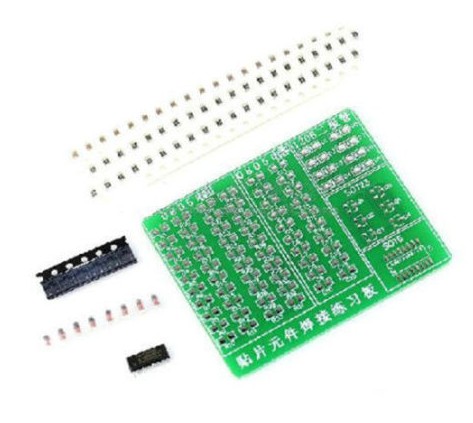
# *Applied Mathematics*

# *Seminar 11*

**Game Theory, Nash equilibrium**

**1 – Competitive game**

The company engaged in the production of teaching sets for high schools and universities in electrical fields and fields focused on industrial automation produces educational sets of electronic components, which also includes a set for mastering basic operations with SMD components. The company can produce three variants (A, B, C) of sets for mounting SMD components (see assignment of past exercises).

However, there is another competing company operating on the market producing similar sets, differing in the thickness of the copper foil on the laminate printed circuit board. Schools use teaching sets from both companies, while teaching sets from individual companies are completely interchangeable for teaching needs. The purchase of teaching sets is then limited by the budgetary resources of individual schools, together they are willing to spend 1 million CZK for each type of teaching set.

Schools prefer different types of learning kits for their teaching, so the company decides which kits to produce and offer to schools in order to get the highest sales, but it has to take into account its competitive rival.

If the company offers the specific type of teaching set as the only competitor on the market, it will be the only one to receive the entire budgetary funds of the schools, but if both companies offer the given set, they will divide the CZK 1 million in half.

The production costs to cover the demand of any set amount to 0.1 million CZK. If a company (or companies) wants to produce two sets at the same time, it must expand the production line, and therefore the average production cost to cover the demand for two sets is 0.4 million CZK. If the company decides to produce all sets at the same time, it must build a new production space, and therefore, after accounting for additional costs, the average production costs for the production of all three sets are CZK 1 million.

**Questions:**

1) Define the set of players.

2) Determine the strategy options of all players.

3) Build a payoff matrix for each player; the payoff is profit.

4) Construct a payoff matrix for first player; the payoff is by how much more payoff he makes

5) What type of game is it?

6) Find and interpret the optimal solution.

Part B

The change in the situation consists in the fact that the second company does not have any available land for the expansion of production premises and therefore has to invest in new construction plots, and therefore the average production costs for the production of all three types of sets at the same time amount to 1.5 million CZK.

**2 – Competition with a new set**

The company plans to offer its teaching sets A, B, C also on the foreign market in Slovakia, by producing and supplying either just one pair of sets, or all three types at the same time. Before deciding what types of kits to produce, the company has done market research and found one relevant competitor that is able to offer kits A, B, C, D and it will supply the market with kits of two types. Based on the market analysis, the company was able to compile the following pay matrix (this is profit):

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Strategies Player 2 | | **B1** | **B2** | **B3** | **B4** | **B5** | **B6** |
| Strategies Player 1 | | Sada A+B | Sada A+C | Sada A+D | Sada B+C | Sada B+D | Sada C+D |
| **A1** | Sada A+B | 0 | -0,1 | -0,3 | -0,1 | -0,3 | -0,1 |
| **A2** | Sada B+C | 0,2 | 0 | -0,2 | -0,1 | -0,3 | -0,3 |
| **A3** | Sada A+C | 0,2 | -0,1 | -0,3 | 0 | -0,2 | -0,3 |
| **A4** | Sada A+B+C | 0,3 | 0,1 | -0,1 | 0,1 | -0,2 | -0,3 |

**Questions:**

1) Define the set of players.

2) Determine the strategy options of all players.

3) In what set of stragegies is this game solvable (pure or mixed)?

4) Construct transformed model for finding optimal solution