A clothing manufacturer has 600 yards of cloth available to make shirts and decorated vests. Each shirt requires 3 yards of material and provides a profit of $5. Each vest requires 2 yards of material and provides profit of $2. The manufacturer wants to guarantee that under all circumstances there are minimum of 100 shirts and 30 vests produced. How many of each garment should be made in order to maximize profit?

**Steps**

1. Define variables
   - Resources: yards of cloth
   - Products: 
     - # of shirts - $S$
     - # of vests - $V$

2. Create a mixture chart

<table>
<thead>
<tr>
<th></th>
<th>cloth</th>
<th>min* product</th>
<th>profit per product</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>3</td>
<td>100</td>
<td>$5</td>
</tr>
<tr>
<td>V</td>
<td>2</td>
<td>30</td>
<td>$2</td>
</tr>
</tbody>
</table>

3. Determine resource constraints + objective function

   \[3S + 2V \leq 600 \quad \text{can't exceed cloth}\]
   \[S \geq 100 \quad \text{min # of shirts (no stated min)}\]
   \[V \geq 30 \quad \text{min # of vests}\]

   \[\text{obj.fnc: } 5S + 2V\]
4) Graph feasible region

\[ 3S + 2V \leq 600 \]

graph =

\[ 3S + 2V = 600 \]

find int. p.t. by axes

\[ S \geq 100 \]

\[ V \geq 30 \]

5) Find all corner points (points of intersection of lines)

\[ S, V \]

\[ A = (100, 30) \]

\[ B = (100, 150) \]

\[ C = (180, 30) \]

\[ 3(100) + 2V = 600 \]

\[ 2V = 300 \]

\[ V = \frac{300}{2} = 150 \]

\[ 3S + 2(150) = 600 \]

\[ 3S = 540 \]

\[ S = \frac{540}{3} = 180 \]

6) Evaluate OBJ function at corner points and select optimal production policy

\[ 5S + 2V \text{ evaluated at } A(100, 30) \]

\[ 5(100) + 2(30) = 560 \]

\[ @ B(100, 150) \]

\[ 5(100) + 2(150) = 800 \]

\[ @ C(180, 30) \]

\[ 5(180) + 2(30) = 960 * \]

\[ 900 + 60 \]

Optimal production policy → make 180 shirts and 30 vests!
Toy manufacturer makes bikes for profit $12 and wagons for profit $10. To produce bikes requires 2 hours machine time and 4 hours painting time. To produce wagons requires 3 hours machine time and 2 hours paint time. There are 60 hours machine time and 80 hours paint time per week. How many of each toy should be produced?

1. Resources:
   - Machine time $\rightarrow$ max 60 hrs
   - Painting time $\rightarrow$ max 80 hrs

2. Products:
   - $B =$ # bikes produced per week
   - $W =$ # wagons produced per week

3. Mixture Chart:

<table>
<thead>
<tr>
<th></th>
<th>Machine Time (60)</th>
<th>Painting Time (80)</th>
<th>Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>2</td>
<td>4</td>
<td>$12</td>
</tr>
<tr>
<td>W</td>
<td>3</td>
<td>2</td>
<td>$10</td>
</tr>
</tbody>
</table>

4. Constraint lines:
   - $2B + 3W \leq 60$
   - $4B + 2W \leq 80$
   - $B \geq 0$
   - $W \geq 0$

   Objective function:
   - $12B + 10W \rightarrow$ maximize
4) Graph feasible region

\[ 2B + 3W = 60 \]
\[ C(10,0) \leq 60 \]
\[ 4B + 2W = 80 \]

5) Find Corner Points

A(0,0)
B(0,20)
C(15,10)
D(20,0)

- Find where the lines intersect:
  \[-2(2B+3W=60) \rightarrow \]
  \[-4B+6W=-120 \]
  \[-4W=-40 \]
  \[W=10 \rightarrow \]
  \[2B+30=60 \]
  \[2B=30 \]
  \[B=15 \]

6) Evaluate Obj. Func at corner points

\[ 12B + 10W \]
\[ C(0,0) = 0 \]
\[ (0,20) = 200 \]
\[ (20,0) = 240 \]
\[ (15,10) = 12(15) + 10(10) \]
\[ = 180 + 100 = 280 \]

Optimal production policy to produce 15 Bikes + 10 Wagons.

If add constraint/min. that need at least 10 of each -> nothing changes!