PRACTICE AND PROCEDURE DIRECTIVE

PPD No. **18a** **EFFECTIVE DATE:** **August 28, 2025**

SUBJECT: **Determining Sample Times and Locations for End Product Asphaltic Concrete**

1. GENERAL

1.1. This procedure outlines the requirements for determining sample times and locations for and product asphaltic concrete.

1.2. The acceptance of end product asphaltic concrete is based on statistical methods making it critical that random sample be obtained. If random samples are not obtained, the test results may not result the true characteristics of the material being evaluated.

1.3. Material should not be excluded from the random sampling process just because it appears to be segregated or non-uniform. With the exception of those areas outlined in the Specifications to be excluded from testing, all material that is placed on the project must be considered. The only way that the test results will give a true picture of all the material included in the project is if samples are taken randomly from all the material placed. It is the nature of random sampling that some of the samples will represent below average material, while others will represent above average material.

1.4. The sample times and locations determined by this procedure should not be shared with the contractor until just prior to the sample being obtained, or in the ease of core locations, until compaction of the lot is completed.

1.5. On the rare occasion, it may be necessary to modify the requirements of this procedure due to plant breakdowns, weather, or other unexpected circumstances. In those cases, the Engineer and contractor must work together to identify the best solution which most closely adheres to the intent of this procedure. That may involve a split lot, obtaining fewer samples than required by specification, or obtaining a sample prior to the time required in cases where the operation is unexpectedly shut down.

2. STATIFIED RANDOM SAMPLING

2.1. In order to ensure that samples represent the true characteristics of the entire lot being tested, a stratified random sampling procedure shall be incorporated into the sampling process. This is accomplished by dividing the lot into sublots. The quantity associated with each sublot is determined by dividing the lot by the number of samples required. Sample times and locations for each sublot are then determined on a random basis. Specific procedures to be followed for selecting sample times for a mixture properties lot and locations for a compaction lot are described below.

3. SAMPLE TIMES FOR MIXTURE PROPERTIES LOT

3.1. Sampling for mixture properties will be based on time or tonnage. When paving is expected to be sporadic during a given shift, it may be more appropriate to sample for mix properties based on tonnage rather than time.

3.2. In order to determine sample times, the expected duration of the paving shift is first divided by the number of samples to determine the duration of each sublot. The sample time within each sublot is then determined on a random basis. This is accomplished by multiplying a random number by the duration of the sublot, and adding that value to the beginning time of the sublot to be sampled. If the duration of the shift changes after production begins, sample times for the remaining samples should be determined using the expected time left in the shift as well as the number of remaining samples.

3.3. The contractor should be expected to obtain an acceptance sample as soon as possible after being notified that a sample is required. Typically the sample should be obtained within 5 minutes of the request.

3.4. Example 1 and Example 2 below illustrate how sample times are determined.

EXAMPLE 1:

The contractor plans to pave from 7:00 am to 5:00 pm. Four plate samples are required based on the specifications for end product asphaltic concrete paving. Determine stratified random sample time for this scenario.

First, divide the lot into four sublots;

10 hour shift / 4 samples per shift = 2.5 hours per sublot

Sublot 1 is from 7:00 am to 9:30 am
Sublot 2 is from 9:30 am to 12:00 pm
Sublot 3 is from 12:00 pm to 2:30 pm
Sublot 4 is from 2:30 pm to 5:00 pm

Then, determine the specific time to sample each sublot;

Random numbers are generated in accordance with Attachment #1. For the sake of this example, assume the four random numbers generated are 0.502, 0.452, 0.841 and 0.046.

Multiply each random number by the duration of the sublot;

0.502 x (2.5 hours) = 1.255 hours
0.452 x (2.5 hours) = 1.130 hours
0.841 x (2.5 hours) = 2.103 hours
0.046 x (2.5 hours) = 0.115 hours

Add the interval determined above to the start time of the sublot to determine actual sample time;

Sample 1 to be taken at 7:00 am plus 1.255 hours = 8:15 am Sample 2 to be taken at 9:30 am plus 1.130 hours = 10:38 am Sample 3 to be taken at 12:00 pm plus 2.103 hours = 2:06 pm Sample 4 to be taken at 2:30 pm plus 0.115 hours = 2:37 pm

EXAMPLE 2:

Assume sample times are determined as shown above in Example 1. However, at 12:45 pm the contractor informs you that they will quit paving at 3:00 pm.

Sample 1 and Sample 2 have already been taken at the times determined in Example 1. At 12:45 pm there are 2 hours and 15 minutes (2.250 hours) remaining in the shift. The stratified random sample times for the two remaining samples are determined as follows.

First, divide the remaining time in the shift into two sublots;

2.250 hour shift/2 samples per shift = 1.125 hours per sublot

Sublot 3 is from 12:45 pm to 1:53 pm
Sublot 4 is from 1:53 pm to 3:00 pm

Then, determine the specific time to sample each remaining sublot;

Two new random numbers are generated in accordance with Attachment #1. For the sake of this example, assume the two random numbers generated are 0.208 and 0.745.

Multiply each random number by the duration of the sublot;

0.208 x (1.125 hours) = 0.234 hours
0.745 x (1.125 hours) = 0.838 hours

Add the interval determined above to the start time of the sublot to determine actual sample time;

Sample 3 to be taken at 12:45 pm plus 0.234 hours = 12:59 pm
Sample 4 to be taken at 1:53 pm plus 0.838 hours = 2:43 pm

3.5. When sampling for mixture properties is based on tonnage, the total tonnage expected for the lot is divided by the number of required samples to determine the quantity of material in each sublot. A random sample is obtained from each sublot using random numbers generated in accordance with Attachment #1.

3.6. Example 3 below illustrates how to determine sampling based on tonnage.

EXAMPLE 3:

The contractor plans to place 1800 tons of mix during a given shift. Four plate samples are required based on the specifications for end product asphaltic concrete paving. Determine stratified random sample tonnages for this scenario.

First, divide the lot into four sublots;

1800 tons84 samples per shirt = 450 tons per sublot

Sublot 1 is material between 0 and 450 tons
Sublot 2 is material between 450 and 900 tons
Sublot 3 is material between 900 and 1350 tons
Sublot 4 is material between 1350 and 1800 tons

Then, determine the specific tonnage when each sample should be taken;

Random numbers are generated in accordance with Attachment #1. For the sake of this example, assume the four random numbers generated are 0.731, 0.344, 0.502 and 0.245

Multiply each random number by the tonnage in each sublot:

0.731 x (450 tons) = 329 tons
0.344 x (450 tons) = 155 tons
0.502 x (450 tons) = 226 tons
0.245 x (450 tons) = 110 tons

Add the tonnage determined above to the tonnage at the beginning of the sublot to determine the sample tonnage;

Sample 1 to be taken at 0 plus 329 tons = 329 tons
Sample 2 to be taken at 450 plus 155 tons = 605 tons
Sample 3 to be taken at 900 plus 226 tons = 1126 tons
Sample 4 to be taken at 1350 plus 110 tons = 1460 tons

4. SAMPLE LOCATIONS FOR COMPACTION LOT

4.1. Sampling for compaction will be based on the area paved, and requires determining a random station and offset for each sample location. When possible, areas to be excluded from testing, as allowed by the specifications and the Engineer, should be eliminated prior to determining the sample locations. It is not acceptable to arbitrarily move a sample a short distance from its determined location because it falls in an area excluded from testing. Rather, when a sample location falls within an area that is not subject to testing a new random location shall be determined for that sample.

4.2. In order to determine sample locations, the total length paved is first divided by the number of samples to determine the length of each sublot. The station limits for each sublot are then calculated followed by the random sample location within each sublot. The sample station is calculated by multiplying a random number by the length of the sublot, and adding that length to the beginning station of the sublot to be sampled. The offset distance is calculated by multiplying a separate random number by the width of the pavement subject to testing, at the station calculated above.

Note: In many cases the width subject to testing will be less than the total width that was paved. The width used in calculating the random offset should be determined based on the top surface of the mat, excluding any slope or other area excluded by specification from testing requirements

4.3. Figure 1 illustrates typical locations to be excluded from testing on a multiple pass paving operation.

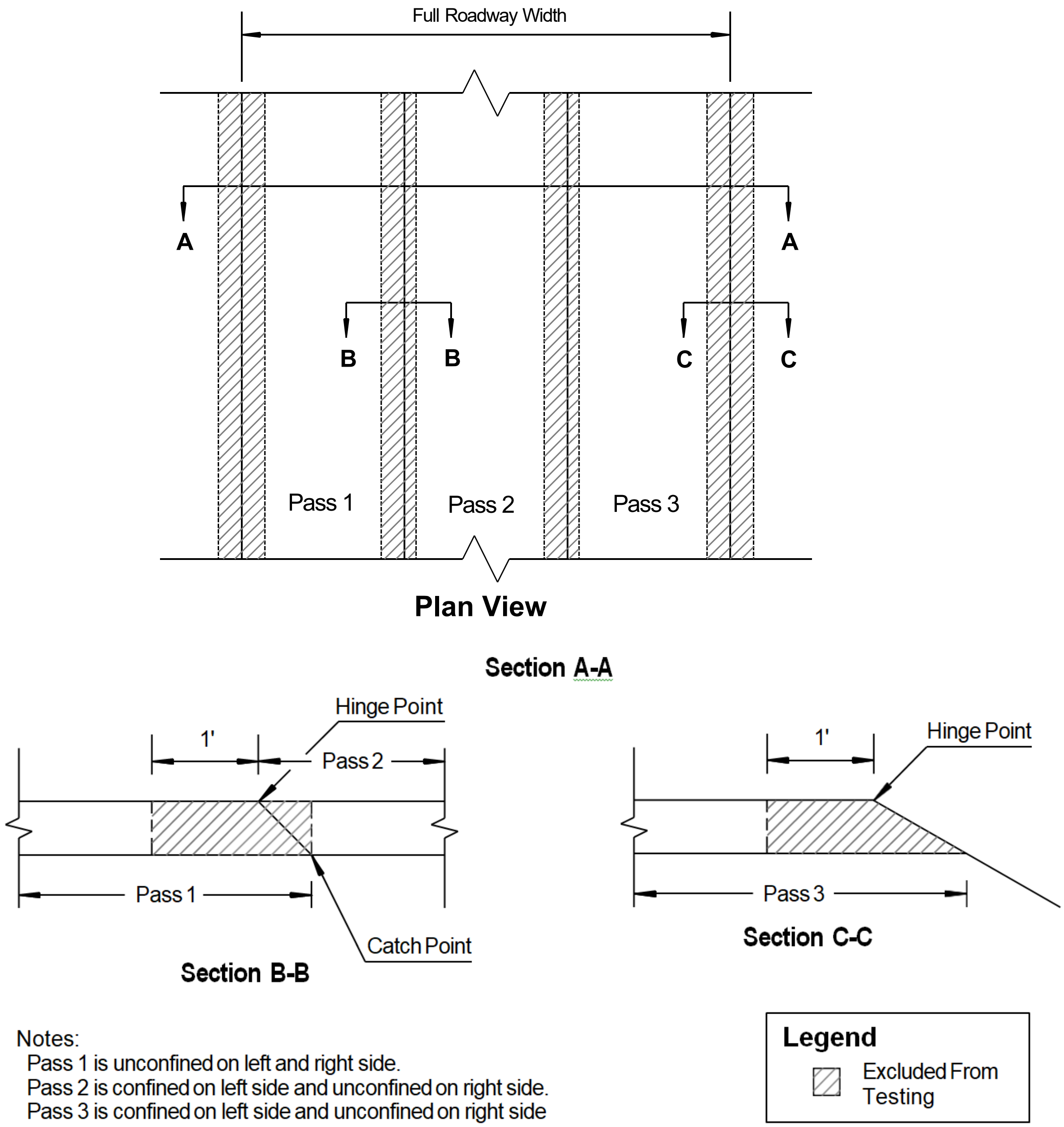

Figure 1 (Not to Scale)

4.4. Example 4 and Example 5 below illustrate how sample locations are determined.

EXAMPLE 4:

The contractor has paved an area as illustrated in Figure 2. The area paved is 6000 feet long and the width varies between 12 and 16 feet, not including the 3:1 slope along the unconfined edge of pavement. The left side of the mat is confined between Sta 10+00 and Sta. 46+00 by a previous lot. The left side of the mat between Sta 46+00 and Sta 70+00, as well as the entire right side of the mat, is unconfined. The specifications exclude from testing the outside 1 foot of the unconfined edge. Ten core samples are required based on the specifications for end product asphaltic concrete paving. Determine the stratified random sample locations for the scenario.

First, divide the lot into ten sublots;

Length of Sublot = 600 feet/10 cores per lot = 600 feet

Sublot 1 is from Sta 10+00 to 16+00
Sublot 2 is from Sta 16+00 to 22+00
Sublot 3 is from Sta 22+00 to 28+00
Sublot 4 is from Sta 28+00 to 34+00
Sublot 5 is from Sta 34+00 to 40+00
Sublot 6 is from Sta 40+00 to 46+00
Sublot 7 is from Sta 46+00 to 52+00
Sublot 8 is from Sta 52+00 to 58+00
Sublot 9 is from Sta 58+00 to 64+00
Sublot 10 is from Sta 64+00 to 70+00

Then, determine the specific location to be sampled from each sublot;

Random numbers are generated in accordance with Attachment #1. Two random numbers are required for each sample location; one for the station, and one for the offset. For the sake of this example, assume the random numbers generated are as follows:

Random Numbers for Stationing:

0.475, 0.721, 0.496, 0.272, 0.458, 0.694, 0.410, 0.150, 0.055, 0455

Random Number for Offsets:

0.056, 0.939, 0.839, 0.800, 0.705, 0.047, 0.236, .0991, 0.170, 0.699

Multiply the first random number (Stationing) by the length of the sublot, and add that to the beginning station of the sublot. Multiply the first random number (Offsets) by the width subject to testing. Round the station to the nearest 1 foot and the offset to the nearest 0.5 foot. The resulting station and offset determines the location for the sample. The process is continued for each sublot;

Sample 1: Station = (0.475 x 600) + Sta 10+00 = Sta 12+85
Offset = (0.056 x 11) = 0.5 ft

Sample 2: Station = (0.721 x 600) + Sta 16+00 = Sta 20+33
Offset = (0.939 x 11) = 10.5 ft

Sample 3: Station = (0.496 x 600) + Sta 22+00 = Sta 24+98
Offset = (0.839 x 11) = 9.0 ft

Sample 4: Station = (0.272 x 600) + Sta 28+00 = Sta 29+63
Offset = (0.800 x 12.45) = 10.0 ft

NOTE: The pavement width at this location varies. The actual width of pavement at each station must be calculated in order to determine the sample offset.

Sample 5: Station = (0.458 x 600) + Sta 34+00 = Sta 36+75
Offset = (0.705 x 15) = 10.5 ft

Sample 6: Station = (0.694 x 600) + Sta 40+00 = Sta 44+16
Offset = (0.047 x 15) = 0.5 ft

Sample 7: Station = (0.410 x 600) + Sta 46+00 = Sta 48+46
Offset = (0.236 x 14) = 3.5 ft

Sample 8: Station = (0.150 x 600) + Sta 52+00 = Sta 52+90
Offset = (0.991 x 14) = 14.0 ft

Sample 9: Station = (0.055 x 600) + Sta 58+00 = Sta 58+33
Offset = (0.170 x 14) = 2.5 ft

Sample 10: Station = (0.455 x 600) + Sta 64+00 = Sta 66+73
Offset = (0.699 x 14) = 10.0 ft

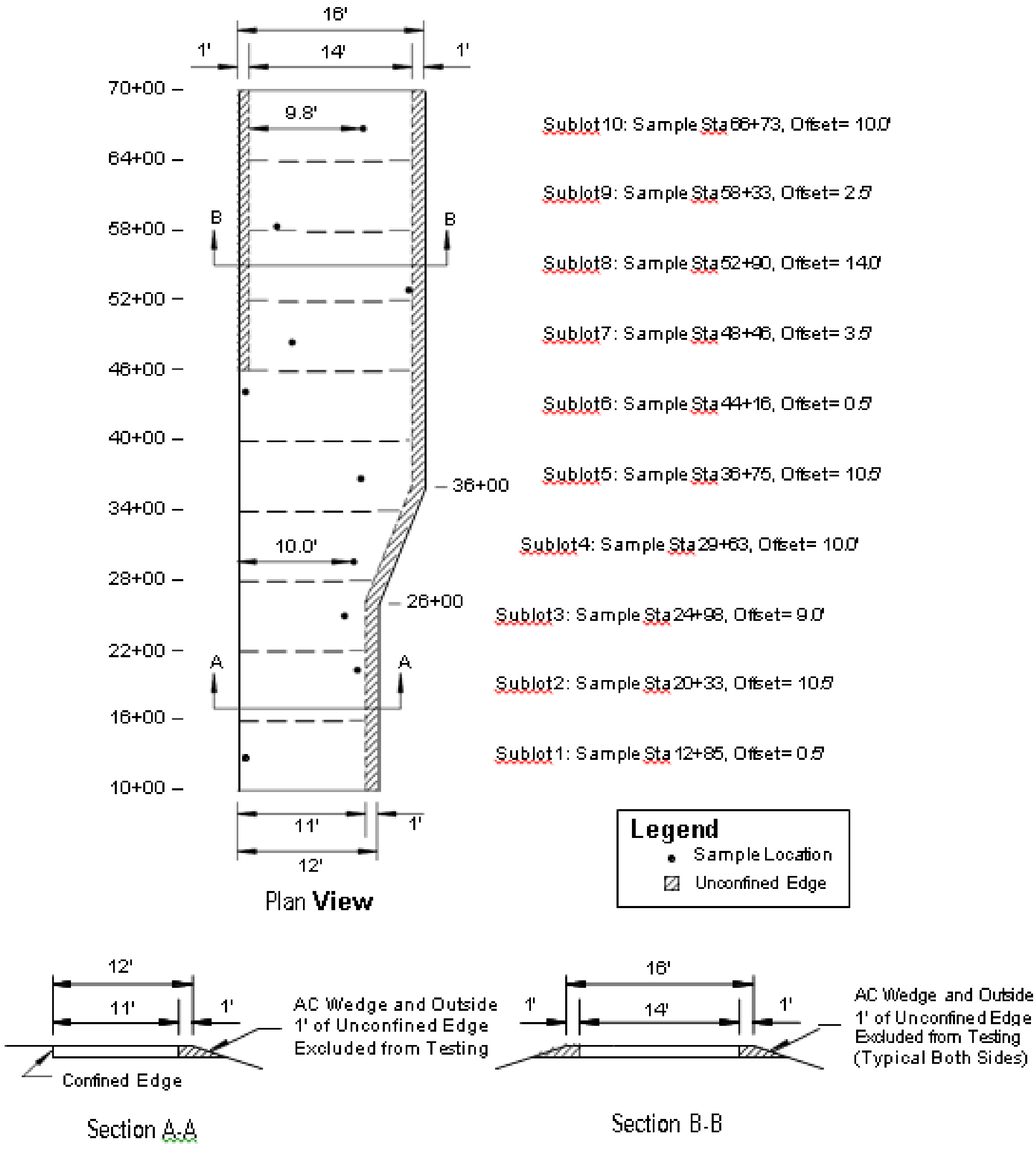

Figure 2
(Not to Scale)

EXAMPLE 5:

Assume the same conditions as outlined in Example 4. However, when laying out Sample 9 it is discovered that a manhole exists at the sample location.

When a sample location falls within an area not subject to testing, a new random location must be determined. It is not acceptable to arbitrarily move a sample location.

Determine a new sample location for Sample 9;

For the sake of this example, assume the new random numbers generated are as follows:

Random number for new station: 0.730

Random number for new offset: 0.412

Sample 9: Station = (0.730 x 600) + Sta 58+00 = Sta 62+38
Offset = (0.412 x 14) = 6.0 ft

Attachment (1)

METHODS FOR SELECTING RANDOM NUMBERS

There are several acceptable methods for selecting random numbers including the use of a calculator, computer spreadsheet, or a random number table.

1) Many calculators have a random number function that can be used to determine random numbers. Each calculator is different and the user should review the manual for a given calculator to determine how to use this function. Sets of random numbers may be generated directly from the calculator by repeated use of this function.

2) Most computer spreadsheets also have a function to generate random numbers. A procedure similar to that described above for calculators can be used to generate a set of random numbers using a computer spreadsheet.

3) In order to properly use a random number table, two “seed” numbers must first be selected to determine a starting row and column within the table. Seed numbers may be determined using a calculator or computer spreadsheet as described above, or they can be determined by “pointing”. To select seed numbers by pointing, place the random number table in front of you and with your eyes closed place a pointer on the table to select the seed number. Suitable pointers would be any devise with a small tip including a pen or mechanical pencil.

   Once two seed numbers are selected, they can be used to determine the starting point for selecting random numbers within the random number table. The first seed number should be multiplied by the number of rows in the table. That product is rounded to the nearest whole number and determines the row for the starting point. The second seed number should be multiplied by the number of columns in the table. That product is rounded to the nearest whole number and determines the column for the starting point. The random number at the intersection of the starting row and column is the first random number used in determining the random sample location. Additional random numbers are selected by moving to the right along the row, or down along the column, until the required number of random numbers are generated. Once the end of a row or column is reached, simply start at the beginning of the next row or column to continue recording random numbers.

4) As an alternate to the methods given above for determining random numbers, the standard practice described in ASTM D3665, “Practice for Random Sampling of Construction Materials”, can be used if desired.

Random Number Table

	1	2	3	4	5	6	7	8	9	10
1	0.566	0.282	0.133	0.355	0.016	0.915	0.813	0.695	0.524	0.309
2	0.706	0.702	0.539	0.107	0.557	0.981	0.959	0.393	0.069	0.746
3	0.113	0.924	0.855	0.781	0.755	0.326	0.071	0.642	0.153	0.646
4	0.129	0.688	0.575	0.584	0.073	0.615	0.384	0.058	0.053	0.992
5	0.031	0.224	0.400	0.324	0.886	0.171	0.768	0.164	0.036	0.921
6	0.944	0.986	0.295	0.664	0.226	0.963	0.546	0.151	0.881	0.586
7	0.484	0.377	0.246	0.852	0.444	0.004	0.335	0.198	0.222	0.078
8	0.193	0.824	0.184	0.828	0.442	0.859	0.890	0.797	0.104	0.571
9	0.872	0.042	0.191	0.650	0.630	0.941	0.091	0.826	0.491	0.519
10	0.213	0.795	0.464	0.773	0.648	0.622	0.024	0.870	0.604	0.056
11	0.606	0.522	0.511	0.408	0.480	0.386	0.460	0.297	0.666	0.344
12	0.446	0.155	0.788	0.595	0.178	0.488	0.961	0.684	0.448	0.639
13	0.500	0.804	0.990	0.999	0.917	0.375	0.426	0.761	0.839	0.770
14	0.879	0.841	0.293	0.697	0.497	0.202	0.120	0.932	0.082	0.559
15	0.240	0.486	0.422	0.679	0.064	0.553	0.440	0.366	0.357	0.850
16	0.764	0.466	0.904	0.884	0.579	0.662	0.238	0.051	0.373	0.562
17	0.753	0.719	0.262	0.200	0.699	0.997	0.515	0.127	0.806	0.713
18	0.109	0.682	0.289	0.637	0.628	0.741	0.910	0.830	0.027	0.431
19	0.060	0.395	0.369	0.206	0.313	0.244	0.304	0.009	0.710	0.817
20	0.131	0.147	0.864	0.528	0.140	0.937	0.597	0.790	0.801	0.451
21	0.766	0.810	0.608	0.799	0.218	0.471	0.435	0.919	0.173	0.617
22	0.095	0.204	0.673	0.535	0.300	0.599	0.286	0.093	0.482	0.100
23	0.397	0.693	0.952	0.229	0.302	0.089	0.613	0.317	0.868	0.759
24	0.284	0.593	0.737	0.135	0.269	0.258	0.544	0.946	0.717	0.266
25	0.002	0.195	0.411	0.551	0.124	0.311	0.906	0.044	0.271	0.437
26	0.728	0.329	0.473	0.337	0.175	0.404	0.273	0.977	0.675	0.331
27	0.815	0.115	0.577	0.633	0.939	0.315	0.098	0.306	0.102	0.138
28	0.591	0.362	0.186	0.644	0.568	0.901	0.624	0.948	0.690	0.162
29	0.029	0.757	0.793	0.291	0.049	0.837	0.537	0.655	0.526	0.322
30	0.013	0.433	0.382	0.346	0.349	0.892	0.144	0.602	0.508	0.808
31	0.908	0.351	0.928	0.080	0.158	0.180	0.555	0.075	0.744	0.364
32	0.708	0.160	0.209	0.231	0.122	0.517	0.775	0.417	0.424	0.320
33	0.189	0.877	0.453	0.233	0.844	0.406	0.777	0.260	0.735	0.220
34	0.930	0.748	0.988	0.242	0.950	0.857	0.380	0.504	0.730	0.875
35	0.333	0.888	0.897	0.513	0.653	0.087	0.912	0.167	0.249	0.255
36	0.895	0.468	0.786	0.169	0.704	0.668	0.018	0.972	0.111	0.280
37	0.784	0.833	0.391	0.142	0.118	0.278	0.819	0.067	0.686	0.402
38	0.955	0.415	0.420	0.040	0.821	0.033	0.211	0.935	0.475	0.251
39	0.619	0.493	0.084	0.235	0.462	0.353	0.506	0.899	0.722	0.011
40	0.340	0.020	0.750	0.564	0.724	0.975	0.626	0.957	0.253	0.670
41	0.371	0.926	0.360	0.038	0.428	0.455	0.966	0.007	0.548	0.531
42	0.495	0.477	0.611	0.182	0.657	0.149	0.848	0.588	0.342	0.726
43	0.635	0.835	0.022	0.779	0.979	0.062	0.275	0.995	0.533	0.866
44	0.582	0.457	0.739	0.264	0.677	0.542	0.983	0.413	0.968	0.389
45	0.861	0.659	0.970	0.715	0.502	0.846	0.047	0.573	0.733	0.215