t								
$Y_{10} = v_1$	2,79097E-06	4,61284E-08	7,44634E-08	$\alpha_{10}(i)$	1,00000	1,00000	1,00000	$\beta_{10}(i)$
$Y_9 = v_3$	2,40343E-06	0,00000	4,51873E-06	$\alpha_9(i)$	4,25017E-01	3,10388E-01	4,18274E-01	$\beta_9(i)$
$Y_8 = v_2$	1,16064E-05	2,54283E-05	0,00000	$\alpha_8(i)$	1,35055E-01	5,28569E-02	1,46093E-01	$\beta_8(i)$
$Y_7 = v_1$	1,37170E-04	2,66283E-06	3,30297E-06	$\alpha_7(i)$	2,00996E-02	3,45288E-02	1,89425E-02	$\beta_7(i)$
$Y_6 = v_1$	3,20008E-04	1,60364E-05	5,13797E-06	$\alpha_6(i)$	8,63441E-03	6,54014E-03	8,48657E-03	$\beta_6(i)$
$Y_5 = v_2$	3,29921E-04	6,47449E-04	0,00000	$\alpha_5(i)$	3,65329E-03	2,63537E-03	3,59649 E-03	$\beta_5(i)$
$Y_4 = v_3$	9,76003E-04	0,00000	3,12326E-03	$\alpha_4(i)$	7,50867E-04	1,54509E-03	6,97578E-04	$\beta_4(i)$
$Y_3 = v_3$	4,24880E-03	0,00000	7,85375E-03	$\alpha_3(i)$	2,28668E-04	9,05609E-05	2,47016E-04	$\beta_3(i)$
$Y_2 = v_2$	1,95769E-02	4,62922E-02	0,00000	$\alpha_2(i)$	7,79366E-05	2,99360E-05	8,44869E-05	$\beta_2(i)$
$Y_1 = v_1$	2,16428E-01	1,36400E-02	1,42400E-02	$\alpha_1(i)$	1,15016E-05	2,99360E-05	1,08442E-05	$\beta_1(i)$
	ω_1	ω_2	ω_3		ω_1	ω_2	ω_3	States

Table .x. Values of the Forward variables   Table .x. Values of the Backward variables

In this section the results obtained from simulation are the four best in minimum energy consumption

$\omega_1 = \text{Path } 1 = \{N_1, N_3, N_4, N_6, N_8, N_{10}\}$, with $(E_1^{min} = 3{,}25 \text{ KJ})$
$\omega_2 = \text{Path } 2 = \{N_1, N_3, N_4, N_6, N_8, N_9, N_{10}\}$, with $(E_1^{min} = 3{,}65 \text{ KJ})$
$\omega_3 = \text{Path } 3 = \{N_1, N_3, N_5, N_7, N_6, N_8, N_{10}\}$, with $(E_1^{min} = 3{,}81 \text{ KJ})$
$\omega_4 = \text{Path } 4 = \{N_1, N_3, N_5, N_7, N_6, N_8, N_9, N_{10}\}$, with $(E_1^{min} = 4{,}71 \text{ KJ})$

$v_1 = \text{cost } 1 = 5 \text{ hop counts of path } 1$
$v_2 = \text{cost } 2 = 6 \text{ hop counts of path } 2$
$v_3 = \text{cost } 3 = 6 \text{ hop counts of path } 3$
$v_4 = \text{cost } 4 = 7 \text{ hop counts of path } 4$

For next chose three best paths, then $\Omega = \{\omega_1, \omega_2, \omega_3\}$ And $V = \{v_1, v_2, v_3\}$ **[9]**

[7]Our simulation generated the computed hidden states, Y as shown below, for a random observational sequence steps for a total of time, T= 10 is **[7]**

- $Y = \{Y_1 = v_1, Y_2 = v_2, Y_3 = v_3, Y_4 = v_3, Y_5 = v_2, Y_6 = v_1, Y_7 = v_1, Y_8 = v_2, Y_9 = v_3, Y_{10} = v_1\}$

So $A = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} = \begin{bmatrix} 0{,}571 & 0{,}179 & 0{,}250 \\ 0{,}401 & 0{,}528 & 0{,}071 \\ 0{,}561 & 0{,}160 & 0{,}279 \end{bmatrix}$

$\Pi = \begin{bmatrix} \Pi_1 = [\mathbf{P}(X_1 = \omega_1)/\lambda] = 0{,}303 \\ \Pi_2 = [\mathbf{P}(X_1 = \omega_2)/\lambda] = 0{,}341 \\ \Pi_3 = [\mathbf{P}(X_1 = \omega_3)/\lambda] = 0{,}356 \end{bmatrix}$ and

$$B = \begin{bmatrix} b_{\omega_1}(v_1) & b_{\omega_1}(v_2) & b_{\omega_1}(v_3) \\ b_{\omega_2}(v_1) & b_{\omega_2}(v_2) & b_{\omega_2}(v_3) \\ b_{\omega_3}(v_1) & b_{\omega_3}(v_2) & b_{\omega_3}(v_3) \end{bmatrix} = \begin{bmatrix} 5/7 & 1/7 & 1/7 \\ 1/25 & 24/25 & 0 \\ 1/25 & 0 & 24/25 \end{bmatrix}$$

The Forward Algorithm $\alpha_{t+1}(j) = b_{\omega_j}(Y_{t+1}) \sum_{i=1}^{3} \alpha_t(i)\, a_{ij}$

Initialization

$$\alpha_1(i) = \mathbf{P}(X_1 = \omega_i/\, \lambda).\mathbf{P}(Y_1/X_1 = \omega_i, \lambda) = \Pi_{\omega_i}.b_{\omega_i}(Y_1)$$

$$\alpha_1(\omega_1) = \Pi_{\omega_1}.\mathrm{b}_{\omega_1}(Y_1 = v_1) - \ \alpha_1(\omega_1) = 0{,}303 \times \frac{5}{7} = 0.216$$
$$\alpha_1(\omega_2) = \Pi_{\omega_2}.\mathrm{b}_{\omega_2}(Y_1 = v_1) - \ \alpha_1(\omega_2) = 0{,}341 \times \frac{1}{25} = 0.01364$$
$$\alpha_1(\omega_3) = \Pi_{\omega_3}.\mathrm{b}_{\omega_3}(Y_1 = v_1) - \ \alpha_1(\omega_3) = 0.356 \times \frac{1}{25} = 0.01424$$

$$\alpha_2(\omega_1) = \mathrm{b}_{\omega_1}(v_2)[\alpha_1(\omega_1)a_{11} + \alpha_1(\omega_2)a_{21} + \alpha_1(\omega_3)a_{31}]$$
$$\alpha_2(\omega_2) = \mathrm{b}_{\omega_2}(v_2)[\alpha_1(\omega_1)a_{12} + \alpha_1(\omega_2)a_{22} + \alpha_1(\omega_3)a_{32}]$$
$$\alpha_2(\omega_3) = \mathrm{b}_{\omega_3}(v_2)[\alpha_1(\omega_1)a_{13} + \alpha_1(\omega_2)a_{23} + \alpha_1(\omega_3)a_{33}]$$

$$\alpha_2(\omega_1) = \frac{1}{7} \times [0.216 \times 0{,}571 + 0.01364 \times 0{,}401 + 0.01424 \times 0{,}561] = 0{,}0195$$
$$\alpha_2(\omega_2) = \frac{24}{25} \times [0.216 \times 0{,}179 + 0.01364 \times 0{,}528 + 0.01424 \times 0{,}160] = 0{,}0462$$
$$\alpha_2(\omega_3) = 0 \times [0.216 \times 0{,}250 + 0.01364 \times 0{,}071 + 0.01424 \times 0{,}271] = 0$$

$$\alpha_3(\omega_1) = \mathrm{b}_{\omega_1}(v_3)[\alpha_2(\omega_1)a_{11} + \alpha_2(\omega_2)a_{21} + \alpha_2(\omega_3)a_{31}]$$
$$\alpha_3(\omega_2) = \mathrm{b}_{\omega_2}(v_3)[\alpha_2(\omega_1)a_{12} + \alpha_2(\omega_2)a_{22} + \alpha_2(\omega_3)a_{32}]$$
$$\alpha_3(\omega_3) = \mathrm{b}_{\omega_3}(v_3)[\alpha_2(\omega_1)a_{13} + \alpha_2(\omega_2)a_{23} + \alpha_2(\omega_3)a_{33}]$$

$$\alpha_3(\omega_1) = \frac{1}{7}[0{,}0195 \times 0{,}571 + 0{,}0462 \times 0{,}401 + 0a_{31}] = 0{,}00424$$
$$\alpha_3(\omega_2) = 0 \times [0{,}0195 \times 0{,}179 + 0{,}0462 \times 0{,}528 + 0a_{32}] = 0$$
$$\alpha_3(\omega_3) = \frac{24}{25}[0{,}0195 \times 0{,}250 + 0{,}0462 \times 0{,}071 + 0a_{33}] = 0{,}00783$$

Initialization

$$\beta_{10}(\omega_1) = \beta_{10}(\omega_2) = \beta_{10}(\omega_3) = 1$$

Induction

$$\beta_t(i) = \sum_{j=1}^{3} a_{ij}\beta_{t+1}(j)\, \mathrm{b}_j(Y_{t+1})$$

$$\beta_9(\mathrm{i}) = \sum_{j=1}^{N} a_{ij}\beta_{(10-1+1)}(\mathrm{j})\ \mathrm{b_j}(\mathrm{Y}_{10-1+1})$$

$$\beta_9(\omega_i) = a_{i1}\beta_{(10)}(\omega_1)b_{\omega_1}(Y_{10}) + a_{i2}\beta_{(10)}(\omega_2)b_{\omega_2}(Y_{10}) + a_{i3}\beta_{(10)}(\omega_3)b_{\omega_3}(Y_{10})$$

$$\beta_9(\omega_1) = a_{11}\beta_{(10)}(\omega_1)b_{\omega_1}(v_1) + a_{12}\beta_{(10)}(\omega_2)b_{\omega_2}(v_1) + a_{13}\beta_{(10)}(\omega_3)b_{\omega_3}(v_1)$$
$$\beta_9(\omega_2) = a_{21}\beta_{(10)}(\omega_1)b_{\omega_1}(v_1) + a_{22}\beta_{(10)}(\omega_2)b_{\omega_2}(v_1) + a_{23}\beta_{(10)}(\omega_3)b_{\omega_3}(v_1)$$
$$\beta_9(\omega_3) = a_{31}\beta_{(10)}(\omega_1)b_{\omega_1}(v_1) + a_{32}\beta_{(10)}(\omega_2)b_{\omega_2}(v_1) + a_{33}\beta_{(10)}(\omega_3)b_{\omega_3}(v_1)$$

$$\beta_9(\omega_1) = 0{,}571 \times 1 \times \frac{5}{7} + 0{,}179 \times 1 \times \frac{1}{25} + 0{,}250 \times 1 \times \frac{1}{25} = 0{,}425$$
$$\beta_9(\omega_2) = 0{,}401 \times 1 \times \frac{5}{7} + 0{,}528 \times 1 \times \frac{1}{25} + 0{,}071 \times 1 \times \frac{1}{25} = 0{,}310$$
$$\beta_9(\omega_3) = 0{,}561 \times 1 \times \frac{5}{7} + 0{,}160 \times 1 \times \frac{1}{25} + 0{,}279 \times 1 \times \frac{1}{25} = 0{,}418$$

$$\beta_8(\omega_1) = a_{11}\beta_{(9)}(\omega_1)b_{\omega_1}(Y_9) + a_{12}\beta_{(9)}(\omega_2)b_{\omega_2}(Y_9) + a_{13}\beta_{(9)}(\omega_3)b_{\omega_3}(Y_9)$$
$$\beta_8(\omega_2) = a_{21}\beta_{(9)}(\omega_1)b_{\omega_1}(Y_9) + a_{22}\beta_{(9)}(\omega_2)b_{\omega_2}(Y_9) + a_{23}\beta_{(9)}(\omega_3)b_{\omega_3}(Y_9)$$
$$\beta_8(\omega_3) = a_{31}\beta_{(9)}(\omega_1)b_{\omega_1}(Y_9) + a_{32}\beta_{(9)}(\omega_2)b_{\omega_2}(Y_9) + a_{33}\beta_{(9)}(\omega_3)b_{\omega_3}(Y_9)$$

$$\beta_8(\omega_1) = 0{,}571 \times 0{,}425 \times \frac{1}{7} + 0{,}179 \times 0{,}310 \times 0 + 0{,}250 \times 0{,}418 \times \frac{24}{25} = 0{,}135$$
$$\beta_8(\omega_2) = 0{,}401 \times 0{,}425 \times \frac{1}{7} + 0{,}528 \times 0{,}310 \times 0 + 0{,}071 \times 0{,}418 \times \frac{24}{25} = 0{,}0528$$
$$\beta_8(\omega_3) = 0{,}561 \times 0{,}425 \times \frac{1}{7} + 0{,}160 \times 0{,}310 \times 0 + 0{,}279 \times 0{,}418 \times \frac{24}{25} = 0{,}146$$