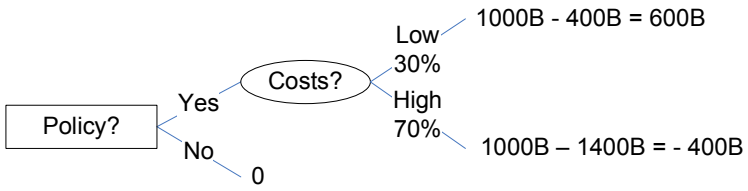
Exam 3, Spring 2007

Notes on Solution

Question 1

Part (a)

The decision tree is shown below, where all payoffs are in billions.



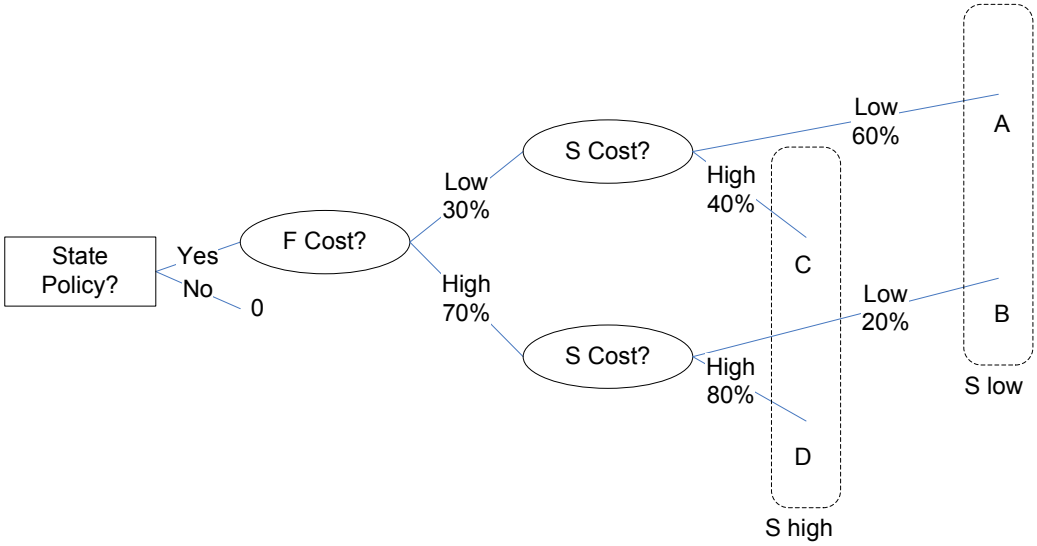
The EV of the "Costs?" node:

EV = 0.3*(600B) + 0.7*(-400B) = - 100B

A risk-neutral government would not adopt the policy: it is too likely that the policy's costs would substantially exceed its benefits.

Part (b)

The first part of the decision tree looks like this:



The probability of ending up at points A-D are listed below:

Point	Fed Cost	Fed Prob	State Cost	Prob	Overall
A	Low	30.0%	Low	60.0%	18.0%
B			High	40.0%	12.0%
C	High	70.0%	Low	20.0%	14.0%
D			High	80.0%	56.0%

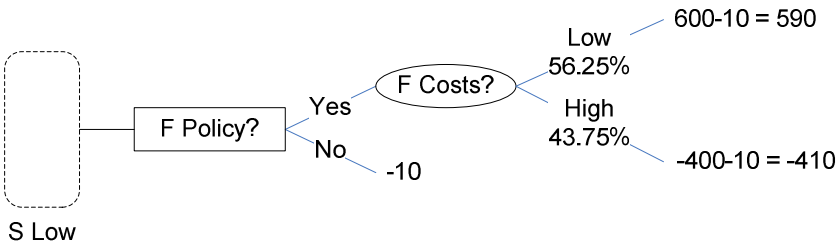
The overall chances of each state cost:

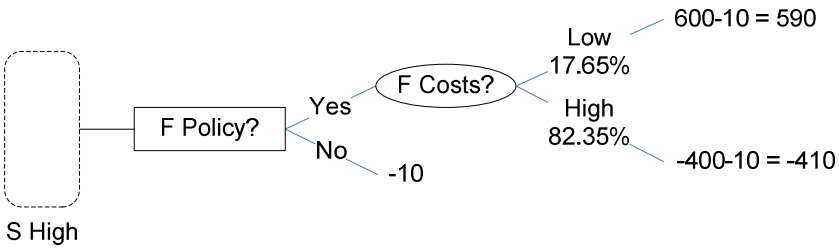
State low 18% + 14% = 32%
State high 12% + 56% = 68%

Depending on the state costs, the conditional probabilities for federal costs will be:

State	Fed	Conditional Probability
Low	Low	18%/32% = 56.25%
	High	14%/32% = 43.75%
High	Low	12%/68% = 17.65%
	High	56%/68% = 82.35%

The decision trees branching off from each of the dotted ellipses above are as shown:

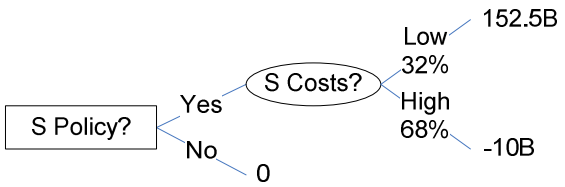




The EV of proceeding with the federal policy when state costs are low is 0.5625*(590B) + 0.4375*(-410B) = 152B. Since that's higher than -10B, if state costs are low, the federal government should proceed with the policy.

The EV of proceeding with the federal policy when state costs are high is 0.1765*(590B) + 0.8235*(-410B) = -234B. Since that's lower than -10B, if state costs are high, the federal government should NOT proceed with the policy.

Finally, taking these outcomes into account, the expected value of the state policy can be calculated:



EV = 0.32*(152.5B) + 0.68*(-10B) = 42B.

The federal government SHOULD pay the state to go ahead. The information the state policy would provide about federal costs is worth $42B more to the federal government than the $10B it would have to pay the state for implementing the policy.

Question 2

Q = K^(0.333) * L^(0.667)

Q	16
Pk	20
Pl	40

K	L	Q	TC	AC
10	20.24	16	1009.54	63.10
11	19.30	16	991.87	61.99
12	18.48	16	979.01	61.19
13	17.75	16	970.02	60.63
14	17.10	16	964.19	60.26
15	16.52	16	960.99	60.06
16	16.00	16	960.00	60.00
17	15.52	16	960.89	60.06
18	15.08	16	963.40	60.21
19	14.68	16	967.30	60.46
20	14.31	16	972.43	60.78
Equation	L = (Q/(K^0.333))^(1/0.667)	Q = K^(0.333) * L^(0.667)	TC = Pk*K + Pl*L	AC = TC/Q

The firm should use 16 units of capital and 16 units of labor. Its average cost will be $60 per unit of output.

Question 3

TC = F + G*Q
P = A - B*Q

F	375
G	20

A	100
B	1

Q	P	TC	TR	Profit	AC	AR
68	32	1735	2176	441	25.51	32
69	31	1755	2139	384	25.43	31
70	30	1775	2100	325	25.36	30
71	29	1795	2059	264	25.28	29
72	28	1815	2016	201	25.21	28
73	27	1835	1971	136	25.14	27
74	26	1855	1924	69	25.07	26
75	25	1875	1875	0	25.00	25
76	24	1895	1824	-71	24.93	24
77	23	1915	1771	-144	24.87	23
78	22	1935	1716	-219	24.81	22
	P = 100 - 1*Q	TC = 375+20*Q	TR = P*Q	Profit = TR-TC	AC = TC/Q	AR = P

The organization should charge $25 and serve 75 clients. It will earn $0 in profits.

Question 4

Part (a)

P = A - B*Q

A:	1020
B:	4

AC, MC: 20

Q	P	TR	TC	Profit	MR	MC
120	540	64800	2400	62400		20
121	536	64856	2420	62436	56	20
122	532	64904	2440	62464	48	20
123	528	64944	2460	62484	40	20
124	524	64976	2480	62496	32	20
125	520	65000	2500	62500	24	20
126	516	65016	2520	62496	16	20
127	512	65024	2540	62484	8	20
128	508	65024	2560	62464	0	20
129	504	65016	2580	62436	-8	20
130	500	65000	2600	62400	-16	20
	P = 1020 - 4*Q	TR = P*Q	TC=20*Q	Profit = TR - TC	MR = ΔTR/ΔQ	MC = 20

The firm would charge $520 for the drug and produce 125 units. Its profit would be $62,500.

Part (b)

Interest rate: 5%

Computing the PV of the 20 year stream of monopoly profits:

Annual profit	62,500
PV forever	1,250,000
PV of years 21+	471,112
PV of years 1-20	778,888

Part (c)

Computing the PV of CS during the patent period:

CS during patent:	31,250.0
CS if forever	625,000
Patent-period CS	389,444

After the patent period, competition in the market will drive the price down to $20. We can find Q via the demand curve: 20 = 1020 - 4*Q, so Q = 250.

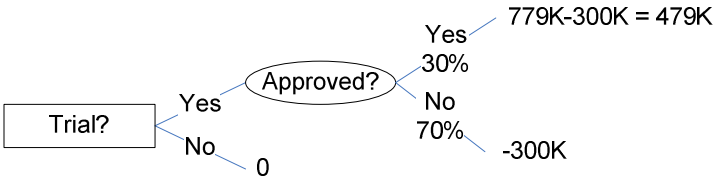
Q	250
CS after patent	125,000
CS if forever	2,500,000
Post-patent CS	942,224

Final step is to add the patent-period and post-patent CS values together. The total CS is the PV of the CS during the patent period plus the PV of the CS after the patent expires:

Total CS:	1,331,668

Part (d)

The firm's decision tree is shown below:



The expected value of running the trial is 0.3*(479K) + 0.7*(-300K) = -66K. A risk neutral firm would not undertake the trial.

The $50,000 subsidy would not work. It's not enough: the EV would still be -16K.

Extending the life of the patent to 40 years would raise the PV of profits as follows:

Annual profit	62,500
PV forever	1,250,000
PV of years 41+	177,557
PV of years 1-40	1,072,443

Using this value instead of 779K would raise the EV of the trial to 22K. A risk neutral firm would now proceed. Thus, policy 2 would work.