● Aim : To determine Cost Effective Analysis while comparing any two treatment pathways.

Given the number of cycles, total states, number of patients, transition probability matrices of transition states, total cost of each states, and QALMs for them, we can compare average costs required and QALMs for NAT and SF.

1. Define Cost of each states and QALM:

state	payoff Cost	QALM
LWSPC	5000	2.0
UC	15000	2.5
ECC	15000	2.0
RFPC	5000	4.0
ESC	20000	5.0
LWUDAPQ	5000	6.0
Dead	0	0.0

For NAT

state	payoff Cost	QALM
LWSPC	5000	2
UC	15000	3
ECC	15000	4
RFPC	5000	5
ESC	20000	7
LWUDAPQ	5000	6
Dead	0	0

->>For SF way ->> For NAT way

2. Define Transition probability matrices of transition states for each pathway:

A) For SF

from \ to	LWSPC	UC	ECC	RFPC	ESC	LWUDAPQ	Dead
LWSPC	0.2	0.10	0.20	0.22	0.10	0.10	0.08
UC	0.0	0.22	0.12	0.15	0.23	0.16	0.12
ECC	0.0	0.00	0.23	0.15	0.26	0.13	0.23
RFPC	0.0	0.00	0.00	0.25	0.14	0.23	0.38
ESC	0.0	0.00	0.00	0.00	0.19	0.36	0.45
LWUDAPQ	0.0	0.00	0.00	0.00	0.00	0.45	0.55
Dead	0.0	0.00	0.00	0.00	0.00	0.00	1.00

B) For NAT

from \ to	LWSPC	UC	ECC	RFPC	ESC	LWUDAPQ	Dead
LWSPC	0.1	0.15	0.18	0.16	0.18	0.20	0.03
UC	0.0	0.18	0.16	0.15	0.18	0.15	0.18
ECC	0.0	0.00	0.20	0.21	0.12	0.20	0.27
RFPC	0.0	0.00	0.00	0.23	0.15	0.23	0.39
ESC	0.0	0.00	0.00	0.00	0.29	0.25	0.46
LWUDAPQ	0.0	0.00	0.00	0.00	0.00	0.35	0.65
Dead	0.0	0.00	0.00	0.00	0.00	0.00	1.00

- **For SF treatment:**

3. To find members in each state in each iteration

Operation: membership_in_state_sf[i,] <- membership_in_state_sf[i - 1,] %*% tr_pr_m_sf

	state						
cycle	LWSPC	UC	ECC	RFPC	ESC	LWUDAPQ	Dead
1	2.000000e+03	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.000
2	4.000000e+02	2.000000e+02	4.000000e+02	4.400000e+02	2.000000e+02	2.000000e+02	160.000
3	8.000000e+01	8.400000e+01	1.960000e+02	2.880000e+02	2.896000e+02	3.872000e+02	675.200
4	1.600000e+01	2.648000e+01	7.116000e+01	1.316000e+02	1.736240e+02	3.916560e+02	1189.480
5	3.200000e+00	7.425600e+00	2.274440e+01	5.106600e+01	7.760456e+01	2.841054e+02	1553.854
6	6.400000e-01	1.953632e+00	6.762284e+00	1.799600e+01	2.983554e+01	1.719951e+02	1770.817
7	1.280000e-01	4.937990e-01	1.917761e+00	5.947187e+00	1.045972e+01	9.353336e+01	1887.520
8	2.560000e-02	1.214358e-01	5.259410e-01	1.876691e+00	3.444945e+00	4.756448e+01	1946.441
9	5.120000e-03	2.927587e-02	1.406587e-01	5.719112e-01	1.084511e+00	2.316620e+01	1975.002
10	1.024000e-03	6.952692e-03	3.688861e-02	1.695944e-01	3.299414e-01	1.097023e+01	1988.485
11	2.048000e-04	1.631992e-03	9.523503e-03	4.920007e-02	9.772464e-02	5.100402e+00	1994.741
12	4.096000e-05	3.795183e-04	2.427205e-03	1.401840e-02	2.832764e-02	2.343197e+00	1997.612
13	8.192000e-06	8.759003e-05	6.119913e-04	3.934619e-03	8.067286e-03	1.068241e+00	1998.919
14	1.638400e-06	2.008901e-05	1.529072e-04	1.090394e-03	2.263714e-03	4.846122e-01	1999.512
15	3.276800e-07	4.583421e-06	3.790702e-05	2.989084e-04	6.273010e-04	2.191645e-01	1999.780
16	6.553600e-08	1.041121e-06	9.334160e-06	8.117277e-05	1.719772e-04	9.892428e-02	1999.901
17	1.310720e-08	2.356001e-07	2.284899e-06	2.186390e-05	4.671274e-05	4.459789e-02	1999.955
18	2.621440e-09	5.314275e-08	5.564201e-07	5.846934e-06	1.258594e-05	2.009123e-02	1999.980
19	5.242880e-10	1.195355e-08	1.348780e-07	1.553745e-06	3.367053e-06	9.047012e-03	1999.991
20	1.048576e-10	2.682210e-09	3.256123e-08	4.105762e-07	8.951344e-07	4.072744e-03	1999.996

4. Total cost and total QALM in particular iterations:

Operation: payoff_trace_sf <- membership_in_state_sf %*% m_payoffs_sf

	payoff	
cycle	Cost	QALM
1	1.000000e+07	4.000000e+03
2	1.820000e+07	6.060000e+03
3	1.376800e+07	5.685200e+03
4	7.633360e+06	3.984976e+03
5	3.696498e+06	2.367372e+03
6	1.680605e+06	1.272821e+03
7	7.434106e+05	6.426136e+02
8	3.259434e+05	3.115251e+02
9	1.429554e+05	1.470721e+02
10	6.296071e+04	6.824270e+01
11	2.787086e+04	3.131137e+01
12	1.239494e+04	1.426278e+01
13	5.532760e+03	6.466982e+00
14	2.476390e+03	2.923712e+00
15	1.110502e+03	1.319407e+00
16	4.986228e+02	5.947516e-01
17	2.240709e+02	2.679136e-01
18	1.007463e+02	1.206350e-01
19	4.531237e+01	5.430542e-02
20	2.038421e+01	2.444266e-02

- **For NAT pathway**

3. To find members in each state in each iteration

Operation:membership_in_state_nat [i,] <- membership_in_state_nat [i - 1,] %*% m_P_nat

	state						
cycle	LWSPC	UC	ECC	RFPC	ESC	LWUDAPQ	Dead
1	2e+03	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.000
2	2e+02	3.000000e+02	3.600000e+02	3.200000e+02	3.600000e+02	4.000000e+02	60.000
3	2e+01	8.400000e+01	1.560000e+02	2.262000e+02	2.856000e+02	4.606000e+02	767.600
4	2e+00	1.812000e+01	4.824000e+01	1.005860e+02	1.541940e+02	3.324360e+02	1344.424
5	2e-01	3.561600e+00	1.290720e+01	3.630318e+01	6.921456e+01	1.908019e+02	1687.012
6	2e-02	6.710880e-01	3.187296e+00	1.162648e+01	2.774365e+01	9.558971e+01	1861.162
7	2e-03	1.237958e-01	7.484333e-01	3.447287e+00	1.029650e+01	4.380852e+01	1941.573
8	2e-04	2.258325e-02	1.698540e-01	9.689363e-01	3.615534e+00	1.886864e+01	1976.354
9	2e-05	4.094985e-03	3.762012e-02	2.619442e-01	1.218329e+00	7.768162e+00	1990.710
10	2e-06	7.400973e-04	8.182821e-03	6.876483e-02	3.978621e-01	3.091828e+00	1996.433
11	2e-07	1.335175e-04	1.755340e-03	1.764564e-02	1.268102e-01	1.199169e+00	1998.654
12	2e-08	2.406315e-05	3.724668e-04	4.447178e-03	3.965653e-02	4.558414e-01	1999.500
13	2e-09	4.334368e-06	7.834706e-05	1.104682e-03	1.221650e-02	1.705596e-01	1999.816
14	2e-10	7.804862e-07	1.636327e-05	2.711801e-04	3.718670e-03	6.302038e-02	1999.933
15	2e-11	1.405175e-07	3.397568e-06	6.592482e-05	1.121195e-03	2.305256e-02	1999.976
16	2e-12	2.529615e-08	7.020000e-07	1.589728e-05	3.354684e-04	8.364559e-03	1999.991
17	2e-13	4.553607e-09	1.444477e-07	3.807589e-06	9.975921e-05	3.015263e-03	1999.997
18	2e-14	8.196793e-10	2.961816e-08	9.067625e-07	2.951946e-05	1.081187e-03	1999.999
19	2e-15	1.475453e-10	6.054785e-09	2.148982e-07	8.700360e-06	3.860100e-04	2000.000
20	2e-16	2.655845e-11	1.234565e-09	5.072021e-08	2.556092e-06	1.373292e-04	2000.000

4. Total cost and total QALM in particular iterations:

Operation: payoff_trace_nat <- membership_in_state_nat %*% m_payoffs_nat

	payoff	
cycle	Cost	QALM
1	1.000000e+07	4.000000e+03
2	2.170000e+07	9.260000e+03
3	1.284600e+07	6.809800e+03
4	6.254390e+06	3.828224e+03
5	2.767848e+06	1.873543e+03
6	1.148930e+06	8.406787e+02
7	4.553025e+05	3.555322e+02
8	1.743861e+05	1.441128e+02
9	6.514293e+04	5.660980e+01
10	2.389406e+04	2.171478e+01
11	8.648613e+03	8.178338e+00
12	3.100522e+03	3.036442e+00
13	1.103892e+03	1.114723e+00
14	3.910883e+02	4.055767e-01
15	1.380694e+02	1.465074e-01
16	4.862256e+01	5.261800e-02
17	1.709277e+01	1.880952e-02
18	6.001316e+00	6.698414e-03
19	2.105225e+00	2.378062e-03
20	7.380406e-01	8.421268e-04

- **Result:**

Average cost and QALM for both pathways.....which is totally depended on transition probabilities, cost and QALM (which we entered approximate)

```
For SF
       Cost         QALM
28152.00415    12.29858


For NAT
       Cost         QALM
27724.67533    13.60159
```