



Ambrogio

composer

MY FIRST CENTS

Ambrogio Riva

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Modify rhythmic loops' time

The tempo and pitch of a sound are closely related and here I want to deepen the mathematical aspects of the relationship time/picht.

There are various ways to "keep time" of rhythmic loops , now all sequencers and VST provide different functions of time-stretching.

In software samplers each midi note can start an audio loop.

In the section Mod / Tune of the sampler Steinberg Halion , which we will use for our evaluations , for pitch checking a resolution up to "cent" of "coarse" (hundredths of a semitone) is expected.

If I lower the pitch of a drum loop (with the option "NoTraspose" selected) this sounds in a slower tempo and vice versa.

If I want to use this feature to "keep time" audio loops and use them as a rhythmic base for a song I must set a rule to match the tempo of the loop with that my song.

For a first evaluation I took a 100bpm loop and executed pitch corrections in semitoni (coarse).

The results "by ear", and therefore rounded up, are the following:

-12=50bpm	-11=52bpm	-10=55bpm	-9=58,5bpm
-8=62bpm	-7=65bpm	-6=70bpm	-5=74bpm
-4=78bpm	-3=83,5bpm	-2=90bpm	-1=96,5bpm
+1=106bpm	+2=113bpm	+3=120bpm	+4=126bpm
+5=134bpm	+6=142bpm	+7=150bpm	+8=159bpm
+9=168bpm	+10=178bpm	+11=189bpm	+12=200bpm

The time difference decreases by lowering the tone (just 2 bpm going from -11 to -12 semitones) and increases by raising the pitch (11 bpm going from +11 to +12)

The constant factor is a ratio of about 1.06 between a time and the following one.

The frequency of the middle LA is 440Hz , of the upper octave is 880Hz, exactly doubled.

This coincides with a doubling time of the loop (from 100 bpm to 200bpm) by increasing the pitch by one octave and halvening (from 100bpm 50 bpm) decreasing the pitch by one octave.

Being divided in cents (100cents = 1 half-step) from an octave to another there are 1200 cents.

The number that raised to the power of 1200 (the cents in an octave) gives me 2 (the ratio between the frequency of a sound and the one of a superior octave) is:

1,0005777895065548592967925757932

If I want to synchronize a drum loop with original time 80bpm with a song on 84bpm time I must find the exponent n of 1.0005777895 I resulting in the ratio between the highest and the lowest value: $84/80 = 5.1$

As an example I attach a table with the rounded-up results corresponding to the 1200 cent of pitch correction.

In the table the closest value to the ratio 1.05 is 84 cents.

From the example above it is clear that the values shown in the table (corresponding to 1200 cents) will not coincide with the relationship between the two times (original loop time and song time)

<i>original loop time</i>	<i>80 bpm</i>
<i>song time</i>	<i>84 bpm</i>
<i>relationship between the two times (84/80)</i>	<i>1,05</i>
<i>nearest table value 84 cents</i>	<i>1,04971668362255</i>
<i>Time loop + 84 cents (80 x 1,04971668362255)</i>	<i>83,977 bpm</i>

In case, as for the previous example , the ratio is approximately in between two values I can possibly listen to both decide which one to adopt.

<i>Higher table value (85 cent)</i>	<i>1,0503231989072</i>
<i>Time loop + 85 cents (80 x 1,0503231989072)</i>	<i>84,026 bpm</i>

If the rhythm loop is a few bars the deviation does not affect the loop as this "imperceptible" advance or delay is to be part of the loop "groove"

<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>
0 01=1,0006	0 31=1,0181	0 61=1,0359	0 91=1,0540	1 21=1,0724
0 02=1,0012	0 32=1,0187	0 62=1,0365	0 92=1,0546	1 22=1,0730
0 03=1,0017	0 33=1,0192	0 63=1,0371	0 93=1,0552	1 23=1,0736
0 04=1,0023	0 34=1,0198	0 64=1,0377	0 94=1,0558	1 24=1,0743
0 05=1,0029	0 35=1,0204	0 65=1,0383	0 95=1,0564	1 25=1,0749
0 06=1,0035	0 36=1,0210	0 66=1,0389	0 96=1,0570	1 26=1,0755
0 07=1,0041	0 37=1,0216	0 67=1,0395	0 97=1,0576	1 27=1,0761
0 08=1,0046	0 38=1,0222	0 68=1,0401	0 98=1,0582	1 28=1,0767
0 09=1,0052	0 39=1,0228	0 69=1,0407	0 99=1,0589	1 29=1,0774
0 10=1,0058	0 40=1,0234	0 70=1,0413	1 00=1,0595	1 30=1,0780
0 11=1,0064	0 41=1,0240	0 71=1,0419	1 01=1,0601	1 31=1,0786
0 12=1,0070	0 42=1,0246	0 72=1,0425	1 02=1,0607	1 32=1,0792
0 13=1,0075	0 43=1,0251	0 73=1,0431	1 03=1,0613	1 33=1,0799
0 14=1,0081	0 44=1,0257	0 74=1,0437	1 04=1,0619	1 34=1,0805
0 15=1,0087	0 45=1,0263	0 75=1,0443	1 05=1,0625	1 35=1,0811
0 16=1,0093	0 46=1,0269	0 76=1,0449	1 06=1,0631	1 36=1,0817
0 17=1,0099	0 47=1,0275	0 77=1,0455	1 07=1,0638	1 37=1,0823
0 18=1,0105	0 48=1,0281	0 78=1,0461	1 08=1,0644	1 38=1,0830
0 19=1,0110	0 49=1,0287	0 79=1,0467	1 09=1,0650	1 39=1,0836
0 20=1,0116	0 50=1,0293	0 80=1,0473	1 10=1,0656	1 40=1,0842
0 21=1,0122	0 51=1,0299	0 81=1,0479	1 11=1,0662	1 41=1,0849
0 22=1,0128	0 52=1,0305	0 82=1,0485	1 12=1,0668	1 42=1,0855
0 23=1,0134	0 53=1,0311	0 83=1,0491	1 13=1,0674	1 43=1,0861
0 24=1,0140	0 54=1,0317	0 84=1,0497	1 14=1,0681	1 44=1,0867
0 25=1,0145	0 55=1,0323	0 85=1,0503	1 15=1,0687	1 45=1,0874
0 26=1,0151	0 56=1,0329	0 86=1,0509	1 16=1,0693	1 46=1,0880
0 27=1,0157	0 57=1,0335	0 87=1,0515	1 17=1,0699	1 47=1,0886
0 28=1,0163	0 58=1,0341	0 88=1,0521	1 18=1,0705	1 48=1,0892
0 29=1,0169	0 59=1,0347	0 89=1,0528	1 19=1,0712	1 49=1,0899
0 30=1,0175	0 60=1,0353	0 90=1,0534	1 20=1,0718	1 50=1,0905

<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>
1 51=1,0911	1 81=1,1102	2 11=1,1296	2 41=1,1494	2 71=1,1695
1 52=1,0918	1 82=1,1109	2 12=1,1303	2 42=1,1500	2 72=1,1701
1 53=1,0924	1 83=1,1115	2 13=1,1309	2 43=1,1507	2 73=1,1708
1 54=1,0930	1 84=1,1121	2 14=1,1316	2 44=1,1514	2 74=1,1715
1 55=1,0937	1 85=1,1128	2 15=1,1322	2 45=1,1520	2 75=1,1722
1 56=1,0943	1 86=1,1134	2 16=1,1329	2 46=1,1527	2 76=1,1728
1 57=1,0949	1 87=1,1141	2 17=1,1335	2 47=1,1534	2 77=1,1735
1 58=1,0956	1 88=1,1147	2 18=1,1342	2 48=1,1540	2 78=1,1742
1 59=1,0962	1 89=1,1154	2 19=1,1348	2 49=1,1547	2 79=1,1749
1 60=1,0968	1 90=1,1160	2 20=1,1355	2 50=1,1554	2 80=1,1755
1 61=1,0975	1 91=1,1166	2 21=1,1362	2 51=1,1560	2 81=1,1762
1 62=1,0981	1 92=1,1173	2 22=1,1368	2 52=1,1567	2 82=1,1769
1 63=1,0987	1 93=1,1179	2 23=1,1375	2 53=1,1574	2 83=1,1776
1 64=1,0994	1 94=1,1186	2 24=1,1381	2 54=1,1580	2 84=1,1783
1 65=1,1000	1 95=1,1192	2 25=1,1388	2 55=1,1587	2 85=1,1789
1 66=1,1006	1 96=1,1199	2 26=1,1394	2 56=1,1594	2 86=1,1796
1 67=1,1013	1 97=1,1205	2 27=1,1401	2 57=1,1600	2 87=1,1803
1 68=1,1019	1 98=1,1212	2 28=1,1408	2 58=1,1607	2 88=1,1810
1 69=1,1025	1 99=1,1218	2 29=1,1414	2 59=1,1614	2 89=1,1817
1 70=1,1032	2 00=1,1225	2 30=1,1421	2 60=1,1620	2 90=1,1824
1 71=1,1038	2 01=1,1231	2 31=1,1427	2 61=1,1627	2 91=1,1830
1 72=1,1045	2 02=1,1238	2 32=1,1434	2 62=1,1634	2 92=1,1837
1 73=1,1051	2 03=1,1244	2 33=1,1441	2 63=1,1641	2 93=1,1844
1 74=1,1057	2 04=1,1251	2 34=1,1447	2 64=1,1647	2 94=1,1851
1 75=1,1064	2 05=1,1257	2 35=1,1454	2 65=1,1654	2 95=1,1858
1 76=1,1070	2 06=1,1264	2 36=1,1460	2 66=1,1661	2 96=1,1865
1 77=1,1076	2 07=1,1270	2 37=1,1467	2 67=1,1668	2 97=1,1871
1 78=1,1083	2 08=1,1277	2 38=1,1474	2 68=1,1674	2 98=1,1878
1 79=1,1089	2 09=1,1283	2 39=1,1480	2 69=1,1681	2 99=1,1885
1 80=1,1096	2 10=1,1290	2 40=1,1487	2 70=1,1688	3 00=1,1892

<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>
3 01=1,1899	3 31=1,2107	3 61=1,2319	3 91=1,2534	4 21=1,2753
3 02=1,1906	3 32=1,2114	3 62=1,2326	3 92=1,2541	4 22=1,2760
3 03=1,1913	3 33=1,2121	3 63=1,2333	3 93=1,2548	4 23=1,2768
3 04=1,1920	3 34=1,2128	3 64=1,2340	3 94=1,2556	4 24=1,2775
3 05=1,1926	3 35=1,2135	3 65=1,2347	3 95=1,2563	4 25=1,2782
3 06=1,1933	3 36=1,2142	3 66=1,2354	3 96=1,2570	4 26=1,2790
3 07=1,1940	3 37=1,2149	3 67=1,2361	3 97=1,2577	4 27=1,2797
3 08=1,1947	3 38=1,2156	3 68=1,2368	3 98=1,2585	4 28=1,2805
3 09=1,1954	3 39=1,2163	3 69=1,2376	3 99=1,2592	4 29=1,2812
3 10=1,1961	3 40=1,2170	3 70=1,2383	4 00=1,2599	4 30=1,2819
3 11=1,1968	3 41=1,2177	3 71=1,2390	4 01=1,2606	4 31=1,2827
3 12=1,1975	3 42=1,2184	3 72=1,2397	4 02=1,2614	4 32=1,2834
3 13=1,1982	3 43=1,2191	3 73=1,2404	4 03=1,2621	4 33=1,2842
3 14=1,1989	3 44=1,2198	3 74=1,2411	4 04=1,2628	4 34=1,2849
3 15=1,1996	3 45=1,2205	3 75=1,2419	4 05=1,2636	4 35=1,2857
3 16=1,2002	3 46=1,2212	3 76=1,2426	4 06=1,2643	4 36=1,2864
3 17=1,2009	3 47=1,2219	3 77=1,2433	4 07=1,2650	4 37=1,2871
3 18=1,2016	3 48=1,2226	3 78=1,2440	4 08=1,2658	4 38=1,2879
3 19=1,2023	3 49=1,2233	3 79=1,2447	4 09=1,2665	4 39=1,2886
3 20=1,2030	3 50=1,2241	3 80=1,2454	4 10=1,2672	4 40=1,2894
3 21=1,2037	3 51=1,2248	3 81=1,2462	4 11=1,2680	4 41=1,2901
3 22=1,2044	3 52=1,2255	3 82=1,2469	4 12=1,2687	4 42=1,2909
3 23=1,2051	3 53=1,2262	3 83=1,2476	4 13=1,2694	4 43=1,2916
3 24=1,2058	3 54=1,2269	3 84=1,2483	4 14=1,2702	4 44=1,2924
3 25=1,2065	3 55=1,2276	3 85=1,2491	4 15=1,2709	4 45=1,2931
3 26=1,2072	3 56=1,2283	3 86=1,2498	4 16=1,2716	4 46=1,2938
3 27=1,2079	3 57=1,2290	3 87=1,2505	4 17=1,2724	4 47=1,2946
3 28=1,2086	3 58=1,2297	3 88=1,2512	4 18=1,2731	4 48=1,2953
3 29=1,2093	3 59=1,2304	3 89=1,2519	4 19=1,2738	4 49=1,2961
3 30=1,2100	3 60=1,2311	3 90=1,2527	4 20=1,2746	4 50=1,2968

<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>
4 51=1,2976	4 81=1,3203	5 11=1,3433	5 41=1,3668	5 71=1,3907
4 52=1,2983	4 82=1,3210	5 12=1,3441	5 42=1,3676	5 72=1,3915
4 53=1,2991	4 83=1,3218	5 13=1,3449	5 43=1,3684	5 73=1,3923
4 54=1,2998	4 84=1,3226	5 14=1,3457	5 44=1,3692	5 74=1,3931
4 55=1,3006	4 85=1,3233	5 15=1,3465	5 45=1,3700	5 75=1,3939
4 56=1,3013	4 86=1,3241	5 16=1,3472	5 46=1,3708	5 76=1,3947
4 57=1,3021	4 87=1,3249	5 17=1,3480	5 47=1,3716	5 77=1,3955
4 58=1,3028	4 88=1,3256	5 18=1,3488	5 48=1,3724	5 78=1,3964
4 59=1,3036	4 89=1,3264	5 19=1,3496	5 49=1,3732	5 79=1,3972
4 60=1,3044	4 90=1,3272	5 20=1,3503	5 50=1,3740	5 80=1,3980
4 61=1,3051	4 91=1,3279	5 21=1,3511	5 51=1,3747	5 81=1,3988
4 62=1,3059	4 92=1,3287	5 22=1,3519	5 52=1,3755	5 82=1,3996
4 63=1,3066	4 93=1,3295	5 23=1,3527	5 53=1,3763	5 83=1,4004
4 64=1,3074	4 94=1,3302	5 24=1,3535	5 54=1,3771	5 84=1,4012
4 65=1,3081	4 95=1,3310	5 25=1,3543	5 55=1,3779	5 85=1,4020
4 66=1,3089	4 96=1,3318	5 26=1,3550	5 56=1,3787	5 86=1,4028
4 67=1,3096	4 97=1,3325	5 27=1,3558	5 57=1,3795	5 87=1,4036
4 68=1,3104	4 98=1,3333	5 28=1,3566	5 58=1,3803	5 88=1,4044
4 69=1,3112	4 99=1,3341	5 29=1,3574	5 59=1,3811	5 89=1,4053
4 70=1,3119	5 00=1,3348	5 30=1,3582	5 60=1,3819	5 90=1,4061
4 71=1,3127	5 01=1,3356	5 31=1,3590	5 61=1,3827	5 91=1,4069
4 72=1,3134	5 02=1,3364	5 32=1,3597	5 62=1,3835	5 92=1,4077
4 73=1,3142	5 03=1,3372	5 33=1,3605	5 63=1,3843	5 93=1,4085
4 74=1,3149	5 04=1,3379	5 34=1,3613	5 64=1,3851	5 94=1,4093
4 75=1,3157	5 05=1,3387	5 35=1,3621	5 65=1,3859	5 95=1,4101
4 76=1,3165	5 06=1,3395	5 36=1,3629	5 66=1,3867	5 96=1,4109
4 77=1,3172	5 07=1,3402	5 37=1,3637	5 67=1,3875	5 97=1,4118
4 78=1,3180	5 08=1,3410	5 38=1,3645	5 68=1,3883	5 98=1,4126
4 79=1,3187	5 09=1,3418	5 39=1,3653	5 69=1,3891	5 99=1,4134
4 80=1,3195	5 10=1,3426	5 40=1,3660	5 70=1,3899	6 00=1,4142

<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>
6 01=1,4150	6 31=1,4398	6 61=1,4649	6 91=1,4905	7 21=1,5166
6 02=1,4158	6 32=1,4406	6 62=1,4658	6 92=1,4914	7 22=1,5175
6 03=1,4167	6 33=1,4414	6 63=1,4666	6 93=1,4923	7 23=1,5183
6 04=1,4175	6 34=1,4423	6 64=1,4675	6 94=1,4931	7 24=1,5192
6 05=1,4183	6 35=1,4431	6 65=1,4683	6 95=1,4940	7 25=1,5201
6 06=1,4191	6 36=1,4439	6 66=1,4692	6 96=1,4948	7 26=1,5210
6 07=1,4199	6 37=1,4448	6 67=1,4700	6 97=1,4957	7 27=1,5219
6 08=1,4208	6 38=1,4456	6 68=1,4709	6 98=1,4966	7 28=1,5227
6 09=1,4216	6 39=1,4464	6 69=1,4717	6 99=1,4974	7 29=1,5236
6 10=1,4224	6 40=1,4473	6 70=1,4726	7 00=1,4983	7 30=1,5245
6 11=1,4232	6 41=1,4481	6 71=1,4734	7 01=1,4992	7 31=1,5254
6 12=1,4241	6 42=1,4489	6 72=1,4743	7 02=1,5000	7 32=1,5263
6 13=1,4249	6 43=1,4498	6 73=1,4751	7 03=1,5009	7 33=1,5271
6 14=1,4257	6 44=1,4506	6 74=1,4760	7 04=1,5018	7 34=1,5280
6 15=1,4265	6 45=1,4515	6 75=1,4768	7 05=1,5026	7 35=1,5289
6 16=1,4273	6 46=1,4523	6 76=1,4777	7 06=1,5035	7 36=1,5298
6 17=1,4282	6 47=1,4531	6 77=1,4785	7 07=1,5044	7 37=1,5307
6 18=1,4290	6 48=1,4540	6 78=1,4794	7 08=1,5052	7 38=1,5316
6 19=1,4298	6 49=1,4548	6 79=1,4802	7 09=1,5061	7 39=1,5324
6 20=1,4306	6 50=1,4557	6 80=1,4811	7 10=1,5070	7 40=1,5333
6 21=1,4315	6 51=1,4565	6 81=1,4820	7 11=1,5079	7 41=1,5342
6 22=1,4323	6 52=1,4573	6 82=1,4828	7 12=1,5087	7 42=1,5351
6 23=1,4331	6 53=1,4582	6 83=1,4837	7 13=1,5096	7 43=1,5360
6 24=1,4340	6 54=1,4590	6 84=1,4845	7 14=1,5105	7 44=1,5369
6 25=1,4348	6 55=1,4599	6 85=1,4854	7 15=1,5113	7 45=1,5378
6 26=1,4356	6 56=1,4607	6 86=1,4862	7 16=1,5122	7 46=1,5387
6 27=1,4364	6 57=1,4616	6 87=1,4871	7 17=1,5131	7 47=1,5395
6 28=1,4373	6 58=1,4624	6 88=1,4880	7 18=1,5140	7 48=1,5404
6 29=1,4381	6 59=1,4632	6 89=1,4888	7 19=1,5148	7 49=1,5413
6 30=1,4389	6 60=1,4641	6 90=1,4897	7 20=1,5157	7 50=1,5422

<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>
7 51=1,5431	7 81=1,5701	8 11=1,5975	8 41=1,6254	8 71=1,6539
7 52=1,5440	7 82=1,5710	8 12=1,5984	8 42=1,6264	8 72=1,6548
7 53=1,5449	7 83=1,5719	8 13=1,5994	8 43=1,6273	8 73=1,6558
7 54=1,5458	7 84=1,5728	8 14=1,6003	8 44=1,6283	8 74=1,6567
7 55=1,5467	7 85=1,5737	8 15=1,6012	8 45=1,6292	8 75=1,6577
7 56=1,5476	7 86=1,5746	8 16=1,6021	8 46=1,6301	8 76=1,6586
7 57=1,5485	7 87=1,5755	8 17=1,6031	8 47=1,6311	8 77=1,6596
7 58=1,5494	7 88=1,5764	8 18=1,6040	8 48=1,6320	8 78=1,6606
7 59=1,5502	7 89=1,5773	8 19=1,6049	8 49=1,6330	8 79=1,6615
7 60=1,5511	7 90=1,5783	8 20=1,6058	8 50=1,6339	8 80=1,6625
7 61=1,5520	7 91=1,5792	8 21=1,6068	8 51=1,6349	8 81=1,6634
7 62=1,5529	7 92=1,5801	8 22=1,6077	8 52=1,6358	8 82=1,6644
7 63=1,5538	7 93=1,5810	8 23=1,6086	8 53=1,6367	8 83=1,6654
7 64=1,5547	7 94=1,5819	8 24=1,6096	8 54=1,6377	8 84=1,6663
7 65=1,5556	7 95=1,5828	8 25=1,6105	8 55=1,6386	8 85=1,6673
7 66=1,5565	7 96=1,5837	8 26=1,6114	8 56=1,6396	8 86=1,6682
7 67=1,5574	7 97=1,5847	8 27=1,6124	8 57=1,6405	8 87=1,6692
7 68=1,5583	7 98=1,5856	8 28=1,6133	8 58=1,6415	8 88=1,6702
7 69=1,5592	7 99=1,5865	8 29=1,6142	8 59=1,6424	8 89=1,6711
7 70=1,5601	8 00=1,5874	8 30=1,6151	8 60=1,6434	8 90=1,6721
7 71=1,5610	8 01=1,5883	8 31=1,6161	8 61=1,6443	8 91=1,6731
7 72=1,5619	8 02=1,5892	8 32=1,6170	8 62=1,6453	8 92=1,6740
7 73=1,5628	8 03=1,5902	8 33=1,6179	8 63=1,6462	8 93=1,6750
7 74=1,5637	8 04=1,5911	8 34=1,6189	8 64=1,6472	8 94=1,6760
7 75=1,5646	8 05=1,5920	8 35=1,6198	8 65=1,6481	8 95=1,6769
7 76=1,5655	8 06=1,5929	8 36=1,6208	8 66=1,6491	8 96=1,6779
7 77=1,5665	8 07=1,5938	8 37=1,6217	8 67=1,6500	8 97=1,6789
7 78=1,5674	8 08=1,5948	8 38=1,6226	8 68=1,6510	8 98=1,6799
7 79=1,5683	8 09=1,5957	8 39=1,6236	8 69=1,6519	8 99=1,6808
7 80=1,5692	8 10=1,5966	8 40=1,6245	8 70=1,6529	9 00=1,6818

<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>
9 01=1,6828	9 31=1,7122	9 61=1,7421	9 91=1,7726	10 21=1,8035
9 02=1,6837	9 32=1,7132	9 62=1,7431	9 92=1,7736	10 22=1,8046
9 03=1,6847	9 33=1,7142	9 63=1,7441	9 93=1,7746	10 23=1,8056
9 04=1,6857	9 34=1,7151	9 64=1,7451	9 94=1,7756	10 24=1,8067
9 05=1,6867	9 35=1,7161	9 65=1,7461	9 95=1,7767	10 25=1,8077
9 06=1,6876	9 36=1,7171	9 66=1,7471	9 96=1,7777	10 26=1,8088
9 07=1,6886	9 37=1,7181	9 67=1,7482	9 97=1,7787	10 27=1,8098
9 08=1,6896	9 38=1,7191	9 68=1,7492	9 98=1,7797	10 28=1,8108
9 09=1,6906	9 39=1,7201	9 69=1,7502	9 99=1,7808	10 29=1,8119
9 10=1,6915	9 40=1,7211	9 70=1,7512	10 00=1,7818	10 30=1,8129
9 11=1,6925	9 41=1,7221	9 71=1,7522	10 01=1,7828	10 31=1,8140
9 12=1,6935	9 42=1,7231	9 72=1,7532	10 02=1,7839	10 32=1,8150
9 13=1,6945	9 43=1,7241	9 73=1,7542	10 03=1,7849	10 33=1,8161
9 14=1,6954	9 44=1,7251	9 74=1,7552	10 04=1,7859	10 34=1,8171
9 15=1,6964	9 45=1,7261	9 75=1,7563	10 05=1,7870	10 35=1,8182
9 16=1,6974	9 46=1,7271	9 76=1,7573	10 06=1,7880	10 36=1,8192
9 17=1,6984	9 47=1,7281	9 77=1,7583	10 07=1,7890	10 37=1,8203
9 18=1,6994	9 48=1,7291	9 78=1,7593	10 08=1,7901	10 38=1,8213
9 19=1,7004	9 49=1,7301	9 79=1,7603	10 09=1,7911	10 39=1,8224
9 20=1,7013	9 50=1,7311	9 80=1,7613	10 10=1,7921	10 40=1,8234
9 21=1,7023	9 51=1,7321	9 81=1,7623	10 11=1,7932	10 41=1,8245
9 22=1,7033	9 52=1,7331	9 82=1,7634	10 12=1,7942	10 42=1,8256
9 23=1,7043	9 53=1,7341	9 83=1,7644	10 13=1,7952	10 43=1,8266
9 24=1,7053	9 54=1,7351	9 84=1,7654	10 14=1,7963	10 44=1,8277
9 25=1,7063	9 55=1,7361	9 85=1,7664	10 15=1,7973	10 45=1,8287
9 26=1,7072	9 56=1,7371	9 86=1,7674	10 16=1,7983	10 46=1,8298
9 27=1,7082	9 57=1,7381	9 87=1,7685	10 17=1,7994	10 47=1,8308
9 28=1,7092	9 58=1,7391	9 88=1,7695	10 18=1,8004	10 48=1,8319
9 29=1,7102	9 59=1,7401	9 89=1,7705	10 19=1,8015	10 49=1,8329
9 30=1,7112	9 60=1,7411	9 90=1,7715	10 20=1,8025	10 50=1,8340

<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>	<i>corse cent=rapp</i>
10 51=1,8351	10 81=1,8671	11 11=1,8998	11 41=1,9330	11 71=1,9668
10 52=1,8361	10 82=1,8682	11 12=1,9009	11 42=1,9341	11 72=1,9679
10 53=1,8372	10 83=1,8693	11 13=1,9020	11 43=1,9352	11 73=1,9691
10 54=1,8383	10 84=1,8704	11 14=1,9031	11 44=1,9363	11 74=1,9702
10 55=1,8393	10 85=1,8715	11 15=1,9042	11 45=1,9375	11 75=1,9713
10 56=1,8404	10 86=1,8725	11 16=1,9053	11 46=1,9386	11 76=1,9725
10 57=1,8414	10 87=1,8736	11 17=1,9064	11 47=1,9397	11 77=1,9736
10 58=1,8425	10 88=1,8747	11 18=1,9075	11 48=1,9408	11 78=1,9747
10 59=1,8436	10 89=1,8758	11 19=1,9086	11 49=1,9419	11 79=1,9759
10 60=1,8446	10 90=1,8769	11 20=1,9097	11 50=1,9431	11 80=1,9770
10 61=1,8457	10 91=1,8780	11 21=1,9108	11 51=1,9442	11 81=1,9782
10 62=1,8468	10 92=1,8790	11 22=1,9119	11 52=1,9453	11 82=1,9793
10 63=1,8478	10 93=1,8801	11 23=1,9130	11 53=1,9464	11 83=1,9805
10 64=1,8489	10 94=1,8812	11 24=1,9141	11 54=1,9476	11 84=1,9816
10 65=1,8500	10 95=1,8823	11 25=1,9152	11 55=1,9487	11 85=1,9827
10 66=1,8510	10 96=1,8834	11 26=1,9163	11 56=1,9498	11 86=1,9839
10 67=1,8521	10 97=1,8845	11 27=1,9174	11 57=1,9509	11 87=1,9850
10 68=1,8532	10 98=1,8856	11 28=1,9185	11 58=1,9521	11 88=1,9862
10 69=1,8542	10 99=1,8867	11 29=1,9196	11 59=1,9532	11 89=1,9873
10 70=1,8553	11 00=1,8877	11 30=1,9207	11 60=1,9543	11 90=1,9885
10 71=1,8564	11 01=1,8888	11 31=1,9219	11 61=1,9554	11 91=1,9896
10 72=1,8575	11 02=1,8899	11 32=1,9230	11 62=1,9566	11 92=1,9908
10 73=1,8585	11 03=1,8910	11 33=1,9241	11 63=1,9577	11 93=1,9919
10 74=1,8596	11 04=1,8921	11 34=1,9252	11 64=1,9588	11 94=1,9931
10 75=1,8607	11 05=1,8932	11 35=1,9263	11 65=1,9600	11 95=1,9942
10 76=1,8618	11 06=1,8943	11 36=1,9274	11 66=1,9611	11 96=1,9954
10 77=1,8628	11 07=1,8954	11 37=1,9285	11 67=1,9622	11 97=1,9965
10 78=1,8639	11 08=1,8965	11 38=1,9296	11 68=1,9634	11 98=1,9977
10 79=1,8650	11 09=1,8976	11 39=1,9308	11 69=1,9645	11 99=1,9988
10 80=1,8661	11 10=1,8987	11 40=1,9319	11 70=1,9656	12 00=2,0000