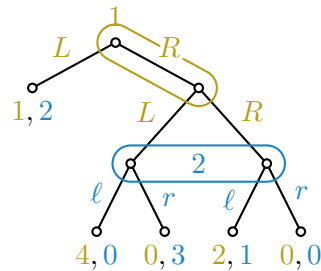# ECON 7011, Semester 110.1, Assignment 4

Please hand in your solutions via NTU Cool before 11:59pm on Tuesday, December 14

1. Consider the following extensive-form game:

   (a) Find all subgame-perfect equilibria in mixed strategies.

   (b) Find all subgame-perfect equilibria in behavior strategies.

   (c) For each SPE in mixed strategies, discuss whether there exist realization equivalent behavior strategy profiles and whether those are SPE as well. Explain.

   (d) Are the players indifferent among all pure strategies in the support of a subgame-perfect equilibrium in behavior strategies? Discuss and relate it to the indifference principle.

2. Consider the conflict between Management and its Workers. Management has to decide whether to (R)aise wages or keep wages (C)onstant during the next year and the Workers decide whether to keep (W)orking or go on (S)trike. Payoffs of the stage-game are as follows:

	W	S
R	6, 6	2, 7
C	7, 2	0, 0

   (a) Find all Nash equilibria of the stage game.

   (b) Find all SPE of the twice-repeated game with discounting that support play of (R, W) in the first period. For which values of δ does there exist such an SPE?

   (c) Find all SPE of the twice-repeated game with discounting that support play of (C, S) in the first period. For which values of δ does there exist such an SPE?

   (d) Interpret the equilibria found in (c). What conditions are necessary for the equilibria to arise? *Hint: argue in terms of players' expectation about continuation play.*

3. Shareholders hire a Manager to manage their company. The Manager chooses a level of effort $e \in [0, 1]$ at cost $c(e) = \frac{e^2}{2}$. The Shareholders offer him/her a wage $w(e) \geq 0$, contingent on the chosen effort e. Expected utilities are $u_1(w, e) = V(1 + ae) - w(e)$ and $u_2(w, e) = w(e) - c(e)$, where $V > 0$ is the value of the company and $a > 0$ measures the impact the of the managers effort on the value of the company.

   (a) Suppose first that Manager chooses effort e, the Manager observe the chosen effort level, and choose a wage $w(e)$. Find all pure-strategy subgame-perfect equilibria of this game.

   (b) Suppose now that Shareholders offers a wage contract $w(e)$ first, observed by the Manager, and then the Manager chooses effort e.

      i. Show that the Shareholders can incentivize the Manager to choose any effort level e_* by appropriately rewarding e_* and punishing any $e \neq e_*$.

      ii. Find all pure-strategy subgame-perfect equilibrium outcomes of this game.

      Hint: the contracts in (a) essentially allow the Manager to choose the effort level.