2)a)i) 1111110011000111111111000000001001111011111110010

From the above sequence

$n_{00}=12,\ n_{01}=6,\ n_{10}=7,\ n_{11}=24$

(Check $r=n_{01}+n_{10}+1=6+7+1=14$, from the above sequence there are 14 runs)

The matrix of transition counts is given by

$$N=\begin{array}{c}0\\1\end{array}\begin{bmatrix}12 & 6\\7 & 24\end{bmatrix}\begin{array}{c}18\\31\end{array}$$

and then $\hat{M}=\begin{bmatrix}12/18 & 6/18\\7/31 & 24/31\end{bmatrix}=\begin{bmatrix}0.6667 & 0.3333\\0.2258 & 0.7742\end{bmatrix}$

The switching probabilities α and β are 0.3333 and 0.2258 respectively.

~~For~~ the sequence to have been generated by a Bernoulli model α should be equal to $1-\beta$, and β should be equal to $1-\alpha$.

$\beta=0.2258\neq 1-\alpha=0.6667$

and $\alpha=0.3333\neq 1-\beta=0.7742$

$\frac{4}{4}$

It seems unlikely that the sequence could have been generated by a Bernoulli process, not least since β and $1-\alpha$, and α and $1-\beta$ are so different in magnitude.

ii)

```
v=c(1,1,1,1,1,1,0,0,1,1,0,0,0,1,1,1,1,1,1,1,1,1,0,0,0,0,0,0,0,0,1,0,0,1,1\
 ,1,1,1,0,1,1,1,1,1,1,1,0,0,1,0)
runstest(v)
Exact test:
    r = 14     [ n0 = 19 , n1 = 31 ]
    SP (total) = 0.001982
Normal approximation:
    r = 14     [ μ = 24.56 , σ = 3.294 ]
    z = -3.206
    SP (total) = 0.001345
```

The significance probability is very small, at 0.001982, and the hypothesis that the sequence