1. When \( x = 18 \) the mixed strategy equilibrium (indifference between the two strategies) is at 50-50. So if \( x > 18 \) the bottom (Pareto efficient) equilibrium is risk dominant; if \( x < 18 \) the top (inefficient) equilibrium is risk dominant.

2. Nash = Subgame perfect since there are no subgames; more strongly any beliefs at the information set “2” if that information set is not reached, so Nash = Sequential when \( x = 2, 3 \); see below for the case \( x = 1 \).

The normal form is

<table>
<thead>
<tr>
<th></th>
<th>u</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>LL</td>
<td>2.5, 2.5</td>
<td>2.5, 2.5</td>
</tr>
<tr>
<td>LR</td>
<td>4, 2.5</td>
<td>2, 1.5+.5x</td>
</tr>
<tr>
<td>RL</td>
<td>4,1.5</td>
<td>2,1</td>
</tr>
<tr>
<td>RR</td>
<td>5.5, 1.5</td>
<td>1.5,.5x</td>
</tr>
</tbody>
</table>

Payoff to 1

\[
\text{NASH} \quad \text{LL and Prob(U) \leq .25 is Nash} \\
\text{RR, U is Nash and strict if } x = 1, 2 \\
\text{RR and Prob(U) \geq .25 and } x = 3 \text{ is Nash} \\
\text{Prob(U) = .25 means 1 is indifferent between all strategies} \\
\text{for 2 the difference between U and D is}
\]

<table>
<thead>
<tr>
<th></th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>LR</td>
<td>1-.5x</td>
</tr>
<tr>
<td>RL</td>
<td>.5</td>
</tr>
</tbody>
</table>
x=1 then only LL is played  
x=2 then only LL and LR are played  
x=3 any weight on LL and RR and equal chances of LR and RL

**Sequential**  
x=2,3 same as Nash  
x=1 LL,d fails sequential since D is dominated by U

**Iterated Weak Dominance**  
x=1,2 (RR,u)

**Trembling Hand**  
x=1,2 any trembling by player 1 leads to U for player 2, forcing RR for player 1  
x=3 any tremble by 1 that puts enough weight on LR leaves 2 willing to play D

3. (a) for all $\sigma_i, \sigma_{-i}$ we have  
$$\max_{\sigma_i} u_i(\sigma_i, \sigma_{-i}) \geq u_i(\sigma_i, \sigma_{-i}) \geq \min_{\sigma_i} u_i(\sigma, \sigma_{-i})$$

(b) consider an aggregate player who controls all of $-i$; the strategy space of such a player are all correlated strategies for these players

(c) a THREE PLAYER game in which minimax>maximin: any example in which players 2 and 3 can do more damage to player 1 by correlating their play than by playing independently; 1 chooses the matrix, 2 chooses row, 3 chooses column

player 1’s payoffs  
$$\begin{bmatrix} 1 & 10 \\ 0 & 10 \end{bmatrix} \begin{bmatrix} 0 & 10 \\ 10 & 0 \end{bmatrix}$$

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