Let us start with the mortality force

```
> m := t ->
  0.0005+0.00007585775*10^(0.038*t);
```

$$m := t \rightarrow 0.0005 + 0.00007585775\ 10^{(0.038\ t)}$$

This is the mortality force in state 3. Note that this is before the correction was issued. You can replace it wia constant 0.4 if you like.

```
> m3:= t -> 0.4*exp(0.002*t);
```

$$m3 := t \rightarrow 0.4\ \mathbf{e}^{(0.002\ t)}$$

We will need the survival probability (see later)

```
> evalf(0.00007585775*10^(0.038*35)/(0.038*ln
  (10)));
```

$$0.01853534490$$

```
> p := t ->
  exp(-0.0005*t-.1853534490e-1*(10^(0.038*t)-
  1));
```

$$p := t \rightarrow \mathbf{e}^{(-0.0005\ t - 0.01853534490\ (10^{(0.038\ t)} - 1))}$$

Let us pretend the contract is valid for life.

```
> dsys1 :=
  {diff(v1(t),t)=(m(35+t)+0.05+0.01)*v1(t)-0.
  01*v2(t),
```

```
diff(v2(t),t)=(m(35+t)+0.03+0.05)*v2(t)-0.0
3*v3(t)-0.03*100000,
diff(v3(t),t)=(m3(35+t)+0.05)*v3(t)-50000,
v1(90)=0,  v2(90)=0,  v3(90)=0 };
```

$$dsys1 := \{ \mathrm{v3}(90) = 0, \mathrm{v1}(90) = 0, \mathrm{v2}(90) = 0, \frac{d}{dt} \mathrm{v1}(t) = (0.0605 + 0.00007585775\ 10^{(1.330 + 0.038\ t)})\ \mathrm{v1}(t) - 0.01\ \mathrm{v2}(t), \frac{d}{dt} \mathrm{v2}(t) = (0.0805 + 0.00007585775\ 10^{(1.330 + 0.038\ t)})\ \mathrm{v2}(t) - 0.03\ \mathrm{v3}(t) - 3000.00, \frac{d}{dt} \mathrm{v3}(t) = (0.4\ \mathbf{e}^{(0.070 + 0.002\ t)} + 0.05)\ \mathrm{v3}(t) - 50000 \}$$

```
> dsol1 := dsolve(dsys1, numeric, range =
0..90);
```

$dsol1$:= **proc**(x_rkf45) ... **end proc**

```
> dsol1(0);
```

$$[t = 0., \mathrm{v1}(t) = 8875.76513937075652, \mathrm{v2}(t) = 69588.8967815554060, \mathrm{v3}(t) = 103995.793231547912]$$

The reserves calculated are correct for states 2 and 3. Let us now amend the value at time 0 for state 1 (see class for explanation) to take into account the fact that the contract is terminated at time 25 if at state 1.

```
> evalf(p(25)*exp(-0.06*25));
```

$$0.1902985564$$

```
> dsol1(25);
```

$[t = 25., \mathrm{v1}(t) = 4395.57887371197102,$
$\mathrm{v2}(t) = 52228.1348577902245, \mathrm{v3}(t) = 99444.4052801718062]$

so the up front premium is

```
> evalf(8875.76513937075652-.1902985564*4395.
  57887371197102);
```

$$8039.292825$$

Now the reserves at time 10 for the life contract

```
> dsol1(10);
```

$[t = 10., \mathrm{v1}(t) = 7255.82044133415458,$
$\mathrm{v2}(t) = 64526.0298765843182, \mathrm{v3}(t) = 102153.606377629825]$

Again the values for states 2 and 3 are correct. To amend the value for state 1 let us first claculate the survival probability for a 45 year old.

```
> evalf(0.00007585775*10^(0.038*45)/(0.038*ln
  (10)));
```

$$0.04446319552$$

```
> p45 := t ->
  exp(-0.0005*t-.4446319552e-1*(10^(0.038*t)-
  1));
```

$$p45 := t \rightarrow \mathbf{e}^{(-0.0005\, t - 0.04446319552\, (10^{(0.038\, t)} - 1))}$$

And here follows the adjustment which will give 5683.79 as the premium.

```
> evalf(p45(15)*exp(-0.06*15));
```

$$0.3576382637$$

```
> evalf(7255.82044133415458-.3576382637*4395.
  57887371197102);
```

$$5683.793245$$

Finally note that the premium fo a 45 year old in state 2 is of course 64526.03