Suggested solutions to 3-mark and 4-mark problems contained in the Additional Sample Questions: Insurance Planning (RAIP) and Retirement Planning (RPEB)

Setion II
Question 6

The earning member of a family aged 35 years expects to earn till next 25 years. He expects an annual growth of 8% in her existing net income of Rs. 5 lakh p.a. If he considers an average investment yield of 6% till his life expectancy of 80 years, what economic value could be ascribed to his life today?

Solution:

Current net income	500,000	Rs. p.a.
Rate of increase of net income	8%	p.a.
Investment yield from investing	6%	p.a.
Number of years the incme is expected to continue	25	years

Economic value would be the all earnings of future years discounted today at the investment yield.

Economic value	15,785,662	Rs.	PV((1+6%)/(1+8%)-1,25,-500000,0,1)

Note 1: The Life Expectancy figure of 80 years is redundant here.

Note 2: The Real Return formula is used here with 'investment yield' taken in numerator and growth taken in denominator.

Alternative method:

Future Value of all earnings for 25 years	67,750,019	Rs.	500000*(1+6%)*((1+6%)^25-(1+8%)^25)/(6%-8%)
Present Value today at the investment yield of 6%	15,785,662	Rs.	67750019/(1+6%)^25

Setion II
Question 7

Mr. X has a 25-year endowment policy, the annual premium being Rs. 15,850 for a sum assured of Rs. 12 lakh. He has paid 18 premiums and has   Rs. 6,50,000 towards declared bonuses on this policy. He has met his objectives and has sufficient cover and wealth support. He does not wish to continue in the policy. He has the option to either make this policy paid up, or surrender the same at a factor of 75% of the paid up value. If he chooses to surrender, what return he should earn on the surrender value to offset the paid up value, when due?

Solution:

Paid up value of the policy	1,514,000	Rs.	1200000*18/25+650000	
Surrender value = 75% of the above paid up value	1,135,500	Rs.	1514000*75%	
Remaining term of the policy	7	years		
Rate to be earned on surrender value to reach paid up	**4.20%**	p.a.	RATE(7,0,-1135500,1514000,)	CAGR

Note: The paid up value would be payable only on due maturity of the policy.

Setion II
Question 8

A retiree of age 60 wants to enter into the reverse mortgage scheme by mortgaging his self-occupied house which is valued at Rs. 80 lakh. An approved lending institution agrees to provide periodic monthly payments under the scheme considering a loan to value ratio of 80% and at a rate of interest of 13.75% p.a. If the retiree opts for a 15-year term of reverse mortage, what fixed periodic monthly payments he stands to receive under the scheme?

Solution:

Value of House	8,000,000	Rs.	
Loan Eligible	6,400,000	Rs.	8000000*80%
Rate of Interest	13.75%	p.a.	
Term	15	years	
	180	months	
Monthly payments under reverse mortgage	**10,703**	Rs.	PMT(13.75%/12,180,0,-6400000,1)

Note:
(1) Calcilation: We generally see in mortgage formula, the loan amount is usually considered with negative sign in PV while FV is 'Nil'. In Reverse Mortgage case, the admissible loan amount is taken with negative sign under FV while PV is 'Nil'. Also, 'begin mode' is considered, i.e. '1' for 'type'.
(2) The annuity period is 20 years. Though the anuity payment stops after 20 years, the loan is not payable as long as the mortgagor survives. After the death of the mortgagor and his/her surviving spouse, the lending institution sells the house and recovers loan amount with interest and the balance, if any is paid to the heirs.

Setion II
Question 9

A retiree of age 65 has fixed pension of Rs. 15,000 per month. His household expenses have exceeded his pension of late and are Rs. 16,000 per month now. He has approached an approved lending institution under Reverse Mortgage Scheme. He is offered fixed monthly payments for 15 years at a rate of interest of 13.75% on Rs. 64 lakh eligible value of his home. He meets his annual expenses as increased by 6% inflation every year and invests the excess amount from his two fixed annuities, fixed pension and reverse mortgage stream, in an investment yielding 10% p.a. at the end of every year starting from this year onwards. You assess at the end of five years thus accumulated fund against the total liability under Reverse Mortgage and find that _____.

Solution:

Value of Reverse Mortgage Loan Eligible	6,400,000	Rs.	
Rate of Interest	13.75%	p.a.	
Term	15	years	
Monthly payments under reverse mortgage	10,703	Rs.	PMT(13.75%/12,180,0,-6400000,1)
Fixed pension	15,000	Rs. p.m.	
Current household expenses	16,000	Rs. p.m.	
Excess funds available for investment: End of year 1	116,439	Rs.	((10703+15000)-16000)*12
Household expenses in the 2nd year	16,960	Rs. p.m.	16000*(1+6%)
Excess funds available for investment: End of year 2	233,001	Rs.	((10703+15000)-16960)*12+116439*(1+10%)
Household expenses in the 3rd year	17,978	Rs. p.m.	16960*(1+6%)
Excess funds available for investment: End of year 3	349,008	Rs.	((10703+15000)-17978)*12+233001*(1+10%)
Household expenses in the 4th year	19,056	Rs. p.m.	17978*(1+6%)
Excess funds available for investment: End of year 4	463,673	Rs.	((10703+15000)-19056)*12+349008*(1+10%)
Household expenses in the 5th year	20,200	Rs. p.m.	19056*(1+6%)
Excess funds available for investment: End of year 5	576,083	Rs.	((10703+15000)-20200)*12+463673*(1+10%)
Mortgage Loan and interest outstanding : End of Year 5	926,830	Rs.	FV(13.75%/12,5*12,-10703,0,1)
Net Liability due to Reverse Mortgage Loan	**350,747**	Rs.	926830-576083

Alternative Method fo finding accumulated fund:

PV: Fixed annuities (Pension+RM stream) for 5-year period	1,286,147	Rs. [1]	PV(10%,5,-(10703+15000)*12,0,1)
PV: Expenses rising @ 6% p.a. for 5-year period	892,675	Rs. [2]	PV((1+10%)/(1+6%)-1,5,-16000*12,0,1)
PV of excess funds to be invested for 4 annual periods	393,472	Rs. [1-2]	*(Investment of excess funds began at the end of year 1, thus 1st accumulation end of year 2, ----)*
Accumulation at the end of year 5	576,083	Rs.	393472*(1+10%)^4

Setion III
Question 4

An individual opened PPF account on 1st April 2007. The amount outstanding in his account on 31st March 2013 was Rs. 4,93,564. If he had a balance of Rs. 2,45,428 on 31st March 2010, what amount can he withdraw and from which date?

Solution:

Time Rule:

Initial subscription date	1-Apr-2007	Year of initial subsription: 2007-08
Expiry of 5 years from the end of FY of initial subscription	31-Mar-2013	Year of withdrawal to be 2013-14

Amount Rule:

1)Balance at the end of 4th FY preceding 2013-14, i.e. at the end of year 2009-10 or as on 31st March 2010	245,428	Rs.	
50% of this balance	122,714	Rs. [1]	
2)Balance at the end of preceding FY, i.e. as on 31st March, 2013	493,564	Rs.	
50% of this balance	246,782	Rs. [2]	
Lower of [1] and [2]	**122,714**	**Rs.**	**From 1st April, 2013 in the year 2013-14**

The Rule of Partial Withdrawal from PPF A/c .: Anytime after the expiry of five years from the end of the financial year in which the initial subscription is made, the subscriber can partially withdraw but not more than fifty percent (50%) from the balance that stood to his / her credit at the end of the fourth financial year immediately preceding the year of withdrawal or at the end of the preceding financial year whichever is lower, less the loan amount (if any). Only one withdrawal is allowed per financial year.

Setion III
Question 5

An annuity product is designed in such a way that it gives first cash flow at 6% of the corpus at the end of first year and thereafter every year in the form of growing annuity at the rate of 5%. If the cash flows are guaranteed for 15 years, what rate of return is obtained on the corpus invested?

Solution:

Suppose the corpus invested is:		100	Rs.
Cash flow at the end of first year		6	Rs.
Growth in annuity in every subsequent year		5.00%	p.a.
Guaranteed period of annuity		15	years
	(-) Corpus invested	(100)	
	+ Cash flow Year 1	6	
	+ Cash flow Year 2	6.30	
	+ Cash flow Year 3	6.62	
	+ Cash flow Year 4	6.95	
	+ Cash flow Year 5	7.29	
	+ Cash flow Year 6	7.66	
	+ Cash flow Year 7	8.04	
	+ Cash flow Year 8	8.44	
	+ Cash flow Year 9	8.86	
	+ Cash flow Year 10	9.31	
	+ Cash flow Year 11	9.77	
	+ Cash flow Year 12	10.26	
	+ Cash flow Year 13	10.78	
	+ Cash flow Year 14	11.31	
	+ Cash flow Year 15	11.88	
	IRR	**3.04%**	

Alternative Method:

Rate of 15 years level annuity of which level payment pre-5% growth is Rs. 6	-1.8678%	RATE(15,6/1.05,-100,0,0)
Annual Growth of 5% built into this annuity to make it growing annuity of which first payment is Rs. 6	**3.04%**	(1+(-1.8678%))*(1+5%)-1

Setion III
Question 6

A retiree has accumulated Rs. 1.86 crore towards his retirement corpus. His current monthly household expenses are Rs. 90,000 which he needs inflation adjusted for 30 years. If he considers average inflation to be 5.5% p.a. from now onwards, what rate of return from a 30 year annuity, payable annually and deferred by one year, should meet his goal?

Solution: (As in the Alternative Solution to Question 5 above)

Accumulated corpus for annuity	18,600,000	Rs.		
Rate of inflation considered	5.50%	p.a.		
Amount of current annual expenses	1,080,000	Rs.	90000*12	
Period of growing annuity	30	months		
Rate of return for annuity	4.0334%	p.m.	RATE(30,1080000,-18600000,0,0)	*Rate of 30 years level annuity of which level payment pre-5.5% growth is*
Annuity return to be targeted	**9.76%**	p.a.	(1+4.0334%)*(1+5.5%)-1	*Rs. 1,080,000. Then, Annual Growth of 5.5% built into this annuity to make it growing annuity of which first payment is Rs. 1,080,000.*

A professional just retired has accumulated Rs. 40 lakh. He invests this corpus in an investment instrument giving return of 8% p.a. His current annual household expenses are Rs. 5 lakh, escalating at inflation of 6% p.a. He would rent out his other fixed property at an expected annual rent of Rs. 1.80 lakh, the rentals increasing at 6% p.a. The balance expenses are met by withdrawing from the invested corpus. The commercial property, currently valued at Rs. 50 lakh, is expected to appreciate at 8% p.a. He expects to sell the property after 15 years to create a fresh corpus for his living expenses. How long the total funds available are expected to last after 15 years?

Solution:

Corpus already accumulated	4,000,000	Rs.			
Investment rate obtained in deferred instrument	8.0%	p.a.			
Current household expenses	500,000	Rs. p.a.			
Rate of inflation of expenses	6.0%	p.a.			
Rent receivable from renting office space on retirement	180,000	Rs. p.a.			
Rate of increase of rentals	6.0%	p.a.			
PV of 6% increasing expenses for 15 years at 8% discount rate	6,112,623	Rs.	500000*(1-((1+6%)^15)/((1+8%)^15))/(8%-6%)	or	PV(1.08/1.06-1,15,-500000/1.06,0,0)
PV of 6% increasing rental for 15 years at 8% discount rate	2,200,544	Rs.	180000*(1-((1+6%)^15)/((1+8%)^15))/(8%-6%)	or	PV(1.08/1.06-1,15,180000/1.06,0,0)
Drawn from corpus in 15 years	3,912,079	Rs.	6112623-2200544		
PV of balance corpus (on investing)	87,921	Rs.	4000000-3912079		
Accumulated investment after 15 years	278,902	Rs.	87921*(1+8%)^15		
Value of commercial property now	5,000,000	Rs.			
Increase in value	8.0%	p.a.			
Valuation after 15 years	15,860,846	Rs.	5000000*(1+8%)^15		
Total fresh corpus after 15 years	16,139,747		278902+15860846		
Expenses required after 15 years	1,198,279	Rs. p.a.	500000*(1+6%)^15		
Period upto which this revised corpus would last	16.7913	years	NPER(1.08/1.06-1,1198279/1.06,-16139747,0,0)		
	16 years 9 months				

A retired person has contracted a 20-year immediate annuity plan which provides an annual stream of income, increasing year-on-year at 5%. He is due to receive 5th installment of Rs. 5.50 lakh which is 6% of the balance corpus remaining in annuity. He wants the term of the annuity to increase. He estimates that Rs. 4.75 lakh would be sufficient for his current living expenses. He proposes this to the annuity provider with other terms remaining as originally agreed. If the yield of the annuity is 6.5% p.a., how many more installments would get added in the restructured annuity than the original?

Solution:

5th cash flow stream to be received	550,000	Rs.	
% of balance amount	6%		
The outstanding balance of corpus before 5th installment	9,166,667	Rs.	550000/6%
Revised withdrawal amount of 8th installment	475,000	Rs.	
Interest rate	6.50%	p.a.	
Growth in annuity as agreed	5%	p.a.	
Outstanding corpus after paying 5th installment (out of 20)	8,691,667	Rs.	9166667-475000
Number of years the corpus to last beginning 6th install.	21.36	Rs.	NPER(1.065/1.05-1,475000*1.05,-8691667*1.065,0,1)
Total installments including already 8 disbursed	26.36		5+21.36
Increase in installments	**6.36**	installments	26.36-20

A retired couple has fixed pension of Rs. 30,000 p.m. while their current living expenses are at 31,000 p.m. They stay in their own house. You advise them to avail a loan under reverse mortgage which is an eligible lump sum of Rs. 40 lakh for 15 years at 12.5% p.a. interest. The annual interest is calculated after every 12 months on the pre-standing balance and added to the outstanding loan amount. You invest the available amount after withholding the excess normal expenses for the first year and considering 6% inflation thereafter at the beginning of every year. If the investment yield is 9% p.a., by what amount outstanding loan would exceed investment after 8 years?

Solution:

Post retirement income currently	30,000	Rs. p.m.	
Post retirement expenses currently	31,000	Rs. p.m.	
Loan eligible under reverse mortgage	4,000,000	Rs.	
Term of reverse mortgage	15	years	
Rate of interest	12.50%	p.a.	
Loan outstanding at the end of 8 years	10,263,138	Rs.	4000000*(1+12.5%)^8
Amount to be invested today	3,988,000	Rs.	4000000-1000*12
Rate of return expected from investment	9.00%	p.a.	
Expected inflation	6.00%	p.a.	
Amount under investment - end of year 1	4,346,920	Rs.	3988000*(1+9%)
Amount under investment - end of year 2	4,700,734	Rs.	(4346920-(31000*(1+6%)-30000)*12)*(1+9%)
Amount under investment - end of year 3	5,060,603	Rs.	(4700734-(31000*(1+6%)^2-30000)*12)*(1+9%)
Amount under investment - end of year 4	5,425,524	Rs.	(5060603-(31000*(1+6%)^3-30000)*12)*(1+9%)
Amount under investment - end of year 5	5,794,312	Rs.	(5425524-(31000*(1+6%)^4-30000)*12)*(1+9%)
Amount under investment - end of year 6	6,165,576	Rs.	(5794312-(31000*(1+6%)^5-30000)*12)*(1+9%)
Amount under investment - end of year 7	6,537,697	Rs.	(6165576-(31000*(1+6%)^6-30000)*12)*(1+9%)
Amount under investment - end of year 8	6,908,798	Rs.	(6537697-(31000*(1+6%)^7-30000)*12)*(1+9%)
Difference between loan liability and investment	(3,354,340)	Rs.	6908798-10263138

Alternative method:

Current annual expenses	372,000	31000*12
PV of 6% escalataing expenses discounted at 9% for 8 years	(2,704,570)	PV(1.09/1.06-1,8,372000,0,1)
PV of fixed pension discounted at 9% for 8 years	(2,171,863)	PV(9%,8,30000*12,0,1)
PV of additional expenses recovered from RM loan disbursed	532,707	2704570-2171863
Balance loan amount to be invested for 8 years at 9% p.a.	3,467,293	4000000-532707
Accumulated value after 8 years	6,908,798	3467293*(1+9%)^8
Shortfall in value accumulated from loan liability	(3,354,340)	6908798-10263138

A 40 year old male individual can get a 15-year with-profit life insurance policy of a company at an annual premium of Rs. 12,046 which gives a sum assured of Rs. 1.5 lakh. The company historically has declared reversionary bonuses and terminal bonus per thousand sum assured at Rs. 35 and Rs. 80, respectively. A term plan with same life and other parameters is generally available for an annual premium of Rs. 3,565. Find the return on investment component of the company's policy on surviving the term.

Solution:

Premium of with-profit policy	12,046	Rs.	
Premium of term policy	3,565	Rs.	
Excess premium on investment component	8,481	Rs.	
Terminal value on surviving the term	240,750	Rs.	Page 6
Return on investment component	7.63%	p.a.	RATE(15,-8481,0,240750,1)