Interventions Tests Summary

To test the nature of interventions as implemented in our project, we wanted to analyze the impact interventions have on the evolution of the game. We developed a testing strategy to test the impact of interventions on the game (compared to no interventions), the variance introduced by interventions, and finally, the different impacts when altering the intervention settings. This strategy fixes the resource file and country file and varies the interventions file. The “MLD 0.5 ARQ 2” input case from part was chosen as the country file due to the variance in resource distributions used for that test case. The “Resources” input case, a file defined specifically for part 2, was chosen to represent the resources. Finally, we used 5 different files to represent different input scenarios. These are summarized in the table below.

|  |  |
| --- | --- |
| Name of Case/File | Notes |
| Interventions Off – No File | “Base Case” for comparison |
| Case 0 | Case 0 of Interventions |
| Case 1 | Case 0 + Added new intervention w/ fixed prob |
| Case 2 | Case 0 + Increased prob. chances |
| Case 3 | Case 2 + Increased Impacts |

The experiment involved analyzing each case of the intervention inputs to determine a mean impact of interventions relative to the base case. The findings are included below.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Case | Δ Quality - Atlantis | Δ Quality - Brobdingnag | Δ Quality - Carpania | Δ Quality - Dinotopia | Δ Quality - Erewhon | Δ Quality - MyCountry |
| no | (942,577) | 3,156,836 | 412,382 | (20,262,319) | (495,939) | 6,170,944 |
| c0 | (1,040,330) | 2,178,906 | (690,763) | (20,155,090) | (493,790) | 6,196,134 |
| c1 | (864,317) | 2,391,948 | 275,666 | (20,177,768) | (8,200,093) | 6,265,465 |
| c2 | (239,022) | 1,227,718 | (660,634) | (20,808,850) | (3,177,970) | 6,358,863 |
| c3 | 284,037 | 1,639,278 | (2,456,399) | (22,166,410) | (9,916,193) | 3,873,433 |
| Mean Interventions | (464,908) | 1,859,463 | (883,033) | (20,827,030) | (5,447,012) | 5,673,474 |
| Std Dev Interventions | 606,240 | 526,994 | 1,140,832 | 942,924 | 4,367,913 | 1,201,878 |
| CI Lower | (1,394,399) | 1,051,473 | (2,632,164) | (22,272,726) | (12,143,924) | 3,830,747 |
| CI Higher | 464,583 | 2,667,453 | 866,099 | (19,381,333) | 1,249,901 | 7,516,200 |

The findings show that the interventions generally impact the game evolution by lowering the change in state quality change after 7 rounds and introducing variance. This is in-line with our original goal for adding interventions. Only in Case 3, which involved numerous high-probability, high-impact events did we notice a substantial drop in quality from beginning to end of game for most of the countries. This confirms that our implementation is flexible enough to alter the game either gently or substantially depending on the input parameters for interventions.

The second part of the experiment involves generating confidence intervals from the data used in experiment 1. Using a t-distribution and alpha of 0.1 (two-tailed), we determined the 80% confidence interval for the intervention impact for each country. Country B was the only country to show a statistically significant reduction in game outcome because of interventions. However, using our domain knowledge and the fact Case 3 had a substantially higher impact than the other cases, we believe our interventions implementation is producing meaningful results in the intended manner (reducing quality only slightly while increasing variance).

A summary of the test cases that were run for interventions is included below.

No Interventions Case:

Parameters:

* # Global Parameters
* num\_rounds = 7
* frontier\_size = 100
* # Calculate solution\_limit and depth limit dynamically based on country properties ?
* use\_dynamic\_solution\_limit = True
* use\_dynamic\_depth\_limit = True
* solution\_limit = 1000
* depth = 3
* interventions\_on = False # Do we want interventions ?
* log\_inequality = False # Track inequality in the world
* seed = 123456654321
* # Parameters for trade selectivity, index 0 and 1 are k and x\_0 for not selective countries,
* # index 2 and 3 are are k and x\_0 for selective countries
* trade\_selectivity\_parameters = [1, 100, 2, 200]
* # Game Input Files
* initial\_state\_filename = "./input\_files/MLD0.5\_ARQ2.xlsx"
* initial\_resource\_filename = "./input\_files/Resources.xlsx"
* initial\_interventions\_filename = "./input\_files/Interventions\_case0.xlsx"
* # Game Output Files
* output\_schedule\_filename = "./output\_files/interventions\_no.txt" # Output - Print for each search best EU and path.
* game\_state\_print = True # Print game state ?
* game\_state\_filename = "./game\_output\_files/interventions\_no.csv" # Game State Delta State Quality outputs

End State:



Case 0:

Parameters:

* # Global Parameters
* num\_rounds = 7
* frontier\_size = 100
* # Calculate solution\_limit and depth limit dynamically based on country properties ?
* use\_dynamic\_solution\_limit = True
* use\_dynamic\_depth\_limit = True
* solution\_limit = 1000
* depth = 3
* interventions\_on = True # Do we want interventions ?
* log\_inequality = False # Track inequality in the world
* seed = 123456654321
* # Parameters for trade selectivity, index 0 and 1 are k and x\_0 for not selective countries,
* # index 2 and 3 are are k and x\_0 for selective countries
* trade\_selectivity\_parameters = [1, 100, 2, 200]
* # Game Input Files
* initial\_state\_filename = "./input\_files/MLD0.5\_ARQ2.xlsx"
* initial\_resource\_filename = "./input\_files/Resources.xlsx"
* initial\_interventions\_filename = "./input\_files/Interventions\_case0.xlsx"
* # Game Output Files
* output\_schedule\_filename = "./output\_files/interventions\_c0.txt" # Output - Print for each search best EU and path.
* game\_state\_print = True # Print game state ?
* game\_state\_filename = "./game\_output\_files/interventions\_c0.csv" # Game State Delta State Quality outputs

End State:



Case 1:

Parameters:

* # Global Parameters
* num\_rounds = 7
* frontier\_size = 100
* # Calculate solution\_limit and depth limit dynamically based on country properties ?
* use\_dynamic\_solution\_limit = True
* use\_dynamic\_depth\_limit = True
* solution\_limit = 1000
* depth = 3
* interventions\_on = True # Do we want interventions ?
* log\_inequality = False # Track inequality in the world
* seed = 123456654321
* # Parameters for trade selectivity, index 0 and 1 are k and x\_0 for not selective countries,
* # index 2 and 3 are are k and x\_0 for selective countries
* trade\_selectivity\_parameters = [1, 100, 2, 200]
* # Game Input Files
* initial\_state\_filename = "./input\_files/MLD0.5\_ARQ2.xlsx"
* initial\_resource\_filename = "./input\_files/Resources.xlsx"
* initial\_interventions\_filename = "./input\_files/Interventions\_case1.xlsx"
* # Game Output Files
* output\_schedule\_filename = "./output\_files/interventions\_c1.txt" # Output - Print for each search best EU and path.
* game\_state\_print = True # Print game state ?
* game\_state\_filename = "./game\_output\_files/interventions\_c1.csv" # Game State Delta State Quality outputs

End State:



Case 2:

Parameters:

* # Global Parameters
* num\_rounds = 7
* frontier\_size = 100
* # Calculate solution\_limit and depth limit dynamically based on country properties ?
* use\_dynamic\_solution\_limit = True
* use\_dynamic\_depth\_limit = True
* solution\_limit = 1000
* depth = 3
* interventions\_on = True # Do we want interventions ?
* log\_inequality = False # Track inequality in the world
* seed = 123456654321
* # Parameters for trade selectivity, index 0 and 1 are k and x\_0 for not selective countries,
* # index 2 and 3 are are k and x\_0 for selective countries
* trade\_selectivity\_parameters = [1, 100, 2, 200]
* # Game Input Files
* initial\_state\_filename = "./input\_files/MLD0.5\_ARQ2.xlsx"
* initial\_resource\_filename = "./input\_files/Resources.xlsx"
* initial\_interventions\_filename = "./input\_files/Interventions\_case2.xlsx"
* # Game Output Files
* output\_schedule\_filename = "./output\_files/interventions\_c2.txt" # Output - Print for each search best EU and path.
* game\_state\_print = True # Print game state ?
* game\_state\_filename = "./game\_output\_files/interventions\_c2.csv" # Game State Delta State Quality outputs

End State:



Case 3:

Parameters:

* # Global Parameters
* num\_rounds = 7
* frontier\_size = 100
* # Calculate solution\_limit and depth limit dynamically based on country properties ?
* use\_dynamic\_solution\_limit = True
* use\_dynamic\_depth\_limit = True
* solution\_limit = 1000
* depth = 3
* interventions\_on = True # Do we want interventions ?
* log\_inequality = False # Track inequality in the world
* seed = 123456654321
* # Parameters for trade selectivity, index 0 and 1 are k and x\_0 for not selective countries,
* # index 2 and 3 are are k and x\_0 for selective countries
* trade\_selectivity\_parameters = [1, 100, 2, 200]
* # Game Input Files
* initial\_state\_filename = "./input\_files/MLD0.5\_ARQ2.xlsx"
* initial\_resource\_filename = "./input\_files/Resources.xlsx"
* initial\_interventions\_filename = "./input\_files/Interventions\_case3.xlsx"
* # Game Output Files
* output\_schedule\_filename = "./output\_files/interventions\_c3.txt" # Output - Print for each search best EU and path.
* game\_state\_print = True # Print game state ?
* game\_state\_filename = "./game\_output\_files/interventions\_c3.csv" # Game State Delta State Quality outputs

End State:

