Assignment 2. PTIC

1. In practice, the actual profits arising in the future will depend on the actual future experience values of the items. The insurer will chose a variety of different assumptions in order to determine how quickly the expected future profit changes on varying any particular assumption.

2. Multiple decrement table

x	$q_x^{(d)}$	$q_x^{(w)}$	$(aq)_x^{(d)}$	$(aq)_x^{(w)}$
40	0.000788	0.1	0.000788	0.0999212
41	0.000962	0.05	0.000962	0.0499519
42	0.001104	0.05	0.001104	0.0499448
43	0.001208	0.05	0.001208	0.0499396

$(ap)_x$	$(x+1)ap$
0.8992908	1
0.9490361	0.8992908
0.9489512	0.85350439
0.9488524	0.8099340

Units / Yrs	Prem	Allocated	Cost of all	Fund after all	Fund before mgt	mgt	Fund at bal
1	100000	90000	85500	0	90630	453.15	90176.85
2	100000	101500	96425	186018.5	197797.961	988.98	196808.9912
3	100000	101500	96425	293233.991	310828.0	1554.14	309274
4	100000	101500	96425	405699	430040.94	2150.204	427891

Ans: A

non-unit fund

Yrs	Non-cost all	Expense	Interest	ngt	extra death	Expected profit
1	10000	12500	-100	453.15	322.94	-2469.79
2	-1500	5000	-260	988.18	291.669	-6067.489
3	-1500	5000	-260	1554.17	210.561	-5416.391
4	-1500	5000	-260	2150.2047	87.107	-4696.90

Qu 3. (i) The profit vector is the vector ~~end~~ of expected end-year profit for policies which are still in force at the start of each year

(ii) The objective specified for the expected level of profit is termed the 'profit criterion'

It is common for those marketing and selling the products to receive part of their salary in the form of a 'productivity' bonus

Ex:

NPV = 40% of initial sale commission

Profit margin = 3% of EPV of premium income

(iii) Profit signature :

$-250, 150, 220, 225)$

Let premium = P

	P	q_x	$t-1(q_x)$
42	$1.04P$	0.001104	$(1-0.001104) = 0.998896$
43	$(1.04)^2 P$	0.001208	0.9976893
44	$(1.04)^2 P$	0.001327	0.996365
		0.001402	0.9949684

EPV Premium = $P + 1.04.P(0.998896) + 1.04^2 P(0.9976895) + (1.04)^3 P(0.9949684$

EPV of Profit = EPV of premium x 0.05

4. The assumption will be the insurer's best estimate of expected future experience. This is term as experience bars

Assuming that the chosen risk discount rate reflected fully the uncertainty in the assumption, no further margin would be taken. (pricing basis)

(ii) There may be people surviving. Also considering everyone die, the reserve will be very high.

(iii) Profit vector:

(-20, -35.20, 50, -28.50, -20, 90.21)

$$_4V = \frac{20}{1.06} = 18.867\,92$$

$$_3V = \frac{28.50 + 18.867\,92\,(P_{73})}{1.06} \quad (P_{73} \rightarrow 0.965\,85)$$

$$= 44.078\,95$$

Revised cash flow

$$_2V = \frac{50 - 44.078\,95\,(P_{72})}{7.275}$$

$$_1V = \frac{35.20}{1.06} \rightarrow 33.2075$$

Revised cash flow = $-20 - P_{(71)}(33.2075)$

$$+ 52.598.$$

Revised profit vector:

(-52.598, 0, 7.275, 0, 0, 90.21)

(i) for a unit-linked life assurance contract, we have:

the unit fund that belongs to the policyholder. This fund keeps tracks of the premiums allocated to units and benefit payable from this fund to policyholders are denominated in these units. This fund is normally subject to unit fund charges.

the non-unit fund that belongs to the company. This fund keeps track of the premiums paid by the policyholder which are not allocated to units together with units fund charges from the unit fund. Company expenses will be charged to this fund together with any non-unit benefits payable to policyholders.

(ii) It is a principle of prudent financial management that once sold and funded at outset, a product should be self-supporting.

However, some products can give profit signatures which have more than one financing phase. In such cases, reserves are required at earlier durations to eliminate future negative cash flows, so that the office does not expect to have to input further money in the future.

	30	31	32	33
6. Yr	1	2	3	4
	-250	-400	-600	1500

Ang mortality Ultimate

x	Yr	q_x	p_x	
30	1	0.000590	0.999411	p_{30}
31	2	0.000602	0.999398	p_{31}
32	3	0.000617	0.999383	p_{32}
33	4	0.000636	0.999364	p_{33}

(i) NPV

$$= \frac{-250}{1.06} - \frac{400}{1.06^2} \times \underset{0.999411}{p_{30}} - \frac{600}{1.06^3} \times \underset{0.99880083}{2p_{30}} + \frac{1500}{1.06^4} \times \underset{0.998192}{3p_{30}}$$

$$\frac{-250}{1.06} - 355.7885 - 503.171 + 1185.99$$

$$91.18 \leftarrow$$

(ii) Zeroisation

$$_2V = \frac{+600}{1.03} = 582.524$$

$$1V = \frac{400 + 582.524\,(p_{31})}{1.03}$$

$$= 1020.91$$

Revised cashflow: $-250 - 1020.91\ p_{30}$

$$= -1270.314$$

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Profit vector: $(-1270.316, 0, 0, 1500)$

$$NPV = \frac{-1270.216}{1.08} + 0 + 0 + \frac{1500}{1.08^4} \quad \text{by } P_{30}$$

$$-75.66$$

NPV after zero location is smaller

7.
Multiple table

x	q_x^d	q_x^w	$(aq)_x^d$
61	0.006433	0.06	0.059614
62	0.009696	0.06	0.0594182
63	0.01134	0.06	0.0593196
64	0.012716	0.06	0.05923704

ap	$_{(t-1)}ap$
0.933953	1
0.9308858	0.933953
0.9293404	0.8694034
0.92804696	0.8079717

Unit

Yr	P	Pre all	Cost All	Fund after all	Fund befr mgt	mgt	Fund
1	30000	12000	11400	0	11970	179.55	11790.45
2	30000	27000	25650	37440.45	39312.47	589.687	38722.8
3	30000	30000	27000	65722.80	69008.94	1035.13	67973.80
4	30000	33000	27000	94973.805	99722	1495.83	98226.17

non-unit fund

Yrs	Prem-cost all	Expense	Interest	mgt	Extra death	maturi	Profit vec
1	18000	11000	245	179.55	567.45	0	6857.1
2	3000	2600	14	589.687	594.143	0	409.544
3	0	2600	-91	1035.13	363.177	0	-2019.047
4	-3000	2600	-196	1495.83	22.556	95716.42	-100034.14

(i) Let P be the annual premium required to meet the company's profit criteria.

(a) Multiple decrement table

Here not all decrements are uniform as whilst deaths can be assumed to be uniformly distributed over the years, surrenders occur only at the year end.

$$(aq)_x^d = q_x^d \qquad (ap)_x^w = (1 - aq_x^d)\, p_x^w$$

x	q_x^d	q_x^w	$(aq)_x^d$	$(aq)_x^w$	$(ap)_x$	$_{t-1}(ap)_x$
45	0.001465	0.05	0.001465	0.049927	0.948608	1
46	0.001622	0.05	0.001622	0.049919	0.948459	0.948608
47	0.001802	0.05	0.001802	0.049910	0.948288	0.899716

unit fund

Yrs	P	Pre all	Cost all	Fund after all	Fund before mgt	mgt	Fund at end
1	P	0.35P	0.3325P	0	0.349125P	0.001745625P	0.347379 P
2	P	1.05P	0.9975P	1.34487 P	1.412123 P	0.007061 P	1.405062 P
3	P	1.05P	0.9975P	2.40256 P	2.52269 P	0.012613 P	2.510077 P

Non-unit fund

Yrs	Prem - cost all	Expense	Interest	mgt	Profit vector
1	0.6675P	0.2P+250	0.0187P -10	0.001745625P	0.487946P -260
2	0.0025P	0.025P +50	-0.0009P -2	0.007061 P	-0.016339P -52
3	0.0025P	0.025P+50	-0.0009P-2	0.92613 P	-0.010787P-52

Yr	Profit vector	Inforce prob	Discount factor	EPV of profit
1	0.487946P-260	1	0.925926	0.451801P - 240
2	-0.016339P-52	0.948608	0.857339	-0.013288P - 42.290
3	-0.010787P-52	0.899716	0.793832	-0.007704P - 37.14

10.

x	q_x	p_x	$(t-1)ap$
50	0.015	0.985	1
51	0.015	0.985	0.985
52	0.015	0.985	0.970225
53	0.015	0.975	0.955671

unit fund

Yr	P	P allocated	Cost all	Policy fee	Fund after all	Fund before mgt	mgt	Fund at end
1	25000	17500	15750	500	0	16317.5	81.5875	16235.9125
2	25000	27500	24750	500	40485.9125	43319.92	216.5996	43103.32
3	25000	27500	24700	500	67353.3	72068.05	360.34	71707.70
4	25000	27500	24750	500	95957.7	102674.7	513.37	1012161.32

non-unit fund

Yr	Prem-cost all	Expense	Policy fee	Interest	mgt	extra deaths
1	~~7500~~ 9250	3500	500	437.5	81.5875	731.46
2	250	1100	500	-24.5	216.5996	328.4506
3	250	1100	500	-24.5	360.34	0
4	250	1100	500	-24.5	513.37	0

-374.5

Profit vector

6037.6275

-486.3506

-44.16

138.87

Discount factor not given