S1) $V_1 = 5221$, $V_2 = 1319$, $V_3 = 9992$, $V_4 = 2400$, $V_5 = 7220$

a) $t_i = -2 \ln\left(\frac{V_i}{9999}\right)$

4'0512, 0'0014, 2'8540, 0'6513, 2'2458

b) $T_j = \sum_{i=1}^{3} t_{3(j-1)+i}$ p. ex. $T_1 = t_1 + t_2 + t_3$ anteriors.

$T_1 = 6'9066$ $T_2 = 3'5437$, $T_3 = 5'9766$

$T_4 = 13'5847$

c) Mètode de Box Muller; amb $n=4$ podem generar 4 nos de la mostra de distribució normal

$x_1 = \cos(2\pi u_2)(-2\ln u_1)^{1/2}$ $u_i = V_i/9999$

$x_2 = \sin(2\pi u_2)(-2\ln u_1)^{1/2}$

$x_1 = \cos\left(2\pi \frac{8421}{9999}\right)\left(-2\ln\left(\frac{6939}{9999}\right)\right)^{1/2} = 0'4678$

$x_2 = \sin\left(2\pi \frac{8421}{9999}\right)\left(-2\ln\left(\frac{6939}{9999}\right)\right)^{1/2} = -0'7153$

$x_3 = \cos\left(2\pi \frac{6160}{9999}\right)\left(-2\ln\left(\frac{1377}{9999}\right)\right)^{1/2} = -1'4848$

$x_4 \quad \sin\left(2\pi \frac{6160}{9999}\right)\left(-2\ln\left(\frac{1377}{9999}\right)\right)^{1/2} = -1'3267$

$x_i \sim N(0,1)$

$y_i = 10 + 2x_i = \begin{cases} 10'9356 \\ 8'5694 \\ 7'0302 \\ 7'3466 \end{cases}$

d) per a cada nº seguint una distribució normal s'agafen 15 valors generats $u \sim (0,1)$

$$z = \sqrt{12 \cdot p} \cdot \left(\frac{1}{p} \sum_{i=1}^{p} u_i - \frac{1}{2} \right) = \qquad p = 15$$

$$\left(u_i = \frac{V_i}{9999} \right)$$

$$\frac{1}{p} \sum u_i = \frac{83934}{15 \cdot 9999} = 0'5596$$

$$\frac{1}{p} \sum u_i = \frac{72949}{15 \cdot 9999} = 0'4863$$

$$z_1 = \sqrt{12 \cdot p} \cdot (0'5596 - 0'5) = 0'7998$$

$$z_2 = \sqrt{12 \cdot p} \cdot (0'4863 - 0'5) = -0'1828$$

$$x_1 = \mu + \sigma z_1 = 11'5996$$

$$x_2 = \mu + \sigma z_2 = \underline{9'6324}$$

S2) a) Mètode de la inversa

$$F_Z(t) = 1 - e^{-(t/b)^a} \qquad a=3,\ b=10$$

(sense truncar)

$$F_Z(15) = 1 - e^{-(1'5)^3} = 0'9657 = \tilde{F}$$

$$\tilde{F}_Z(t) = \frac{1}{\tilde{F}}\left(1 - e^{-(t/b)^a}\right)$$

$$\left[-\ln(1-\tilde{F}\cdot u)\right]^{1/a}\cdot b = t \quad \leftarrow \text{fórmula pel mètode de la inversa.}$$

ó simplement

$$t_1 = b\cdot\left[-\ln(u\cdot\tilde{F})\right]^{1/a} =$$

$$= 10\left[-\ln\left[\frac{5221}{9999}\cdot 0'9657\right]\right]^{1/3} = 5'77335$$

$$t_2 = 10\left[-\ln\left[\frac{1319}{9999}\cdot 0'9657\right]\right]^{1/3} = 12'72$$

Mètode del rebuig:

funció de densitat de Weibull: $f_Z(t) = \dfrac{a t^{a-1} e^{-(t/b)^a}}{b^a}$

a) Es genera un nº a l'atzar entre 0 i 15

s'adopta $t_1 = 15\cdot\frac{5221}{9999} = 7'8322$

$$f_Z(7'8322) = \frac{3\cdot 7'8322^2\, e^{-(0'78322^3)}}{10^3} = 0'113823$$

Cal conèixer quin és el valor màxim de $f_Z(t)$

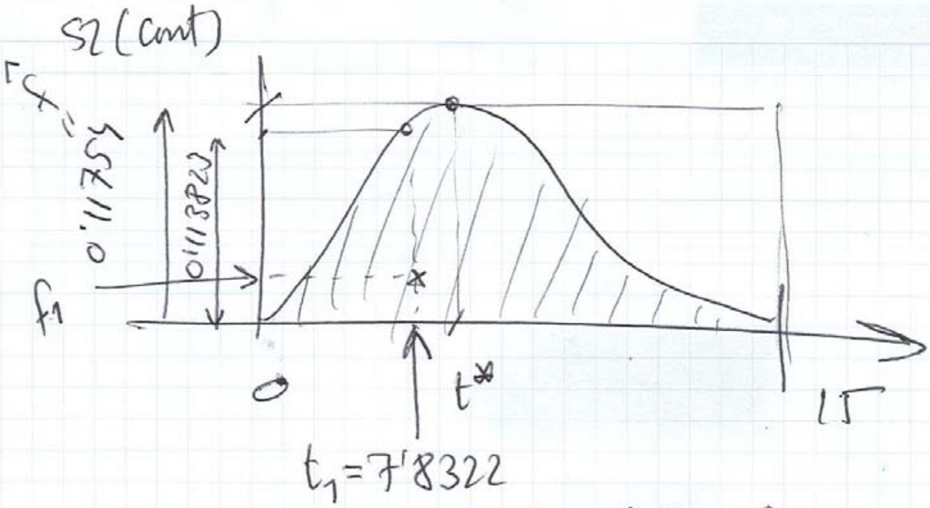
$$\frac{df_Z}{dt} = 0 \rightarrow \frac{df}{dt} = e^{-(t/b)^a}\, t^{a-2}\frac{a}{b^a}\left[(a-1) - \frac{a}{b^a}t^a\right] = 0 \Rightarrow$$

$$t^* = \left[(-1+a)\frac{b^a}{a}\right]^{1/a} = \left[2\,\frac{10^3}{3}\right]^{1/3} = 8'7358$$

Es genera un nº entre $[0,\ 0'11754] \rightarrow \frac{1319}{9999}\cdot 0'11754 =$

$f_Z(8'7358) = 0'11754$

$= \underline{0'015505} = f_1$



Ja que el punt $(t_1, f_1) = (7'8322, 0'015505)$ cau dins de l'àrea //// s'accepta t_1 com element dins de la mostra

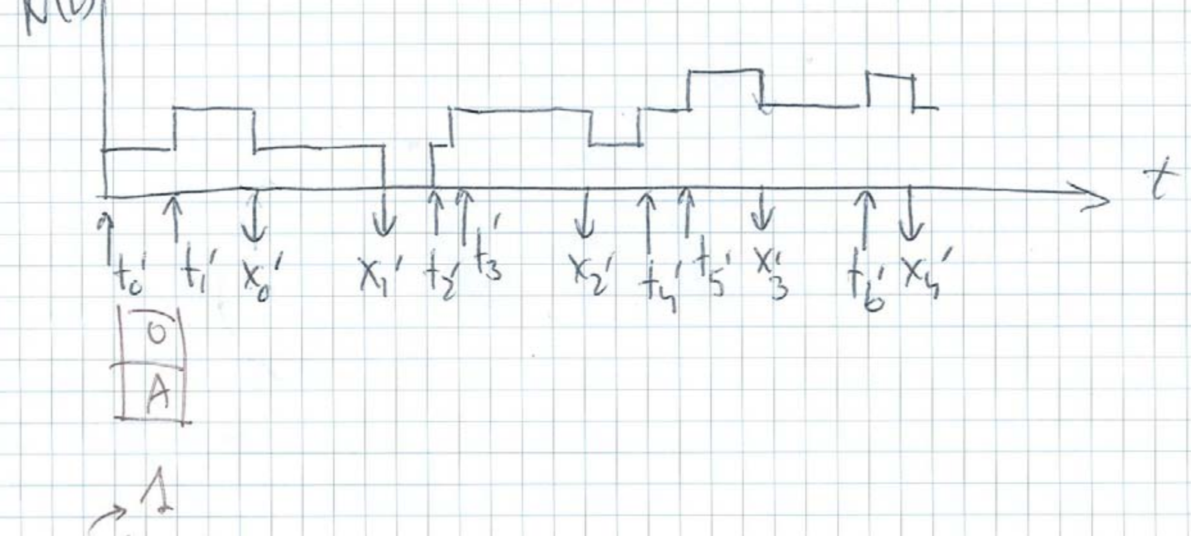
Tipus succés A = arribada , S = fi servei

Instant
Tipus

Traça de simulació.

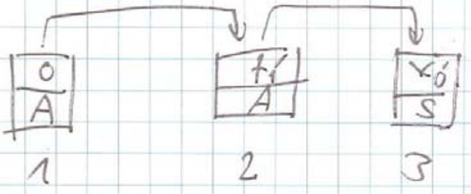
N° Succés	Tipus	Client (nº)	TCR	Servidors lliures	Q	Propera Arrib.	Propera Sortida
1	A	0	0	0	0	1'2995	2
2	A	1	1'2995	0	1	5'3508	2
3	S	0	2	0	0	5'3508	4.
4	S	1	4	1	0	5'3508	—
5	A	2	5'3508	0	0	5'3222	7'3508
6	A	3	5'3522	0	1	8'2062	7'3508
7	S	2	7'3508	0	0	8'2062	9'3508
8	A	4	8'2062	0	1	8'8575	9'3508
9	A	5	8'8575	0	2	11'1032	9'3508
10	S	3	9'3508	0	1	11'1032	11'3508
11	A	6	11'1032	0	2	11'7498	11'3508
12	S	4	11'3508	0	1	11'7498	13'3508

Es crea inicialment un succés (A); s'inicialitza la llista; arbitràriament és dona instant t=0;
S'inicia l'algoritme: es processa el primer succés que es una A; es genera nova A (succés 2); la primera arribada entra en servei; es genera temps de servei X_1;



ordre de creació

1)

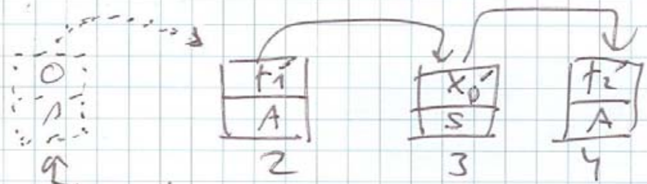


$t_0 = 0.$

$t_1 = -2 \ln \frac{5221}{9999} = 1'2995$

$x_0 = 2$; $t_1' = t_1$ $x_0' = x_0$

2)



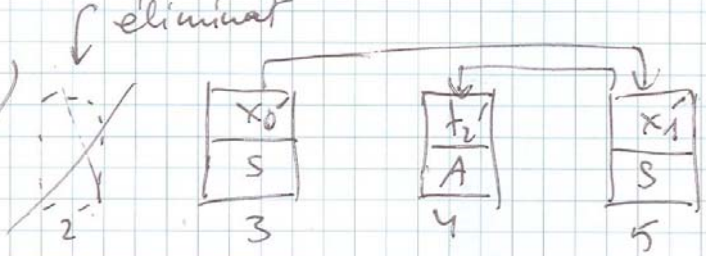
queda eliminat

$t_{ac} = t_1'$

$t_2 = -2 \ln \left(\frac{1319}{9999}\right) = 4'051$

$t_2' = t_1' + t_2 =$
$= 5'3508$

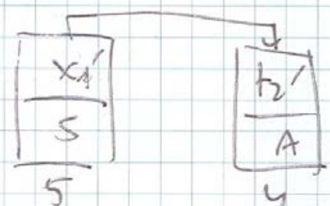
3)



$t_{ac} = x_0'$

$x_1' = t_{ac} + 2 =$
$= 4$

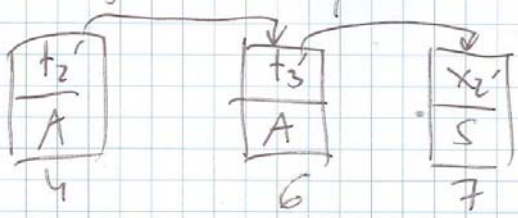
4)



$t_{ac} = x_1'$

cua buida

5)



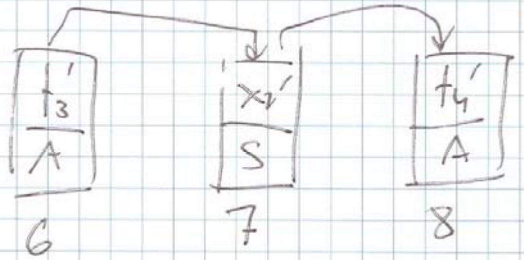
$t_{ac} = t_2'$

$t_3 = -2 \ln \frac{9992}{9999} =$
$= 1'4 \cdot 10^{-3}$

$t_3' = t_{ac} + t_3 = 5'3522$

$x_2' = t_{ac} + 2 = 7'3508$

6)

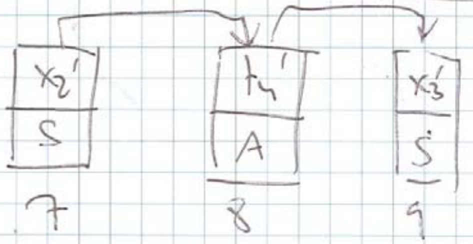


$t_{ac} = t_3'$

$t_4' = t_{ac} + t_4 = 8'2062$

$t_4 = -2 \ln \frac{2400}{9999} = 2'8540$

7)

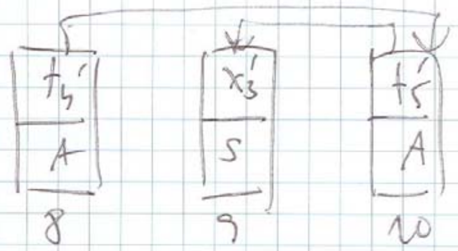


Cua plena; es genera temps de servei

$t_{ac} = x_2'$

$x_3' = 7'3508 + 2 = 9'3508$

8)



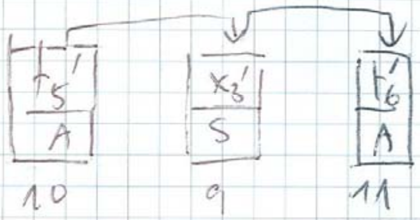
$t_{rk} = t_4'$

generem ambulància

$t_5 = -2\ln\left(\frac{7220}{9999}\right) = 0'6512$

$t_5' = 8'8575$

9)

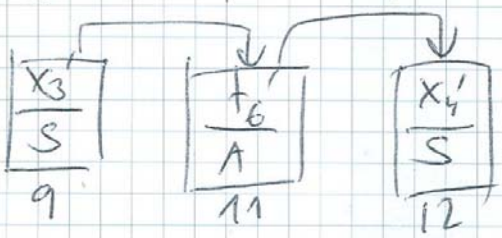


$t_{rk} = t_5'$

$t_6 = -2\ln \frac{3253}{9999} = -2'2458$

$t_6' = 11'1032 = t_{rk} + t_6$

10)

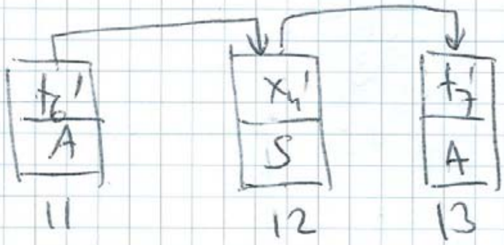


$t_{rk} = 9'3508 = x_3'$

$x_4' = t_{rk} + 2 =$

$= 11'3508$

11)

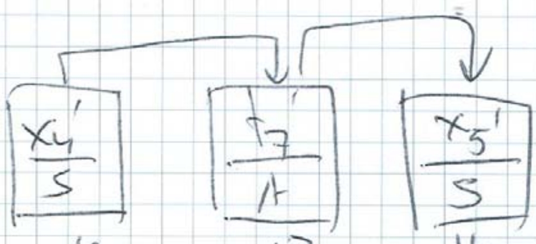


$t_{rk} = t_6'$

$t_7' = t_{rk} + t_7 = 11'7498$

$t_7 = -2\ln\frac{7237}{9999} = 0'6465$

12)



$t_{rk} = x_4' = 11'3508$

$x_5' = t_{rk} + 2 = 13'3508$

Fi de simulació (s'han servit 5 clients)

54) X = compra setmanal en nº unitats
N = existència (nº unitats en magatzem)
Ing = Ingressos acumulats
Pen = Penalitzacions "
TR = instant de propera recepció de Q unitats
TCK = clock time

$N = 30,\ r = 10,\ TR = 0$

<u>Per</u> TCK = 1 fins N
  <u>Si</u> TCK = TR <u>llavors</u>
    $N = N + Q$ (inici de setmana)
  <u>fisi</u>
  $X = \text{Poisson}(\lambda = 8)$
  Vendes = $N - \max\{N-X, 0\}$
  NoVendes = $\max\{X-N, 0\}$
  $N = \max\{N-X, 0\}$ (final de setmana)
  Ing = Ing + 10 · Vendes
  Pen = Pen + 1 · NoVendes
  Si $N < r$ llavors $TR = TCK + 2$
  Escrime X, N, Vendes, NoVendes, TR ;
<u>Fi Per</u>

Poden generar-se a priori n valors aleatoris per X, $X_1 \ldots X_n$; en fem el primer

$\lambda = 8$ clients/set $\rightarrow E[T] = 1/8$ set

$t_1 = -\frac{1}{8}\ln\left(\frac{5221}{9999}\right) = 8'122 \cdot 10^{-2}$ $\quad t_5 = -\frac{1}{8}\ln\left(\frac{7220}{9999}\right) = 4'07 \cdot 10^{-2}$

$t_2 = -\frac{1}{8}\ln\left(\frac{1319}{9999}\right) = 0'2532$ $\quad t_6 = -\frac{1}{8}\ln\left(\frac{3253}{9999}\right) = 0'1403$

$t_3 = -\frac{1}{8}\ln\left(\frac{9992}{9999}\right) = 8'7539 \cdot 10^{-5}$ $\quad t_7 = -\frac{1}{8}\ln\left(\frac{7237}{9999}\right) = 4'04 \cdot 10^{-2}$

$t_4 = -\frac{1}{8}\ln\left(\frac{2400}{9999}\right) = 0'1783$ $\quad t_8 = -\frac{1}{8}\ln\left(\frac{1146}{9999}\right) = 0'2707$

Observem que $\sum_{i=1}^{7} f_i = 0'923761$ mentre que

$$\sum_{i=1}^{8} f_i = 1'0049$$

per tant s'adopta per $X_1 = 7$.

Suposem que surten 7, 9, 11, 6, 8, 5, 7, 10, 8, 4, 6, 12

Set.	X	N	Vendes	No Vendes	TR
1	7	23	7	0	0
2	9	14	9	0	0
3	11	3	11	0	5
4	6	0	3	3	5
5	8	22	8	0	5
6	5	17	5	0	5
7	7	10	7	0	5
8	10	0	10	0	10
9	8	0	0	8	10
10	4	26	4	0	10
11	6	20	6	0	10
12	12	8	12	0	14