Applying Nash Equilibrium to Rock, Paper, Scissors, Lizard, and Spock

	Rock	Paper	Scissors	Spock	Lizard
Rock	0,0	-1,1	1,-1	-1,1	1,-1
Paper	1,-1	0,0	-1,1	1,-1	1,-1
Scissors	-1,1	1,-1	0,0	-1,1	1,-1
Spock	1,-1	-1,1	1,-1	0,0	-1,1
Lizard	-1,1	1,-1	-1,1	1,-1	0,0

σ_R = Probability of player 1 playing Rock

E_R = Expected outcome of player 2 while playing Rock

$$\sigma_R + \sigma_P + \sigma_{SC} + \sigma_{SP} + \sigma_L = 1$$

$$\sigma_L = 1 - (\sigma_R + \sigma_P + \sigma_{SC} + \sigma_{SP})$$

$$E_R = (\mathbf{0} * \sigma_R) + (\mathbf{-1} * \sigma_P) + (\mathbf{1} * \sigma_{SC}) + (\mathbf{-1} * \sigma_{SP}) + (\mathbf{1} * \sigma_L)$$

$$= -1\sigma_P + \sigma_{SC} - \sigma_{SP} + 1 - \sigma_R - \sigma_P - \sigma_{SC} - \sigma_{SP}$$

$$= -\sigma_R - 2\sigma_P - 2\sigma_{SP} + 1$$

$$E_P = (\mathbf{1} * \sigma_R) + (\mathbf{0} * \sigma_P) + (\mathbf{-1} * \sigma_{SC}) + (\mathbf{1} * \sigma_{SP}) + (\mathbf{-1} * \sigma_L)$$

$$= \sigma_R - \sigma_{SC} + \sigma_{SP} - (1 - \sigma_R - \sigma_P - \sigma_{SC} - \sigma_{SP})$$

$$= \sigma_R - \sigma_{SC} + \sigma_{SP} - 1 + \sigma_R + \sigma_P + \sigma_{SC} + \sigma_{SP}$$

$$= 2\sigma_R + 2\sigma_{sp} + \sigma_P - 1$$

$E_{SC} = (-1 * \sigma_R) + (1 * \sigma_P) + (0 * \sigma_{SC}) + (-1 * \sigma_{SP}) + (1 * \sigma_L)$

$= - \sigma_R + \sigma_P - \sigma_{SP} + (1 - (\sigma_R + \sigma_P + \sigma_{SC} + \sigma_{SP}))$

$= - \sigma_R + \sigma_P - \sigma_{SP} + 1 - \sigma_R - \sigma_P - \sigma_{SC} - \sigma_{SP}$

$= - \sigma_R + \sigma_P - \sigma_{SP} + 1 - \sigma_R - \sigma_P - \sigma_{SC} - \sigma_{SP}$

$= - 2 \sigma_R - \sigma_{SC} - 2 \sigma_{SP} + 1$

$E_{SP} = (1 * \sigma_R) + (-1 * \sigma_P) + (1 * \sigma_{SC}) + (0 * \sigma_{SP}) + (-1 * \sigma_L)$

$= \sigma_R - \sigma_P + \sigma_{SC} - (1 - (\sigma_R + \sigma_P + \sigma_{SC} + \sigma_{SP}))$

$= \sigma_R - \sigma_P + \sigma_{SC} - 1 + \sigma_R + \sigma_P + \sigma_{SC} + \sigma_{SP}$

$= 2 \sigma_R + 2 \sigma_{SC} + \sigma_{SP} - 1$

$E_L = (-1 * \sigma_R) + (-1 * \sigma_P) + (1 * \sigma_{SC}) + (1 * \sigma_{SP}) + (0 * \sigma_L)$

$= - \sigma_R - \sigma_P + \sigma_{SC} - \sigma_{SP}$

$E_R = E_P = E_{SC} = E_{SP} = E_L$

Using these equations, we will eventually reach that the Nash Equilibrium for the game Rock, Paper, Scissors, Spock and Lizard is:

For player 1, $\sigma_R = \frac{1}{5}$, $\sigma_P = \frac{1}{5}$, $\sigma_{SC} = \frac{1}{5}$, $\sigma_{SP} = \frac{1}{5}$, *and* $\sigma_L = \frac{1}{5}$
and similarly
For player 2, $\sigma_R = \frac{1}{5}$, $\sigma_P = \frac{1}{5}$, $\sigma_{SC} = \frac{1}{5}$, $\sigma_{SP} = \frac{1}{5}$, *and* $\sigma_L = \frac{1}{5}$