Estatística descritiva

Normalização dos dados

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Slides e notebook em:

github.com/tetsufmbio/IMD0033/

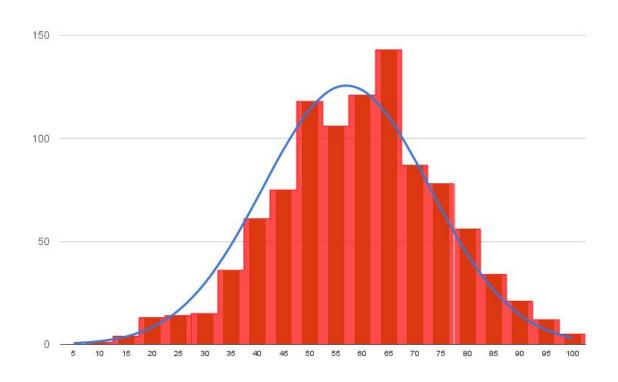
Objetivos da aula

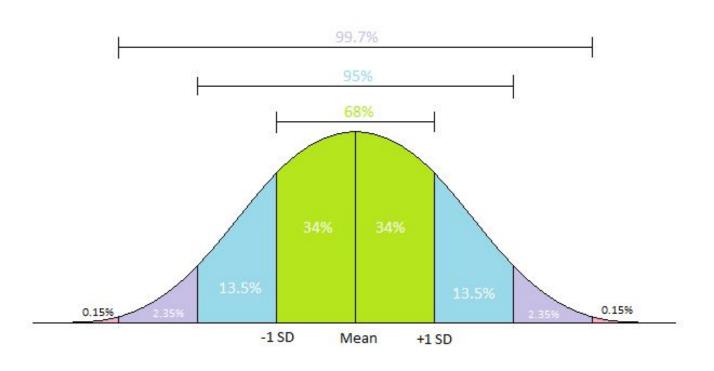
Noções de normalização dos dados

Z-score;

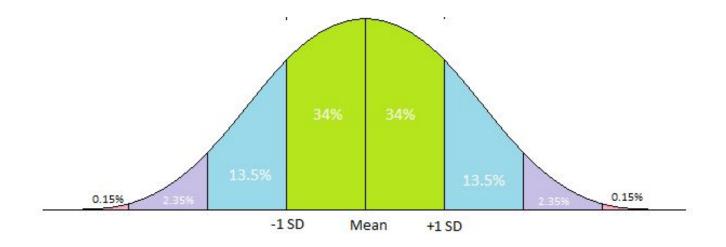
Medidas de dispersão dos dados:

- Amplitude;
- Amplitude entre os quartis;
- Variância e desvio padrão.

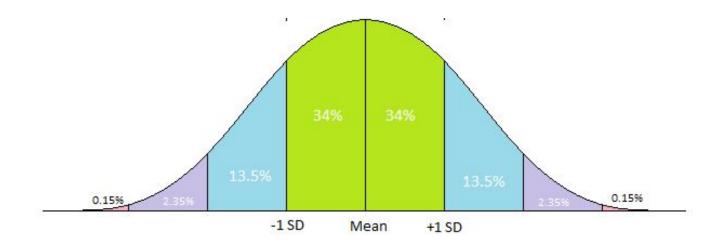




Média=60; desvio padrão=15; se eu tirei 75... 84% estão abaixo

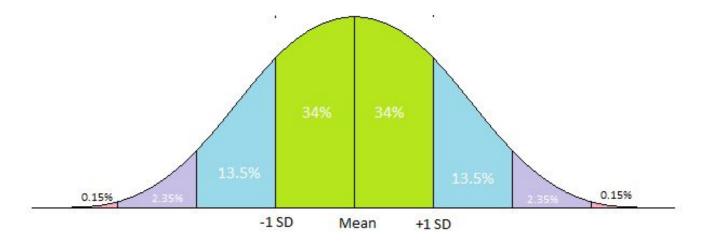


Média=60; desvio padrão=15; se eu tirei 80...



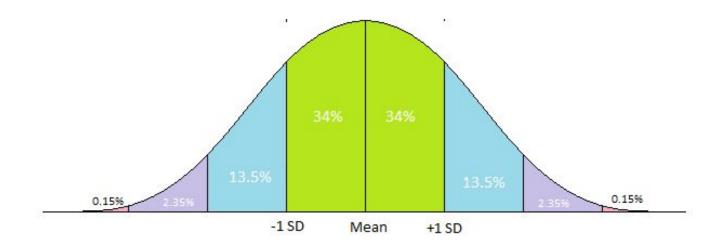
Função da distribuição normal

$$F(x) = \frac{1}{\sigma\sqrt{2\pi}}e^{-(x-\mu)^2/2\sigma^2}$$



Se eu tirei 80, quantos desvios padrão estou da média?

Média=60; desvio padrão=15

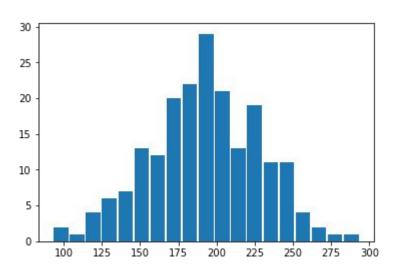


Z-score

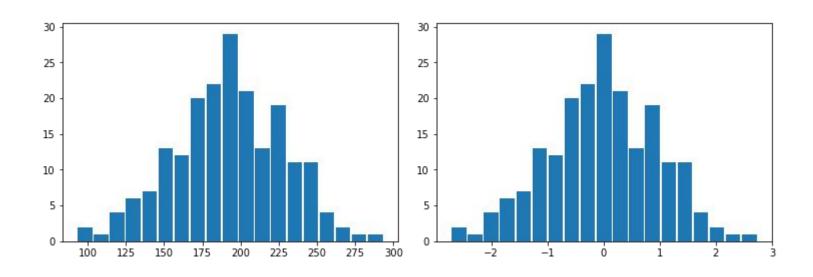
Z-score \rightarrow unidades de desvio padrão de um determinado valor em um conjunto de dados de média μ e desvio padrão σ .

$$z = \frac{x - \mu}{\sigma}$$

O que acontece se eu aplicar o z-score em todo dado...?



O que acontece se eu aplicar o z-score em todo dado...?



Qual é a média e o desvio padrão dos dados transformados em z-score?

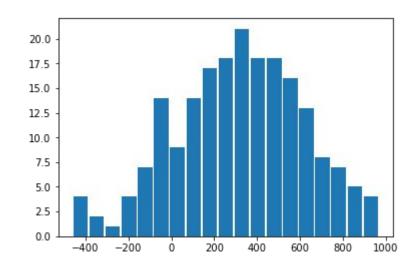
$$\mu = 0$$

$$\sigma = 1$$

Calcule o z-score para cada valor de um outro conjunto de dados...

Qual foi a média?

Qual foi o desvio padrão?



Quando os dados são transformados em z-score...

Ele se transforma em um conjunto de dados de:

- $\mu = 0$
- $\sigma = 1$

Transformar os dados em Z-score é uma forma de padronizar (normalizar) os dados;

Gera uma distribuição normal padrão.



Área sob a curva de uma distribuição normal padrão

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2} - \infty \le x \le \infty$$

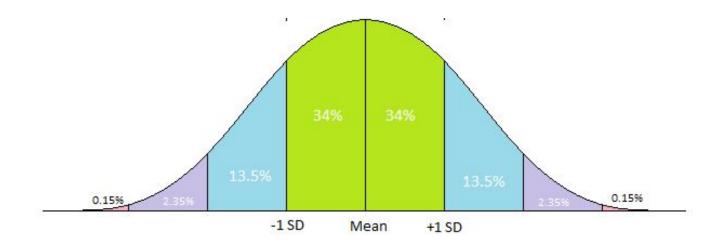
$$= \frac{1}{1 \times \sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-0}{1}\right)^2} - \infty \le x \le \infty$$

$$= \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}(z)^2} - \infty \le z \le \infty$$

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1.7 0.9554 0.9564 0.9573 0.9582 0.9591 0.9599 0.9608 0.9616 1.8 0.9641 0.9674 0.9666 0.9661 0.9671 0.9678 0.9681 0.9691 1.9 0.9713 0.9719 0.9776 0.9732 0.9738 0.9744 0.3730 0.9782 2.1 0.9821 0.9826 0.8330 0.9883 0.9973 0.9783 0.9893 0.9803 0.9882 2.2 0.9821 0.9824 0.3830 0.9881 0.8973 0.9878 0.9873 0.9884 0.9884 0.9871 0.8675 0.9873 0.9881 0.9894 0.9884 0.98871 0.8975 0.9978 0.9990 0.9991 0.9904 0.9904 0.9909 0.9991 0.9914 0.9945 0.9963 0.9987 0.9927 0.9928 0.9991 0.9941 0.9944 0.9945 0.9948 0.9969 0.9911 0.9946 0.9948 0.9969 0.9991 0.9946 0.9948 0.9969	0.9535 0.9545
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1.9 0.9713 0.9719 0.9726 0.9732 0.9738 0.9734 0.9734 0.9734 0.9734 0.9739 0.9788 0.9793 0.9783 0.9793 0.9783 0.9793 0.9783 0.9839 0.9830 0.9832 2.1 0.9821 0.9826 0.9830 0.9834 0.9838 0.9842 0.9846 0.9850 2.2 0.9861 0.9884 0.9884 0.9879 0.9878 0.9884 0.9884 2.3 0.8983 0.9896 0.9891 0.9901 0.9901 0.9901 0.9901 0.9903 0.9909 0.9911 2.4 0.9918 0.9920 0.9922 0.9922 0.9927 0.9923 0.9941 0.9944 0.9945 0.9946 0.9963 0.9968 0.9969 0.9961 0.9962 0.9962 0.9961 0.9961 0.9962 0.9962 0.9963 0.9966 0.9965 0.9965 0.9965 0.9965 0.9966 0.9967 0.9968 0.9966 0.9967 0.9968	0.9699 0.9706
2.0 0.9772 0.9778 0.9783 0.9788 0.9793 0.9788 0.8903 0.9803 0.9834 0.9833 0.9834 0.9833 0.9844 0.9838 0.9841 0.9838 0.9842 0.9838 0.9847 0.9878 0.9878 0.9881 0.9824 2.3 0.9893 0.9896 0.9991	0.9761 0.9767
2.1 0.9821 0.9826 0.9830 0.9833 0.9842 0.9846 0.9850 2.2 0.9861 0.9886 0.9871 0.9875 0.9878 0.9881 0.9891 2.3 0.9893 0.9896 0.9898 0.9901 0.9904 0.9906 0.9909 0.9911 2.4 0.9918 0.9920 0.9922 0.9922 0.9923 0.9931 0.9942 0.9943 0.9944 0.9946 0.9948 0.9948 2.5 0.9938 0.9940 0.9943 0.9944 0.9946 0.9948 0.9948 2.6 0.9953 0.9945 0.9967 0.9959 0.9960 0.9961 0.9962 2.7 0.9965 0.9967 0.9968 0.9969 0.9971 0.9971 0.9972	0.9812 0.9817
2.2 0.9861 0.9864 0.9888 0.9871 0.9875 0.9878 0.9881 0.9882 2.3 0.9893 0.9890 0.9991 0.9990 0.9991 0.9990 0.9991 0.9991 0.9992 0.9909 0.9911 2.4 0.9918 0.9920 0.9922 0.9927 0.9922 0.9923 0.9931 0.9941 0.9944 0.9944 0.9945 0.9948 0.9949 2.6 0.9953 0.9955 0.9966 0.9957 0.9959 0.9960 0.9961 0.9962 2.7 0.9965 0.9967 0.9968 0.9969 0.9971 0.9972	0.9854 0.9857
2.3 0.9893 0.9896 0.9898 0.9901 0.9904 0.9906 0.9909 0.9911 2.4 0.9918 0.9920 0.9922 0.9927 0.9927 0.9929 0.9927 2.5 0.9938 0.9940 0.9941 0.9943 0.9945 0.9946 0.9948 0.9948 2.6 0.9953 0.9955 0.9956 0.9956 0.9956 0.9960 0.9961 0.9961 2.7 0.9965 0.9966 0.9968 0.9960 0.9971 0.9972	0.9887 0.9890
2.5 0.9938 0.9940 0.9941 0.9943 0.9945 0.9946 0.9948 0.9949 2.6 0.9953 0.9955 0.9956 0.9957 0.9959 0.9960 0.9961 0.9962 2.7 0.9965 0.9966 0.99967 0.9988 0.9969 0.9970 0.9971 0.9972	0.9913 0.9916
2.6 0.9953 0.9955 0.9956 0.9957 0.9959 0.9960 0.9961 0.9962 2.7 0.9965 0.9966 0.9967 0.9968 0.9969 0.9970 0.9971 0.9972	0.9934 0.9936
2.7 0.9965 0.9966 0.9967 0.9968 0.9969 0.9970 0.9971 0.9972	0.9951 0.9952
	0.9963 0.9964
2.8 0.9974 0.9975 0.9976 0.9977 0.9977 0.9978 0.9979 0.9979	0.9973 0.9974
	0.9980 0.9981
2.9 0.9981 0.9982 0.9983 0.9984 0.9984 0.9985 0.9985	0.9986 0.9986
3.0 0.9987 0.9987 0.9988 0.9988 0.9989 0.9989 0.9989	0.9990 0.9990
3.1 0.9990 0.9991 0.9991 0.9991 0.9992 0.9992 0.9992 0.9992	0.9993 0.9993
3.2 0.9993 0.9993 0.9994 0.9994 0.9994 0.9994 0.9995	0.9995 0.9995
3.3 0.9995 0.9995 0.9995 0.9996 0.9996 0.9996 0.9996 0.9996 0.9996 3.4 0.9997 0	0.9996 0.9997 0.9997 0.9998

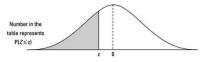
Voltando a questão

Média=60; desvio padrão=15; se eu tirei 80...



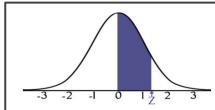
Diferentes tabelas de z-score

-0.5	.1041	.1014	.1700	.1702	.1730	.1711	.1000	.1000	.1050	.1011
-0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
-0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
-0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
-0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
-0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
-0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
-0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
-0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
-0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-3.6	.0002	.0002	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001
-3.5	.0002	.0002	.0002	.0002	.0002	.0002	.0002	.0002	.0002	.0002
-3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
-3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
-3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
-3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
-3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
-2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
-2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
-2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
-2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
-2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
-2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
-2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
-2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
-2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
-2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
-1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
-1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
-1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
-1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
-1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
-1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
-1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
-1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
-1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
-1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
-0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
	F000	****	4000	1000	****	****		4704	****	

Diferentes tabelas de z-score



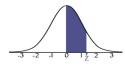
STANDARD NORMAL TABLE (Z)

Entries in the table give the area under the curve between the mean and z standard deviations above the mean. For example, for z = 1.25 the area under the curve between the mean (0) and z is 0.3944.

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0190	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141

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ш	2.1	0.4903	0.4900	0.4907	0.4900	0.4909	0.4970	0.4971	0.4372	0.4373	0.4374
П	2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
ı	2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
ı	3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
ı	3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.4993
ı	3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
l	3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
l	3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998



STANDARD NORMAL TABLE (Z)

Entries in the table give the area under the curve between the mean and z standard deviations above the mean. For example, for z = 1.25 the area under the curve between the mean (0) and z is 0.3944.

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0190	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2969	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3513	0.3554	0.3577	0.3529	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927 0.4945	0.4929	0.4931 0.4948	0.4932	0.4934	0.4936 0.4952
2.6	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.7	0.4955	0.4955	0.4956	0.4957	0.4959	0.4970	0.4961	0.4902	0.4963	0.4964
2.8	0.4903	0.4975	0.4907	0.4908	0.4909	0.4978	0.4979	0.4979	0.4973	0.4974
2.9	0.4974	0.4973	0.4976	0.4977	0.4977	0.4976	0.4979	0.4979	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4999	0.4992	0.4993	0.4993
3.2	0.4990	0.4993	0.4991	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.4995
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.4997
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4998
0.4	J.400/	J.435/	J.433/	J.455/	J.400/	J.455/	J.455/	J.#35/	J.400/	V.4000