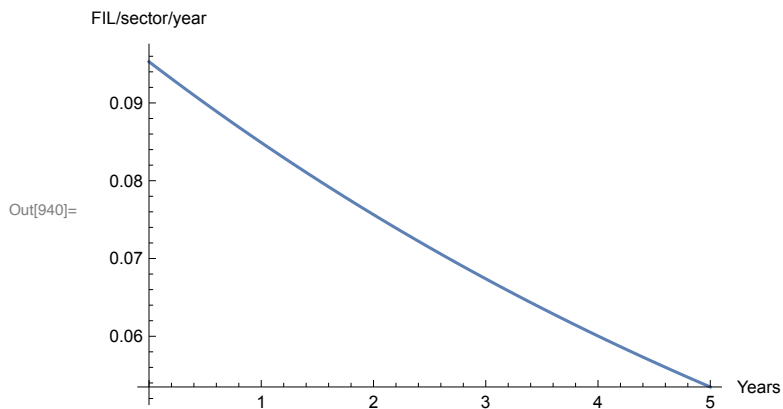# Shortfall burn

```
In[937]:= SimpleDecayRate =
    lambda /. Solve[{Exp[-lambda * 6] == 1 / 2, lambda ∈ Reals}, lambda][[1]];
CurrentlyRewards = 0.09;
MintingApprox[years_] = CurrentlyRewards * Exp[-SimpleDecayRate * years] /
    Integrate[Exp[-SimpleDecayRate * years], {years, 0, 1}]
Plot[MintingApprox[years], {years, 0, 5},
  AxesLabel → {"Years", "FIL/sector/year"}]
```

Out[939]= $0.0952987 \times 2^{-years/6}$

Out[940]=


```
In[1227]:= Integrate[MintingApprox[years], {years, 0, 1}];
CumMintingApprox = Integrate[MintingApprox[years], {years, tau, t}]
CumRewardsPerSector[t_, tau_] = 0.82492156339436` (-2^{-t/6} + 2^{-tau/6});
Plot[CumRewardsPerSector[years, 0],
  {years, 0, 5}, AxesLabel → {"Years", "FIL/sector"}]
```

Out[1228]= $0.824922 \left(-2^{-t/6} + 2^{-tau/6}\right)$

Out[1230]=
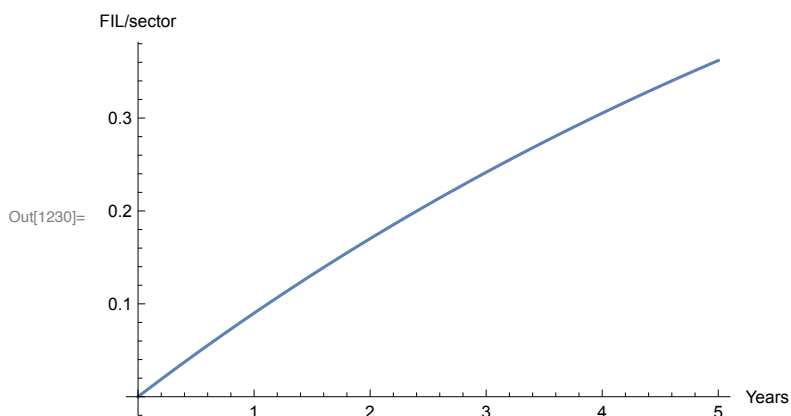
In[1231]:= `FullInitialPledge = 0.21;(*pledge per sector*)`
`CumRewardsPerSectorReceived[BorrowFraction_, t_, tau_] :=`
` If[CumRewardsPerSector[t, tau] < FullInitialPledge * BorrowFraction,`
`  0, CumRewardsPerSector[t, tau] - FullInitialPledge * BorrowFraction]`
`Plot[Evaluate@Table[CumRewardsPerSectorReceived[BorrowFraction, t, 0],`
`  {BorrowFraction, 0, 0.5, 0.1}], {t, 0, 3}, AxesLabel → {"Years", "FIL/sector"},`
` PlotLegends → Table[StringJoin[{"Shortfall = ", ToString@BorrowFraction}],`
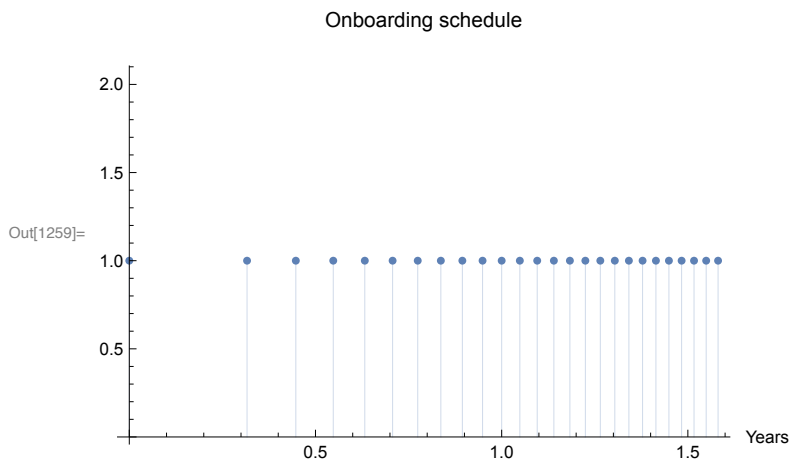`  {BorrowFraction, 0, 0.5, 0.1}], PlotLabel → "Income Recieved"]`

Out[1233]=
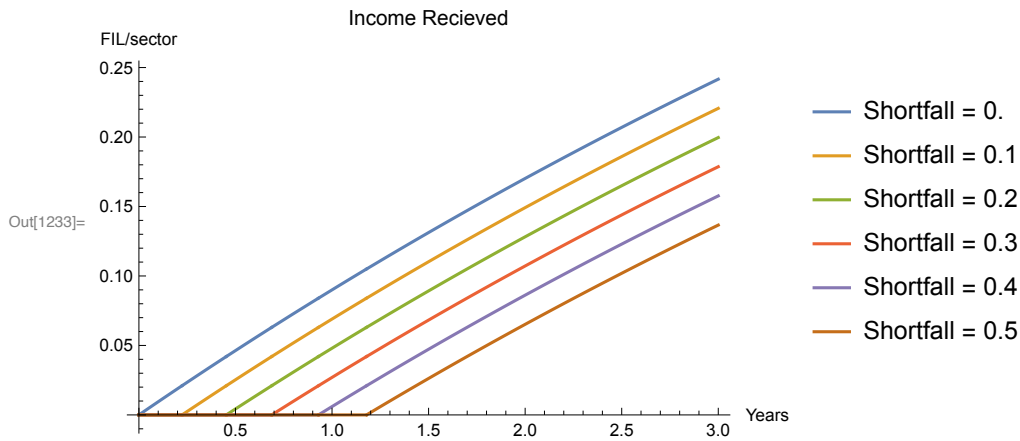
## Burn shortfall interaction with onboarding dynamics

In[1258]:= `LinearOnboardingSchedule = Table[i^0.5, {i, 0, 2.5, 0.1}];`
`delta = 0.0001;`
`ListPlot[Transpose@`
`  {LinearOnboardingSchedule, Table[1, {i, 1, Length@LinearOnboardingSchedule}]},`
` Filling → Axis, AxesLabel → {"Years", ""}, PlotLabel → "Onboarding schedule"]`

Out[1259]=

In[1260]:= **ShortFallPledge[BorrowFraction_] := FullInitialPledge * (1 - BorrowFraction)**
Plot[Evaluate@
  Table[CumRewardsPerSectorReceived[0.25, t, LinearOnboardingSchedule〚i〛],
   {i, 0, Length@LinearOnboardingSchedule}], {t, 0, 5},
 AxesLabel → {"Years", "Cumulative rewards per sector\n (FIL/32GiB)"},
 PlotLabel → "25% shortfall"]

Out[1261]=
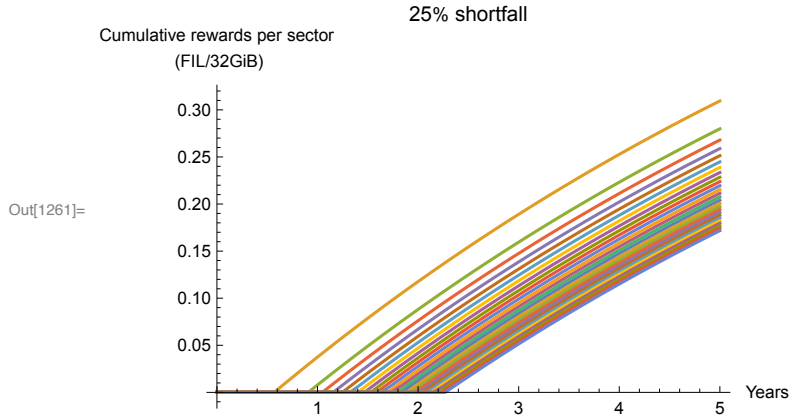
```
In[1283]:= AggShortfallPledge[BorrowFraction_, tt_] :=
            Length[Select[LinearOnboardingSchedule, # < tt &]] *
              ShortFallPledge[BorrowFraction]
          AggCumRewardsPerSectorReceived[BorrowFraction_, t_] :=
            Sum[CumRewardsPerSectorReceived[BorrowFraction, t,
              LinearOnboardingSchedule[[i]]], {i, 1, Length@LinearOnboardingSchedule}]
          AnnualisedFoFR[BorrowFraction_?NumericQ, t_?NumericQ] :=
            ((AggShortfallPledge[BorrowFraction, t] +
                  AggCumRewardsPerSectorReceived[BorrowFraction, t]) /
                AggShortfallPledge[BorrowFraction, t])^(1/t) - 1
          FoFRperYear[BorrowFraction_?NumericQ, t_?NumericQ] :=
            AggCumRewardsPerSectorReceived[BorrowFraction, t] /
              (t * AggShortfallPledge[BorrowFraction, t])
```
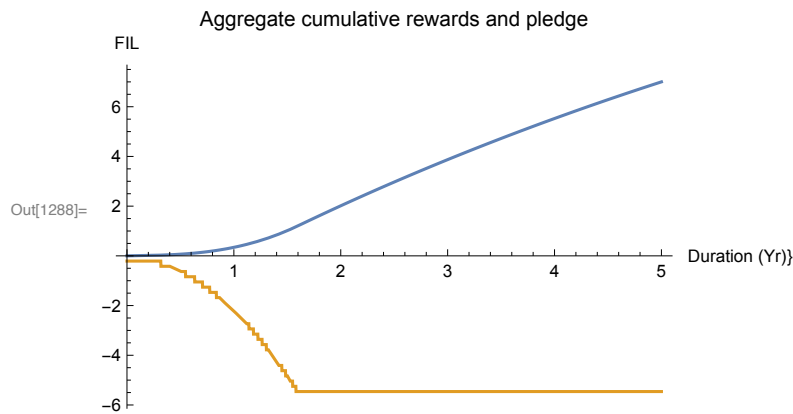
```
          shortfallTest = 0;
          Plot[{AggCumRewardsPerSectorReceived[shortfallTest, t],
            -AggShortfallPledge[shortfallTest, t]}, {t, 0, 5}, PlotRange → All,
           PerformanceGoal → "Quality", AxesLabel → {"Duration (Yr)}", "FIL"},
           PlotLabel → "Aggregate cumulative rewards and pledge"]
```
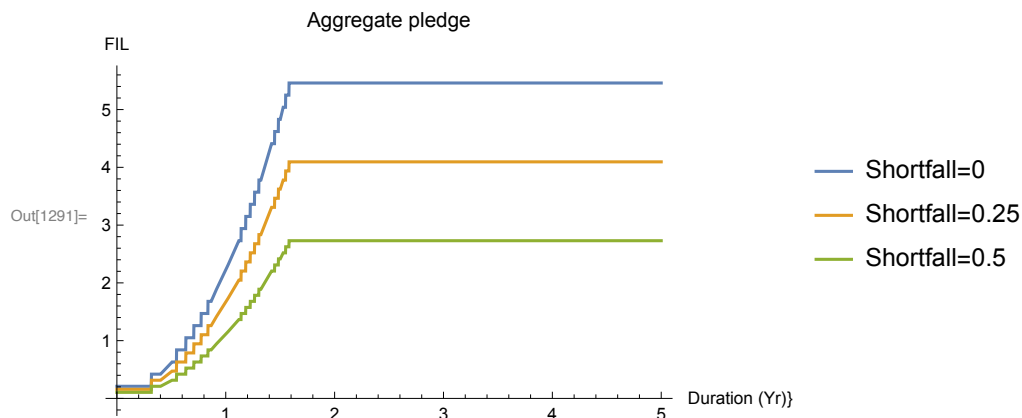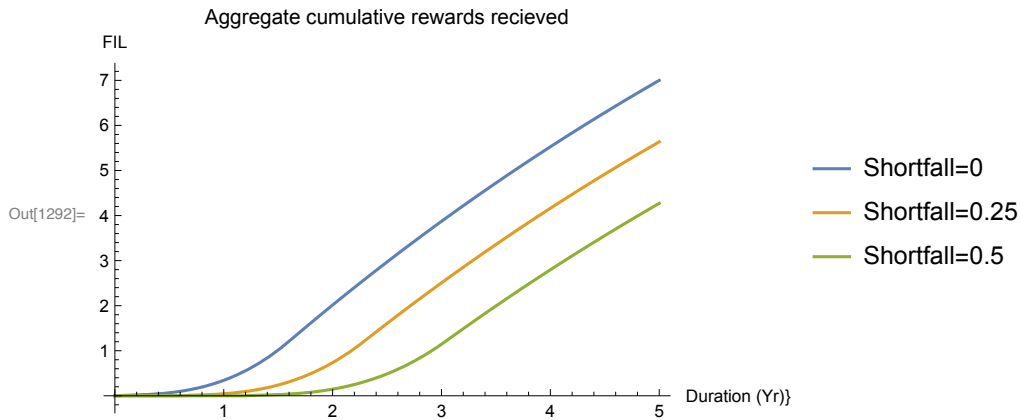
Out[1288]=


```
In[1291]:= Plot[{AggShortfallPledge[0, t],
            AggShortfallPledge[0.25, t], AggShortfallPledge[0.5, t]},
           {t, 0, 5}, PlotRange → All, PerformanceGoal → "Quality",
           PlotLegends → {"Shortfall=0", "Shortfall=0.25", "Shortfall=0.5"},
           AxesLabel → {"Duration (Yr)}", "FIL"}, PlotLabel → "Aggregate pledge"]
```
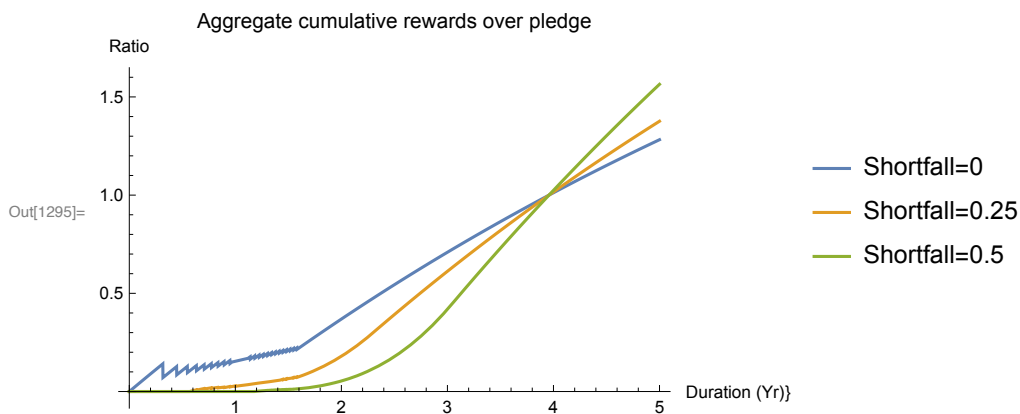
Out[1291]=

In[1292]:= `Plot[{AggCumRewardsPerSectorReceived[0, t],`
`   AggCumRewardsPerSectorReceived[0.25, t],`
`   AggCumRewardsPerSectorReceived[0.5, t]}, {t, 0, 5}, PlotRange → All,`
`  PerformanceGoal → "Quality", AxesLabel → {"Duration (Yr)}", "FIL"},`
`  PlotLegends → {"Shortfall=0", "Shortfall=0.25", "Shortfall=0.5"},`
`  PlotLabel → "Aggregate cumulative rewards recieved"]`

Out[1292]=

In[1295]:= `Plot[{AggCumRewardsPerSectorReceived[0, t] / AggShortfallPledge[0, t],`
`   AggCumRewardsPerSectorReceived[0.25, t] / AggShortfallPledge[0.25, t],`
`   AggCumRewardsPerSectorReceived[0.5, t] / AggShortfallPledge[0.5, t]},`
`  {t, 0, 5}, AxesLabel → {"Duration (Yr)}", "Ratio"},`
`  PlotLegends → {"Shortfall=0", "Shortfall=0.25", "Shortfall=0.5"},`
`  PlotLabel → "Aggregate cumulative rewards over pledge"]`

Out[1295]=

In[1241]:= `AnnualisedFoFR[0, 1]`
`AggCumRewardsPerSectorReceived[0, 1]`
`AggShortfallPledge[0, 1]`

Out[1241]= `0.16297`

Out[1242]= `0.342236`

Out[1243]= `2.1`

In[1300]:=
```
Plot[{100 * AnnualisedFoFR[0, t], 100 * AnnualisedFoFR[0.25, t],
   100 * AnnualisedFoFR[0.5, t]}, {t, 1, 7}, PlotRange → All,
  PlotLegends → {"0% Shortfall", "25% Shortfall", "50% Shortfall"},
  GridLines → Automatic, AxesLabel → {"Duration", "%"},
  PlotLabel → "FoFR annualised", PerformanceGoal → "Quality"]
Plot[{100 * FoFRperYear[0, t], 100 * FoFRperYear[0.25, t],
   100 * FoFRperYear[0.5, t]}, {t, 1, 7}, PlotRange → All,
  PlotLegends → {"0% Shortfall", "25% Shortfall", "50% Shortfall"},
  GridLines → Automatic, AxesLabel → {"Duration", "%"},
  PlotLabel → "FoFR per year", PerformanceGoal → "Quality"]
```

Out[1300]=

Out[1301]=
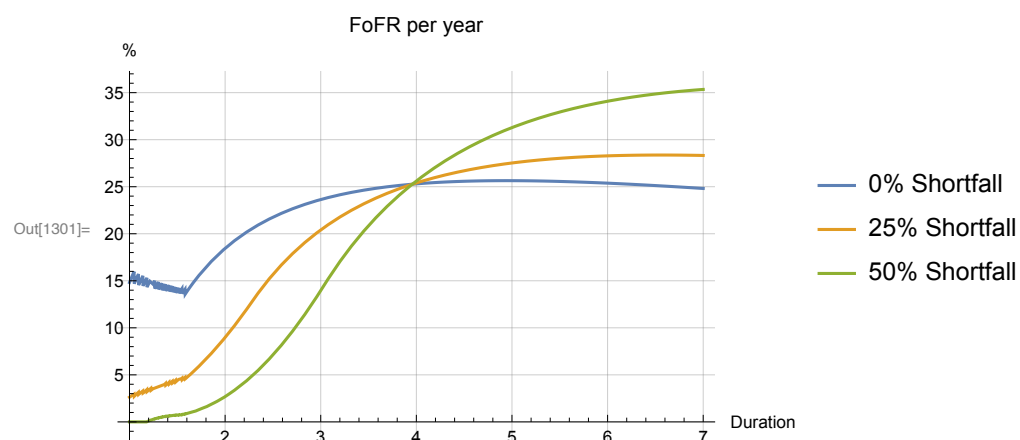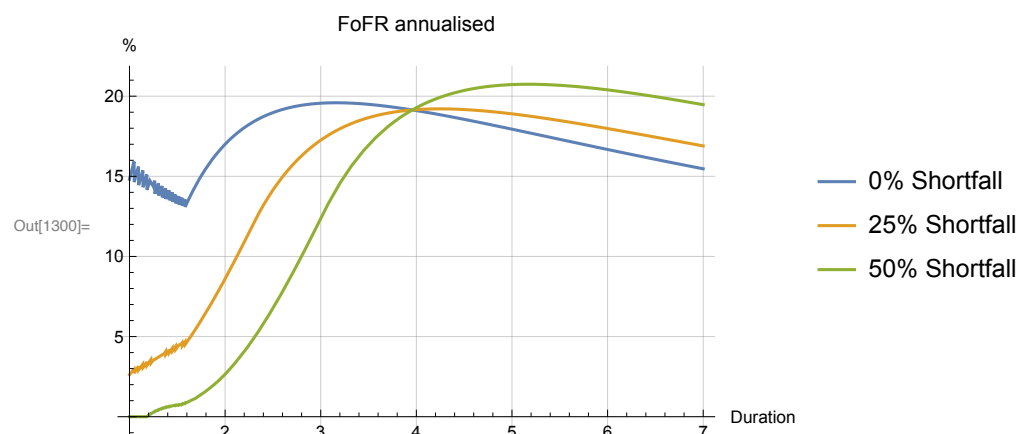
```
In[1159]:= ShortFallFeeBurnTake[t_, burntakePCT_] := If[t < 1,
              CumRewardsPerSector[t] * burntakePCT, CumRewardsPerSector[1] * burntakePCT]
          RepaymentFeeTake[t_, pledgetakePCT_] := If[t < 1,
              CumRewardsPerSector[t] * pledgetakePCT, CumRewardsPerSector[1] * pledgetakePCT]
          OrdinaryReturns[t_, pledgetakePCT_, burntakePCT_] := CumRewardsPerSector[t] -
              RepaymentFeeTake[t, pledgetakePCT] - ShortFallFeeBurnTake[t, burntakePCT]
```

```
          GraphicsGrid[Partition[
            Table[Plot[{ShortFallFeeBurnTake[t, 0.25], RepaymentFeeTake[t, shortfall],
                OrdinaryReturns[t, shortfall, 0.25]}, {t, 0, 5}, PlotRange → All,
              PlotLabel → StringJoin[{"Shortfall = ", ToString@ shortfall}],
              PlotLegends → Placed[{"Burn Take", "Repay Take", "Ordinary return"}, Top],
              AxesLabel → {"Duration", "FoFR"}],
             {shortfall, 0, 0.75, 0.25}], 2], ImageSize → Large]
```
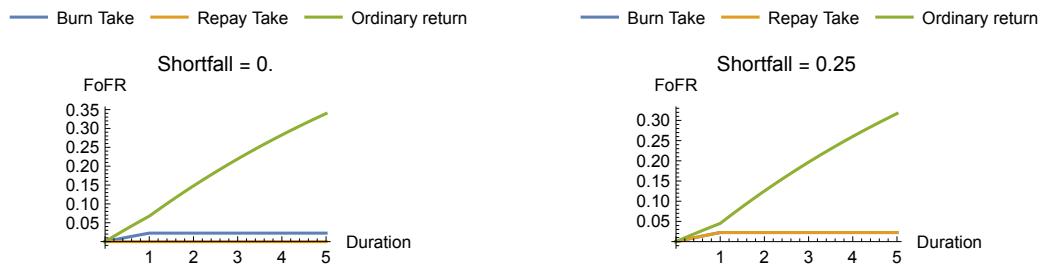
Out[1162]=
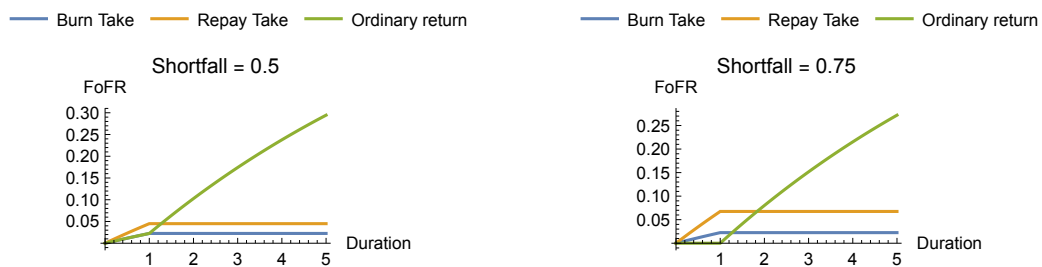

```
In[870]:= OrdinaryReturns[1, 0.25, 0.75]
          RepaymentFeeTake[1, 0.75] - ShortFallFeeBurnTake[1, 0.25]
          FullInitialPledge
```

Out[870]= 0.

Out[871]= 0.045

Out[872]= 0.21

In[1169]:=
```
simpleROI[t_, pledgetakePCT_] :=
  (OrdinaryReturns[t, 0.25, pledgetakePCT] + RepaymentFeeTake[t, pledgetakePCT] -
     ShortFallFeeBurnTake[t, 0.25]) / ((1 - pledgetakePCT) * FullInitialPledge * t)
Plot[
 Evaluate@Table[simpleROI[t, shortfall], {shortfall, 0, 0.75, 0.25}], {t, 1, 10}]
```

Out[1170]=