Exercise 1E

1 a

Lower bound

$$= \frac{18+4+23+8+27+19+3+26+30+35+32}{50}$$

$$= \frac{225}{50}$$

$$= 4.5$$

Therefore 5 bins (4 bins will be insufficient)

b i Bin 1: 18 + 4 + 23 + 3
Bin 2: 8 + 27
Bin 3: 19 + 26
Bin 4: 30
Bin 5: 35
Bin 6: 32

ii Putting list into descending order

35 32 30 27 26 23 19 18 8 4 3

Bin 1: 35 + 8 + 4 + 3
Bin 2: 32 + 18
Bin 3: 30 + 19
Bin 4: 27 + 23
Bin 5: 26

iii For example
Bin 1: 32 + 18
Bin 2: 27 + 23
Bin 3: 35 + 8 + 4 + 3 } Full bins
Bin 4: 19 + 26
Bin 5: 30

2 a Bin 1: A(30) + B(30) + C(30) + D(45) + E(45)
Bin 2: F(60) + G(60) + H(60)
Bin 3: I(60) + J(75)
Bin 4: K(90)
Bin 5: L(120)
Bin 6: M(120)

b Bin 1: M(120) + I(60)
Bin 2: L(120) + H(60)
Bin 3: K(90) + J(75)
Bin 4: G(60) + F(60) + E(45)
Bin 5: D(45) + C(30) + B(30) + A(30)

2 c

Lower bound =

$$\frac{30+30+30+45+45+60+60+60+60+75+90+120+120}{180}$$

$$= \frac{825}{180}$$

$= 4.5$ **so 5 tapes needed at least.**

Since a minimum of 5 tapes are needed and **b** uses 5 tapes it is optimal.

d For example
Bin 1: M(120)
Bin 2: L(120)
Bin 3: K(90) + A(30)
Bin 4: G(60) + F(60)
Bin 5: H(60) + I(60)
Bin 6: J(75) + E(45) } Full bins
Bin 7: B(30) + C(30) + D(45)

3 a First-fit does not rely on observation, it takes the items in the order given.
Whereas full-bin uses observation to find combinations of items.

b Bin 1: A(4) + B(7) + C(13) + D(6)
Bin 2: E(13) + F(4) + G(12)
Bin 3: H(14) + I(6)
Bin 4: J(11)
This uses 4 lanes.

c By inspection,
A(4) + B(7) + C(13) + D(6) = 30
E(13) + I(6) + J(11) = 30
F(4) + G(12) + H(14) = 30
Bin 1: A, B, C, D
Bin 2: E, I, J
Bin 3: F, G, H
Each of the three lanes is full, so solution is optimal.

4 a

$$\frac{3+3+4+4+4+4+5+5+5+7+8+8}{15} = 4$$

rolls

b For example,
Bin 1: L(8) J(7)
Bin 2: K(8) I(5)
Bin 3: H(5) G(5) F(4)
Bin 4: E(4) D(4) C(4) B(3)
Bin 5: A(3)
5 rolls used and 15 m wasted.

4 c Doesn't always give an optimal solution.

d For example,
Bin 1: A(3) + C(4) + L(8)
Bin 2: B(3) + D(4) + E(4) + F(4)
Bin 3: G(5) + H(5) + I(5)
Bin 4: J(7) + K(8)
4 rolls used and no carpet is wasted, so solution is optimal.

5 a Bin 1: H(25) + A(8)
Bin 2: G(25)
Bin 3: F(24) + B(16)
Bin 4: E(22) + C(17)
Bin 5: D(21)

b

$$\text{Lower bound} = \frac{8+16+17+21+22+24+25+25}{40}$$
$$= \frac{158}{40}$$
$$= 3.95$$

∴ Lower bound is 4.

c There are 5 programs over 20MB. It is not possible for any two of these to share a bin. So at least 5 bins will be needed, so 4 will be insufficient.