



Dynamic Super Modular Game Theory Overview



What Is Dynamic Super Modular Game Theory?

- Using the non-cooperative game theory, competition in the pharmaceutical market can be analyzed
- Each company makes strategic decisions in response to actions and decisions made by the competition
- There are three types of strategies: Pure, Mixed, and Dominant



Pure, Mixed, & Dominant Strategies

- Pure strategies are implemented when a company tries to optimize its utility function through changes in select variables
- Dominant equilibrium for a company is the decision that reflects the best action regardless of any actions made by the competition. Most games in this market do not have stable dominant equilibrium
- Mixed strategies employ a combination of both pure and dominant strategies



Nash Equilibrium

- The interaction of all companies strategies results in equilibrium
- Each company does the best it can given the competition's best actions
- Nash equilibrium can be obtained by solving n simultaneous equations



Outcomes of Dynamic Game Theory

- Every decision support formula should answer the question:
 - “How can a company maximize its profits within market constraints?”
- From these tools, Nash equilibrium, quantities, and other variables can be determined



Outcomes of Dynamic Game Theory (Con't)

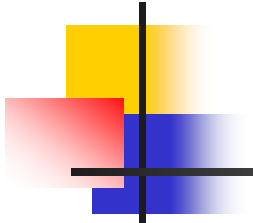
- The Net Present Value (NPV) can then be derived from the equilibrium data
- Final outcome is a comparison between NPV's of future cash flows
 - The final decision is the optimal option
 - The optimal option is the one that creates the highest NPV



Utilizing The Dynamic Game Theory Creates Winners

- The market is far more complex than simply being deterministic
 - The market is about probabilities
 - It is also about dynamic theory specifications
- The winners have the right tools
 - Respond quickly and make the right decisions based upon available data
 - Respond to imminent changes

Application of Dynamic Game Theory



| Drug | Manufacturer | Notes |
|-------------|------------------------|---|
| CX516 | Cortex Pharmaceutical | Designed for people with short term memory loss for mild cognitive impairment. Ampakines amplify neurotransmitters which stimulate the production of more synapses |
| Memantine | Merz/Forest Labs | Designed for people with Alzheimers. Targets the cell receptor that controls the intake of glutamate. When used, patients were able to remain living independently for 6 months to 1 year longer than those in the placebo group |
| SGS742 | Saegis Pharmaceuticals | Blocks gaba which inhibits memory consolidation |
| MEM1414 | Memory Pharmaceuticals | Inhibits an enzyme which breaks down cyclic-AMP. C-AMP plays a role in strengthening synapses. C-AMP activates the protein CREB which switches on genes that control the release of neurotransmitters essential to long term memory |

Application of Dynamic Game Theory (2)

| Drug | Manufacturer | Notes |
|------------------------------|---|--|
| Reminyl Exelon Aricept | Johnson & Johnson Novartis Pfizer | Designed for Alheimers. Inhibits an enzyme that breaks down acetylcholine, a chemical linked to memory. Can delay the downward trajectory in the early stages of mild cognitive impairment. Can cause nausea and loss of appetite. All three drugs are currently on the market |
| Aspirin | | Being investigated for its anti-inflammatory effects relative to Alheimers |
| Statins | | Being investigated for their ability to decrease plaque buildup. It is hoped that statins will work in the brain to decrease the rock-hard plaque that destroys neurons and leads to Alheimers |



Application of Dynamic Game Theory (3)

- For every “game” there are state and strategic variables
- State variables
 - Competitor’s actions
 - Institution Regulations
 - Familiarity
- Strategic variables
 - Advertising
 - Price
 - Promotion
- By manipulating the strategic variables to best balance the actions taken by competitor’s, optimal profits can be achieved.

Application of Dynamic Game Theory (4)

- There is a potential \$2 billion market for Alzheimer prescription drugs.
- Each company (the players) competes against each other by taking strategic actions for the market
 - Example: Pfizer, Novartis, and Johnson & Johnson all market Alzheimer drugs that boosts acetylcholine levels in the brain
 - Pfizer is selling Aricept for \$54.95 and is the product most people are familiar with
 - Johnson & Johnson is selling Reminyl for \$52.00 but is not as well known as Aricept
 - Novartis is marketing Exelon for \$50.00 but is not as well known as the other products
 - Potential Games for each company
 - Novartis could increase advertising to make the public more familiar with their product
 - Johnson & Johnson could offer a promotion to give their product a higher circulation, and thus increase familiarity
 - Pfizer could lower their price to \$51.95 to give them a competitive advantage of being cheaper and more familiar than Reminyl.
 - In response to each of the players games, each company would then take another action by manipulating their strategic variables