Exam 3, Fall 2005

Notes on Solution

Question 1

r:	5%

Benefits of Olympics

Year 12 games	1,000	million
Tourism, 13+	25	million
Tourism, 12	500	million
Total at 12	1,500	million
Total today	835	

Alternative Bids

Bid	Cost	Net PV	Prob of Win	EV
A	300	535	50%	267.6
B	600	235	90%	211.7

Option A has the higher expected value, so it would be the better proposal. It's not as likely to win, but the net payoff is much higher if it does win. Note that since the city doesn't have to pay unless its proposal is chosen, the EV is equal to $\rho*(835-\text{cost})+(1-\rho)*0$, where ρ is the probability of winning.

Question 2

Q = K^(0.5) * L^(0.5)

Pk	24
Pl	54

Q	K	L	Q	TC	AC
18	24	13.50	18	1305.00	72.50
18	25	12.96	18	1299.84	72.21
18	26	12.46	18	1296.92	72.05
18	27	12.00	18	1296.00	72.00
18	28	11.57	18	1296.86	72.05
18	29	11.17	18	1299.31	72.18
18	30	10.80	18	1303.20	72.40
18	31	10.45	18	1308.39	72.69
18	32	10.13	18	1314.75	73.04
18	33	9.82	18	1322.18	73.45
18	34	9.53	18	1330.59	73.92
Equation		L = (Q/(K^0.5))^(1/0.5)	Q = K^(0.5) * L^(0.5)	TC = Pk*K + Pl*L	AC = TC/Q

The firm should use 27 units of capital and 12 units of labor. Its average cost will be $72 per unit of output.

Question 3

				Subsidy	14000
TC = F + G*Q		F	4000	A	1100
P = A - B*Q		G	300	B	20

Q	P	TC	TR	AC	AR	AR-AC
46	180	17800	22280	386.96	484.347826	97.39
47	160	18100	21520	385.11	457.87234	72.77
48	140	18400	20720	383.33	431.666667	48.33
49	120	18700	19880	381.63	405.714286	24.08
50	100	19000	19000	380.00	380	0.00
51	80	19300	18080	378.43	354.509804	-23.92
52	60	19600	17120	376.92	329.230769	-47.69
53	40	19900	16120	375.47	304.150943	-71.32
54	20	20200	15080	374.07	279.259259	-94.81
55	0	20500	14000	372.73	254.545455	-118.18
56	-20	20800	12880	371.43	230	-141.43
	P = 1100 - 20Q	TC = 4000+300Q	TR = P*Q+14000	AC = TC/Q	AR = P	AR-AC

The organization should charge $100 and house 50 people. Including the subsidy, its revenue will just cover its costs and it will earn zero profit.

Question 4

Part (a)

P = A - B*Q

A: 125
B: 5

MC: 25

Q (million)	P	TR (million)	TC (million)	Profit (million)	MR	MC
5	100	500	125	375		25
6	95	570	150	420	70	25
7	90	630	175	455	60	25
8	85	680	200	480	50	25
9	80	720	225	495	40	25
10	75	750	250	500	30	25
11	70	770	275	495	20	25
12	65	780	300	480	10	25
13	60	780	325	455	0	25
14	55	770	350	420	-10	25
15	50	750	375	375	-20	25
	P = 125 - 5*Q	TR = P*Q	TC=25*Q	Profit = TR - TC	MR = ΔTR/ΔQ	MC = 25

The firm should charge $75 for the device and produce 10 million units. Its profit will be $500 million.

Part (b)

First task is to compute the PV of the 20 year stream of monopoly profits:

Annual profit	500	million	
PV forever	10,000	million	=500/r
Payments after 20	3,769	million	=10000/(1+r)^20
Value through 20	6,231	million	=10000-3769

Next task is compute the CS during the patent period (years 1-20):

CS during patent:	250	=(1/2)*10*(125-75)
CS if forever	5,000	=250/r
CS after 20	1,884	=5000/(1+r)^20
Net CS during patent	3,116	=5000-1884

After the patent period, competition in the market will drive the price down to $25. We can find Q via the demand curve: 25 = 125 - 5Q so Q = 20 million.

Q	20	=(125-25)/5
CS after patent	1,000	=(1/2)*(125-25)*20
CS if forever	20,000	=1000/r
Post-patent CS	7,538	=20000/(1+r)^20

Final step is to add the 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:	10,653	=3116+7538

Part (c)

Cost of trial	1,000

The payoff if the trial succeeds is the PV of profit from above less the cost of the test. If the trial fails, the payoff is the cost of the test.

Outcome	Prob	Payoff	Prob*Payoff
Trial Succeeds	10%	5,231	523
Trial Fails	90%	-1,000	-900
		Expected Profit:	-377

A risk-neutral firm would not proceed with the project because the EV is negative. On average, the firm would expect to lose $377M in present value terms.

Part (d)

The subsidy increases both payoffs by $500 million (since it reduces the firm's cost of the project to $500 million). Hence the firm's problem becomes the following:

Subsidy	500

Outcome	Prob	Payoff	Prob*Payoff
Trial Succeeds	10%	5,731	573
Trial Fails	90%	-500	-450
		Expected Profit:	123

The EV is now positive, so the firm will undertake the project.

From the government's point of view, the subsidy reduces the SS generated by the policy by 1.2*500 = $600 million:

Outcome	Prob	PS Payoff	CS Payoff	Subsidy	Tot SS	Prob*SS
Trial Succeeds	10%	5,731	10,653	-600	15,784	1,578
Trial Fails	90%	-500	0	-600	-1,100	-990
					Expected SS:	588

Since the EV of the project (including the full CV cost of the revenue needed to underwrite it) is positive, a risk-neutral government would proceed with the subsidy.