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Q1: Expected Value: A card is drawn from a standard 52-card deck. If the card is an Ace, you win $10; otherwise, you lose $1. Set up the payoff table and find the expected value of the game.

<table>
<thead>
<tr>
<th>$x_i$</th>
<th>$p_i$</th>
<th>$10(\frac{1}{13}) + (-1)(\frac{12}{13}) = \frac{-2}{13}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0.52</td>
<td>0.48</td>
</tr>
<tr>
<td>-1</td>
<td>0.48</td>
<td></td>
</tr>
</tbody>
</table>

\[ E(X) = 0.154 \]

Q2: What is the annual percentage yield for money invested at
A. 9.3% compounded semiannually? 0.9516
B. 9% compounded continuously? 0.9426
C. Which is the better investment? A or 9.3% compounded semiannually.

A. Formula: \( A P Y \)
Ans: 0.9522 = 9.52%
B. Formula: \( C A P Y \)
Ans: 0.9426 = 9.42%
C. \( 9.3\% \) compounded semiannually.

Q3: At what annually compounded rate must money be invested, if it is to double in 5 years?

\[ \text{If } A = 2, \quad t = 5, \quad P = 1, \quad \text{then } \quad R = \frac{A}{P}^{1/5} - 1 \]

\[ R = \text{annual rate} \]
Ans: 9.488% or 9.49%

Q4: Rental costs for office space have been going up at 4.8% per year compounded annually for the past 5 years. If office space is now $35 per square foot, what were the rental rates 5 years ago?

\[ A = 35 \]
\[ P = P \cdot 1.048 \]
\[ 1 = 0.48 \]
\[ N = 5 \]
Q5: If $2,000 is deposited each quarter into an ordinary annuity paying 8% compounded quarterly.

A. Complete the balance sheet for the first three quarters.

<table>
<thead>
<tr>
<th>period</th>
<th>deposit</th>
<th>interest</th>
<th>balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2,000</td>
<td>0.00</td>
<td>2,000</td>
</tr>
<tr>
<td>2</td>
<td>2,000</td>
<td>0.02 (2000)</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>2,000</td>
<td>0.02 (4,080)</td>
<td>80.80</td>
</tr>
</tbody>
</table>

B. When will the account have a value of $100,000?

\[ F = 100,000 \]
\[ S = 2000 \]
\[ I = \frac{.08}{4} = .02 \]
\[ N = 35.003 \]

Q6: The Hartford offered an annuity that pays 4.8% compounded monthly. What equal monthly deposit should be made into this annuity in order to have $50,000 in 10 years?

\[ F = 50,000 \]
\[ S = 325.453 \]
\[ I = \frac{.048}{12} \]
\[ N = 10 \times 12 = 120 \]

Q7: A stock trading company charges a commission of \$20 + 1% of the principal for both the purchase and sale of stocks. An investor purchases 200 shares at $21.50 a share, holds the shares for 26 weeks, and then sells the stock for $25.00 a share. Find the annual rate of interest earned with this investment.

\[ \text{paid} = 200 \times 21.50 + (20 + 0.1 \times 4300) \]
\[ = 4300 + 6.3 \]
\[ = 4306.3 \]

\[ \text{revenue} = 200 \times 25 - (20 + 0.1 \times 5000) \]
\[ = 5000 - 70 \]
\[ = 4930 \]

\[ A = 4930 \]
\[ P = 4363 \]
\[ R = .2599 \]
\[ T = .5 \]
Q8: A retiree has an annuity that pays 5.6% compounded quarterly with a current balance of $30,000. He wants to make equal quarterly withdrawals so that at the end of 5 years the account balance is $0.

A. What is the value of each withdrawal?
B. How much interest was earned during the first year?

Formula: \( PV \)

A. Ans: \( $3,673.20 \)
B. Ans: \( $75.13 \)

Q9: A family has a $150,000, 20-year mortgage at 6% compounded monthly.

A. Complete the amortization table for the first two payments.

<table>
<thead>
<tr>
<th>Period</th>
<th>Payment</th>
<th>interest (0.005) (unpaid bal)</th>
<th>reduction on unpaid balance</th>
<th>unpaid balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>150,000</td>
</tr>
<tr>
<td>1</td>
<td>1074.65</td>
<td>750</td>
<td>324.65</td>
<td>149,675.35</td>
</tr>
<tr>
<td>2</td>
<td>1074.65</td>
<td>748.30</td>
<td>326.37</td>
<td>149,349.98</td>
</tr>
</tbody>
</table>

B. After 5 full years of payments, what is the unpaid balance of the mortgage?
C. How much interest is paid during the 20 years?

B. \( PV = 127349.34 \)
\( S = 1074.65 \)
\( \Sigma = 0.005 \)
\( N = 240 - 5(12) = 180 \)

C. \( \text{Total paid} = 1074.65(240) = 257916.00 \)
\( \text{Interest} = \text{Total paid} - 150000 = 107916 \)
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• If you are not using the MATH SOLVER, you may use scratch paper to do your calculations.

Q1: Expected Value: A card is drawn from a standard 52-card deck. If the card is an heart, you win $5; otherwise, you lose $1. Set up the payoff table and find the expected value of the game to you.

<table>
<thead>
<tr>
<th>$x_i$</th>
<th>5</th>
<th>-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p_i$</td>
<td>\frac{13}{52} = \frac{1}{4}</td>
<td>\frac{39}{52} = \frac{3}{4}</td>
</tr>
</tbody>
</table>

\[ E(X) = \frac{1}{4} \cdot 5 + \frac{3}{4} \cdot (-1) = \frac{2}{4} - \frac{3}{4} = \frac{2}{4} - \frac{1}{2} \]

Q2: What is the annual percentage yield for money invested at

A. 8% compounded continuously?
B. 8.1% compounded semiannually?

C. Which is the better investment? 

A. Formula: \( \text{CAPY} \)
\[ E = \frac{0.8264}{M} \]
\[ R = 0.081 \]
\[ M = 2 \]

B. Formula: \( \text{APY} \)
\[ E = \frac{0.08328}{R} \]
\[ R = 0.08 \]

Q3: At what annually compounded rate must money be invested, if it is to double in 6 years?

\[ A = 2000 \text{ or } 2000 \text{ e}^{rT} \]
\[ P = 100 \text{ or } 100 \text{ e}^{rT} \]
\[ \frac{R}{T} = 1 \]

Q4: Rental costs for office space have been going up at 3.8% per year compounded annually for the past 5 years. If office space is now $25 per square foot, what were the rental rates 5 years ago?

\[ A = 25 \]
\[ P = \text{25 e}^{0.038} \]
\[ R = 0.38 \]
\[ T = 5 \]
Q5: A stock trading company charges a commission of **$20 + 1% of the principal** for both the purchase and sale of stocks. An investor purchases 200 shares at $18.50 a share, holds the shares for 26 weeks, and then sells the stock for $22.00 a share. Find the annual rate of interest earned with this investment.

```
purchase: 200 (18.50) + commission = 3754

receives: 200 (22) - commission = 4336
```

Formula: \( S = \frac{1}{1 + \frac{r}{100}} \)

An: \( S_{0.082} = 30.8\% \)

\[ A = \frac{4336}{3754} \]
\[ p = 3.757 \]
\[ R = 3.082 \]
\[ T = 0.5 \]

Q6: If $4,000 is deposited each quarter into an ordinary annuity paying 8% compounded quarterly.

A. Complete the balance sheet for the first three quarters.

<table>
<thead>
<tr>
<th>period</th>
<th>deposit</th>
<th>interest</th>
<th>balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4,000.00</td>
<td>0.00</td>
<td>4,000.00</td>
</tr>
<tr>
<td>2</td>
<td>4,000.00</td>
<td>.02 (4000)</td>
<td>8,080.00</td>
</tr>
<tr>
<td>3</td>
<td>4,000.00</td>
<td>.02 (8080)</td>
<td>12,241.60</td>
</tr>
</tbody>
</table>

B. When will the account have a value of $100,000?

\[ F = 100,000 \]
\[ S = 400 \]
\[ I = \frac{.08}{4} = .02 \]
\[ N = \text{?} \]

Q7: The Hartford offered an annuity that pays 5.5% compounded semiannually. What equal semi-annual deposit should be made into this annuity in order to have $80,000 in 10 years?

\[ FV = 80,000 \]
\[ S = 3053.74 \]
\[ I = .055/2 = .0275 \]
\[ N = 10 \times 2 = 20 \]
Q8: A retiree has an annuity that pays 5.2% compounded quarterly with a current balance of $30,000. He wants to make equal quarterly withdrawals so that at the end of 5 years the account balance is $0.

A. What is the value of each withdrawal?

B. How much interest was earned during the first year?

B. PV = 30,000

\[ S = 17\text{,}13\text{.}12 \]

\[ R = .052/4 = .013 \]

\[ N = 5 \times 4 = 20 \]

B. After 1 yr, \( N = 16 \) and \( PV = 24,603.44 \)

\[ \therefore \text{Account value decreased} (30,000 - 24,603.44) = 5,396.56. \]

\[ \therefore \text{He received} 17\text{,}13\text{.}12 \times 4 = 68,524.48 \]

\[ \therefore \text{Interest} = 68,524.48 - 5,396.56 = \$14,555.92 \]

Q9: A family has a $200,000, 20-year mortgage at 6% compounded monthly.

A. Complete the amortization table for the first two payments.

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<thead>
<tr>
<th>Period</th>
<th>Payment</th>
<th>interest</th>
<th>reduction on unpaid balance</th>
<th>unpaid balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>200,000</td>
</tr>
<tr>
<td>1</td>
<td>1432.86</td>
<td>819.20</td>
<td>433.64</td>
<td>199,569.14</td>
</tr>
<tr>
<td>2</td>
<td>1432.86</td>
<td>997.84</td>
<td>434.02</td>
<td>199,132.12</td>
</tr>
</tbody>
</table>

B. After 5 full years of payments, what is the unpaid balance of the mortgage?

B. \( \bar{P} = 169,799.20 \)

\[ S = 1432.86 \times 2 \]

\[ I = .005 \]

\[ N = 240 - 5(12) = 180 \text{ payments left} \]

A. \( \text{Paid} - 200,000 = 1432.86 \times 240 - 200,000 \]

\[ = 343,886.40 - 200,000 \]

\[ = 143,886.40 \]
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\[ E(X) = \] 6

Q2: What is the annual percentage yield for money invested at

A. 9.3% compounded semiannually?
B. 9% compounded continuously?
C. Which is the better investment? ______

A. Formula ________
Ans: ______________
B. Formula:__________
Ans:________________

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Formula __________
Ans: _____________

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<td>1</td>
<td>2,000.00</td>
<td>0.00</td>
<td>2,000.00</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
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<td></td>
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B. When will the account have a value of $100,000?

Formula ______
Ans: ________________

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Ans: ________________

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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>150,000</td>
</tr>
<tr>
<td>1</td>
<td>1074.65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1074.65</td>
<td></td>
<td></td>
<td></td>
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Q9: A family has a $150,000, 20-year mortgage at 6% compounded monthly.
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   C. How much interest is paid during the 20 years?

   Formula: ____________
   B. Ans: ____________
   C. Ans: ____________
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\[
\begin{array}{|c|c|}
\hline
x_i & \ \ \\
\hline
p_i & \ \ \\
\hline
\end{array}
\]

\[E(X) = \text{__________} \]

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A. Formula ______
   Ans: ________________
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Ans: ______________

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<th>balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4,000.00</td>
<td>0.00</td>
<td>4,000.00</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. When will the account have a value of $100,000?

Formula _______

B. Ans: ______________

Q7: The Hartford offered an annuity that pays 5.5% compounded semiannually. What equal semi-annual deposit should be made into this annuity in order to have $80,000 in 10 years?

Formula __________

Ans: ______________
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A. What is the value of each withdrawal?
B. How much interest was earned during the first year?

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<th>Payment</th>
<th>interest</th>
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<th>unpaid balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>200,000</td>
</tr>
<tr>
<td>1</td>
<td>1432.86</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1432.86</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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