Calculation of Nash-Harsanyi Solutions

Maanav Jhatakia
MSc. Engineering and Policy Analysis, Delft University of Technology
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The following is a PDF of the code used for the calculation of symmetric and asymmetric Nash-Harsanyi solutions.

In[1]:=
```
(*The following characteristic value functions have each been
 divided by 1e9 for sake of Mathematica's algorithm convergence*)
ve = 5.125744170;
vs = 0.460925711;
vet = 0.463206226;
vgc = 6.681922000;
```

In[ ]:=
```
Maximize[{(x - ve) * (y - vs) * (z - vet), x + y + z == vgc,
  x ≥ ve, y ≥ vs, z ≥ vet, x > 0, y > 0, z > 0}, {x, y, z}]
```

In[5]:=
```
{0.00935151719593653`,
 {x → 5.336426131786796`, y → 0.6716076786380306`, z → 0.6738881895751727`}}
```

Out[5]=
```
{0.00935152, {x → 5.33643, y → 0.671608, z → 0.673888}}
```

In[6]:=
```
Maximize[{(x - ve) + (y - vs) + (z - vet), x + y + z == vgc,
  x ≥ ve, y ≥ vs, z ≥ vet, x > 0, y > 0, z > 0}, {x, y, z}]
```

Out[6]=
```
{0.632046, {x → 5.12574, y → 0.460926, z → 1.09525}}
```

In[7]:=
```
alpha1 = 0.75;
alpha2 = 0.15;
alpha3 = 0.10;
```

In[ ]:=
```
Maximize[{((x - ve) ^ (alpha1)) * ((y - vs) ^ (alpha2)) * ((z - vet) ^ (alpha3)),
  x + y + z == vgc, x ≥ ve, y ≥ vs, z ≥ vet}, {x, y, z}]
```

Out[ ]=
```
{0.30441, {x → 5.59978, y → 0.555733, z → 0.526411}}
```

In this, we first assume the dominant player to be Egypt (alpha1).

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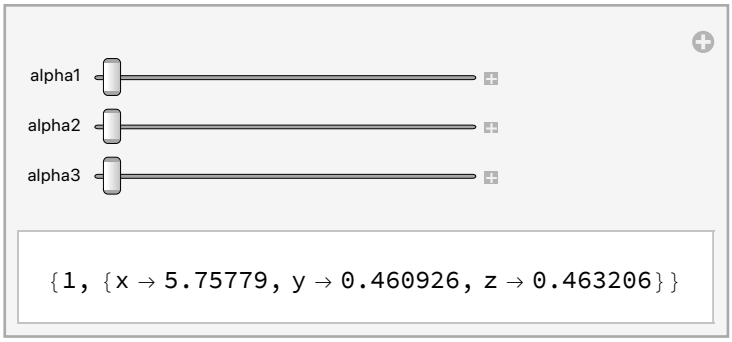
In[10]:=
```
Manipulate[Maximize[{(*Objective function*)
   ((x - ve) ^ (alpha1)) * ((y - vs) ^ (alpha2)) * ((z - vet) ^ (alpha3)),
   (*Constraints*)x + y + z == vgc, x ≥ ve, y ≥ vs, z ≥ vet}, {x, y, z}],
 {alpha1, 0, 1, 0.05}, {alpha2, 0, 1 - alpha1 - alpha3, 0.05},
 {alpha3, 0, 1 - alpha1 - alpha2, 0.05},
 DynamicWrapper["", Export["test.csv", {alpha1, alpha2, alpha3, x, y, z}, "CSV"]]]
```

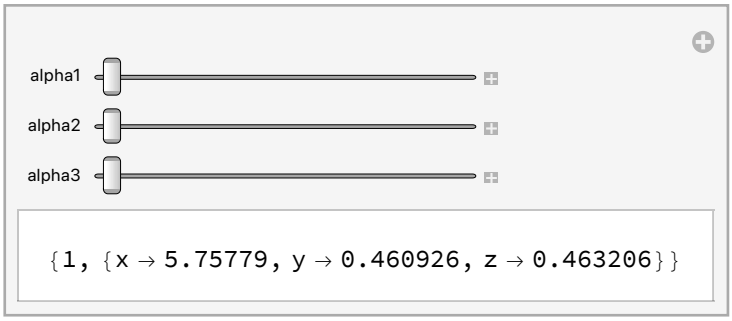
Out[10]=



Now, we assume Sudan to be the dominant player (alpha2).

In[11]:=
```
Manipulate[Maximize[{(*Objective function*)
   ((x - ve) ^ (alpha1)) * ((y - vs) ^ (alpha2)) * ((z - vet) ^ (alpha3)),
   (*Constraints*)x + y + z == vgc, x ≥ ve, y ≥ vs, z ≥ vet}, {x, y, z}],
 {alpha1, 0, 1 - alpha2 - alpha3, 0.05}, {alpha2, 0, 1, 0.05},
 {alpha3, 0, 1 - alpha2 - alpha1, 0.05}]
```

Out[11]=



Now, we assume Ethiopia to be the dominant player (alpha3).

In[12]:=
```
Manipulate[Maximize[{(*Objective function*)
    ((x - ve) ^ (alpha1)) * ((y - vs) ^ (alpha2)) * ((z - vet) ^ (alpha3)),
    (*Constraints*)x + y + z == vgc, x ≥ ve, y ≥ vs, z ≥ vet}, {x, y, z}],
 {alpha1, 0, 1 - alpha3 - alpha2, 0.05}, {alpha2, 0, 1 - alpha3 - alpha1, 0.05},
 {alpha3, 0, 1, 0.05}]
```

Out[12]=