7.4 Financial Applications of Percents

Interest

To understand the financial applications in this section dealing with interest, we must first define some terms. Then we will learn how to using these ideas to solve problems.

Principal: The principal is the original amount of money borrowed on which interest is calculated.

Interest: The interest is the fee charged by a lender to borrow money.

Interest rate: The interest rate is the rate, stated as a percent, charged for the amount borrowed per period of time, usually one year. Interest can be divided into two categories: simple interest and compound interest.

Simple interest: Simple interest is calculated on the original principal only. Accumulated interest from prior periods is not used in calculations for the following periods. Simple interest is normally used for a single period of less than a year, such as 30 or 60 days.

Compound interest: Compound interest arises when interest is added to the principal; the interest that has been added also earns interest. We need a complicated formula to calculate compound interest, so we will only study simple interest problems in this section.

To show the difference between these two types of interest, suppose you deposit $500 each into two accounts, one with simple interest and one with compound interest. The simple interest will be calculated on the $500 deposited in the account every time it is calculated. However the compound interest will be calculated on the account balance (of the deposit amount plus any interest already earned).

<table>
<thead>
<tr>
<th>Simple interest account</th>
<th>Compound interest account</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest</td>
<td>Balance</td>
</tr>
<tr>
<td>$15.00</td>
<td>$515.00</td>
</tr>
<tr>
<td>$15.00</td>
<td>$530.00</td>
</tr>
<tr>
<td>$15.00</td>
<td>$545.00</td>
</tr>
<tr>
<td>$15.00</td>
<td>$560.00</td>
</tr>
<tr>
<td>$15.00</td>
<td>$575.00</td>
</tr>
</tbody>
</table>

How do we calculate simple interest on a loan (or a deposit)? The solution is in the formula \( I = Prt \), where \( I \) is the interest, \( P \) is the principal (amount loaned or deposited), \( r \) is the interest rate, and \( t \) is the time measured in years. In the simple interest formula, you can solve for any of the four quantities \( (I, p, r, \text{ or } t) \) if the other three quantities are known.
Note: The rate is given in percent from and must be changed to decimal form.

**Example 1:** What is the simple interest on a loan of $6,000 for one year if the interest rate is 8.25%?

- Loan of $6,000 = P
- one year = t
- interest rate of 8.25% = 0.0825 = r
- \( I = Prt \)
- \( I = (6000)(.0825)(1) \)
- \( I = 495 \)

Thus the interest is $495.

**Practice 1:** What is the simple interest on a loan of $30,000 for one year if the interest rate is 2.25%?

**Watch It:** [http://youtu.be/cswAoxpYt5o](http://youtu.be/cswAoxpYt5o)  
**Answer:** $675

**Example 2:** If Barry borrows $2,000 for 3 years at a 13% annual simple interest rate, how much interest will Barry pay?

- Borrows $2,000 = P
- for 3 years = t
- at a 13% annual simple interest rate = 0.13 = r
- \( I = Prt \)
- \( I = (2000)(.13)(3) \)
- \( I = 780 \)

Thus the interest is $780.

To pay off the loan, Barry would have to pay back the $2,000 that he borrowed plus the additional $780 in interest:

- $2,000 + $780
- = $2,780.

**Practice 2:** If Sarah borrows $1,000 for 4 years at a 13% annual simple interest rate, how much interest will Sarah pay?

**Watch It:** [http://youtu.be/QEM2M6GCNoo](http://youtu.be/QEM2M6GCNoo)  
**Answer:** $520
Example 3: What is the interest gained in a $1,500 investment at an 8% annual simple interest rate for 9 months?

Notice that the time is given in months, and since we are given an annual interest rate, we must convert the 9 months to years. Since there are 12 months in a year, 9 months represents \( \frac{9}{12} \) of a year. So we divide \( 9 \div 12 = 0.75 = t \)

\[
I = Prt \\
I = (1500)(.08)(.75) \\
I = 90
\]

The interest is $90.

The value of the investment at the end of 9 months would be the original investment amount plus the interest earned:

\[
$1,500 + $90 = $1,590.
\]

Practice 3: What is the interest earned on an account with an initial investment of $1250 at a 4.5% annual simple interest rate for 6 months?

Watch It: [http://youtu.be/pZtT9T_ekp4](http://youtu.be/pZtT9T_ekp4)  
Answer: $28.13

Example 4: What simple annual rate is necessary for an investment to grow from $200 to $500 in two years?

\[
P = $200 \\
t = two years
\]

Since the investment is to grow from $200 to $500, there is an increase based on the interest added to the account.

Interest = $500 – $200  
= 300 = 1

\[
I = P \times r \times t \\
300 = 200 \times r \times 2 \\
300 = 400r \\
0.75 = r \\
0.75 \times 100\% = r \\
75\% = r
\]

Thus the interest rate is 75\%.
Practice 4: Sarah needs $15,000 for college in 6 years. If she invests $5000 now, what simple annual rate is necessary for the investment to grow to $15,000 in 6 years?

Watch It: [Link to video]

Answer: 33.3%

Example 5: How much time does it take an investment of $3,000 to triple in value if the annual simple interest rate is 20%?

\[ P = $3,000 \]
\[ r = 20\% = 0.20 \]

If the investment triples from $3000, the final balance is 3 times 3000 = $9000.

The difference from investment to ending balance is interest.
\[ I = $9,000 - $3,000 = $6,000. \]

\[ I = P \times r \times t \]
\[ 6000 = 3000 \times 0.20 \times t \]
\[ 6000 = 600t \]
\[ 10 = t \]

It will take ten years for the investment to triple in value.

Practice 5: If the annual simple interest rate at a bank is 10%, how many years does Maria need to leave her $4000 in the bank so that she doubles the value?

Watch It: [Link to video]

Answer: 10 years
**Total Cost:** If interest is charged, the *total cost* is the principal and the interest added together.

We use the following variables and formula to compute the total cost in simple interest problems.

<table>
<thead>
<tr>
<th><strong>CALCULATING TOTAL COST WITH SIMPLE INTEREST</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>[ A = P + I \quad \text{or} \quad A = P + Prt ]</td>
</tr>
<tr>
<td>[ A = \text{Total Cost} ]</td>
</tr>
</tbody>
</table>

**Example 6:** A television costs $900. The store gives Ray credit calculated with simple interest at 30% over 2 years. How much does Ray pay for his television?

The television costs $900, so \( P = 900 \)

The interest rate is 30%, so \( r = .30 \)

The length of the loan is two years, so \( t = 2 \).

Substitute these values into the formula \( A = P + Prt \).

\[
A = P + Prt \\
A = 900 + (900)(.30)(2) \\
A = 900 + 540 \\
A = 1440
\]

So, the total amount that Ray would pay is $1,440.

**Practice 6:** Leroy buys a $1200 computer. The store gives him credit using simple interest at 20% over 2 years. How much does Leroy pay for his computer?

**Watch It:** [http://youtu.be/i5YNp2mNABE](http://youtu.be/i5YNp2mNABE)  **Answer:** $1680
Credit Cards and Simple Interest

Credit cards are often used instead of cash to purchase goods and services. The material that follows explains some of the terminology found in credit card transactions and use agreements.

**Annual Percentage Rate (APR):** The *Annual Percentage Rate* is the annual interest rate associated with the credit card.

**Credit Limit:** The *Credit limit* is the maximum amount the cardholder is allowed to charge on a credit card.

**Transaction Fee:** *Transaction Fees* are fees charged to the customer for late payments, exceeding the credit limit, or other non-interest fees.

**Period:** The *period* is the length of time used to calculate the balance (usually 365 days).

**Periodic Rate:** The *Periodic Rate* is the *Annual Percentage Rate* divided by the *period*.

**Purchases:** *Purchases* are charges on a credit card from purchasing goods and services.

**Cash Advances:** *Cash advances* are charges on a credit card for cash received.

**Balance Transfers:** *Balance transfers* are charges on a credit card from transfers from other accounts.

**Finance Charge:** The *finance charge* is the total amount to be paid in transaction fees and interest.

**Grace Period:** The *grace period* is the allotted period of time by which a credit card balance must be paid in order to avoid *finance charges*.

How is the interest on a credit card calculated?
Most widely used credit cards (Visa, MasterCard, American Express, Discover, etc.) use the Average Daily Balance approach to calculate the amount of interest on purchases during a period of time. In this section, we will explain how to calculate the Average Daily Balance.

Consider the following credit card statement.

<table>
<thead>
<tr>
<th>DATE</th>
<th>TRANSACTION</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/18</td>
<td>Pleasant Pastures Gas</td>
<td>$10.00</td>
</tr>
<tr>
<td>4/23</td>
<td>Blue Mollusk Seafood Restaurant</td>
<td>$35.00</td>
</tr>
<tr>
<td>5/01</td>
<td>Payment Received</td>
<td>$100.00</td>
</tr>
<tr>
<td>5/10</td>
<td>New Army Clothing Store</td>
<td>$65.00</td>
</tr>
</tbody>
</table>

What is the amount of interest for this period?

The first thing we must find is the Average Daily Balance.

From April 15 through April 17, the balance is $240.00 (3 days)
From April 18 through April 22, the balance is $240.00 + $10.00 = $250.00 (5 days)
From April 23 through April 30, the balance is $250.00 + $35.00 = $285.00 (8 days)
From May 1 through May 9, the balance is $285.00 - $100.00 = $185.00 (9 days)
From May 10 through May 14, the balance is $185.00 + $65.00 = $250.00 (5 days)

To find the Average Daily Balance, we multiply each balance by the respective number of days, add those products together, and divide by 30 (since the statement covers 30 days.)

\[
\text{Avg. Daily Bal.} = \frac{(240 \times 3 + 250 \times 5 + 285 \times 8 + 185 \times 9 + 250 \times 5)}{30} \\
= \frac{(720 + 1250 + 2280 + 1665 + 1250)}{30} \\
= \frac{7165}{30} \\
= 238.83
\]

The amount of interest is obtained using the Simple Interest Equation \( I = Prt \). The principal is the average daily balance, the rate is the annual percentage rate, and the time is in years (the number of days divided by 365).

\[
I = Prt \\
I = 238.83 \times (0.229) \times \left(\frac{30}{365}\right) \\
I = 4.50
\]

Therefore, the interest for this account for this period is $4.50.
Example 7: Let's look at another statement.

Weripuoff National Bank Credit Card
Covering the Period July 23 through August 24
APR = 19.8%
Beginning Balance: $174.76
Average Daily Balance: $249.11

<table>
<thead>
<tr>
<th>DATE</th>
<th>TRANSACTION</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/25</td>
<td>McReynold's Restaurant</td>
<td>$11.45</td>
</tr>
<tr>
<td>7/28</td>
<td>Washington Merlins Basketball Tickets</td>
<td>$212.00</td>
</tr>
<tr>
<td>7/31</td>
<td>Payment Received</td>
<td>$200.00</td>
</tr>
<tr>
<td>8/12</td>
<td>High's Black Swamp Theatres</td>
<td>$31.75</td>
</tr>
<tr>
<td>8/20</td>
<td>WEW Cooked Wrestling Tickets</td>
<td>$150.00</td>
</tr>
</tbody>
</table>

What is the amount of interest for this period?
The amount of interest is:
\[ I = Prt \]
\[ I = 249.11 \times (0.198) \times (33/365) \]
\[ I = 4.46 \]
Therefore the interest for this account for this period is $4.46.

Practice 7: Use the following credit card statement to determine the amount of interest for the given statement period.

Statement from the IGOTU Bank Credit Card
Statement Period: December 15 thru Jan 14
APR=23%
Beginning Balance: $125.00
Average Daily Balance: $215.48

<table>
<thead>
<tr>
<th>DATE</th>
<th>TRANSACTION</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/16</td>
<td>Yummy Food Store</td>
<td>$65.00</td>
</tr>
<tr>
<td>12/19</td>
<td>Holly Meadows Farms</td>
<td>$45.00</td>
</tr>
<tr>
<td>12/30</td>
<td>Payment Received</td>
<td>$85.00</td>
</tr>
<tr>
<td>01/05</td>
<td>Never Say Never Boutique</td>
<td>$100.00</td>
</tr>
</tbody>
</table>

Watch It: http://youtu.be/f5951w6eD-k
Answer: $4.21
These two examples show a reasonable amount of interest for one month. Of course this is only one month's worth of interest and many people have higher balances than the balances in the two previous examples. Remember, the Average Daily Balance approach is used to determine the interest on purchases. Interest obtained from the use of cash advances and balance transfers may be obtained another way, usually with an entirely different Annual Percentage Rate. In fact, most cash advances use the Compound Interest Formula (compounded daily).

**Watch All:** [http://youtu.be/u_waANazbEQ](http://youtu.be/u_waANazbEQ)
7.4 Financial Applications of Percents Exercises

1. A bank charges 6% simple interest. How much must you pay on a loan of $2000 for three years?

2. A bank charges 5% simple interest. How much interest must you pay on a loan of $700 for 2 years?

3. A bank charges 8.75% simple interest. How much interest must you pay on a loan of $4000 for one year?

4. A bank charges 7.5% simple interest. How much interest must you pay on a loan of $8000 for one year?

5. What is the interest on a $650 simple interest loan with a 10% rate for 18 months?

6. What is the total amount in interest made on a $1000 simple interest investment if the rate is 8% and the term is 3 years?

7. How much would Jerry pay in total if he borrows $2000 at 15% simple interest for 5 years?

8. A computer costs $1100. If a company is charging 30% simple interest for 3 years, how much is paid in total for the computer?

9. How much interest is earned if you invest $25,000 for 3 months at 5.25% simple interest rate?

10. How much interest is earned if you invest $25,000 for 3 years at 5.25% simple interest rate?

11. What is the account balance after 10 months if you deposit $7000 into a simple interest account earning 2%?

12. What interest rate is needed in order to double an initial investment of $2000 for five years?

13. What amount is the principal in a savings account if $3000 is earned in interest after 6 years at 4% simple interest rate?

14. Approximately how long will it take for an initial investment of $825 to become $1000 if it is invested at a 3.5% simple interest rate?

15. How many months does it take to turn $4800 into $6000 if it is invested at a 30% simple interest rate?
16. Find the amount of interest from purchases for the credit card account below.

Tingling National Bank Credit Card  
Covering the Period January 11 through February 10  
APR = 15.5%  
Beginning Balance: $200.00  
Average Daily Balance: $202.74

<table>
<thead>
<tr>
<th>DATE</th>
<th>TRANSACTION</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/17</td>
<td>Payment</td>
<td>$80.00</td>
</tr>
<tr>
<td>1/20</td>
<td>Purchase</td>
<td>$35.00</td>
</tr>
<tr>
<td>2/01</td>
<td>Purchase</td>
<td>$100.00</td>
</tr>
<tr>
<td>2/04</td>
<td>Purchase</td>
<td>$45.00</td>
</tr>
</tbody>
</table>

17. Find the amount of interest from purchases for the credit card account below.

Tanglang National Bank Credit Card  
Covering the Period November 17 through December 17  
APR = 16.9%  
Beginning Balance: $1231.24  
Average Daily Balance: $1301.36

<table>
<thead>
<tr>
<th>DATE</th>
<th>TRANSACTION</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>11/25</td>
<td>Purchase</td>
<td>$65.21</td>
</tr>
<tr>
<td>11/30</td>
<td>Purchase</td>
<td>$11.48</td>
</tr>
<tr>
<td>12/6</td>
<td>Purchase</td>
<td>$163.95</td>
</tr>
<tr>
<td>12/13</td>
<td>Payment</td>
<td>$300.00</td>
</tr>
</tbody>
</table>
18. Find the amount of interest from purchases for the credit card account below.

Tonglong National Bank Credit Card  
Covering the Period October 10 through November 9  
APR = 9.9%  
Beginning Balance: $569.18  
Average Daily Balance: $673.54

<table>
<thead>
<tr>
<th>DATE</th>
<th>TRANSACTION</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/19</td>
<td>Purchase</td>
<td>$23.99</td>
</tr>
<tr>
<td>10/22</td>
<td>Purchase</td>
<td>$100.00</td>
</tr>
<tr>
<td>10/31</td>
<td>Purchase</td>
<td>$65.50</td>
</tr>
<tr>
<td>11/2</td>
<td>Payment</td>
<td>$20.00</td>
</tr>
<tr>
<td>11/6</td>
<td>Purchase</td>
<td>$78.06</td>
</tr>
</tbody>
</table>

19. Find the amount of interest from purchases for the credit card account below.

Tinglung National Bank Credit Card  
Covering the Period April 1 through April 25  
APR = 12.0%  
Beginning Balance: $0.00  
Average Daily Balance: $182.00

<table>
<thead>
<tr>
<th>DATE</th>
<th>TRANSACTION</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/1</td>
<td>Purchase</td>
<td>$100.00</td>
</tr>
<tr>
<td>4/4</td>
<td>Purchase</td>
<td>$100.00</td>
</tr>
<tr>
<td>4/20</td>
<td>Credit</td>
<td>$25.00</td>
</tr>
</tbody>
</table>
20. Find the amount of interest from purchases for the credit card account below.

<table>
<thead>
<tr>
<th>DATE</th>
<th>TRANSACTION</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/02</td>
<td>Purchase</td>
<td>$256.78</td>
</tr>
<tr>
<td>01/04</td>
<td>Payment</td>
<td>$497.15</td>
</tr>
<tr>
<td>01/05</td>
<td>Purchase</td>
<td>$78.99</td>
</tr>
<tr>
<td>01/07</td>
<td>Purchase</td>
<td>$22.21</td>
</tr>
<tr>
<td>01/20</td>
<td>Payment</td>
<td>$800.00</td>
</tr>
</tbody>
</table>

Tingbling National Bank Credit Card
Covering the Period January 1 through February 1
APR = 9.9%
Beginning Balance: $1,987.65
Average Daily Balance: $1548.03

21. Makenzie did not use her credit card this past month, but she carried a balance of $1215. She just received her statement covering the period March 15 through April 14, and her average daily balance is the $1215 carried over from last month. If the APR is 10.99%, how much interest was added to the balance?

22. Stewart purchased items for this semester’s classes with his new credit card on August 10th. The total was $4500 and it was his first charge on the credit card. His statement comes for the period August 10 through September 10 so his average daily balance is $4500. With an introductory APR of 8.99%, what is the interest amount?

23. Samuel only uses his credit card to purchase presents for family and friends. Recently he purchased quite a few gifts. He carried an average daily balance of $1865 into this statement which runs from July 8 through August 7. With APR of 15.99%, what is the new balance, including the new interest added?

24. William has a balance of $2734 on his credit card that has an APR of 24%. This statement covers a period of 31 days. What is the interest for the period?

25. In problem 24, suppose William decides to only make the minimum payment of $108, what would the balance be for the next period?
7.4 Financial Applications of Percents Exercise Answers

1. The interest is $360.
2. The interest is $70.
3. The interest is $350.
4. The interest is $600.
5. The interest is $97.50.
6. The interest is $240.00.
7. The total amount paid is $3,500.
8. The total amount paid for the computer was $2,090.
9. The interest is $328.13.
10. The interest is $3937.50.
11. The account balance is $7116.67.
12. The interest rate is 20%.
13. $12,500 was deposited.
14. Just over 6 years
15. 10 months
16. The interest for the period is $2.67.
17. The interest for the period is $18.68.
18. The interest for the period is $5.66.
19. The interest for the period is $1.50.
20. The interest for the period is $13.44.
21. The interest for the period is $11.34.
22. The interest for the period is $35.47.
23. The interest for the period is $25.33 and the new balance is $1890.33.
24. The interest for the period is $55.73.
25. The new balance is $2681.73. (Previous balance $2734 + interest 55.73 – payment 108)