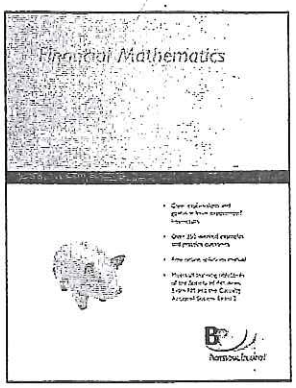

PROFESSIONAL EDUCATION™

Financial Mathematics

A Practical Guide for Actuaries and other Business Professionals

By Chris Ruckman, FSA & Joe Francis, FSA, CFA

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Additional Questions for Ch 1

Kellison

Chapter 1 Practice Questions

Question guide

- Questions 1.1 – 1.10 test material from Sections 1.1 – 1.5.
- Questions 1.11 – 1.16 test material from Sections 1.6 – 1.8.
- Questions 1.17 – 1.20 are from the SOA/CAS Course 2 exam or the IOA/FOA 102 exam.

Question 1.1

$300 is deposited in a bank account, which pays simple interest of 3.5% a year. Calculate the accumulated value of the deposit after 6 years.

Question 1.2

Fund P earns interest at a simple rate of 4% a year. Fund Q earns interest at a simple rate of $i\%$ a year. $100 is invested in fund P and $118.50 is invested in fund Q. The accumulated amount in the two funds will be equal after 5 years. Determine the simple rate of interest i.

Question 1.3

$800 is deposited in a bank account, which pays compound interest of 5.25% a year. Calculate the accumulated value of the deposit after 15 years.

Question 1.4

Fund P earns interest at a compound rate of 4% a year. Fund Q earns interest at a compound rate of $i\%$ a year. $100 is invested in fund P and $118.50 is invested in fund Q. The accumulated amount in the two funds will be equal after 5 years. Determine the compound rate of interest i.

Question 1.5

Using an annual effective rate of interest of 5%, find the present value of an investment of $5,000 at time 20 years.

Question 1.6

Your great-great-great grandfather set aside $10 on July 1, 1876 in an account paying 5% annual effective interest. Assuming no additional deposits or withdrawals were made, what is the account balance on January 1, 2004? What would the account balance have been if the account had been paying an annual effective interest rate of 10% instead of 5% all of these years?

Question 1.7

Larry has a credit card balance of $10,000. The annual effective interest rate on the credit card is 15%. Larry takes out a home equity loan to pay off his credit card balance. The interest rate on the home equity loan is 5%. Ignoring taxes, how much does this strategy save Larry, assuming he pays off the loan in full 18 months from now?

Question 1.8

Using an annual effective rate of discount of 5% per year, find the accumulated value at time 20 years of an investment of \$5,000 at time 0.

Question 1.9

Using a simple rate of discount of 4% per year, find the present value of a payment of \$5,000 at time 3 months.

Question 1.10

A \$15,000 car loan is repaid with one payment of \$18,375.65 after 36 months. What is the annual effective discount rate?

Question 1.11

\$500 is paid at time 8 years at a constant force of interest of 10%. Determine the present value of the investment at time 0.

Question 1.12

\$1,000 is paid at time 6 years. Find the present value at time 4 years using a force of interest of $\delta_t = 0.05 + 0.002t$.

Question 1.13

Find the accumulated value at time 5 years of \$30 that is invested at time 0. Use a force of interest of $\delta_t = 0.02t + 0.01$.

Question 1.14

A payment of \$1,000 is due at time 15 years. Between times 0 to 5 years, the annual effective rate of interest is 7%. Between times 5 and 10 years it is 9% and between times 10 and 15 years it is 4%. Calculate the present value of the payment at time 0.

Question 1.15

\$100 is invested at time 0. The constant force of interest is 7% from time 0 to time 5 years and 5% from time 5 to time 8 years. Determine the accumulated value of the investment at time 8 years.

Question 1.16

The effective annual rate of discount has been 4% for the last 5 years. Prior to that, it was 5%. A bank account has a balance of \$457 today. A single deposit of \$X was placed in the account 8 years ago. Calculate the value of X.

Question 1.17 SOA/CAS

Bruce and Robbie each open up new bank accounts at time 0. Bruce deposits \$100 into his bank account, and Robbie deposits \$50 into his. Each account earns an annual effective discount rate of d. The amount of interest earned in Bruce's account during the 11th year is equal to \$X. The amount of interest earned in Robbie's account during the 17th year is also equal to \$X. Calculate X.

Question 1.18 SOA/CAS

Ernie makes deposits of \$100 at time 0, and \$X at time 3. The fund grows at a force of interest $\delta_t = 0.01t^2$, $t > 0$. The amount of interest earned from time 3 to time 6 is \$X.

Calculate X.

Question 1.19 SOA/CAS

David can receive one of the following two payment streams:

(i) \$100 at time 0, \$200 at time n, and \$300 at time $2n$
(ii) \$600 at time 10.

At an annual effective interest rate of i, the present values of the two streams are equal.

Given $v^n = 0.75941$, determine i.

Question 1.20 IOA/FOA

The force of interest, δ_t is:

$$\delta_t = \begin{cases} 0.04 & 0 < t \le 5 \\ 0.01(t^2 - t) & t > 5 \end{cases}$$

Calculate the present value of \$100 payable at time 10.

Solutions to practice questions

Free online solutions manual

Detailed worked solutions to every practice question in this book can be downloaded free of charge from the BPP Professional Education website at **www.bpp.com**. Follow the links to the Actuarial Division, then select support for the SOA/CAS exams, and finally click on the Mathematics of Finance (MF) home page. Other useful study resources can also be found here.

Chapter 1: Interest rates

Q1.1: $363.00

Q1.2: 0.253%

Q1.3: $1,723.54

Q1.4: 0.529%

Q1.5: $1,884.45

Q1.6: The accumulated value is $5,030.78 at 5% and $1,894,817.37 at 10%.

Q1.7: $1,573.08

Q1.8: $13,947.55

Q1.9: $4,950.00

Q1.10: 6.542%

Q1.11: $224.66

Q1.12: $886.92

Q1.13: $40.50

Q1.14: $380.87

Q1.15: $164.87

Q1.16: $319.48

Q1.17: $38.90

Q1.18: $784.60

Q1.19: $3.511%

Q1.20: $6.45