%	\$100.00	\$2.04	\$119.99
November	30	1.97%	\$100.00	\$1.97	\$121.96
December	31	2.04%	\$100.00	\$2.04	\$124.00
Yearly Interest Rate					24.00%

Fixed Rate Mortgages

By law⁶, Canadian fixed rate mortgages compound interest semi-annually – that is, every six months. From what we learned in class, we know that an APR of 24%, compounded semi-annually, implies an interest rate of 12% per six months, and that this corresponds to an interest rate of $(1 + 12\%)^2 - 1 = 25.44\%$ per year.

There's just one problem: mortgage payments are usually made monthly. How can we reconcile this with interest only being compounded every six months? The approach the banks take is to calculate a monthly interest rate that is *equivalent* to charging the required semi-annual interest rate. This is the monthly rate they charge. For our sustained example of an advertised APR of 24%, that means the monthly interest rate corresponding to a semi-annual interest rate of 12%. We need to answer the question: what must monthly interest rate be so that if we borrow \$100 for 6 months, we need to pay \$112 in principal plus interest?

$$(1 + i_{\text{monthly}})^6 = (1 + 12\%)$$

$$i_{\text{monthly}} = (1 + 12\%)^{1/6} - 1 = 1.907\% \text{ (approx.)}$$

In the table below, we see what this means for the month-by-month balance.

⁶ Marshall, A. (n.d.). A Guide to Mortgage Interest Calculations in Canada [Web Page]. Retrieved from <http://www.yorku.ca/amarshal/mortgage.htm>

Month	Days	%	Fixed Rate Mortgages (Law) APR = 24%		
			Balance (Start)	Interest Charged	Owed (End of Month)
January	31	1.91%	\$100.00	\$1.91	\$101.91
February	28	1.91%	\$101.91	\$1.94	\$103.85
March	31	1.91%	\$103.85	\$1.98	\$105.83
April	30	1.91%	\$105.83	\$2.02	\$107.85
May	30	1.91%	\$107.85	\$2.06	\$109.90
June	31	1.91%	\$109.90	\$2.10	\$112.00
July	31	1.91%	\$112.00	\$2.14	\$114.14
August	31	1.91%	\$114.14	\$2.18	\$116.31
September	30	1.91%	\$116.31	\$2.22	\$118.53
October	31	1.91%	\$118.53	\$2.26	\$120.79
November	30	1.91%	\$120.79	\$2.30	\$123.09
December	31	1.91%	\$123.09	\$2.35	\$125.44
Yearly Interest Rate					25.44%

Variable Rate Mortgages

Variable rate mortgages typically compound interest monthly⁷. This means that for an advertised APR of 24%, they charge 2% compound interest per month, leading to⁸ an annual interest rate of $(1 + 2\%)^{12} - 1 = 26.82\%$.

Conclusion

The take-home lesson from this exercise is, *always read the fine print!* The same advertised APR can mean very different things, even within the same financial product class (credit cards or mortgages). In our simple example, 24% APR could mean an annual interest rate of 24%, 25.44% or 26.82%.

⁷ “Interest rates are compounded monthly, not in advance.” Footnote 3 from Mortgage Rates [Web Page]. (n.d.). Retrieved from <https://www.rbcroyalbank.com/mortgages/mortgage-rates.html> on May 19, 2020.

⁸ This is a slight simplification. Real-world APRs often include fees. The Royal Bank’s posted rates cited above assume a processing fee of \$300 is charged on a 5-year mortgage of \$250,000. Also, as the name implies, the rate charged can change with time.

Appendix: Comparison of debt accumulation by product

Assumptions: Borrow \$100 for a year at an APR of 24%, fees ignored

Month	Owed (end of month)			
	TD Credit Card	RBC Credit Card	Fixed Rate Mortgage	Variable Mortgage
January	\$102.04	\$102.04	\$101.91	\$102.00
February	\$103.92	\$103.88	\$103.85	\$104.04
March	\$106.04	\$105.92	\$105.83	\$106.12
April	\$108.13	\$107.89	\$107.85	\$108.24
May	\$110.26	\$109.86	\$109.90	\$110.41
June	\$112.51	\$111.90	\$112.00	\$112.62
July	\$114.80	\$113.94	\$114.14	\$114.87
August	\$117.14	\$115.98	\$116.31	\$117.17
September	\$119.45	\$117.95	\$118.53	\$119.51
October	\$121.89	\$119.99	\$120.79	\$121.90
November	\$124.29	\$121.96	\$123.09	\$124.34
December	\$126.82	\$124.00	\$125.44	\$126.82