1) Huntington Bank offers an account that pays 5%, compounded daily. They decide to change to compounding four times a year. What interest rate should they offer to obtain the same annual effective rate as the original account?

> $\left(1+\frac{i}{4}\right)^{4}=\left(1+\frac{.05}{365}\right)^{365}$

$1.040604010 = 1.051267381$ **(1)**

> $i := 4\cdot\left(\left(1+\frac{.05}{365}\right)^{\frac{365}{4}}-1\right)$

$i := 0.050310228$ **(2)**

2) On January 1, I win a prize the pays $P at the beginning of each month for 10 years with the first payment starting immediately. Find $P given that the present value of my prize at 4% interest compounded monthly is $1,000,000.

> $i := \frac{.04}{12}; j := 1+i; n := 12\cdot 10$

$i := 0.003333333333$

$j := 1.003333333$

$n := 120$ **(3)**

> $solve\left(\frac{\left(j^{n}-1\right)}{i}\cdot j\cdot j^{-n}\cdot X = 1000000, X\right)$

10090.87838 **(4)**

3)You borrow $5,000 at the beginning of year 1 at 4% annual effective interest. You pay $1000 at the end of year 1, and $2,000 at the end of year 2, $P at the end of year 3, $400 at the end of year 4, and $400 at the end of year 5, after which you owe nothing. Find P.

> $i := .04;$

$i := 0.04$ **(5)**

> $solve\left(5000\cdot(1+i)^{5} = 1000(1+i)^{4}+2000\cdot(1+i)^{3}+X\cdot(1+i)^{2}+400\cdot(1+i)+400, X\right)$

1708.282128 **(6)**

4) First Bank pays 3% interest, compounded daily. I open an account on January 1 by depositing 10, 000. Thereafter, I deposit $200 at the end of each month for 5 years for a total of 60 deposits. What is the balance in my account immediately after the 60th deposit? Assume that each month has 365/12 days.

> $i := \frac{.03}{365}; j := (1+i)^{\frac{365}{12}}; ii := j-1$

$i := 0.00008219178082$

$j := 1.002503031$

$ii := 0.002503031$ **(7)**

> $Ans := \frac{\left(j^{60}-1\right)}{ii}\cdot 200 + j^{60}\cdot 10000$

$Ans := 24548.80028$ **(8)**

> $Ans := \frac{\left(j^{60}-1\right)}{ii}\cdot 200 + (1+i)^{5\cdot 365}\cdot 10000$

$Ans := 24548.80049$ **(9)**

5) An account earns 2% annual effective discount for the first two years, 3% annual effective interest for the third year and 4% annual effective force of interest for the last three years. What is the annual

effective interest rate on the account?

> $d := .02;\ i := .03;\ del := .04;\ ii := \frac{d}{1-d};\ iii := \exp(del) - 1;$

$$d := 0.02$$
$$i := 0.03$$
$$del := 0.04$$
$$ii := 0.02040816327$$
$$iii := 0.040810774 \quad \textbf{(10)}$$

> $ans := \left((1+ii)^2 \cdot (1+i) \cdot (1+iii)^3\right)^{\frac{1}{6}} - 1$

$$ans := 0.032167234 \quad \textbf{(11)}$$

6) You borrow $300,000 to buy a house which you finance at 4% annual interest, compounded monthly. How many months will it take to pay off the loan if you pay $3000 at the end of each month?

> $i := \frac{.04}{12};\ j := 1 + i;$

$$i := 0.003333333333$$
$$j := 1.003333333 \quad \textbf{(12)}$$

> $300000\, j^n = \frac{3000 \cdot (j^n - 1)}{i}$

$$4.472497869\ 10^5 = 4.417493607\ 10^5 \quad \textbf{(13)}$$

> $\frac{i \cdot 300000}{3000} j^n = j^n - 1$

$$0.4969442076 = 0.490832623 \quad \textbf{(14)}$$

> $q := \frac{i \cdot 300000}{3000}$

$$q := 0.3333333333 \quad \textbf{(15)}$$

> $jn := solve((q-1) \cdot x = -1, x)$

$$jn := 1.500000000 \quad \textbf{(16)}$$

> $n := \frac{\ln(jn)}{\ln(j)}$

$$n := 121.8421647 \quad \textbf{(17)}$$

7) You borrow $150,000 to buy a house which you finance with a 30 year loan at 4% annual interest, compounded monthly on which you pay $716.12 at the end of each month. How much do you owe at the end of the second year—i.e. immediately after the 24th payment?

> $PP := 716.12$

$$PP := 716.12 \quad \textbf{(18)}$$

> $Owe := 150000 \cdot j^{24} - \frac{PP \cdot (j^{24} - 1)}{i}$

$$Owe := 1.446093437\ 10^5 \quad \textbf{(19)}$$

8) In problem 7, immediately after the 24th payment, I refinance the loan at 3% interest per year. Assuming that the answer to Problem 7 is $100,000 (which is not correct), find the new annual payment.

> $i := \frac{.03}{12}; j := 1 + i; n := 12 \cdot 30 - 24$

$$i := 0.002500000000$$
$$j := 1.002500000$$
$$n := 336 \quad \textbf{(20)}$$

> $Ans := solve\left(0 = 100000 \cdot j^{n} - \frac{Q \cdot (j^{n} - 1)}{i}, Q\right)$

$$Ans := 440.2674240 \quad \textbf{(21)}$$

9) I bought $50,000 bought of RC Penney stock on January 1. I bought $5000 worth of RC Penney stock on March 1 and sold $2000 of RC Penney stock on May 1. On January 1, 2010, I sold all of my RC Penney stock for $54849.16 Approximate the rate of return on my investment.

This is NOT part of the solution. Here I am creating the problem.:

> $i := .035;$

$$i := 0.035 \quad \textbf{(22)}$$

> $50000 \cdot (1 + i) + 5000 \cdot \left(1 + \frac{10}{12} i\right) - 2000 \cdot \left(1 + \frac{8}{12} i\right)$

$$54849.16667 \quad \textbf{(23)}$$

Here is the solution:

> $solve\left(50000 \cdot (1 + x) + 5000 \cdot \left(1 + \frac{10}{12} i\right) - 2000 \cdot \left(1 + \frac{8}{12} x\right) = 54849.16, x\right)$

$$0.03499986308 \quad \textbf{(24)}$$

10) What price should you pay for a $4,000 face value, 10 year bond which has $100 quarterly coupons, assuming that you want a 3% yield, compounded quarterly?

> $i := \frac{.03}{4}; j := 1 + i; n := 4 \cdot 10$

$$i := 0.007500000000$$
$$j := 1.007500000$$
$$n := 40 \quad \textbf{(25)}$$

> $P := j^{-n} \cdot \left(\frac{(j^{n} - 1)}{i} \cdot 100 + 4000\right)$

$$P := 6411.285687 \quad \textbf{(26)}$$

11) The bond in question (10) is sold after two years, immediately after the payment of the coupon, to an investor wanting a 2% yield. What should the selling price of the bond be?

> $i := \frac{.02}{4}; j := 1 + i; n := 4 \cdot 8$

$$i := 0.005000000000$$
$$j := 1.005000000$$
$$n := 32 \quad \textbf{(27)}$$

> $P := j^{-n} \cdot \left(\frac{(j^{n} - 1)}{i} \cdot 100 + 4000\right)$

$$P := 6360.262689 \quad \textbf{(28)}$$

12) At the beginning of year 1 I deposit $1000 into an account that is earning 4% interest compounded

annually. At the beginning of each subsequent year I deposit 3 % more than I did the previous year. Find the final accumulation in the account at the end of year 40.

> $i := .04; j := 1 + i; ii := .03; jj := 1 + ii; P := 1000$

$$i := 0.04$$
$$j := 1.04$$
$$ii := 0.03$$
$$jj := 1.03$$
$$P := 1000 \quad \textbf{(29)}$$

> $A = P \cdot j^{40} + jj \cdot P \cdot j^{39} + jj^2 \cdot P \cdot j^{38} + ... + jj^{39} \cdot P \cdot \mathrm{j}$

Error, invalid sum/difference

$$A = P \cdot j^{40} + jj \cdot P \cdot j^{39} + jj^2 \cdot P \cdot j^{38} + ... + jj^{39} \cdot P \cdot j$$

> $= jj^{39} \cdot j \cdot P \cdot \left(\left(\frac{j}{jj} \right)^{39} + \left(\frac{j}{jj} \right)^{38} + ... + 1 \right)$

Error, invalid sum/difference

$$= jj^{39} \cdot j \cdot P \cdot \left(\left(\frac{j}{jj} \right)^{39} + \left(\frac{j}{jj} \right)^{38} + ... + 1 \right)$$

> $Ans := \dfrac{jj^{39} \cdot j \cdot P \cdot \left(\left(\frac{j}{jj} \right)^{40} - 1 \right)}{\frac{j}{jj} - 1}$

$$Ans := 1.600542126\ 10^5 \quad \textbf{(30)}$$

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