

Le Poisson de Sisyphe (The Fish of Sisyphus)

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April 2, 2023

1 The first piece, Op. (-78), No. 1

1. Select an arbitrary piece or a part of a piece. Hereafter, the selected piece will be denoted by the original piece.
2. Determine the value of the time constant τ [sec.] associated with the counter (see Sec .4).
3. Start the counter at the same time as the performance of the original piece begins.
4. Restart the performance from the beginning of the original piece when the counter goes up.
5. The performance is over when the end of the original piece is reached before the counter goes up.

2 The second piece, Op. (-78), No. 2

1. Select the original piece.
2. Determine the value of the time constant τ [sec.] associated with the counter.
3. Determine the number M and split the original piece into M parts of the approximately same duration. The parts are named Part 1, Part 2, ..., and Part M in increasing order of time.

4. Start the counter at the same time as the performance of the original piece begins.
5. When the counter goes up, restart the performance from the beginning of the part that the performer was playing at the time.
6. The performance is over when the end of the original piece is reached before the counter goes up.

3 The third piece, Op. (-78), No. 3

1. Select the original piece.
2. Determine the value of the time constant τ [sec.] associated with the counter.
3. Determine the number M and split the original piece into M parts of the approximately same duration. The parts are named Part 1, Part 2, ..., and Part M in increasing order of time.
4. Start the counter at the same time as the performance of the original piece begins.
5. Operate the coin (see Sec. 4).
6. When the performer was playing Part i at the time the counter went up, restart the performance from the beginning of Part $(i + 1)$ if the value of the coin was $+$ and restart the performance from the beginning of Part $(i - 1)$ if the value of the coin was $-$. If the performer was playing Part 1 and the value of the coin was $-$ then restart the performance from the beginning of Part 1. If the performer was playing Part M and the value of the coin was $+$ then the performance is over at the moment.
7. The performance is over when the end of the original piece is reached before the counter goes up.

4 Device

The counter is a device that displays a sample of the Poisson process $N_\tau(t)$ with the time constant τ [sec.], where t is the time measured from the beginning of the performance. See Sec. A for the definition of the Poisson process. The value of $N_\tau(t)$ itself is of no importance. The required function for the counter is to signal the moments that $N_\tau(t)$ changes (the counter goes up) to the performer by light or sound. The value $\{+, -\}$ of the coin used in the third piece should be also notified to the performer. It is preferable that the number of the part which the performer should play next is notified directly rather than the value of the coin.

The Poisson process $N_\tau(t)$ may be generated by using a computer or by using Tables 1, 2 in Sec. B. The values of the coin $\{+, -\}$ may be generated by using a computer, by throwing a real coin, or by using Table 3 in Sec. C. The Poisson process $N_\tau(t)$ may be generated during the performance or prepared before the performance. However, it is preferable that the performer does not know the timing of the counter going up in advance.

5 Examples of the settings

5.1 The first piece, Op. (-78), No. 1

Let the duration of the original piece be $T = 60$ [sec.] and the time constant be $\tau = 30$ [sec.]. By using the data of Table 1 in Sec. B from the beginning, one obtains

$$13.2, 15.6, 33.3, 1.8, 51.1, 5.9, 1.7, 21.4, 76.3$$

for the time intervals between successive counts in the unit of second. In this case, the performer plays the original piece for (1) 13.2 sec. from the beginning, (2) 15.6 sec. from the beginning, (3) 33.3 sec. from the beginning, (4) 1.8 sec. from the beginning, (5) 51.1 sec. from the beginning, (6) 5.9 sec. from the beginning, (7) 1.7 sec. from the beginning, (8) 21.4 sec. from the beginning, and then (9) 60 sec. to the end to terminate the whole performance. The total duration is approximately 204 sec. .

5.2 The second piece, Op. (-78), No. 2

Let the duration of the original piece be $T = 60[\text{sec.}]$ and the time constant be $\tau = 15[\text{sec.}]$. Let the number of divisions be $M = 4$ and then the duration of each part is $T/M = 15[\text{sec.}]$. By using the data of Table 1 in Sec. B from the beginning, one obtains

6.6, 7.8, 16.7, 0.9, 25.5, 3.0, 0.9, 10.7, 38.1

for the time intervals between successive counts in the unit of second. In this case, the performer plays the original piece for (1) 6.6 sec. from the beginning of Part 1, (2) 7.8 sec. from the beginning of Part 1, (3) 16.7 sec. from the beginning of Part 1, (4) 0.9 sec. from the beginning of Part 2, (5) 25.5 sec. from the beginning of Part 2, (6) 3.0 sec. from the beginning of Part 3, (2) 0.9 sec. from the beginning of Part 3, (8) 10.7 sec. from the beginning of Part 3, (9) 30 sec. from the beginning of Part 3 to the end to terminate the whole performance. The total duration is approximately 102 sec. .

5.3 The third piece, Op. (-78), No. 3

Let the duration of the original piece be $T = 60[\text{sec.}]$ and the time constant be $\tau = 15[\text{sec.}]$. Let the number of divisions be $M = 4$ and then the duration of each part is $T/M = 15[\text{sec.}]$. By using the data of Table 1 in Sec. B from the beginning, one obtains

6.6, 7.8, 16.7, 0.9, 25.5, 3.0, 0.9, 10.7, 38.1

for the time intervals between successive counts in the unit of second. By using the data of Table 3 in Sec. C from the beginning, one obtains

+, -, +, -, -, -, +, +.

In this case, the performer plays the original piece for (1) 6.6 sec. from the beginning of Part 1, (2) 7.8 sec. from the beginning of Part 2, (3) 16.7 sec. from the beginning of Part 1, (4) 0.9 sec. from the beginning of Part 3, (5) 25.5 sec. from the beginning of Part 2, (6) 3.0 sec. from the beginning of Part 2, (2) 0.9 sec. from the beginning of Part 1, (8) 10.7 sec. from the beginning of Part 2, (9) 30 sec. from the beginning of Part 3 to the end to terminate the whole performance. The total duration is approximately 102 sec. .

6 Notes on the performance

The time constant τ [sec.] is the average time interval between successive counts. Let the duration of the original piece be T [sec.] and the number of divisions be M . The number of repetitions and the total duration time for the performance increase on average as τ [sec.] becomes small in comparison with T [sec.] for the first piece and T/M [sec.] for the second and third pieces. The number of repetitions depends nearly as an exponential function of T/τ so that the total duration may be too large to perform actually when τ is very small. Conversely, when τ [sec.] is too large in comparison with T [sec.] (for the first piece) or T/M [sec.] (for the second and third pieces), the probability that the performance ends without any repetition increases. The selection of the original piece, the setting of the value of τ with regards to T , and the setting of the number of divisions M are left to the performer and they affect the impression of the performance.

To avoid undesirable cases such that the performance ends without any repetition, it is safe to prepare an early part of the Poisson process (for example, up to the first 2 or 3 counts) before the performance. If the early part of the Poisson process was undesirable, one may generate it once again. The remaining part of the Poisson process may be generated during the performance. However, the method to generate the Poisson process must be fixed before the performance and cannot be altered during the performance. Especially, the performer may not arbitrarily ignore the counts since the process is not a sample from the Poisson process anymore then.

A Poisson process

The Poisson process is a stochastic process that models the counting numbers of events that randomly occur in time. It is assumed that the correlations between different events are absent. Let $N_\tau(t)$ be the counting number of the events in a time interval of time t . The time constant τ is the average time interval between successive events. Since the counting number $N_\tau(t)$ is a stochastic process, $N_\tau(t)$ are different functions of t among different samples (different experiments). In every single sample (experiment), time intervals between successive events may take various values. The number of people entering a shop, the number of children born in a city, or the number of earthquakes that occurred in a country in a certain time interval of t may

be approximated by a Poisson process if the correlations among the events are small and negligible. A mathematical definition of the Poisson process is given as follows.

Definition 1. A counting process $\{N_\tau(t), t \geq 0\}$ is called a Poisson process with the time constant $\tau(> 0)$ if

1. $N_\tau(0) = 0$,
2. $N_\tau(t)$ is stationary and has independent increments,
3. the probability such that $N_\tau(t) = n$ is given by $e^{-t/\tau} \frac{(t/\tau)^n}{n!}$, $n = 0, 1, 2, \dots$

See a standard textbook of the probability theory for further explanations.

B Random number table for generating Poisson processes

The value of the counter $N_\tau(t)$ is 0 at $t = 0$ and it increases one by one afterward in a Poisson process. Therefore, a sample of a Poisson process is specified when the times t_i at which the value of the counter goes up to i ($i = 1, 2, 3, \dots$) are given. Alternatively, the time intervals $\Delta t_i = t_i - t_{i-1}$ may be given to specify a sample of a Poisson process, where $t_0 = 0$. The time intervals between successive counts obey the exponential distribution

$$P_\tau(\Delta t) = \frac{1}{\tau} e^{-\frac{\Delta t}{\tau}}, \quad (\Delta t \geq 0).$$

Table 1, 2 are tables of pseudorandom numbers obeying the exponential distribution with the time constant $\tau = 1$. One may choose a value from the table as the first interval $\Delta t_1 = t_1 - t_0$ [sec.] for the counts. Then one may choose another value from the table as the next interval $\Delta t_2 = t_2 - t_1$ [sec.]. One may repeat the procedure to generate a sample of the Poisson process. One may start from an arbitrary number in the table and proceed in the order or point randomly. However, one may not arbitrarily skip undesirable values or repeat the same value since the resultant sequence is not a sample of the Poisson process anymore. The method for selecting numbers fixed at the outset should not be changed till the end. If the obtained sample was undesirable, one may discard the sample and redo the entire selection. To generate a sample of the Poisson process with the time constant τ [sec.] different from 1, one can use the tables with all values multiplied by τ [sec.].

0.441	0.521	1.110	0.059	1.702	0.198	0.057	0.712
2.542	0.768	1.177	1.996	2.460	0.280	0.588	0.074
3.001	0.443	0.109	0.384	1.759	0.132	0.271	0.934
1.592	0.555	0.368	2.300	2.404	0.840	1.763	3.413
0.063	0.635	1.011	0.743	0.480	0.463	0.835	1.420
0.892	0.601	0.496	1.567	1.632	0.035	4.379	1.017
3.770	1.626	2.462	0.671	0.250	1.253	2.206	2.681
0.090	2.554	0.926	0.167	0.694	1.775	0.560	0.572
0.066	1.530	2.685	1.738	0.164	1.206	0.305	0.704
0.221	0.610	0.512	0.363	0.830	1.491	0.514	0.025
0.153	0.710	0.092	0.062	0.878	0.339	0.705	2.190
0.485	0.204	0.355	1.856	0.652	1.098	0.762	1.307
1.233	0.983	0.759	0.839	0.635	1.345	0.475	0.172
1.738	0.104	0.183	0.773	4.611	1.520	0.663	1.357
0.371	0.067	0.292	1.081	0.708	0.011	0.025	0.813
0.573	0.627	0.370	0.470	1.250	1.040	2.244	0.321
0.104	1.159	3.725	0.577	0.671	1.494	1.201	0.626
0.020	1.416	0.197	1.390	0.456	1.197	0.403	0.081
0.446	1.012	0.119	1.165	0.008	0.958	0.394	2.236
2.288	0.945	0.971	0.846	0.385	1.208	0.314	0.139
0.175	0.144	0.219	0.816	0.360	1.104	0.592	1.063
1.940	0.271	0.319	0.018	0.120	0.309	0.100	0.204
0.463	0.200	0.157	1.348	0.919	1.114	0.068	0.986
0.531	0.911	0.437	1.062	0.767	0.187	0.273	1.326
1.623	0.332	2.297	0.428	0.800	1.217	2.143	0.238
0.673	0.080	0.314	2.719	1.455	2.335	0.698	0.800
0.405	0.444	0.228	1.864	0.617	0.760	3.154	0.420
3.291	0.964	0.368	0.076	0.608	2.014	1.743	1.120
1.044	0.029	0.757	2.097	0.130	0.132	0.174	1.789
0.675	0.239	1.048	1.412	0.668	0.957	0.240	0.091
0.892	0.499	1.356	0.295	0.123	1.452	1.140	2.905
0.829	3.157	1.103	0.122	0.290	0.418	2.449	0.066

Table 1: Table of pseudorandom numbers obeying the exponential distribution $p(\Delta t) = (\Delta t)^{-1}e^{-\Delta t}$ Part 1.

0.479	0.578	0.997	0.616	1.498	0.938	0.048	1.118
0.337	1.983	1.264	0.581	0.078	0.701	2.066	0.904
0.532	2.358	1.104	0.060	1.025	0.988	0.282	0.344
0.433	0.108	2.213	2.030	0.231	0.013	0.171	1.601
0.339	0.792	0.585	1.200	1.361	1.917	0.538	2.642
0.753	1.333	0.106	0.009	0.183	0.397	0.454	1.001
0.486	0.120	0.336	0.049	0.517	0.488	0.165	0.460
0.347	0.131	0.015	1.453	0.013	0.227	0.096	0.465
5.143	0.988	3.045	1.491	1.119	0.045	3.235	0.999
1.620	1.130	4.842	0.501	0.848	1.738	0.350	1.239
0.314	0.500	0.535	1.115	0.235	0.609	3.397	1.549
0.697	0.283	1.396	1.331	0.744	1.327	1.992	0.008
1.213	0.122	0.007	2.969	0.424	0.631	0.186	2.150
0.173	0.649	0.914	2.233	0.121	0.597	0.350	0.079
0.011	2.215	0.208	1.894	1.309	0.481	0.452	0.323
2.815	0.016	0.055	0.592	2.522	0.615	0.965	1.760
1.167	0.209	0.167	0.245	1.415	2.125	0.582	0.493
0.995	2.203	1.079	0.796	2.341	1.156	0.001	0.219
1.017	0.534	1.195	0.162	2.052	0.266	3.331	0.366
0.257	0.858	0.126	0.659	4.573	0.411	1.313	1.295
1.164	0.736	1.115	0.075	0.644	2.163	0.299	1.842
0.599	0.187	2.078	0.720	1.085	0.670	0.700	1.530
0.881	0.736	0.145	0.950	2.023	0.430	1.383	1.454
0.524	0.446	0.628	1.326	2.524	0.362	0.399	1.922
0.499	0.000	1.368	1.492	5.876	1.130	0.232	1.682
0.504	0.397	0.992	0.983	1.062	0.487	2.108	0.519
0.282	0.031	1.380	0.961	1.374	0.050	1.716	0.609
1.266	1.322	0.616	0.197	0.378	0.858	0.423	0.869
1.553	1.259	0.352	0.679	2.412	5.704	0.289	0.040
0.950	0.701	0.135	0.626	0.255	0.136	0.110	2.517
1.058	1.044	0.956	3.787	3.157	1.319	0.850	0.526
2.171	0.097	0.504	0.391	0.422	0.216	0.876	0.111

Table 2: Table of pseudorandom numbers obeying the exponential distribution $p(\Delta t) = (\Delta t)^{-1}e^{-\Delta t}$ Part 2.

C Random number table for the coin

The values of the coin in the third piece, Op. (-78), No. 3 may be determined by using Table 3. One may start from an arbitrary position in the table and proceed in the order or point randomly. However, one may not arbitrarily skip undesirable values or repeat the same value.

+	-	+	-	-	-	+	+	+	-	+	+	-	-	-	+
+	-	-	-	+	-	+	+	-	+	+	+	+	+	+	+
-	-	+	-	-	+	+	+	+	+	+	-	+	+	+	+
+	+	-	+	+	-	-	+	+	-	+	+	-	+	-	-
-	-	+	-	+	-	+	+	-	+	-	+	+	+	-	+
+	-	+	-	-	+	+	-	+	+	+	-	+	-	+	+
+	+	-	+	-	-	+	-	+	+	+	+	+	+	-	+
-	+	-	-	+	+	-	+	+	-	+	-	-	+	-	-
-	+	+	+	+	+	+	-	+	+	+	-	+	+	+	+
+	-	+	+	+	-	-	+	-	+	+	-	+	+	+	-
-	+	-	+	-	-	-	-	+	+	-	+	+	-	+	+
-	+	-	+	+	+	-	+	-	+	-	-	+	-	-	-
-	-	+	+	+	+	+	+	-	-	+	-	-	-	-	+
-	-	-	+	+	+	+	+	+	+	-	+	-	-	-	-
-	+	+	+	-	+	+	-	-	-	+	+	-	-	-	-
+	+	+	-	-	-	+	+	+	+	-	-	+	-	+	+
+	-	+	+	-	-	+	+	+	-	-	-	+	-	+	-
+	+	+	+	-	+	-	-	+	-	+	-	-	+	+	-
+	-	+	-	-	-	+	+	-	-	+	+	-	+	+	+
+	-	+	-	+	+	-	+	+	-	-	-	+	-	-	-
-	+	-	+	+	-	+	-	+	+	-	+	+	-	-	+
+	+	-	+	+	+	+	-	+	-	-	-	-	+	-	+
-	+	-	+	-	-	-	-	+	-	+	+	+	-	-	-
+	-	-	-	-	-	-	-	-	+	+	-	-	-	+	-
+	+	+	-	-	+	+	+	+	-	+	-	+	-	-	-
+	+	+	+	-	+	-	+	+	-	-	+	-	+	+	+
+	-	-	+	+	+	-	-	+	+	+	-	-	-	-	+
-	+	+	-	-	+	-	+	+	-	-	-	-	+	+	+
+	-	+	-	-	-	+	-	+	-	+	+	+	+	+	+
-	+	-	+	-	+	-	+	-	+	-	+	-	-	+	+
-	+	-	-	+	-	-	-	-	-	+	-	-	+	+	+
-	+	+	-	+	-	-	-	-	+	+	+	-	+	+	+

Table 3: Table of pseudorandom variables obeying the discrete uniform distribution $p(\Delta t) = (\Delta t)^{-1}e^{-\Delta t}$.