



(X)	0	0	x
0	(0)	x	0
x	0	(0)	x
0	x	x	(x)

(X)	0	0	0
x	(X)	x	0
0	0	(X)	x
0	0	x	(X)

$$\begin{aligned}
 r_1 &= 1 & c_1 &= 2 \\
 r_2 &= 2 & c_2 &= 1 \\
 r_3 &= 2 & c_3 &= 2 \\
 r_4 &= 2 & c_4 &= 2
 \end{aligned}$$

$$\begin{aligned}
 r_1 &= 4 & c_1 &= 3 \\
 r_2 &= 2 & c_2 &= 3 \\
 r_3 &= 3 & c_3 &= 2 \\
 r_4 &= 3 & c_4 &= 4
 \end{aligned}$$

branch  
bound

$m \times m$   
 col row  
 $m \times m-1$   
 col row

2 =	(X)	0	0	x
1 =	0	(0)	x	0
2 =	x	0	(0)	x
3 =	0	x	x	(x)
	2	1	2	3



$$\begin{aligned}
 &\frac{\text{count}+1}{2} && 5\frac{1}{2} \\
 &\text{floor}\left(\frac{\text{count}+1}{2}\right) && = 2.5
 \end{aligned}$$

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x 0 0 x  
0 0 x 0  
x 0 0 x  
0 x x x

$\overline{x}$  0 0  $\overline{x}$  =    0 x 0 x     $\overline{0}$  x 0 x     $\overline{x}$  x 0 0  
 0 0 x 0 =    0 0 x 0    x 0 0 0    0 0 0 x  
 x 0 0 x =    0 x 0 x    x 0 x x    x 0 x x  
 0 x x x =    x 0 x x

$m \times (m-1)$   
 $1 \times 0$   
 $c_1 = 1$   $\begin{pmatrix} x \\ x \\ 0 \\ 0 \end{pmatrix}$   
 $c_1 = 2$

$c_1 = 1$

$c_1 = 2$

$c_1 = 3$

2

2

2

$m \times m$   
 $1 \times 1$

$c_1 = 3$   $\begin{pmatrix} 0 \\ x \\ x \\ 0 \end{pmatrix}$   
 $r_1 = 3$  0 x x 0

$\overline{0}$  x 0 x  
 x 0 0 0  
 0 x 0 x  
 x 0 x x

$c_1 = 2$   
 $r_1 = 1$

$\overline{x}$  0 0 0  
 0 x 0 x  
 0 x 0 x  
 x 0 x x

$\overline{0}$  x 0 x  
 0 x 0 x  
 x 0 0 0  
 x 0 x x

$c_1 = 3$   
 $r_1 = 3$

$c_1 = 2$   
 $r_1 = 3$



X	0	0	0
0	X	0	X
0	X	0	X
X	0	X	X

X	0	0	0
0	X	0	X
0	X	0	X
X	0	X	X

X	0	0	0
0	0	X	X
0	0	X	X
X	X	0	X

X	0	0	0
0	X	X	0
0	X	X	0
X	X	0	X

2	X	1
Col		row
$c_1 = 2$		
$c_2 = 2$		
$r_1 = 1$		

$c_1 = 2$
$c_2 = 1$
$r_1 = 1$

$c_1 = 2$
$c_2 = 3$
$r_1 = 1$

②

X	0	0	0
0	0	X	X
0	0	X	X
X	X	0	X

Diagram illustrating a sequence of three matrices and their associated cost and revenue values, connected by arrows indicating a flow or transformation.

**Matrix 1 (Left):**

X	0	0	0
0	0	X	X
0	0	X	X
X	X	0	X

$c_1 = 3$      $r_1 = 1$   
 $c_2 = -2$      $r_2 = -3$

**Matrix 2 (Middle):**

X	0	0	0
0	0	X	X
0	0	X	X
X	X	0	X

$c_1 = 2$      $r_1 = 1$   
 $c_2 = 1$      $r_2 = 2$

**Matrix 3 (Right):**

X	0	0	0
X	X	0	X
0	0	X	X
0	0	X	X

$c_1 = 2$      $r_1 = 1$   
 $c_2 = 1$      $r_2 = 2$

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x	0	0	0
x	x	0	x
0	0	x	x
0	0	x	x

③

x	0	0	0
x	x	0	x
0	0	x	x
0	0	x	x

$$c_1 = 2$$

$$c_2 = 1$$

$$c_3 = 2$$

$$r_1 = 1$$

$$r_2 = 3$$

x	0	0	0
x	x	x	0
0	0	x	x
0	0	x	x

$$c_1 = 2$$

$$c_2 = 1$$

$$c_3 = 2$$

$$r_1 = 1$$

$$r_2 = 2$$

$$\begin{aligned} r_1 &= 1 & c_1 &= 2 \\ r_2 &= 2 & c_2 &= 1 \\ r_3 &= 2 & c_3 &= 2 \end{aligned}$$

x	0	0	0
x	x	x	0
0	0	x	x
0	0	x	x