# When Money Shrinks, and Using the Models

Every factor is 1 plus or minus the rate. Decay: A = P(1 - r)^t. 0.87 is losing 13%. Debt grows like savings. Change P or r and say what happens. How long: use a table.

## 1 THE VOCABULARY
### Words we use

Depreciation losing value over time.
Decay factor 1 – r: what you multiply by each time.
Decay rate r: the percent lost, the distance below 1.
Doubling time how long an amount takes to double.
Growth factor 1 + r: above 1 grows, below 1 shrinks.

- Watch out for these.
- Reading 0.85 as losing 85%. It keeps 85% and loses 15%.
- Writing a 13% loss as 0.13. The factor is 0.87.
- Thinking interest only helps. On a debt it grows what you owe.
- Treating 72 divided by the rate as exact. It is an estimate.

## 2 THE METHOD
### Start from 1

1. KEEPING ALL OF IT IS 1 the do-nothing number.
2. GROWTH add the rate: 5% gives 1.05.
3. LOSS take the rate away: 13% gives 0.87.
4. BACKWARD how far is the factor from 1? 0.85 is 0.15 below: 15% lost.
5. HOW LONG build a table until the goal is passed.

**WHY THE FACTOR IS 1 MINUS THE RATE**
Losing 13% means keeping the other 87%. B – 0.13B = B(1 – 0.13) = 0.87B, the distributive property again.

## 3 A CAR
### $35{,}000(0.87)^t$

| | |
|---|---|
| 35,000 | the price when new |
| $0.87 = 1 - 0.13$ | loses 13% each year |
| $0.87^3 = 0.658503$ | power first |
| $35{,}000 \times 0.658503 = \$23{,}047.61$ | about $23,048 after 3 years |
| never $0 | positive times positive stays positive |

**DOUBLING TIME**
$500 at 8%: year 9 is $999.50, year 10 is $1,079.46. About 9 years. Check: 72 ÷ 8 = 9.

**SAY IT OUT LOUD**
Start from 1, keeping all of it. Add the rate to grow, take it away to shrink.