

(a)

If it is in "good state", the PV for a single machine is

$$PV = 28,000 + \frac{37500}{1.1} + \frac{37500}{1.1^2} + \dots$$

$$= 28,000 + 37500 \cdot \left(\frac{\frac{1}{1.1}}{1 - \frac{1}{1.1}} \right)$$

$$= 28,000 + 375,000$$

$$= 403,000$$

If it is in bad state,

$$PV = 28000 + 11500 \times \left(\frac{\frac{1}{1.1}}{1 - \frac{1}{1.1}} \right)$$

$$= 28,000 + 115,000$$

$$= 143,000.$$

So the expected PV for a single machine is

$$PV = 403,000 \times 0.65 + 143,000 \times 0.35$$

$$= 312,000.$$

if the company creates the small vehicle,
the cost is

$$C = 5,000,000 + 170,000 \times 100$$

$$= 22,000,000,$$

$$\text{Total NPV} = 312,000 \times 100 - 22,000,000$$

$$= 9,200,000.$$

if the company creates the large vehicle

the cost is

$$C = 29,000,000 + 170,000 \times 250$$

$$= 71,500,000.$$

$$\text{Total NPV} = 312,000 \times 250 - 71,500,000$$

$$= 6,500,000$$

So the company should create a small vehicle.

(b)

In the good state, the PV of a machine

is

$$PV = \frac{37500}{1.1} + \frac{37500}{1.1^2} + \dots$$

$$= 37500 \frac{\frac{1}{1.1}}{1 - \frac{1}{1.1}}$$

$$= 375000$$

If the company decides to create a small vehicle, the cost is

$$C = \frac{1}{1.1} [5,000,000 + 160,000 \times 100]$$
$$= \frac{21,000,000}{1.1}$$

$$\text{The NPV} = 375000 \times 100 - \frac{21,000,000}{1.1}$$
$$= 18,409,091$$

If the company creates large vehicles
the cost

$$C = \frac{1}{1.1} [29,000,000 + 160,000 \times 250]$$

$$= \frac{1}{1.1} [69,000,000]$$

$$\text{The NPV} = 375000 \times 250 - \frac{69,000,000}{1.1}$$

$$= 31022727$$

So the company should create large vehicles.

In the bad states the PV of a single machine is

$$PV = \frac{115000}{1.1} + \frac{115000}{1.1^2} + \dots$$

$$= 115,000$$

For small vehicles,

$$C = \frac{1}{1.1} [5,000,000 + 200,000 \times 100]$$

$$= \frac{27,000,000}{1.1}$$

$$NPV = 115,000 \times 100 - \frac{27,000,000}{1.1}$$

$$= -11,227,273$$

For large vehicles,

$$C = \frac{1}{1.1} [29,000,000 + 200,000 \times 250]$$

$$= \frac{1}{1.1} 79,000,000$$

$$NPV = 1150000 \times 250 - \frac{79000000}{1.1}$$

$$= -43,068,182$$

So the company should not create the vehicle.

The value of the option is

$$P = 0.65 \times 31,022,727 + 0.35 \times 0 - 9200000$$

$$= 10,64,773.$$