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> restart;
> #p0 is previous risky behavior (prob of disease); p1 is risky
  behavior; v(p1) utility of risky behavior; theta cost of disease;
> x1:=v(p1+x)-p0*theta-p1*(1-p0)*theta;

$$x1 := v(p1 + x) - p0 \theta - p1 (1 - p0) \theta \quad (1)$$

> x2:=diff(x1,p1);

$$x2 := D(v)(p1 + x) - (1 - p0) \theta \quad (2)$$

> x3:=implicitdiff(x2,p1,p0);

$$x3 := - \frac{\theta}{D^{(2)}(v)(p1 + x)} \quad (3)$$

> x4:=implicitdiff(x2,p1,p0,p0);

$$x4 := - \frac{D^{(3)}(v)(p1 + x) \theta^2}{D^{(2)}(v)(p1 + x)^3} \quad (4)$$

> parms:=b=1.656,e=.588,c=.083,theta=.85,alpha=.986,x=0;

$$parms := b = 1.656, e = 0.588, c = 0.083, \theta = 0.85, \alpha = 0.986, x = 0 \quad (5)$$

> v:=p1->(p1-b/e)^2/(e*p1-1);

$$v := p1 \rightarrow \frac{\left(p1 - \frac{b}{e}\right)^2}{e p1 - 1} \quad (6)$$

> factor(simplify(diff(v(p1),p1,p1)));
  factor(simplify(diff(v(p1),p1,p1,p1)));

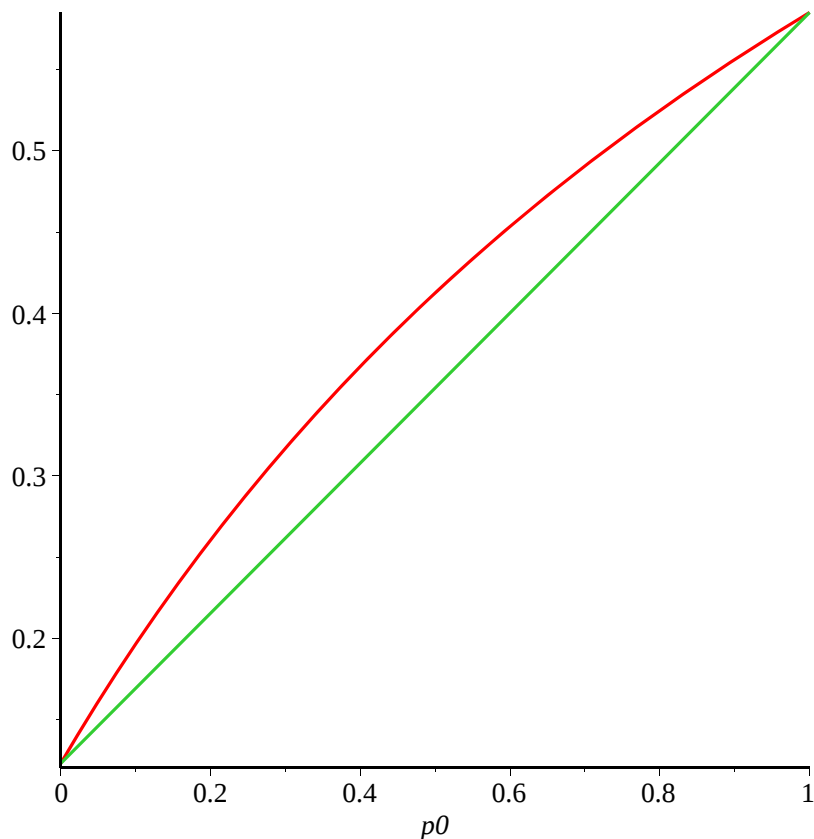
$$\frac{2(b-1)^2}{(e p1 - 1)^3} - \frac{6 e (b-1)^2}{(e p1 - 1)^4} \quad (7)$$

> #solve for optimal p1
  x5:=solve(x2,p1)[2];

$$x5 := - \frac{1}{(1 + \theta e p0 - \theta e) e} \left( -\theta e^2 x + \theta e + x e - 1 + \theta e^2 p0 x - \theta e p0 \right. \\ \left. + \sqrt{1 - 2 b - \theta e + \theta e p0 + b^2 + 2 \theta e b - \theta e b^2 - 2 \theta e p0 b + \theta e p0 b^2} \right) \quad (8)$$

> #choice of p1 with [red] and without [green] testing.
> plot(subs(parms,[x5,(1-p0)*subs(p0=0,x5)+p0*subs(p0=1,x5)]),p0=0.
  .1);

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> x6:=subs(p1=x5,x1);
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$$x6 := \left( -\frac{1}{(1 + \theta e p0 - \theta e) e} \left( -\theta e^2 x + \theta e + x e - 1 + \theta e^2 p0 x - \theta e p0 \right. \right. \\ \left. \left. + \sqrt{1 - 2b - \theta e + \theta e p0 + b^2 + 2\theta e b - \theta e b^2 - 2\theta e p0 b + \theta e p0 b^2} \right) + x - \frac{b}{e} \right) \\ \left( e \left( -\frac{1}{(1 + \theta e p0 - \theta e) e} \left( -\theta e^2 x + \theta e + x e - 1 + \theta e^2 p0 x - \theta e p0 \right. \right. \right. \\ \left. \left. + \sqrt{1 - 2b - \theta e + \theta e p0 + b^2 + 2\theta e b - \theta e b^2 - 2\theta e p0 b + \theta e p0 b^2} \right) + x \right) - 1 \right) \\ - p0 \theta + \frac{1}{(1 + \theta e p0 - \theta e) e} \left( \left( -\theta e^2 x + \theta e + x e - 1 + \theta e^2 p0 x - \theta e p0 \right. \right. \\ \left. \left. + \sqrt{1 - 2b - \theta e + \theta e p0 + b^2 + 2\theta e b - \theta e b^2 - 2\theta e p0 b + \theta e p0 b^2} \right) (1 - p0) \theta \right)$$

(9)

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> #utility without test [red], with test of cost c but no treatment [green], with test of cost c and treatment [yellow]
plot(subs(parms,[x6,(1-p0)*subs(p0=0,x6)+p0*subs(p0=1,x6)-c,(1-p0)*subs(p0=0,x6)+p0*subs(p0=1,x6+.08*alpha)-c]),p0=0..1,color=[red,green,yellow]);
```

