Exam 3, Fall 2004

Notes on Solution

Question 1

r: 5%

Cost of research project:

period	amount	PV
0	0	0.00
1	60	57.14
2	60	54.42
3	60	51.83
4	60	49.36
5	60	47.01
	total PV	259.77

Value of design, low demand

6	10.00	low value in each year from 6 onward
5	200.00	PV of stream in year 5
0	156.71	PV of stream in year 0

net PV, low -103.06

Value of design, high demand

6	20.00	high value in each year from 6 onward
5	400.00	PV of stream in year 5
0	313.41	PV of stream in year 0

net PV, high 53.64

Computing the expected value:

case	prob	net PV
low	0.40	-41.23
high	0.60	32.19

Expected NPV: -9.04 Expected net PV is negative: bad idea to carry out the project.

Question 2

Q = K^(1/4) * L^(3/4)

Pk	16
Pl	3

Q	K	L	Q	TC	AC
96	10	204.03	96	772.09	8.04
96	11	197.65	96	768.95	8.01
96	12	192.00	96	768.00	8.00
96	13	186.95	96	768.84	8.01
96	14	182.38	96	771.15	8.03
96	15	178.24	96	774.71	8.07
96	16	174.44	96	779.33	8.12
96	17	170.95	96	784.86	8.18
96	18	167.73	96	791.18	8.24
96	19	164.73	96	798.20	8.31
96	20	161.94	96	805.82	8.39
Equation		L = (Q/(K^0.25))^(1/0.75	Q = K^(1/4) * L^(3/4)	TC = Pk*K + Pl*L	AC = TC/Q

The firm should use 12 units of capital and 192 units of labor. Its average cost will be $8.00 per unit of output.

Question 3

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

F	10000
G	300

A	1000
B	10

Q	P	TC	TR	AC	AR	AR-AC
45	550	23500	24750	522.22	550	27.78
46	540	23800	24840	517.39	540	22.61
47	530	24100	24910	512.77	530	17.23
48	520	24400	24960	508.33	520	11.67
49	510	24700	24990	504.08	510	5.92
50	500	25000	25000	500.00	500	0.00
51	490	25300	24990	496.08	490	-6.08
52	480	25600	24960	492.31	480	-12.31
53	470	25900	24910	488.68	470	-18.68
54	460	26200	24840	485.19	460	-25.19
55	450	26500	24750	481.82	450	-31.82
	P = 1000 - 10Q	TC = 10000+300Q	TR = P*Q	AC = TC/Q	AR = P	AR-AC

The organization should charge $500 and enroll 50 students. Its revenue will just cover its costs.

Question 4

Part (a)

P = A - B*Q

A:	6000
B:	100

Q	P	TC	TR	MR
25	3500		87500	
26	3400		88400	900
27	3300		89100	700
28	3200		89600	500
29	3100		89900	300
30	3000		90000	100
31	2900		89900	-100
32	2800		89600	-300
33	2700		89100	-500
34	2600		88400	-700
35	2500		87500	-900
	P = 6000 - 100*Q	TC = 0	TR = P*Q	MR = ΔTR/ΔQ

The firm should charge $3000 for the test and produce 30 units. It has no costs so its total revenue of $90,000 will be profit.

Part (b)

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

PV forever	1,800,000	= 90,000/0.05
Payments after 20	678,401	= 1,800,000/(1.05)^20
Value through 20	1,121,599	= 1,800,000 - 459,169

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

CS during patent:	45,000	= (1/2)*(6000-3000)*30
CS if forever	900,000	= 45,000/0.05
CS after 20	339,201	= 900,000/(1.05)^20
Net CS during patent	560,799	= 900,000 - 339,201

After the patent period, the test is available for free. Q increases until W2P (and hence P) is driven to zero: 0 = 6000 - 100*Q. Therefore, Q = 60 after the patent expires:

CS after patent	180,000	= (1/2)*6000*60
CS of $180,000 forever	3,600,000	= 180,000/0.05
Post-patent CS	1,356,802	= 3,600,000/(1.05)^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: 1,917,602 = 560,799 + 1,356,802

Part (c)

Cost of trial 1,000,000

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	75%	121,599	91,199
Trial Fails	25%	-1,000,000	-250,000
		Expected Profit:	-158,801

A risk-neutral firm would NOT proceed with the trial because the EV is negative. On average, the firm would expect to lose about $159K.

Part (d)

The firm only looks at profit (PS) when making its decision and ignores the CS the test would generate. For efficiency, we would need to consider BOTH PS and CS:

Outcome	Prob	PS Payoff	CS Payoff	Tot Payoff	Prob*Payoff
Trial Succeeds	75%	121,599	1,917,602	2,039,201	1,529,400
Trial Fails	25%	-1,000,000	0	-1,000,000	-250,000
				Expected SS:	1,279,400

From the standpoint of efficiency, the trial SHOULD be conducted: the expected SS is positive. The firm's decision is inefficient: patients gain enough in expected CS to be able to compensate the firm for conducting the trial and still come out ahead. One possible financial arrangement would be for the government to pay for part or all of the cost of the trial. As long as it pays enough for the EV of the profit decision to be positive, the firm will proceed with the trial.