# redoing the "Drawing from a Reservior" model

## dynamic parameters

In[1]:=
```
T = 2;
d = .06;
g = .01;
```

## benefits (build demand using parameters from Chap 2 and integrate under it)

In[4]:=
```
q0 = 35 000;
p0 = 3;
elast = -1 / 2;
c = q0 / p0^elast;
wlog = (1 + g)^(t - 1) * c * p^elast;
mb = p /. Flatten[Simplify[Solve[w == %, p]]];
```

In[10]:=
```
Assuming[{W > 100}, tb = ∫_100^W mb dw]
```

Out[10]=
$$\frac{3.60259 \times 10^7\, e^{0.0199007\, t}\, (-100. + W)}{W}$$

## costs

In[11]:=
```
tc = 50 000 + 1.95 * W + 0.000015 * W^2;
```

## hydrologics

Numbers in line 1 of following cell are opt water uses for 1st 2 periods as computed in chap 3. The intent here is to compute a reservoir amount which exactly allows this 2-period consumption assuming mean inflows of 27000.

In[12]:=
```
initialstored = 31 573.3 + 31 673.4 - 2 * 27 000
annualflow = 27 000;
```

Out[12]=
```
9246.7
```

## develop work matrix

In[14]:=
```
wvector = Prepend[Array[w, T - 1], w0];
work = Table[1., {t, T}, {j, 8}];
work[[1, 1]] = 0;
Do[work[[t + 1, 1]] = t, {t, T - 1}]
Do[work[[t, 2]] = W /. Flatten[Solve[D[(tb - tc), W] == 0, W, Reals]], {t, 1, T}]
Do[work[[t, 3]] = wvector[[t]], {t, T}]
Do[work[[t, 4]] = (tb - tc) /. W → work[[t, 3]], {t, T}]
Do[work[[t, 5]] = work[[t, 4]] / (1 + d) ^ (t - 1), {t, T}]
work[[1, 6]] = initialstored + annualflow;
Do[work[[t, 6]] = work[[t - 1, 6]] + annualflow - work[[t - 1, 3]], {t, 2, T}]
work[[1, 7]] = initialstored + annualflow;
work[[1, 8]] = Min[work[[1, 2]], work[[1, 7]]];
Do[{work[[t, 7]] = work[[t - 1, 7]] + annualflow - work[[t - 1, 8]],
  work[[t, 8]] = Min[work[[t, 2]], work[[t, 7]]]}, {t, 2, T}]
rslts = TableForm[Prepend[work, {"Period", "MNB=0@", "w", "NBs",
    "PV(NBs)", "Reserv@Start", "MyopicReserv", "MyopicUse"}]];
Dual = D[work[[1, 4]], w0];
```

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## Expected NPV

A crude bit of re-coding and amenable to only two periods as written here. Run separately for each line of Table 4.1.

In[36]:=
```
w0 = .;
centerprob = 1 / 3.;
overunder = 8000.;
enpv = Simplify[work[[1, 5]]
     + (((1. - centerprob) / 2.) * (work[[2, 5]] /.
          w[1] → (-w0 + initialstored + annualflow + annualflow - overunder)))
     + (centerprob * (work[[2, 5]] /. w[1] → (-w0 + initialstored +
             annualflow + annualflow)))
     + (((1. - centerprob) / 2.) * (work[[2, 5]] /. w[1] →
           (-w0 + initialstored + annualflow + annualflow + overunder)))];
answr = NMaximize[{enpv, w0 ≥ 0.}, w0];
w0 = w0 /. Flatten[answr[[2]]]
Dual
```

Out[41]= 30 704.3

Out[42]= 1.02702