**Experiment No. 4** **June 12, 2013, 12:49 pm**

# Doubly Constrained Gravity Model

Input Values :

| Base Year Origin-Destination Cost Matrix | | | |
|---|---|---|---|
| Zone | 1 | 2 | 3 |
| 1 | 3 | 10 | 15 |
| 2 | 10 | 5 | 10 |
| 3 | 15 | 10 | 5 |

| Future Year Origins Total | | | |
|---|---|---|---|
| Zone | 1 | 2 | 3 |
| | 10 | 15 | 8 |

| Future Year Destinations Total |
|---|

| Zone | 1 | 2 | 3 |
|---|---|---|---|
| | 7 | 16 | 10 |

**Impedance Function used : Power function**

$[F_{ij} = C_{ij}^{-2}]$

| Impedance Matrix Calculations (Fij) | | | |
|---|---|---|---|
| Zone | 1 | 2 | 3 |
| 1 | 0.1111 | 0.01 | 0.0044 |
| 2 | 0.01 | 0.04 | 0.01 |
| 3 | 0.0044 | 0.01 | 0.04 |

## Selected Accuracy : Individual Cell

## Entered Accuracy Level (i.e., percentage of error): 3 %

Iteration # 1

**Calculations**

| i | j | Bj | Dj | F(Cij) | BjDjF(Cij) | SumBjDjF(Cij) | Ai |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 7 | 0.1111 | 0.7778 | 0.9822 | 1.0181 |
| 1 | 2 | 1 | 16 | 0.01 | 0.16 | 0.9822 | 1.0181 |
| 1 | 3 | 1 | 10 | 0.0044 | 0.0444 | 0.9822 | 1.0181 |
| 2 | 1 | 1 | 7 | 0.01 | 0.07 | 0.81 | 1.2346 |
| 2 | 2 | 1 | 16 | 0.04 | 0.64 | 0.81 | 1.2346 |
| 2 | 3 | 1 | 10 | 0.01 | 0.1 | 0.81 | 1.2346 |
| 3 | 1 | 1 | 7 | 0.0044 | 0.0311 | 0.5911 | 1.6917 |
| 3 | 2 | 1 | 16 | 0.01 | 0.16 | 0.5911 | 1.6917 |
| 3 | 3 | 1 | 10 | 0.04 | 0.4 | 0.5911 | 1.6917 |

| i | j | Ai | Oi | F(Cij) | AiOiF(Cij) | SumAiOiF(Cij) | Bj |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 1.0181 | 10 | 0.1111 | 1.1312 | 1.3766 | 0.7264 |
| 1 | 2 | 1.0181 | 15 | 0.01 | 0.1852 | 1.3766 | 1.0226 |
| 1 | 3 | 1.0181 | 8 | 0.0044 | 0.0602 | 1.3766 | 1.2957 |
| 2 | 1 | 1.2346 | 10 | 0.01 | 0.1018 | 0.9779 | 0.7264 |
| 2 | 2 | 1.2346 | 15 | 0.04 | 0.7407 | 0.9779 | 1.0226 |
| 2 | 3 | 1.2346 | 8 | 0.01 | 0.1353 | 0.9779 | 1.2957 |
| 3 | 1 | 1.6917 | 10 | 0.0044 | 0.0452 | 0.7718 | 0.7264 |
| 3 | 2 | 1.6917 | 15 | 0.01 | 0.1852 | 0.7718 | 1.0226 |
| 3 | 3 | 1.6917 | 8 | 0.04 | 0.5414 | 0.7718 | 1.2957 |

**Origin-Destination Matrix [$T_{ij}$]**

| Zone | 1 | 2 | 3 | Oi | Oi' |
|---|---|---|---|---|---|
| 1 | 5.7524 | 1.6658 | 0.5863 | 10 | 8.0045 |

| | | | | | |
|---|---|---|---|---|---|
| 2 | 0.9417 | 12.1198 | 2.3994 | 15 | 15.461 |
| 3 | 0.3059 | 2.2144 | 7.0143 | 8 | 9.5345 |
| Dj | 7 | 16 | 10 | | |
| Dj' | 7 | 16 | 10 | | |

Iteration # 2

**Calculations**

| i | j | Bj | Dj | F(Cij) | BjDjF(Cij) | SumBjDjF(Cij) | Ai |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 0.7264 | 7 | 0.1111 | 0.565 | 0.7862 | 1.2719 |
| 1 | 2 | 1.0226 | 16 | 0.01 | 0.1636 | 0.7862 | 1.2719 |
| 1 | 3 | 1.2957 | 10 | 0.0044 | 0.0576 | 0.7862 | 1.2719 |
| 2 | 1 | 0.7264 | 7 | 0.01 | 0.0509 | 0.8349 | 1.1978 |
| 2 | 2 | 1.0226 | 16 | 0.04 | 0.6545 | 0.8349 | 1.1978 |
| 2 | 3 | 1.2957 | 10 | 0.01 | 0.1296 | 0.8349 | 1.1978 |
| 3 | 1 | 0.7264 | 7 | 0.0044 | 0.0226 | 0.7045 | 1.4195 |
| 3 | 2 | 1.0226 | 16 | 0.01 | 0.1636 | 0.7045 | 1.4195 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 | 3 | 1.2957 | 10 | 0.04 | 0.5183 | 0.7045 | 1.4195 |

| i | j | Ai | Oi | F(Cij) | AiOiF(Cij) | SumAiOiF(Cij) | Bj |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 1.2719 | 10 | 0.1111 | 1.4132 | 1.6434 | 0.6085 |
| 1 | 2 | 1.2719 | 15 | 0.01 | 0.1797 | 1.6434 | 1.0423 |
| 1 | 3 | 1.2719 | 8 | 0.0044 | 0.0505 | 1.6434 | 1.4484 |
| 2 | 1 | 1.1978 | 10 | 0.01 | 0.1272 | 0.9594 | 0.6085 |
| 2 | 2 | 1.1978 | 15 | 0.04 | 0.7187 | 0.9594 | 1.0423 |
| 2 | 3 | 1.1978 | 8 | 0.01 | 0.1136 | 0.9594 | 1.4484 |
| 3 | 1 | 1.4195 | 10 | 0.0044 | 0.0565 | 0.6904 | 0.6085 |
| 3 | 2 | 1.4195 | 15 | 0.01 | 0.1797 | 0.6904 | 1.0423 |
| 3 | 3 | 1.4195 | 8 | 0.04 | 0.4542 | 0.6904 | 1.4484 |

**Origin-Destination Matrix [$T_{ij}$]**

| Zone | 1 | 2 | 3 | Oi | Oi' |
|---|---|---|---|---|---|
| 1 | 6.0197 | 2.1212 | 0.8188 | 10 | 8.9597 |
| 2 | 0.7653 | 11.9851 | 2.6022 | 15 | 15.3526 |
| 3 | 0.215 | 1.8938 | 6.579 | 8 | 8.6877 |
| Dj | 7 | 16 | 10 | | |
| Dj' | 7 | 16 | 10 | | |

Iteration # 1000

**$[D_j][F_{ij}]$**

| i | j | Bj | Dj | F(Cij) | BjDjF(Cij) | SumBjDjF(Cij) | Ai |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 0.5122 | 7 | 0.1111 | 0.3984 | 0.6394 | 1.564 |
| 1 | 2 | 1.0656 | 16 | 0.01 | 0.1705 | 0.6394 | 1.564 |
| 1 | 3 | 1.586 | 10 | 0.0044 | 0.0705 | 0.6394 | 1.564 |
| 2 | 1 | 0.5122 | 7 | 0.01 | 0.0359 | 0.8764 | 1.141 |
| 2 | 2 | 1.0656 | 16 | 0.04 | 0.682 | 0.8764 | 1.141 |
| 2 | 3 | 1.586 | 10 | 0.01 | 0.1586 | 0.8764 | 1.141 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 | 1 | 0.5122 | 7 | 0.0044 | 0.0159 | 0.8208 | 1.2183 |
| 3 | 2 | 1.0656 | 16 | 0.01 | 0.1705 | 0.8208 | 1.2183 |
| 3 | 3 | 1.586 | 10 | 0.04 | 0.6344 | 0.8208 | 1.2183 |

| i | j | Ai | Oi | F(Cij) | AiOiF(Cij) | SumAiOiF(Cij) | Bj |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 1.564 | 10 | 0.1111 | 1.7378 | 1.9523 | 0.5122 |
| 1 | 2 | 1.564 | 15 | 0.01 | 0.1712 | 1.9523 | 1.0656 |
| 1 | 3 | 1.564 | 8 | 0.0044 | 0.0433 | 1.9523 | 1.586 |
| 2 | 1 | 1.141 | 10 | 0.01 | 0.1564 | 0.9385 | 0.5122 |
| 2 | 2 | 1.141 | 15 | 0.04 | 0.6846 | 0.9385 | 1.0656 |
| 2 | 3 | 1.141 | 8 | 0.01 | 0.0975 | 0.9385 | 1.586 |
| 3 | 1 | 1.2183 | 10 | 0.0044 | 0.0695 | 0.6305 | 0.5122 |
| 3 | 2 | 1.2183 | 15 | 0.01 | 0.1712 | 0.6305 | 1.0656 |
| 3 | 3 | 1.2183 | 8 | 0.04 | 0.3898 | 0.6305 | 1.586 |

**Origin-Destination Matrix [$T_{ij}$]**

| Zone | 1 | 2 | 3 | Oi | Oi' | | |
|---|---|---|---|---|---|---|---|
| 1 | 6.231 | 2.6665 | 1.1025 | 10 | 10 | | |
| 2 | 0.6137 | 11.6718 | 2.7145 | 15 | 15 | | |
| 3 | 0.1553 | 1.6616 | 6.183 | 8 | 8 | | |
| Dj | 7 | 16 | 10 | Dj' | 7 | 16 | 10 |

## Current Iteration # 1000