# Chapter 1

# What is Operations Research?

# Set 2.1a

Buy three roundtrip tickets for the first three weeks only—cost = 3× \$400 = \$1200. Though the cost is cheaper, it is not feasible because it covers only three out of the required five weeks.

Given a string of length L:

(1) $h = .3L$, $w = .2L$, Area $= .06L^2$
(2) $h = .1L$, $w = .4L$, Area $= .04L^2$

Solution (2) is better because the area is larger

$L = 2(w + h)$
$w = L/2 - h$

$z = wh = h(L/2 - h) = Lh/2 - h^2$

$\delta z/\delta h = L/2 - 2h = 0$

Thus, $h = L/4$ and $w = L/4$.

Solution is optimal because z is a concave function

(a)
Let T = Total tie to move all four individuals to the other side of the river. the objective is to determine the transfer schedule that minimizes T.

(b)
Let t = crossing time from one side to the other. Use codes 1, 2, 5, and 10 to represent Amy, Jim, John, and Kelly.

continued...

4 cont.

| East | Crossing | West |
|---|---|---|
| 5,10 | (1,2)→ **(t = 2)** | 1,2 |
| 1,5,10 | **(t = 1)**←(1) | 2 |
| 1 | (5,10)→ **(t = 10)** | 2,5,10 |
| 1,2 | **(t = 2)**←(2) | 5,10 |
| none | (1,2)→ **(t = 2)** | 2,5,10 |
| Total = 2 + 1 + 10 + 2 + 2 = 17 minutes | | |

| | | Jim | |
|---|---|---|---|
| | | Curve | Fast |
| Joe | Curve | .500 | .200 |
| | Fast | .100 | .300 |

(a)
Alternatives:
Joe: Prepare for curve or fast ball.
Jim: Throw curve of fast ball.

(b)
Joe tries to improve his batting score and Jim tries to counter Joe's action by selecting a less favorable strategy. This means that neither player will be satisfied with a single (pure) strategy.

The problem is not an optimization situation in the familiar sense in which the objective is maximized or minimized. Instead, the conflicting situation requires a compromise solution in which neither layer is tempted to change strategy. Game theory (Chapter 14) provides such a solution.

**Let L=ops. 1 and 2=20 sec, C=ops. 3 and 4=25 sec, U=op. 5=20 sec**

**Gant chart:** L1+load horse 1, L2=load horse 2, etc.

**one joist**: 0---L1---**20**---C1---45----U1+L1---**85**----U2+L2----125---U1+L1---**165**---U2+L2---*205*

**20**-L2-40 45---C2----70 **85**---C1---110 125---C2---140

**165**-C1-190

*205*---C2---230---U2---250

Total = 250

Loaders utilization=[250-(5+25)]/250=88%

Cutter utilization=[250-(20+15+15+15+15)]/250=68%

**two joists**: 0---2L1---**40**-----2C1-----**90**----2(U1+L1)---**170**----2C1----220---2U1---260

**40**---2L2---80 **90**---2C2----140 **170**---2U2---210

Total =260

Loaders utilization=[260-(10+10)]/260=92%

Cutter utilization=[260-(40+30+40)]/250=58%

**three joists**: 0---3L1---**60**------3C1------**135**------3C2---------210----3U2----270

**60**---3L2---120 **135**-----3U1-----195

Total =270

Loaders utilization=[270-(15+15)]/270=89%

Cutter utilization=[270-(60+60)]/270=56%

**Recommendation:** One joist at time gives the smallest time. The problem has other alternatives that combine 1, 2, and 3 joists. Cutter utilization indicates that cutter represents the bottleneck.