Q13. (i) To calculate Mortality Profit, we need death strain.

Till 31 Dec 2018, 17 years are passed,

Therefore, 17V35 Pro = 15203\*(200000)\*A52:<8> - 82774000\*a due52<8>

17V35 Pro = 2232524063 – 5719519507

17V35 Pro = 1660572112

17V35 Pro Per Policy = 109226.6074

Now, Death strain = Sum assured - 17V35

Death strain = 200000- 109226.6074

Death strain = 90773.3926

Mortality Profit = EDS – ADS

EDS (Expected Death Strain) = 15203\*q51\*90773.3926

EDS (Expected Death Strain) = 15203\*0.002809\*90773.3926

EDS (Expected Death Strain) = 3876498.337

ADS (Actual Death Strain) = 46\*90773.3926

ADS (Actual Death Strain) = 4175576.06

Mortality profit = -299077.723

Now, for annuities, 17V35 Pro = 12352\*(10000)\*a due82

=> 17V35 Pro = 840093735

=> 17V35 Pro per policy = 68012.77

Mortality profit = EDS – ADS

EDS = 12352\*q81\*(-68012.77)

EDS = -50365299.6

ADS = 746\*(-68012.77)

ADS = -50737526.42

Mortality profit = 372226.82

(ii) a) Since, expected death in case of endowment assurance is less than actual death.

ie, Expected death = 15203\*0.002809

= 42.705

Actual death = 46

There is a mortality loss in the case of endowment assurance.

b) Since there is a single premium, the reserve from starting is positive and as long as there is no huge amount of difference between the ADS and EDS, there will be mortality profit.

Q12. I) Loan amount = 80000

Loan term = 10 years

Interest rate = 8% pa

Now,

12P(a(12)<10>) = 80000

=> P = (80000) / (12\*6.9527) = 958.86011

Therefore, Level monthly payments = 958.8601

ii) Now, till 1 Nov 2018, 34 level instalments have been paid.

=> Remaining instalments = 86

Therefore, loan outstanding(1 Nov 2018) = NPV of remaining instalments

NPV = 958.86 \* (V+V^2+V^3+V^4+........+V^86)

NPV = 958.86 \* [V{(1-V^86)/(1-V)}]

Here, we need to convert interest into monthly.

=> [1+{(i^12)/12}]^12 = (1+i)

=> i^12 = 0.07721

Now, Interest per month = (0.07721/12) = 0.006434

=> NPV = 958.86\*[{1-1.006434^(-86)}/0.006434] = 63180.538

Therefore, loan outstanding at 1 Nov 2018 = 63180.538

iii) a) New loan outstanding = 63180.538 + 250 = 63430.54

Now, interest given = 9% pa convertible monthly

Mean interest per month = 0.09/12 = 0.0075

Now, equation of value = 63430.54 = 900\*[{1-1.0075^(-n)}/0.0075]

=> 0.528588 = [1-1.0075^(-n)]

=> 0.471412 = 1.0075^(-n)

=> (1/0.471412) = 1.0075^(-n)

Taking log on both sides,

ln(1/0.471412) = n ln(1.0075)

=> -ln(0.471412) = n \* 0.0074720

=> 0.752023 = n \* 0.0074720

=> n = 100.6454

Therefore, New date of loan repayment = 31 July 2026

b) 63430.54 = 900\*[{1-1.0075^(-100)}/0.0075] + P\*100^(-101)

= 63157.16045 + P\*1.0075^(-101)

=> P = 581.45560

Therefore, final instalment = 581.4556

Q11. I) Expected ROR = 9% pa effective

Maximum price the investor must pay to get the expected ROR is just the NPV of all the dividends paid.

Let no. of shares the investor purchase = 100 nominal

Therefore, NPV = (40\*1.05\*V^2) + (40\*1.05\*1.04\*V^3) +(40\*1.05\*1.04\*1.03\*V^4) + (40\*1.05\*1.04\*1.03^2\*V^5)+.....+inf.

= (42\*V^2) + (43.68\*V^3) + (44.9904\*V^4) + (44.9904\*1.03\*V^5) + (44.9904\*1.03^2\*V^6) + ......+ inf.

= 35.3506 + 33.72897 + 31.87233 + 44.9904\*1.03\*V^5\*[1 + 1.03\*V + 1.03^2\*V^2 + 1.03^3\*V^3 + .....inf.]

= 100.9519 + 30.1179\* [1/{1-1.03\*1.09^(-1)}]

= 100.9519 + 30.1179 \* 18.1667

= 648.09375

Now, since we purchase 100 nominal.

Therefore, price per share = 6.4809375

Q10. ii) Condition required for equality of prospective and reterospective reserve

1. Reterospective and prospective reserves are calculated on the same basis.
2. Basis (Premiums) = Basis (Reserves)

iii) Sum assured = 5

Age = x

Annual premium = P

Now, P = S\*A barx / a duex

=> S\*A barx = P\*a duex

=> S\*(A barx^1:<t> + t|A barx) = P\*(a duex:<t> + t|a duex)

=> S\*A barx:<t> + S\*t|A barx = P\*a duex:<t> + Pt|a duex­

=> S\*A barx:<t> + S\*t\*p\*x\*V^t\*A barx+t = P\*a duex:<t> + t\*p\*x\*V^t\*a duex+t\*P

=> S\*A barx:<t> - P\*a duex:<t> = P\*t\*p\*x\*V^t\*a duex+t - S\*t\*p\*x\*V^t\*A barx+t

=>{(S\*A barx:<t> - P\*a duex:<t>) / t\*p\*x} \* (i+1) = P\*a duex+t - S\*A barx+t

=> tVRetro  = tVPro

=> Hence proved.

Q8. I) Accumulated value at t = 9

Amount = 15000 made at time 1

=> A(1,9) \* 15000 = 15000 \* [e^ + e^

= 15000 \* [e^{0.003t+(0.005t^2)/2}[2,1] + e^{0.045t-(0.0025t^2)/2}[9,2]]

= 15000 \* [e^{(0.06+0.01)-(0.03+0.0025)} + e^{(0.405-0.10125)-(0.09-0.005)}]

= 15000 \* [e^(0.07-0.0325) + e^(0.30375-0.085)]

= 15000 \* [e^0.0375 + e^0.21875]

= 34240.98157