BEAM Mode Choice Algorithms

Algorithm 1 Algorithm for Determining Mode Choice Alternatives in BEAM

```
Require:
$i : origin$
$j : destination$
$n : agent$
$N : population$
$t : trip$
$P : plan$
$\vec{R}(i,j) : Router\ alternatives$
$\vec{RH}(i,j) : Ridehail\ alternatives$
$\vec{H}(i,j) : HOV\ alternatives$
$\vec{M}(i,j) : Final\ modal\ alternatives$
$C : Current\ Mode$
$I : Trip\ Index$

$\vec{R} \equiv \vec{R}(i,j)$
$\vec{RH} \equiv \vec{RH}(i,j)$
$\vec{H} \equiv \vec{H}(i,j)$
$\vec{M} \equiv \vec{M}(i,j)$
for $n \in N$ do
    for $t \in P$ do
        procedure DetermineHOVAlternatives($\vec{R}$, $C$)
            if $C = None$ then
                if $\vec{R} \ni CAR$ then
                    $\vec{H} \leftarrow (HOV2, HOV3)$
                else if $\vec{R} \ni HOV2$ then
                    $\vec{H} \leftarrow (HOV3)$
                else if $\vec{R} \ni HOV3$ then
                    $\vec{H} \leftarrow (HOV2)$
                else if $\vec{R} \ni WALK$ then
                    $\vec{H} \leftarrow (HOV2\_TELEPORT, HOV3\_TELEPORT)$
                end if
            else
                $\vec{H} \leftarrow None$
            end if
        end procedure
```

Algorithm 1 continued

```
        **procedure** DetermineFinalModalAlternatives($\vec{R}$, $\vec{RH}$, $\vec{H}$, $C$, $I$)
            **if** $C = DRIVE\_TRANSIT \lor BIKE\_TRANSIT$ **then**
                **if** $I = 0$ **then**
                    **if** $C = DRIVE\_TRANSIT$ **then**
                        $\vec{M} \leftarrow (DRIVE\_TRANSIT)$
                    **else**
                        $\vec{M} \leftarrow (BIKE\_TRANSIT)$
                    **end if**
                **else**
                    $\vec{M} \leftarrow (WALK\_TRANSIT, RIDEHAIL\_TRANSIT)$
                **end if**
            **else if** $C = WALK\_TRANSIT \lor RIDEHAIL\_TRANSIT$ **then**
                **if** $C = WALK\_TRANSIT$ **then**
                    $\vec{M} \leftarrow (WALK\_TRANSIT)$
                **else**
                    $\vec{M} \leftarrow (RIDEHAIL\_TRANSIT)$
                **end if**
            **else if** $C = HOV2\_TELEPORT \lor HOV3\_TELEPORT$ **then**
                **if** $C = HOV2\_TELEPORT$ **then**
                    $\vec{M} \leftarrow (HOV2\_TELEPORT)$
                **else**
                    $\vec{M} \leftarrow (HOV3\_TELEPORT)$
                **end if**
            **else if** $C = CAR$ **then**
                $\vec{M} \leftarrow (CAR)$
            **else**
                $\vec{M} \leftarrow \vec{R} + \vec{RH} + \vec{H}$
            **end if**
        **end procedure**
    **end for**
**end for**
```

Algorithm 2 Algorithm for Selecting Final Modal Alternative in BEAM

```
Require:
$i : origin$
$j : destination$
$n : agent$
$N : population$
$t : trip$
$P : plan$
$\vec{A} : attributes\,of\,agent$
$a : attribute\,value$
$\vec{M}(i,j) : Modal\,alternatives$
$m : alternative \in M(i,j)$
$\vec{U}(\vec{M}(i,j), \vec{A}) : Utilities\,for\,alternatives$
$u : utility \in \vec{U}(\vec{M}(i,j), \vec{A})$
$\vec{c} : attribute\,coefficients$
$\mathbb{P} : probability$
$Mode : chosen\,mode\,for\,agent\,(n)\,on\,trip\,(t)$
$f(\vec{X})$ : This function takes a vector of modes and their probabilities of being chosen. With those probabilities it builds them into a cumulative distribution function, generates a random number and then drops the mode with the closest probability. This process continues until only one mode is left.

$\vec{M} \equiv \vec{M}(i,j)$
$\vec{U} \equiv \vec{U}(\vec{M}, \vec{A})$
for $n \in N$ do
    for $t \in P$ do
        procedure DetermineFinalModalAlternative($\vec{M}$, $\vec{A}$, $\vec{c}$)
            for $m \in \vec{M}$ do
                $u \leftarrow \sum_{a \in \vec{A}} a \times c_a$
                $\vec{U} + = [m, u]$
            end for
            $S \leftarrow \sum_{u \in \vec{U}} e^u$
            for $u \in \vec{U}$ do
                $\mathbb{P}(u) \leftarrow e^u / S$
                $\vec{B} + = [m, \mathbb{P}(u)]$
            end for
            $Mode \leftarrow f(\vec{B})$
        end procedure
    end for
end for
```