Summary Notes for Week 2: Mixed-Strategy Nash Equilibrium

Mixed Strategy Nash Equilibrium

pure strategy: only one action is played with positive probability

mixed strategy: more than one action is played with positive probability (this addresses the uncertainty of player 1 about player 2's actions and vice versa)

Column

Row

	Heads	Tails	
Heads	(1, –1)	(–1, 1)	$1p + -1(1 - p) = 2p - 1$
Tails	(–1, 1)	(1, –1)	$-1p + 1(1 - p) = 1 - 2p$

Image taken from: https://saylordotorg.github.io/text_introduction-to-economic-analysis/s17-03-mixed-strategies.html

In order for there to be a mixed strategy Nash equilibrium, when player 1 responds with a mixed strategy, player 2 must respond in such a way that he is indifferent to either option. This is because if $2p – 1 > 1 – 2p$, then Row is better off, on average, playing Heads than Tails. Similarly, if $2p – 1 < 1 – 2p$, then Row is better off playing Tails than Heads. Thus, if Row is better of playing X than Y, then he will just keep playing X such that it is just a pure strategy and not a mixed strategy game.

If, on the other hand, $2p – 1 = 1 – 2p$, then Row gets the same payoff no matter what Row does. Therefore, a mixed strategy Nash equilibrium involves at least one player playing a randomized strategy and no player being able to increase his or her expected payoff by playing an alternate strategy.

Woman

Man

	Baseball (p)	Ballet ($1 - p$)	Man's E Payoff
Baseball (q)	(3, 2)	(1, 1)	$3p + 1(1 - p) = 1 + 2p$
Ballet ($1 - q$)	(0, 0)	(2, 3)	$0p + 2(1 - p) = 2 - 2p$
Woman's E Payoff	$2q + 0(1 - q) = 2q$	$1q + 3(1 - q) = 3 - 2q$	

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