OR-604 Problem 1 -- Modelling -- Charb-Auto manufactures

Decision variables

In [89]:
```
%%latex
\begin{equation}
sedan_{us}, sedan_{ca} , sedan_{mx}
minvan_{us}, minvan_{ca} , minvan_{mx}
suv_{us}, suv_{ca} , suv_{mx}
pikup_{us}, pickup_{ca} , pickup_{mx}
sportscar_{us}, sportscar_{ca} , sportscar_{mx}
\end{equation}
```

$$sedan_{us}, sedan_{ca}, sedan_{mx} minvan_{us}, minvan_{ca}, minvan_{mx} suv_{us}, suv_{ca}, suv_{mx} pikup_{us}, pickup_{ca}, pickup_{mx} sportscar_{us} sportscar_{mx}$$

The above variables are the counts of manufactured vehicles subscripted by factory location.

Objective function

Maximize profit equation givem below.

In [90]:
```
%%latex
\begin{equation}
profit = 8000(sedan_{us} + sedan_{ca} + sedan_{mx}) +
12000(minvan_{us} + minvan_{ca} + minvan_{mx}) +
17000(suv_{us} + suv_{ca}  + suv_{mx}) +
12000(pikup_{us} + pickup_{ca}  + pickup_{mx}) +
25000(sportscar_{us} + sportscar_{ca}  + sportscar_{mx})
\end{equation}
```

$$profit = 8000(sedan_{us} + sedan_{ca} + sedan_{mx}) + 12000(minvan_{us} + minvan_{ca} + minvan_{mx}) + 17000(suv_{us} + suv_{ca} + 12000(pikup_{us} + pickup_{ca} + pickup_{mx}) + 25000(sportscar_{us} + sportscar_{ca} + sportscar_{mx})$$

Constraints

In [91]:
```
%%latex
Rule that limits production hours.
\begin{equation}
\begin{bmatrix}
    20400 \\
    15000 \\
    8320
\end{bmatrix}
\ge
\begin{bmatrix}
    2*sedan_{us} + 2.5*minvan_{us} + 1*suv_{us} + 1.5*pikup_{us} + 3*sportscar_{us}\\
    2.25*sedan_{ca} + 3*minvan_{ca} + 0*suv_{ca} + 1*pikup_{ca} + 0*sportscar_{ca} \\
    0*sedan_{mx} + 2*minvan_{mx} + 1.25*suv_{mx} + 0*pikup_{mx} + 4.1*sportscar_{mx}
\end{bmatrix}
\ge
\begin{bmatrix}
    0 \\
    0 \\
    0
\end{bmatrix}
\end{equation}
Rule that limits the counts of the vehicles.
\begin{equation}
0 \le sedan_{us} \le 1500,\\ 0 \le sedan_{ca} \le 1200,\\0 \le sedan_{mx} \le 600,\\
0 \le minvan_{us} \le 2500,\\ 0 \le minvan_{ca} \le 1300,\\0 \le minvan_{mx} \le 800,\\
0 \le suv_{us} \le 1400,\\ 0 \le suv_{ca} \le 900,\\ 0 \le suv_{mx} \le 1200,\\
0 \le pikup_{us} \le 2200,\\ 0 \le pickup_{ca} \le 450,\\ 0 \le pickup_{mx} \le 1500,\\
0 \le sportscar_{us} \le 1000,\\ 0 \le sportscar_{ca} \le 500,\\ 0 \le sportscar_{mx} \le 250
\end{equation}
```

Rule that limits production hours.

$$\begin{bmatrix} 20400 \\ 15000 \\ 8320 \end{bmatrix} \geq \begin{bmatrix} 2 * sedan_{us} + 2.5 * minvan_{us} + 1 * suv_{us} + 1.5 * pikup_{us} + 3 * sportscar_{us} \\ 2.25 * sedan_{ca} + 3 * minvan_{ca} + 0 * suv_{ca} + 1 * pikup_{ca} + 0 * sportscar_{ca} \\ 0 * sedan_{mx} + 2 * minvan_{mx} + 1.25 * suv_{mx} + 0 * pikup_{mx} + 4.1 * sportscar_{mx} \end{bmatrix} \geq \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

Rule that limits the counts of the vehicles.

$$0 \leq sedan_{us} \leq 1500,$$
$$0 \leq sedan_{ca} \leq 1200,$$
$$0 \leq sedan_{mx} \leq 600,$$
$$0 \leq minvan_{us} \leq 2500,$$
$$0 \leq minvan_{ca} \leq 1300,$$
$$0 \leq minvan_{mx} \leq 800,$$
$$0 \leq suv_{us} \leq 1400,$$
$$0 \leq suv_{ca} \leq 900,$$
$$0 \leq suv_{mx} \leq 1200,$$
$$0 \leq pikup_{us} \leq 2200,$$
$$0 \leq pickup_{ca} \leq 450,$$
$$0 \leq pickup_{mx} \leq 1500,$$
$$0 \leq sportscar_{us} \leq 1000,$$
$$0 \leq sportscar_{ca} \leq 500,$$
$$0 \leq sportscar_{mx} \leq 250$$

OR-604 Problem 2 -- Modelling -- Casino

Decision variables

In [92]:
```
%%latex
\begin{equation}
x_{nb} = Nickle\;Bandit\;slot\;machine\;counts
\end{equation}
\begin{equation}
x_{dr} = Dime Robber\;slot\;machine\;counts
\end{equation}
\begin{equation}
x_{d-r} = Dollar-Rama\;slot\;machine\;counts
\end{equation}
\begin{equation}
x_{gp} = Grandma\;Pension\;slot\;machine\;counts
\end{equation}
\begin{equation}
x_{hdd} = Hoop-De-Doo\;slot\;machine\;counts
\end{equation}
\begin{equation}
x_{ml} = Mother\;Load\;slot\;machine\;counts
\end{equation}
\begin{equation}
x_{bj} = Black\;Jack\;slot\;machine\;counts
\end{equation}
```

$$x_{nb} = Nickle\ Bandit\ slot\ machine\ counts$$
$$x_{dr} = DimeRobber\ slot\ machine\ counts$$
$$x_{d-r} = Dollar - Rama\ slot\ machine\ counts$$
$$x_{gp} = Grandma\ Pension\ slot\ machine\ counts$$
$$x_{hdd} = Hoop - De - Doo\ slot\ machine\ counts$$
$$x_{ml} = Mother\ Load\ slot\ machine\ counts$$
$$x_{bj} = Black\ Jack\ slot\ machine\ counts$$

Objective function

Maximize profit equation givem below.

In [93]:
```
%%latex
\begin{equation}
profit = (2000-800)x_{nb} + (3500-400)x_{dr} + (4500-1500)x_{d-r} + (750-200)x_{gp} + (3000-1000)x_{hdd} + (2
500-500)x_{ml} + (3000-500)x_{bj}
\end{equation}
```

$$profit = (2000-800)x_{nb} + (3500-400)x_{dr} + (4500-1500)x_{d-r} + (750-200)x_{gp} + (3000-1000)x_{hdd} + (2500-5$$
$$+ (3000-500)x_{bj}$$

Constraints

In [94]:
```
%%latex
Rule that limits the area in sq.feets.
\begin{equation}
0 \le 2x_{nb} + 2.5x_{dr} + 6x_{d-r} + 2.75x_{gp} + 3.5x_{hdd}  + 4x_{ml} + 2.75x_{bj}  \le 3000 \\
\end{equation}
Rule that limits worker maintanence time.
\begin{equation}
0 \le 0.67x_{nb} + 1x_{dr} + 2x_{d-r} + 1.1x_{gp} + 0.67x_{hdd}  + 0.5x_{ml} + 0.75x_{bj}  \le 5167 \\
\end{equation}
Rule that limits slot machine counts.
\begin{equation}
0 \le x_{nb} \le 200 \\
0 \le x_{dr} \le 150 \\
0 \le x_{d-r} \le 100 \\
0 \le x_{gp} \le 250 \\
0 \le x_{hdd} \le 125 \\
0 \le x_{ml} \le 100 \\
0 \le x_{bj} \le 250 \\
\end{equation}
```

Rule that limits the area in sq.feets.

$$0 \le 2x_{nb} + 2.5x_{dr} + 6x_{d-r} + 2.75x_{gp} + 3.5x_{hdd} + 4x_{ml} + 2.75x_{bj} \le 3000$$

Rule that limits worker maintanence time.

$$0 \le 0.67x_{nb} + 1x_{dr} + 2x_{d-r} + 1.1x_{gp} + 0.67x_{hdd} + 0.5x_{ml} + 0.75x_{bj} \le 5167$$

Rule that limits slot machine counts.

$$\begin{equation}
0 \le x_{nb} \le 200 \\
0 \le x_{dr} \le 150 \\
0 \le x_{d-r} \le 100 \\
0 \le x_{gp} \le 250 \\
0 \le x_{hdd} \le 125 \\
0 \le x_{ml} \le 100 \\
0 \le x_{bj} \le 250 \\
\end{equation}$$

OR-604 Problem 3 -- Modelling -- Distillery

Decision variables

In [95]:
```
%%latex
\begin{equation}
x_{p} = Product\;barrel\;counts
\end{equation}
\begin{equation}
x_{sbb} = Small\;Batch\;Bourbon\;barrel\;counts
\end{equation}
\begin{equation}
x_{sbbb} = Single\;Barrel\;Bonded\;Bourbon\;barrel\;counts
\end{equation}
\begin{equation}
x_{pwfb} = Port\;Wine\;Finished\;Bourbon\;barrel\;counts
\end{equation}
\begin{equation}
x_{sr} = Stanky\;Rye\;barrel\;counts
\end{equation}
\begin{equation}
x_{pwfr} = Port\;Wine\;Finished\;Rye\;barrel\;counts
\end{equation}
```

$$x_{p} = Product\;barrel\;counts$$
$$x_{sbb} = Small\;Batch\;Bourbon\;barrel\;counts$$
$$x_{sbbb} = Single\;Barrel\;Bonded\;Bourbon\;barrel\;counts$$
$$x_{pwfb} = Port\;Wine\;Finished\;Bourbon\;barrel\;counts$$
$$x_{sr} = Stanky\;Rye\;barrel\;counts$$
$$x_{pwfr} = Port\;Wine\;Finished\;Rye\;barrel\;counts$$

Objective function

In [96]:
```
%%latex
\begin{equation}
profit = 2000x_{p} + 3000x_{sbb} + 3500x_{sbbb} + 5000x_{pwfb} + 2500s_{sr} + 4000x_{pwfr}
\end{equation}
```

$$profit = 2000x_{p} + 3000x_{sbb} + 3500x_{sbbb} + 5000x_{pwfb} + 2500s_{sr} + 4000x_{pwfr}$$

Constraints

In [97]:
```
%%latex
rule that limits hours.
\begin{equation}
24x_{p} + 36x_{sbb} + 26x_{sbbb} + 26x_{pwfb} + 15s_{sr} + 18x_{pwfr} \le 4000
\end{equation}
rules that limits counts should not go below zero.
\begin{equation}
x_{p} \ge 20 \\ x_{sbb} \ge 30 \\ x_{sbbb} \ge 35 \\ x_{pwfb} \ge 20 \\ s_{sr} \ge 15 \\ x_{pwfr} \ge 20
\end{equation}
rule that limits inventory utilization for PortWineFinishedBourbon and PortWineFinishedRye along with SingleB
atchBourbon.
\begin{equation}
40 \le x_{pwfb} + x_{pwfr} \le 50 \\
35 \le x_{sbb} \le 36
\end{equation}
rule that limits raw materials in (pounds).
\begin{equation}
0 \le 25x_{p} + 27x_{sbb} + 27x_{sbbb} + 30x_{pwfb} + 5s_{sr} + 18x_{pwfr} \le 3500 \\
0 \le 12x_{p} + 12x_{sbb} + 8x_{sbbb} + 20x_{pwfb} + 5s_{sr} + 5x_{pwfr} \le 1500 \\
0 \le 12x_{sbb} + 8x_{sbbb} + 20s_{sr} + 30x_{pwfr} \le 1800 \\
0 \le 12x_{p} + 8x_{sbbb}  \le 1800 \\
\end{equation}
```

rule that limits hours.

$$24x_p + 36x_{sbb} + 26x_{sbbb} + 26x_{pwfb} + 15s_{sr} + 18x_{pwfr} \leq 4000$$

rules that limits counts should not go below zero.

$$x_p \geq 20$$
$$x_{sbb} \geq 30$$
$$x_{sbbb} \geq 35$$
$$x_{pwfb} \geq 20$$
$$s_{sr} \geq 15$$
$$x_{pwfr} \geq 20$$

rule that limits inventory utilization for PortWineFinishedBourbon and PortWineFinishedRye along with SingleBatchBourbon.

$$40 \leq x_{pwfb} + x_{pwfr} \leq 50$$
$$35 \leq x_{sbb} \leq 36$$

rule that limits raw materials in (pounds).

$$0 \leq 25x_p + 27x_{sbb} + 27x_{sbbb} + 30x_{pwfb} + 5s_{sr} + 18x_{pwfr} \leq 3500$$
$$0 \leq 12x_p + 12x_{sbb} + 8x_{sbbb} + 20x_{pwfb} + 5s_{sr} + 5x_{pwfr} \leq 1500$$
$$0 \leq 12x_{sbb} + 8x_{sbbb} + 20s_{sr} + 30x_{pwfr} \leq 1800$$
$$0 \leq 12x_p + 8x_{sbbb} \leq 1800$$