7 Simple Interest

**Exercise 7.1**

1. Interest paid = *I = Prt* = $1500(0.045) = $39.38

3. Interest earned = *I = Prt* = $25,000(0.0025)3 = $187.50

5. Term of loan = *t* =  =  = 7 months

7. Interest rate = *r* =  =  = 0.0875 = 8.75% per annum

9. *I = Prt* = $5000(0.055) = $114.58

11. *P* =  =  = $6500.00

13. *r* =  =  = 0.0420 = 4.20% per annum

15. *t* =  =  = 11 months

17. Interest on the first term deposit = *Prt* = $10,000(0.022) = $55.00

Principal amount of the second deposit = $10,055.00

Interest on the second term deposit = $10,055.00(0.022) = $55.30

The interest earned on the second deposit is larger because both

the original $10,000 principal and the $55.00 interest earned on the first

deposit earn interest during the second 3-month term.

**Exercise 7.2**

(Note: 2020 is a leap year so the serial numbers of days in that year have been increased by 1)

1. Number of days = (October 1, 2019) – (June 17, 2019) = 274 – 168 = 106 days

Interest due = *I = Prt* = $3800(0.075) = $82.77

3. Number of days = (May 30, 2020) – (December 1, 2019)

= [(May 30, 2020) – 0] + [(December 31, 2019) – (December 1, 2019)]

= 151 + (365 – 335)

= 181 days

Interest earned = *I = Prt* = $85,000(0.039) = $1643.88

5. Number of days = (April 15, 2021) – (October 16, 2020)

= [(April 15, 2021) – 0] + [(December 31, 2020) – (October 16, 2020)]

= 105 + (366 – 290)

= 181 days

Interest owed = *I = Prt* = $27,000(0.057) = $763.18

7. Number of days = (July 7, 2019) – (January 15, 2019) = 188 – 15 = 173 days

Interest rate earned = *r* =  =  × 100% = 8.55%

9. Number of days = (September 3) – (June 26 of same year) = 246 – 177 = 69 days

*I = Prt* = $2750(0.03) = $15.60

11. *r* =  =  × 100% = 1.50%

13. *t* =  =  = 0.11230 year = 0.11230 × 365 days = 41 days

15. Term of loan, *t* =  =  = 0.25209 year = 0.25209 × 365 days = 92 days

Serial number of end date = June 26, 2019 + 92 days = 177 + 92 = 269

That is, the end date is the 269th day of 2019. Therefore,

End date is Sept 26, 2019.

17. Term = *t* =  =  = 0.690345 year = 0.690345 × 365 days = 252 days

Serial number of start date = November 16, 2019 – 252 days = 320 – 252 = 68

The loan was granted on March 9, 2019.

19. *t* =  =  = 0.31506 year = 0.31506 × 365 days = 115 days

Serial number of repayment date = November 23 + 115 days = 327 + 115 = 442

That is, the repayment date is 442 – 365 = 77th day of the subsequent year.

Therefore, the repayment date was March 18 of the subsequent year.

**In the following solutions to problems 21 and 22, the number of days in each interval is determined by adding the number of days for each partial month and full month in the interval. Problems 23 and 24 are solved by an alternative approach—the interval length is determined by using the serial numbers for dates (Table 7.2).**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 21. | *Interval* | *Number of days* | *Int. rate* | *Interest* |
|  | Mar 1 to Apr 17 | 31 + 16 = 47 | 7.5% | $57.945➀ |
|  | Apr 17 to June 30 | 14 + 31 + 29 = 74 | 8.0% | $97.315 |
|  | June 30 to Aug 1 | 1 + 31 = 32 | 7.75% | $40.767 |
|  |  |  | Total: | $196.03 |

➀ *I = Prt* = $6000(0.075) = $57.945

Interest totalling $196.03 will be owed on August 1.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 23. | *Interval* | *Number of days* | *Int. rate* | *Interest* |
|  | Sept 30 to Nov 2 | 306 – 273 = 33 | 4.7% | $12.748➀ |
|  | Nov 2 to Jan 1 | 1 + 365 – 306 = 60 | 5.2% | $25.644 |
|  | Jan 1 to Feb 1 | 32 – 1 = 31 | 5.0% | $12.740 |
|  |  |  | Total: | $51.13 |

➀ *I = Prt* = $3000(0.047) = $12.748

Amount required to pay off the loan on February 1 = *P + I* = $3000 + $51.13 = $3051.13

**Exercise 7.3**

1. Maturity value = *S = P*(1 *+ rt*) = $2950 = $2950(1.02625) = $3027.44

3. Maturity value of loan will be

*S = P*(1 *+ rt*) = $4500 = $4500(1.09875) = $4944.38

5. Loan principal =  =  =  = $780.00

7. Principal component =  =  =  = $14,100.00

Interest component = Balance – Principal = $15,379.58 – $14,100.00 = $1279.58

9. Accrued interest = *I = S – P* *=* $1828.02 – $1750 = $78.02

Interest rate = *r* =  =  = 0.1070 = 10.70%

11. Interest charged = *I = S – P* *=* $798.63 – $780.82 = $17.81

Interest rate = *r* =  =  = 0.1850 = 18.50%

13. Amount earned = *I = S – P =* $9,800 – $9625.63 = $174.37

Duration of investment = *t* =  =  = 0.64697 year = 236.14 days

Therefore, the value of the investment will surpass the $9800 goal at 237 days.

15. Amount earned = *I = S – P =* $8083.33 – $7760 = $323.33

Term of investment = *t* =  =  = 0.66666 year = 8 months

17. Term = October 1 − March 26 = 274 − 85 = 189 days

 =  =  = $19,619.04

19. In effect, there is a $75 interest charge for paying the $2000 balance after 5 months instead of paying at the beginning of the year. The annual rate of simple interest is

*r* =  =  = 0.0900 = 9.00%

21. The $60 higher price for the deferred payment option may be viewed as a $60

interest charge on the cash price of $1535. The implied annual interest rate is

*r* =  =  = 0.0782 = 7.82%

If you can earn a rate of return greater than 7.82% on a 6‑month investment, you

would be better off to invest the $1535 now and take A & B's deferred payment option.

23. *I = S – P =* $2100 – $2000 = $100

*t* =  =  = 0.487805 year = 0.487805 × 365 days = 178.05 days

The balance owed will first exceed $2100 on the 179th day after July 13.

December 31 – July 13 = 365 – 194 = 171 days. Eight more days are required to surpass $2100. Therefore, the amount owed will first exceed $2100 on January 8.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 25. |  |  | *Number* | *Interest for* |
|  | *Principal* | *Interval* | *of days* | *sub‑interval* |
|  | $2200 | June 23 to Dec 31 | 191 | $83.464 ➀ |
|  | $1800 | Aug 5 to Dec 31 | 148 | $52.915 |
|  | $1300 | Oct 31 to Dec 31 | 61 | $15.751 |
|  |  |  | Total: | $152.13 |

➀ *I = Prt =* $2200(0.0725) = $83.464

The total amount required to pay off the loan is $5300 + $152.13 = $5452.13.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 27. |  | *Number* |  | *Interest* | *Maturity* |
|  | *Interval* | *of days* | *Principal* | *rate* | *value* |
|  | Nov 16 to Apr 1 | 137 ➀ | $74,000 | 6.3% | $ 75,749.85 ➁ |
|  | Dec 30 to Apr 1 | 93 ➂ | $66,000 | 5.9% | $ 66,992.17 |
|  | Feb 8 to Apr 1 | 53 ➃ | $ 92,000 | 5.1% | $ 92,681.30 |
|  |  |  |  | Total: | $235,423.32 |

➀ (365 – 320) + (91 + 1) = 137 days

➁ *S = P*(1 *+ rt*) = $74,000 = $75,749.85

➂ (365 – 364) + 92 = 93 days

➃ 92 – 39 = 53 days

The total amount from the three term deposits maturing on April 1 will be $235,423.32.

**Concept Questions (Section 7.4)**

1. “Equivalent payments” are alternative payments (on different dates) that will put the recipient in the same economic position.

3. Calculate the equivalent values of all three payments at the same focal date. The payment with the highest equivalent value on that focal date is the one with the largest economic value.

**Exercise 7.4**

1. Equivalent amount today =  =  = $551.38

3. Equivalent amount in 174 days = *S = P*(1 *+ rt*) = $5230 = $5360.89

5. Number of days in the interval = 7 + 31 + 30 = 68

Prior equivalent value is  =  = $990.77

7. Rasheed can expect to pay the equivalent value of $450, ninety days later.

That is, *S = P*(1 *+ rt*) = $450 = $453.05

9. Increase in nominal value = *I = S – P =* $1975 – $1936.53 = $38.47

Implied rate of return *r* =  =  = 0.0725 = 7.25%

11. Increase in nominal value = *I = S – P =* $850.26 – $830 = $20.26

Time interval = *t* =  =  = 0.24656 year = 90 days

13. Increase in nominal value = *I = S – P =* $4850 – $4574.73 = $275.27

Time interval = *t* =  =  = 0.68768 year = 251 days early

15. The equivalent value of $5230, five months from now is

*S = P*(1 *+ rt*) = $5230(1 + 0.006 × 5) = $5386.90 < $5500

The $5500 payment has the larger economic value.

For the two amounts to be equivalent, $5230 should be able to earn

*I* = $5500 – $5230 = $270 in five months. Money would need to earn an annual rate of

*r* =  =  = 0.0103 = 1.03% per month

The amounts would be equivalent if money can earn 1.03% per month.

17. Anna should choose the alternative having the lower economic value.

Equivalent value of $560, 60 days from now is

*S = P*(1 *+ rt*) = $560 = $569.90 < $570

Anna should pay $560 now because it has the lower economic value.

For the two amounts to be equivalent, $560 should be able to earn

*I* = $570 – $560 = $10 in 60 days. Money would need to earn an annual rate of

*r* =  =  = 0.1086 = 10.86%

The two payments would be equivalent if money can earn 10.86%.

19. We can view the extra $2560 –$2495 = $65 cost at Store B as an interest

charge for a $2495 loan for 8 months. Let us compare the implied interest

rate on this “loan” to the interest rate Nicholas is earning on his CSBs.

In effect, the interest rate charged on the “loan” is

*r* =  =  = 0.0391 = 3.91%

This is essentially the same interest rate as the rate Nicholas is earning

on his CSBs. The two options are essentially equivalent.

21. Equivalent value =  =  = $2902.06 today

=  = $2933.99 in 2 months

=  = $2966.63 in 4 months

= $3000 in 6 months

= *P*(1 + *rt*) = $3000 = $3033.75 in 8 months

= $3000 = $3067.50 in 10 months

= $3000 = $3101.25 in 12 months

23. *a.* The current economic value of an offer is the present value of the payments

discounted at the interest rate the Chans can earn on low-risk short-term investments.

For the Smiths’ offer,

*P* = $45,000 +  = $45,000 +  = $142,799.51

For the Kims’ offer,

*P* = $29,000 +  = $143,832.54

*b.* The Chan’s should accept the Kims’ offer which is worth

$143,832.54 – $142,799.51 = $1033.03 more in current dollars.

25. The time period from March 29 to August 20 is 232 – 88 = 144 days.

For $1348 to earn $1389 – $1348 = $41 in 144 days,

*r* =  =  = 0.0771 = 7.71%

Money must earn 7.71% for the two payments to be equivalent.

**Concept Questions (Section 7.5)**

1. The economic value of a nominal amount of money depends on the date when it is paid. This property of money is called the time value of money.

3. Today’s economic value is lower. This economic value is the lump amount today that is equivalent to the payment stream. In other words, the lump amount along with its interest earnings could pay the series of scheduled payments. (The last payment would reduce the remaining funds to zero.) When interest rates are higher, a smaller lump amount will be sufficient to generate the payment stream because more interest will be earned to help meet the payments.

**Exercise 7.5**

1. Equivalent value, 6 months from now = $500 + $300

= $506.25 + $301.875

= $808.13

3. Equivalent single payment, 90 days from now = $900 + 

= $905.918 + $987.02

= $1892.94

5. Equivalent single payment, 60 days from now

= $1000 +  + 

= $1005.753 + $1498.563 + $1971.641

= $4475.96

7. *a.* Equivalent value today =  + = $1951.22 + $1904.76

= $3855.98

*b.* Equivalent value 6 months from today = $2000 + 

= $2000 + $1951.22

= $3951.22

*c.* The equivalent value of a specified payment stream will be greater at a later date

than at an earlier date because of the time value of money.

9. Equivalent payment today = $850 + = $850.00 + $1104.78= $1954.78

11. *a.* Stream 1’s economic value today = $900 + $1400

= $912.9452 + $1410.7397

= $2323.68

*b.* Stream 2’s economic value today

=  +  + 

= $797.7052 + $595.7157 + $988.1557

= $2381.58

Stream 2 payments have a $57.90 greater economic value (in today’s dollars).

13. Maturity value of the $750 obligation = $750 = $774.38

Maturity value of the $950 obligation = $950 = $1011.75

Equivalent value of the scheduled payments 4 months from now

= $774.38 + $1011.75 = $792.77 + $1011.75 = $1804.52

Thelma should be willing to accept a payment of $1804.52 four months from now.

15. Let *x* represent the size of the second replacement payment.

The equivalent value of the scheduled payments on the focal date is

$2600 +  = $2647.01 + $3093.01 = $5740.02

The equivalent value of the replacement payments on the focal date is

$3000 + *x* = $3020.34 + *x*

For equivalence of the two streams,

$3020.34 + *x* = $5740.02

*x* = $2719.68

The second payment must be $2719.68.

# Exercise 7.6

1. Let *x*  represent the unknown payment.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Payment | Date | No. of days | Present value |
|  | $1000 | May 1 | 31 + 30 = 61 | $990.07 ➀ |
|  | $1000 | June 1 | 61 + 31 = 92 | $985.10 |
|  | *x* | July 1 | 92 + 30 = 122 | 0.9803395*x* ➁ |

➀ *P* =  = $990.07 ➁ *P* =  = 0.9803395*x*

Original loan = Sum of present values of the payments

$3000 = $990.07 + $985.10 + 0.9803395*x*

$1024.83 = 0.9803395*x*

*x* = $1045.38

A payment of $1045.38 on July 1 will pay off the loan.

3. Let *x* represent the unknown payment.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Payment | *Date* | *No. of days* | *Present value* |
|  | *x* | April 13 | 31 + 12 = 43 | 0.9939113*x* ➀ |
|  | $1100 | May 27 | 43 + 18 + 26 = 87 | $1086.533 ➁ |
|  | $1100 | July 13 | 87+ 5 + 30 + 12 = 134 | $1079.394 |

➀ *P* =  = 0.9939113*x* ➁ *P* = = $1086.533

Original loan = Present value of all payments

$3000 = 0.9939113*x* + $1086.533 + $1079.394

$834.073 = 0.9939113*x*

*x* = $839.18

The April 13 payment must be $839.18.

5. Let *x* represent the size of each loan payment. Since the original loan

equals the sum of the present values of all loan payments, then

$1000 =  + 

= 0.9954998*x* + 0.9910399*x*

= 1.9865397*x*

*x* = $503.39

Each loan payment was $503.39.

7. Let *x* represent the size of each payment. Then

$2500 =  + + 

= 0.9942005*x* + 0.9884679*x* + 0.9799918*x*

= 2.9626602*x*

*x* = $843.84

Each payment should be $843.84.

9. Let *x* represent the size of each payment. Then

$5000 =  +  +  + 

= 0.98118280*x* + 0.97203728*x* + 0.96306069*x* + 0.95424837*x*

= 3.87052914*x*

*x* = $1291.81

Each loan payment is $1291.81.

11. Let *x* represent the third payment.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | *Payment* | *Date* | *No. of days* | *Present value* |
|  | $2000 | June 1 | 8 + 31 = 39 | $1989.37 |
|  | $2000 | Aug 1 | 39 + 30 + 31 = 100 | $1972.97 |
|  | *x* | Oct 1 | 100 + 31 + 30 = 161 | 0.9784211*x* |

Since the original loan = Sum of present values of all payments,

$6000 = $1989.37 + $1972.97 + 0.9784211*x*

$2037.66 = 0.9784211*x*

*x* = $2082.60

The third payment is $2082.60.

13. Let *x* represent the size of each payment. Then

$4000 = +  + 

= 0.9795918*x* + 0.9696970*x* + 0.96*x*

= 2.9092888*x*

*x* = $1374.91

Each of the three payments is $1374.91.

# Review Problems

1. The number of days from November 19, 2019 to March 3, 2020 is

(365 – 323) + 63 = 105 days

The amount that had to be invested on November 19, 2019 was

 =  = $9872.20

3. The duration of the loan was

*t* =  =  = 0.671224 year = 245 days

November 27 comes 245 days after March 27. The loan was repaid on November 27.

5. *r* =  =  = 0.0475 = 4.75%

7. Number of days from April 29 to June 14 = 2 + 31 + 13 = 46 days

The economically equivalent payment on April 29 is

 =  = $59,729.01

Sheldrick Contracting should propose to pay $59,729.01.

9. Number of days from August 18 to January 23 is 14 + 30 + 31 + 30 + 31 + 22 = 158

Equivalent value on January 23 is

*P*(1 *+ rt*) = $1000 = $1028.14

11. *a.* The economic value of the payments today is

 +  = $4901.96 + $4807.69 = $9709.65

*b.* The economic value today is

 +  = $4934.21 + $4870.13 = $9804.34

Today’s economic value of the future payments is the amount of money paid today that can generate the future scheduled payments. At *lower* prevailing interest rates, you will need *more* money today to deliver the scheduled payments.

13. Maturity value of the first term deposit is

*P*(1 *+ rt*) = $15,000 = $15,118.36

Maturity value of the second term deposit is

*P*(1 *+ rt*) = $15,118.36 = $15,237.65

The total interest earned is $237.65.

15. The equivalent value 2 months from now of the scheduled payments is

$1000 +  = $1014.58 + $7468.88 = $8483.46

A single payment of $8483.46 two months from now will place the payee

in an equivalent financial position.

17. *a.* Current economic value of Offer A = $40,000 +  = $193,846.15

Current economic value of Offer B = $30,000 + = $193,235.29

Offer A is worth $193,846.15 and Offer B is worth $193,235.29.

*b.* The Parsons should select Offer A which is worth

$193,846.15 – $193,235.29 = $610.86 more.

*c.* Value of Offer A = $40,000 + = $190,943.40

Value of Offer B = $30,000 += $191,650.49

The Parsons should accept Offer B which is worth $707.09 more.

19. The size of the payment due 3 months ago is

$1200 = $1251.00

The size of the payment due 3 months from now is

$800 = $868.00

The equivalent value 4 months from now of these scheduled payments is

$1251 + $868 = $1300.26 + $872.88 = $2173.14

Aisha should be willing to accept a payment of $2173.14 four months from now.