00 5000 9984 50 60146 35301 100 84134 2447 01 5000 9984 57 6647 34639 1101 86137 33331 05 51994 3986 57 70844 34534 1103 86131 33331 05 51994 57 71046 34134 1208 35033 33312 1104 86133 33333 06 53983 39963 67 71306 33112 1107 86033 21304 06 53983 39963 67 71303 33112 1107 8603 21305 11 54175 39033 66 71333 31113 8796 21006 11 54175 39034 67 71303 31113 8793 21093 11 5417 39131 1117 8864 1108 86393 21034 12 54033 31113 31123	00								
50399 39892 57 60847 35020 1.02 84773 51994 39876 53 700544 348.90 1.02 84574 51994 39876 53 700544 348.90 1.02 84534 51994 39871 57 71256 34105 1.06 85543 51994 39713 59 77256 33122 1.10 85543 51984 39733 59 77255 33122 1.10 85543 53185 39963 67 73253 33121 1.00 85543 53173 39635 67 73253 33121 1.11 8664 55952 39934 77 74513 32306 1.14 87106 55956 39934 77 74513 32306 1.16 8793 55956 39131 66 73173 31634 1.16 8564 55956 39131 73 3123 <t< td=""><td>10</td><td>.50000</td><td>39894</td><td>.50</td><td>.69146</td><td>.35207</td><td>1.00</td><td>.84134</td><td>.24197</td></t<>	10	.50000	39894	.50	.69146	.35207	1.00	.84134	.24197
51078 39816 5.2 00841 34671 10.2 84614 51934 39865 5.3 70044 34671 10.2 84614 51934 39875 5.3 70044 34671 10.2 84514 51934 39767 5.7 711266 34423 1.05 85543 51983 39767 5.8 71904 33711 1.07 85543 53188 39763 5.6 71304 33721 1.10 85543 53567 39538 6.6 71357 33321 1.10 85544 54776 39538 6.6 71357 33351 1.10 85544 55367 39387 6.6 71337 33918 1.12 85646 55367 39387 6.6 71337 33018 1.12 85646 55367 39387 7.7 77137 30164 1.17 87266 55376 39387 1.13 31659 </td <td></td> <td>50399</td> <td>.39892</td> <td>.51</td> <td>.69497</td> <td>.35029</td> <td>1.01</td> <td>.84375</td> <td>.23955</td>		50399	.39892	.51	.69497	.35029	1.01	.84375	.23955
51197 3987/6 54 70540 34467 1.03 84530 51994 39847 57 70540 34467 1.03 85543 51994 39737 57 71266 33718 109 85543 51994 39737 57 71966 33912 1.07 85543 53185 39733 50 77255 33322 1.08 85543 53172 39664 52 71215 33322 1.08 85543 53172 39053 63 71215 33322 1.10 85643 55952 39448 56 71215 332506 1.11 8706 55952 39448 56 71215 33246 1.11 87106 559503 39423 37153 31634 1.12 8706 559503 39543 77315 31634 1.12 8706 559513 39543 32506 1.14 87106 85131	02	50798	39886	.52	.69847	.34849	1.02	.84614	.23713
51994 39841 54 70840 34248 1.04 85083 51994 39767 57 712.66 34105 1.06 85763 52392 39767 57 713.66 33912 1.06 85763 53188 39767 58 712.66 33912 1.10 85763 53188 39767 58 712.66 333521 1.10 85763 53567 39563 67 73293 333221 1.11 86433 54756 39383 67 74313 332918 1.06 85763 55667 39383 67 74891 32296 1.11 87166 55657 39383 67 74891 32296 1.12 87986 55657 39383 67 74837 31874 1.17 8796 55656 33831 77 77133 30968 1.12 8798 55792 31874 1.17 71173	03	.51197	.39876	.53	.70194	.34667	1.03	.84850	.2347
51904 39841 55 70804 34244 LOS 55314 52338 39737 56 71366 339115 LOS 55343 53388 39737 57 71366 339115 LOS 55343 53388 39054 61 77575 33912 LOS 55344 54380 39654 61 77575 33912 LOS 56546 54380 39654 61 77575 33912 LOS 56546 54381 565 71355 33121 LOS 56546 55573 39938 66 74517 33918 LI 5796 55635 39331 66 74537 33056 LI 5796 55635 39346 77 76424 30785 LI 5796 55735 39181 66 73377 1364 LI 5796 55735 39184 77 771337 30136 LI	2	.51595	.39862	54	.70540	.34482	1.04	.85083	.2323
52392 39823 56 71226 34105 106 35311 106 35313 55 55543 53188 39767 57 71506 33321 109 35511 207 35563 53188 39763 59 71204 33321 109 35511 54776 39563 67 73207 33321 111 86660 55172 39503 65 74537 32018 111 86660 55172 39503 65 74537 3208 1111 86660 55172 39303 65 74537 3208 1116 8793 55173 39114 77 7433 3206 1116 8793 55173 39114 76 7453 31163 1117 86660 55173 39114 77 7413 3206 1117 86660 55173 31153 112 8866 7453 30114 87930	02	.51994	.39844	5	70884	.34294	C0.1	#T609	9677
52790 5977 57 71566 33912 107 8796 53188 39057 59 71240 33121 110 85594 53186 39737 59 72240 33121 1111 8659 54176 39608 64 72901 33121 1111 8659 55675 39593 67 73861 32205 1111 8659 55675 39393 66 74513 32206 1114 8659 55735 39393 66 74513 32205 1118 81706 56730 39393 66 74513 31225 1129 81908 56730 39393 66 7451 30265 1128 89016 57143 39024 71 76115 31125 1128 89016 58913 76613 7733 30144 1127 89017 58911 38061 773 30265 1248 89017	90	52392	19822	95	71226	34105	1.06	.85543	.2274
55188 59767 58 71904 33718 1.08 8.993 54386 39673 50 77237 33322 1.10 8654 54786 39633 50 77237 33321 1.10 8654 54786 39634 61 72907 33121 1.11 8650 55476 39939 64 71891 32206 1.11 87206 55567 39337 66 74215 32307 1.11 8650 55565 39348 55 74215 32306 1.11 87206 57535 39104 71 71153 3106 1.21 8950 57535 39104 70 75804 31255 1.18 8866 57335 39104 77 7733 3014 1.25 8993 57335 39136 7163 30136 1.21 8650 58317 30234 76424 30783 1.23 8993<	20	06265	10707	25	71566	33912	1.07	.85769	.2250
53386 39733 59 77240 33321 1.10 86314 54776 39635 67 77277 33321 1.11 8650- 54776 39635 67 77327 33321 1.11 8650- 55357 399387 65 74355 33713 1.11 8650- 55356 399448 55 74315 32206 1.11 8650- 56356 39337 567 74337 32184 1.117 8650- 56356 39337 67 7437 32086 1.16 87938 57335 39104 70 75804 31225 1.19 88100 57335 39131 57 7733 30134 1.17 8193 57735 39131 57 7733 30134 1.27 8793 57926 38835 77 7733 30134 1.27 8943 57937 38836 77 7733 30	08	53188	39767	.58	.71904	.33718	1.08	.85993	.2226
51983 39665 60 72575 33321 110 8643 54776 39608 63 73857 33121 1112 86680 54776 39508 63 73857 33121 1112 86680 5567 39598 64 73891 33206 114 87286 55982 39948 65 74913 32297 111 86680 56736 39323 66 75175 3104 1117 8100 57935 39104 70 75804 3153 1129 8100 57935 39104 70 75115 31006 121 8905 57935 39104 70 75137 30104 122 8907 58901 3866 77 7733 30105 121 8975 58913 3866 74 7733 3016 122 8907 58913 3866 74 7733 3016	00	53586	39733	59	.72240	.33521	1.09	.86214	.2202
54786 39654 61 72907 33121 1.11' 86590 55367 39539 62 73237 33121 1.11' 86564 55367 39539 62 73237 32391 1.12' 86564 55367 39539 65 74215 32391 1.14' 87286 55356 39323 66 74537 31864 1.16' 81008 57356 39104 71 76115 31006 1.12' 8100 57355 39104 71 76115 31006 1.21' 8946 57355 39104 71 76115 31006 1.21' 8946 57935 39946 77 7733 30114 1.25' 8945 58971 38967 75 7733 30134 1.23' 8945 58986 76 7733 30134 1.23' 8945 58986 76 7753 30339 1.24' <	10	.53983	39695	.60	.72575	.33322	1.10	.86433	.2178
5776 3908 52 7327 3218 112 5664 55172 39595 65 7457 3206 114 8706 55172 39505 65 7457 3206 114 8706 55162 39505 67 74801 32206 114 8706 55162 39505 67 74801 3143 117 8706 57142 39121 66 7457 3206 112 8709 57143 31659 114 117 8719 8706 57143 31659 112 8193 976 8706 57926 31934 77 7713 3014 117 8793 57943 3856 77 7713 3013 112 8945 59055 3836 77 7713 3014 125 8945 59055 38366 77 7713 3014 125 8945 59		00275	10664	19	71007	33121	111.	86650-	2154
55172 39539 64 73565 32711 117 8706 55567 39303 65 74537 3206 1115 8706 55565 39448 65 74537 3206 1115 8793 56356 39323 66 74537 33086 1.16 8793 56356 39323 67 74837 31874 1.17 8190 57345 39104 77 76115 31006 1.21 8893 57356 39331 66 7433 30134 1.27 8993 58831 39024 77 7733 30134 1.27 8893 58931 3866 77 7733 30134 1.27 8995 58931 3866 77 7733 30144 1.27 8995 58931 3846 77 7733 30144 1.27 8995 61409 38133 76 7733 30144 <t< td=""><td>11</td><td>92776</td><td>10005</td><td>29</td><td>LECEL</td><td>32918</td><td>1.12</td><td>86864</td><td>2130</td></t<>	11	92776	10005	29	LECEL	32918	1.12	86864	2130
55567 39505 64 73801 32307 115 87286 55756 39323 65 74215 32307 115 8708 57536 39323 65 74215 3105 116 8708 57535 39104 70 75804 31125 120 8890 57535 39104 71 76115 31006 121 8806 57535 39104 71 76115 31006 121 8906 58317 39034 71 76115 31016 121 8886 58971 38904 71 7613 30134 127 8906 58971 38966 76 7733 30114 125 89973 58971 38667 75 7733 30134 127 89917 58971 38864 76 7733 30134 127 89917 59103 3823 38364 77 7733	12	55172	39550	63	73565	32713	1.13	87076	.2106
55982 39448 65 74215 32297 1.15 87493 56756 39387 66 74537 31869 1.16 87900 57142 39323 67 74537 31869 1.16 87900 57142 39181 69 75490 31443 1.17 87900 57142 39104 71 77153 31056 1.27 8493 57926 39104 71 7613 30136 1.27 8893 58931 3865 77 76730 30563 1.27 88945 58931 3866 77 7733 30134 1.23 8965 59035 38536 76 7751 30356 1.26 8965 59045 3856 77 7793 3014 1.27 8945 59045 38261 77 7793 29659 1.26 8965 50191 3816 77 7793 29659	14	55567	39505	64	13891	.32506	1.14	.87286	.2083
56356 39387 66 7457 32086 1.16 87638 57735 39233 67 74577 31874 1.17 87900 57535 39114 77 7430 31143 1.19 87900 57535 39104 71 75135 31056 1.20 88493 57335 39104 71 76115 31066 1.21 88298 58935 38933 73 76115 31036 1.23 89053 59035 38835 73 77335 30134 1.23 89053 59045 38566 75 77335 30134 1.23 89455 59035 38351 73 77335 30134 1.23 89455 50043 38136 77 77935 29559 1.20 89435 50173 38166 77 77935 29559 1.27 89455 50179 501317 28639 1.27 <	15	.55982	.39448	.65	.74215	.32297	1.15	.87493	.2059
56750 59322 67 74857 51874 117 81900 57142 39213 68 75175 31874 117 81900 57142 39213 68 75175 31163 112 81900 57305 39104 71 76115 31006 1.21 8846 58906 3853 77 75730 30553 1.22 8845 58905 38536 77 77303 30114 1.25 89055 58906 77 77303 30139 1.23 89055 58836 77 77303 30134 1.27 89055 59831 76 7733 30114 1.25 89455 61005 38361 78 7733 30114 1.25 89455 6109 3133 80 78814 239059 1.26 89455 6100 3133 80 78814 239059 1.27 89955	16	SKASK	19197	99	74537	32086	1.16	87698	2035
57142 39233 56 75175 31659 11.8 88100 57335 39104 72 75413 31006 1.21 8843 57335 39104 71 76115 31006 1.21 8846 58317 39034 71 76115 31006 1.21 8846 58931 38963 73 77337 30134 1.27 8847 58931 38762 73 77337 30114 1.27 8845 59935 38361 75 77337 30114 1.27 8845 59936 38361 75 77337 30114 1.27 8945 61026 38361 76 7733 30134 1.27 8945 61026 38361 78 7733 29339 1.28 89417 61026 38361 78 7833 2823 1.29 8945 61026 38361 783 28263 1.28	17	02095	CCF05	23	74857	31874	1.17	87900	2012
57335 90181 66 75400 31443 1119 88298 57926 39104 70 75804 31125 12.0 88493 58317 39904 71 76115 31005 12.2 88866 58935 77 76713 30136 12.2 88865 59935 3853 77 76730 30563 12.2 88465 59045 38766 77 7737 30134 12.5 89045 59045 38566 77 7737 30134 12.5 89445 59166 3851 76 7737 30134 12.6 89417 50191 38766 77 77935 29959 12.7 89455 51026 3813 76 7733 20141 12.9 89455 51307 31544 28059 1.20 29931 12.4 90490 6177 381347 28639 28244 1.31 2	10	CALCS	20053	89	75175	31659	1.18	.88100	1988
57926 59104 70 75804 51225 1.20 88493 58917 39034 71 76115 31006 1.21 88685 58906 38833 73 76470 30365 1.22 88687 58905 38833 73 76730 30365 1.21 88665 59871 38667 73 77337 30114 1.25 89951 59871 38466 77 77935 29431 1.26 89951 61026 38361 76 7783 29559 1.27 89951 61026 38366 77 77935 29659 1.27 89951 61026 38366 77 77935 28659 1.29 99047 61026 38361 78 78230 29431 1.28 89951 61026 38303 31734 28731 2319 90020 90147 61301 37534 7734 29959	10	55572	30181	69	75490	31443	1.19	.88298	.1965
58317 39024 71 76115 31006 1.21 88686 58706 38940 72 76415 30785 1.22 88671 59705 38946 73 76514 30785 1.23 88675 59871 38667 75 77337 30114 1.23 88675 59871 3866 76 77637 30039 1.24 89965 60257 38346 76 77637 30014 1.26 89917 60135 38346 76 77337 30114 1.26 89917 61026 38346 76 7783 29431 1.27 89917 61102 38339 278 78332 29339 1.28 89917 61102 38330 37534 282 78339 23307 1.29 99490 61203 37534 282 78339 23504 1.37 90430 61307 37534 27324	20	57926	39104	.70	.75804	.31225	1.20	.88493	.1941
58705 38940 72 76424 30785 1122 88877 59945 38767 73 77337 30114 1124 89647 59871 38762 73 77337 30114 1124 89647 59845 75 77337 30114 1126 89647 59871 38765 75 77337 30114 1126 89435 60257 38366 76 77637 30339 1128 89437 61026 38366 76 7733 29359 127 8973 61103 38351 78 78330 29431 127 8973 61103 38351 78 7833 2823 79635 290490 61263 37534 28 7933 28534 139 90436 63307 37534 28 79537 28734 137 90436 63307 37533 28 80354 137 90436 <td>16</td> <td>58317</td> <td>1000F</td> <td>11</td> <td>76115</td> <td>31006</td> <td>1.21</td> <td>88686</td> <td>1918</td>	16	58317	1000F	11	76115	31006	1.21	88686	1918
5905 3855 77 76730 30563 1123 80665 59441 38672 74 7737 3014 125 89617 59441 38672 74 7737 3014 125 89617 50455 38466 77 7737 3014 125 89617 60757 38566 77 7757 7337 3014 125 89617 61026 38561 76 77637 29887 126 89617 61190 38251 78 78524 29909 1129 89796 61307 38163 77 71935 29659 1137 90147 65307 3754 64 79955 28096 133 90490 65307 3754 64 79955 28064 133 90490 65307 3764 64 77734 28269 137 90490 65307 3764 64 79756 <t< td=""><td></td><td>58706</td><td>38940</td><td>22</td><td>76424</td><td>30785</td><td>1.22</td><td>88877</td><td>1895</td></t<>		58706	38940	22	76424	30785	1.22	88877	1895
59484 38762 74 77105 30339 1.24 89251 59771 38667 75 77337 30114 1.25 89753 60635 38466 77 77935 29659 1.27 89795 61026 38361 78 78230 29431 1.26 89795 61026 38361 78 78230 29431 1.27 89795 61026 38361 78 78230 29431 1.29 89793 611791 38133 28737 1.31 900400 50330 5173 90147 61791 37534 287 7955 28737 1.31 90490 63307 37534 287 7955 28034 1.32 90468 63307 37534 287 79764 1.32 90468 63307 37534 287 27764 1.36 90466 64053 37764 28793 27796 1.36	23	59095	38853	13	76730	.30563	1.23	89065	.1872
59871 38667 75 77337 30114 1.25 89435 60257 38568 76 77637 29887 1.26 89617 610265 38366 77 77333 29887 1.26 89617 610265 38366 77 77333 29887 1.26 89617 610265 38351 79 78330 29431 1.28 89973 611901 38131 79 78814 29000 1.28 89973 611791 38139 87 78617 231 1.37 90149 61230 37534 87 79355 28704 1.37 90838 63307 37534 86 80511 27798 1.37 90838 65173 37554 86 80511 27562 1.36 91496 6405 37535 87 80351 27738 1.37 90838 65773 36973 28034 1.37	24	59484	.38762	.74	.77035	.30339	1.24	.89251	.1849
60757 38568 76 77637 2987 1.26 89617 610643 38361 77 77935 29659 1.27 89765 61170 38361 77 77935 29659 1.27 89765 61171 38136 77 778524 29200 1.29 90473 61171 38033 8114 28959 1.31 90490 90147 61172 38033 817 78524 29200 1.29 90336 623307 37554 87 79332 28734 1.31 90490 63307 37554 87 79335 28269 1.37 90486 63307 37554 87 80751 27064 1.37 91466 64031 37754 87 77738 1.37 91466 64331 37755 88 81037 27038 1.37 91466 64331 37755 88 81377 27086	.25	.59871	.38667	.75	.77337	.30114	1.25	.89435	.1826
60645 38466 77 77935 29559 1.27 89796 611036 38331 78 78334 229200 1.29 80971 611791 38136 79 78524 229200 1.29 90147 611791 38139 80 7814 28969 1.30 90130 611791 38139 80 7814 28969 1.31 90490 62337 31780 33 79673 28209 1.33 90490 63307 37654 54 79955 28209 1.33 90496 64331 37780 33 79673 28269 1.37 90498 64331 37554 56 80234 27734 1.37 91466 64303 37715 58 8077 27086 1.37 9088 64333 37254 56 8057 27086 1.37 91466 64303 37115 88 81057 <	26	12009	38568	26	77637	.29887	1.26	89617	.1803
61026 38361 78 78230 29431 1/28 89973 61191 381351 78 78534 239431 1/29 90147 61191 381351 78 78544 238969 1/20 90130 62172 38023 81 79103 28737 1/31 90490 62172 38023 81 79103 28737 1/31 90490 62330 37534 87 79553 28873 1/32 90480 63307 37534 87 79555 28034 1/32 90490 65363 37754 87 8031 27798 1/37 90480 64031 37753 88 8057 27708 1/37 90988 64033 37115 86 8057 27764 1/36 91966 64033 36677 92 81137 27666 1/42 91244 65717 36577 92 81127 <	27	60643	.38466	11.	.77935	.29659	1.27	36796	.1781
61409 38251 79 78534 22000 1.29 90147 61791 38139 80 78814 28960 1.30 90320 62172 38033 87 78814 28960 1.37 90326 65230 37780 82 79380 28504 1.37 90490 65307 37534 87 79673 28269 1.37 90488 65307 37524 87 79380 28704 1.37 90834 65307 37534 87 79334 27354 1.37 90834 64058 37753 87 80351 27564 1.37 90836 64033 37755 87 80351 27564 1.37 91466 64033 37755 87 80351 27754 1.37 91466 64033 37755 87 81037 27564 1.47 92073 6576 36677 91859 27324	28	.61026	.38361	.78	.78230	.29431	1.28	.89973	.1758
61791 38139 360 78814 28969 1.30 90320 62172 38023 81 79103 28737 1.31 90490 62357 37780 33 79673 28269 1.33 90490 63307 37564 54 79955 28204 1.33 90490 64307 37524 55 80234 27738 1.37 90498 64431 37754 56 80234 27738 1.37 90484 64431 37255 58 80751 27738 1.37 90484 64431 37753 1.87 27734 1.37 91466 64431 37755 210866 1.37 91466 65413 36877 30751 2.9 81057 27086 65413 36877 36877 2.0669 1.40 91466 65413 36877 90 81194 2.40 92073 655426 36873	29	61409	.38251	62.	.78524	.29200	1.29	.90147	.1736
62172 38023 81 79103 287 731 1.31 90490 65252 377903 82 79533 28569 1.32 90634 65357 37780 82 79533 28559 1.33 90490 65367 3754 53 79535 28504 1.33 90684 65363 37524 55 79385 28504 1.34 9088 64363 37524 55 80734 27738 1.37 9088 64451 37254 56 80511 27562 1.36 9149 65173 36877 36871 28648 1.37 9148 65173 36877 36871 27364 1.40 9174 65173 36877 36871 27648 1.40 92073 65716 36576 92 82121 26129 1.47 92073 65716 36577 96 81394 25466 1.47 <td< td=""><td>.30</td><td>16119.</td><td>.38139</td><td>.80</td><td>.78814</td><td>.28969</td><td>1.30</td><td>.90320</td><td>.1713</td></td<>	.30	16119.	.38139	.80	.78814	.28969	1.30	.90320	.1713
65357 37903 82 79389 28504 1.32 90658 63307 37738 83 79657 28204 1.32 90658 63307 37534 84 79955 28034 1.34 90958 63307 37534 84 79955 28034 1.34 90958 64058 37754 85 80311 27562 1.36 91149 64031 37115 86 80511 27562 1.36 91149 64031 37115 87 8075 27762 1.36 91149 65173 36977 287 8075 27562 1.36 9124 65573 36977 918127 27669 1.42 9174 65713 36577 92839 1.42 92764 65763 35537 92839 1.47 92073 66716 36539 92121 26139 1.47 92064 6773 35633	31	62172	.38023	18.	.79103	.28737	1.31	.90490	1691
65930 37758 53 79673 28234 1.33 90824 653307 37554 87 79673 28234 1.33 90824 653307 37524 87 79953 28234 1.35 9149 65435 37524 87 80511 27562 1.36 9146 64431 37235 87 80785 27738 1.37 91466 64431 37255 87 80785 27734 1.37 91466 654173 36973 36973 298 81037 27066 1.37 91466 65716 35677 90 81327 27066 1.40 91924 65716 35675 92 81327 25649 1.40 92073 65705 35572 3634 25649 1.47 92073 65706 35573 99 81327 25647 1.44 92073 67003 35573 99 81347	.32	.62552	.37903	.82	.79389	.28504	1.32	.90658	.1665
63307 37554 56 79355 280234 21798 1.37 90988 64318 37351 56 80234 27798 1.35 91495 64431 37253 56 80351 27504 1.37 91495 64431 37255 87 80785 27324 1.37 91646 64803 37115 88 81037 27646 1.37 91466 64803 37115 88 81037 27648 1.40 91924 65540 36678 91 81859 26639 1.41 92073 65541 36678 91 81859 265369 1.41 92073 66501 36578 92 82121 25663 1.46 92207 66706 36573 97 83147 25669 1.47 92207 67035 36533 97 83945 25405 1.46 92056 67724 3588 1.47	33	.62930	.37780	.83	.79673	.28269	1.33	.90824	.1647
0.05063 J7124 00 00.244 2.1795 1.19 J1145 64058 37115 86 80511 27756 1.37 91406 64131 37125 87 8073 89 811057 27864 1.37 91406 645173 36877 86 81157 27664 1.37 91406 655173 36877 87 81057 276649 1.41 91406 65510 36577 90 811994 26609 1.41 92073 66276 92 82121 26139 1.42 92270 66276 35526 92 82131 25647 1.42 92207 667705 36639 25649 1.44 92073 92647 67003 36771 99 83147 25406 1.46 92067 67724 35639 25647 24631 1.47 92056 92647 68773 99 83147 25406 <td>4</td> <td>.63307</td> <td>37654</td> <td>-84</td> <td>.79955</td> <td>.28034</td> <td>1.34</td> <td>93606</td> <td>162</td>	4	.63307	37654	-84	.79955	.28034	1.34	93606	162
64058 37391 86 80511 27362 1.36 91308 6403 37115 87 80511 27354 1.36 91406 6403 37115 87 8075 27324 1.37 91406 64173 36973 87 81037 20848 1.37 91406 65542 36877 90 81327 26848 1.39 91774 65510 36576 92 81327 26609 1.40 91924 66276 36571 93 81327 26609 1.41 92073 66376 36571 93 8239 25647 1.46 92054 66703 36517 93 25647 1.46 92054 67003 35613 95 82894 25406 1.46 92054 677365 36033 95 82894 25406 1.46 92054 677365 35553 98 83646 2463 1	CF.	63050.	47CIS.	C0.	40709	96117	CC-1	stife:	
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	47	.68082	.35723	.97	83398	.24923	1.47	.92922	.135
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* Abridged from Biometrika Tables for Statisticians, vol. 1 (2nd edition), edited by E. S. Pearson and H. O. Hartley, Cambridge University Press, London, 1958, table 1, with permission of the Biometrika Trustees.

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APPENDIX D

(x)

Φ(x)

Tabulation of the Standard Normal Distribution*

141	.00013	.00013	.00012	.00012	00011	.00011	.00011	.00010	01000'	60000	60000.	60000	80000	80000	.00007	00007	00000	.00006	00000	.00006	00000	.00005	.00005	00003	.00005	.00004	00004	.00004	.00004	,00004	*0000	.00003	.00003	00003	00003	.00003	20000.	.00002	.00002	.00002	20000	20000.	.00002	.00002	20000.	.00002
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	4.00	4.01	4.02	4.03	4.04	4.05	4.06	4.07	4.08	4.09	4.10	4.11	4.12	414	4.15	4.16	4.17	4.18	4.19	4.20	4.21	4.22	4.23	4.25	4.26	4.28	4 20	4.30	4.31	4.32	4 24	4.35	4.36	4.37	4.38	4.39	4.40	4.41	4.42	4.43	4.44	6.40	4.46	4.47	4.48	4.49
	.00087	.00084	.00081	.00079	.00076	.00073	.00071	.00068	.00066	.00063	19000	.00059	1 5000	5000	.00051	.00049	.00047	.00046	.00044	.00042	.00041	.00039	.00038	.00035	.00034	.00031	00030	.00029	.00028	.00027	97000	.00024	.00023	.00022	.00021	.00021	07000.	.00019	.00018	.00018	/1000	.00016	.00016	.00015	41000.	.00014
	<i>TT999.</i>	879978	99978	61666.	08666	18666.	18666.	.99982	68666.	.99983	99984	.99985 00005	C8666	09666	78666.	18666	88666	88666	68666	68666	06666	06666	06666	16666	99992	99992	00000	66666	66666	66666	46666	99994	99994	56666.	56666	56666	66666	\$6666.	96666.	96666	96666	96666	96666	96666	16666	16666.
	3.50	3.51	3.52	3.53	3.54	3.55	3.56	3.57	3.58	3.59	3.00	3.61	20.5	2.02	3.65	3.66	3.67	3.68	3.69	3.70	3.71	3.72	3.73	3.75	3.76	3.78	3 70	3.80	3.81	3.82	3.83	3.85	3.86	3.87	3.88	3.89	3.90	3.91	3.92	3.93	3.94	3.95	3.96	3.97	3.98	3.99
	.00443	.00430	.00417	.00405	.00393	.00381	.00370	.00358	.00348	.00337	17500	00317	10500.	86700	.00279	.00271	.00262	.00254	.00246	.00238	.00231	.00224	.00216	.00210	.00196	.00184	00178	.00172	.00167	.00161	90100	.00146	.00141	.00136	.00132	.00127	.00123	00119	.00115	.00111	10100.	.00104	00100.	16000	00004	06000
	.99865	99866.	.99874	.99878	.99882	.99886	99889.	.99893	76892.	00666.	c0666.	90666	01666	61666	91666	12666	99924	.99926	99929	.99931	.99934	.99936	.99938	.99940	.99944	99948	00000	.99952	539953	.99955	15666	09666	19666.	.99962	99964	.99965	00666.	89666	69666	02666.	12666	21666.	579973	99974	52665	.99976
	3.00	3.01	3.02	3.03	3.04	3.05	3.06	3.07	3.08	3.09	3.10	3.11	3.12	2.1.5	3.15	3.16	3.17	3.18	3.19	3.20	3.21	3.22	3.23	3.24	3.26	3.28	2 20	3.30	3.31	3.32	56.6	3.35	3.36	3.37	3.38	3.39	3.40	3.41	3.42	3.43	3.44	3.45	3.46	3.47	3.48	3.49

0.01506 0.01303 0.01468 0.01323 0.01324 0.01256 0.01256 0.01256 0.01190 0.01190 0.01190 0.01190 0.01190 0.01190 0.01190 0.01190 0.01190 0.01190 0.01190 0.00351 0.00578 0.0057 .01753 .01709 .01667 .01625 .01585 (x) 99379 99396 99413 99430 99446 99477 99547 99547 99547 99557 99557 99557 99557 99557 99557 99577 99577 99577 99577 99577 99774 99774 99774 99774 99774 99774 99774 99774 99774 99774 99774 99774 997755 99775 99775 99775 99775 99775 99775 99775 99775 99775 99775 99819 99825 99831 99836 99836 99846 99851 99856 99861 99865 (x) 22.55 25 * 0.05399 0.04780 0.04879 0.04879 0.04882 0.04882 0.04491 0.04491 0.04491 0.04491 0.04491 0.04491 0.044128 0.033746 0.033748 0.0337 (*) 977725 97778 97831 97882 97932 97932 98030 981077 981077 981079 981079 98250 98331 98331 98331 98539 98539 98578 98 99202 992245 99286 99286 99305 99324 99324 99361 99361 99086 99111 99134 99158 99180 (x) 22.00 22.20 20.00 20.00 20 * 1,2352 1,2558 1,2578 1,2578 1,2578 1,2578 1,114500 1,114500 1,114500 1,114500 1,114500 1,114500 1,114500 1,114500 1,114500 1,114500 1,114500 1,114500 1,114500 1,114500 1,1145000 1,1145000 1,11450000000000000000000000000000 06438 06316 06195 06077 05959 05844 05618 05508 05508 05399 (x) 94062 94179 94208 94208 94208 94208 94208 94208 94208 94208 94208 94208 94208 94208 94208 95008 95008 95008 95008 95008 95008 95008 95008 95008 93319 93448 93574 93699 93822 93822 93822 97193 97257 97320 97381 97381 97500 97558 97615 97670 97725 (x) 11.50 11.51 11.53 H

510 Applied Probability

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Appendix D. 511

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Formulas

Pythagorean relations

 $1 + \cot^2 \alpha = \csc^2 \alpha$ $1 + \tan^2 \alpha = \sec^2 \alpha$, $\sin^2\alpha + \cos^2\alpha = 1,$

Angle-sum and angle-difference relations

 $\cos(\alpha + \beta)\cos(\alpha - \beta) = \cos^2 \alpha - \sin^2 \beta = \cos^2 \beta - \sin^2 \alpha$ $\sin(\alpha + \beta)\sin(\alpha - \beta) = \sin^2 \alpha - \sin^2 \beta = \cos^2 \beta - \cos^2 \alpha$ $\sin (\alpha + \beta) = \sin \alpha \cos \beta + \cos \alpha \sin \beta$ $\sin (\alpha - \beta) = \sin \alpha \cos \beta - \cos \alpha \sin \beta$ $\cos (\alpha + \beta) = \cos \alpha \cos \beta - \sin \alpha \sin \beta$ $\cos (\alpha - \beta) = \cos \alpha \cos \beta + \sin \alpha \sin \beta$ $\tan \left(\alpha + \beta \right) = \frac{\tan \alpha + \tan \beta}{1 - \tan \alpha \tan \beta}$ $1 + \tan \alpha \tan \beta$ $\cot(\alpha - \beta) = \frac{1}{\cot\beta - \cot\alpha}$ $\cot(\alpha + \beta) = \frac{\cos \beta}{\cot \beta + \cot \alpha}$ $\tan \alpha - \tan \beta$ U $\tan(\alpha - \beta)$

Double-angle relations

 $1 - \tan^2 \alpha$ $1 + \tan^2 \alpha$ $\cos 2\alpha = \cos^2 \alpha - \sin^2 \alpha = 2\cos^2 \alpha - 1 = 1 - 2\sin^2 \alpha = 0$ $\cot 2\alpha = \frac{\cot^2 \alpha}{2} - 1$ $2 \cot \alpha$ $1 + \tan^2 \alpha$ $2 \tan \alpha$ $\sin 2\alpha = 2 \sin \alpha \cos \alpha = 1 - \tan^2 \alpha$ $2 \tan \alpha$ $\tan 2\alpha = -$

Multiple-angle relations

 $\sin 6\alpha = 32^{\circ}\cos^{5}\alpha \sin \alpha - 32\cos^{3}\alpha \sin \alpha + 6\cos \alpha \sin \alpha$ $\cos n\alpha = 2\cos(n-1)\alpha\cos\alpha - \cos(n-2)\alpha$ $\cos 6\alpha = 32 \cos^6 \alpha - 48 \cos^4 \alpha + 18 \cos^2 \alpha \sin n\alpha = 2\sin(n-1)\alpha\cos\alpha - \sin(n-2)\alpha$ $\cos 5\alpha = 16\cos^5\alpha - 20\cos^3\alpha + 5\cos\alpha$ $\sin 5\alpha = 5\sin \alpha - 20\sin^3 \alpha + 16\sin^5 \alpha$ $\sin 4\alpha = 4\sin\alpha\cos\alpha - 8\sin^3\alpha\cos\alpha$ $1 - \tan(n - 1) \alpha \tan \alpha$ $\cos 4\alpha = 8\cos^4 \alpha - 8\cos^2 \alpha + 1$ $\tan(n-1)\alpha + \tan \alpha$ $1 - 6 \tan^2 \alpha + \tan^4 \alpha$ $4 \tan \alpha - 4 \tan^3 \alpha$ $\cos 3\alpha = 4\cos^3 \alpha - 3\cos \alpha$ $\sin 3\alpha = 3\sin \alpha - 4\sin^3 \alpha$ $3 \tan \alpha - \tan^3 \alpha$ $1 - 3 \tan^2 \alpha$ $\tan 3\alpha =$ $\tan n\alpha =$ $\tan 4\alpha =$

Formulas for Use in Trigonometry

 $= \cot \frac{1}{2}(\beta - \alpha)$ $\cot \alpha - \cot \beta = \frac{\sin(\beta - \alpha)}{\cdot}$ $\cos \alpha \cos \beta$ $\sin(\alpha - \beta)$ $\tan \alpha - \tan \beta =$ $\cos \alpha - \cos \beta$ $\sin \alpha + \sin \beta$ $\cos \alpha - \cos \beta = -2 \sin \frac{1}{2} (\alpha + \beta) \sin \frac{1}{2} (\alpha - \beta)$ $\cos \alpha + \cos \beta = 2\cos \frac{1}{2}(\alpha + \beta)\cos \frac{1}{2}(\alpha - \beta)$ $\sin \alpha - \sin \beta = 2\cos \frac{1}{2}(\alpha + \beta)\sin \frac{1}{2}(\alpha - \beta)$ $\sin \alpha + \sin \beta = 2 \sin \frac{1}{2} (\alpha + \beta) \cos \frac{1}{2} (\alpha - \beta)$ $\sin \alpha \sin \beta = \frac{1}{2} \cos(\alpha - \beta) - \frac{1}{2} \cos(\alpha + \beta)$ $\cos \alpha \cos \beta = \frac{1}{2} \cos(\alpha - \beta) + \frac{1}{2} \cos(\alpha + \beta)$ $\sin \alpha \cos \beta = \frac{1}{2} \sin(\alpha + \beta) + \frac{1}{2} \sin(\alpha - \beta)$ $\cos \alpha \sin \beta = \frac{1}{2} \sin(\alpha + \beta) - \frac{1}{2} \sin(\alpha - \beta)$ Function-sum and function-difference relations $\tan \alpha + \tan \beta = \frac{\sin(\alpha + \beta)}{\cos \alpha \cos \beta},$ $\tan \frac{1}{2}(\alpha - \beta)$ $\tan \frac{1}{2}(\alpha + \beta)$ $\sin(\alpha + \beta)$ $\cot \alpha + \cot \beta = \frac{1}{\sin \alpha \sin \beta}$ Function-product relations H $\sin \alpha + \sin \beta$ $\sin \alpha - \sin \beta$

Half-angle relations

 $\frac{1}{\cos\alpha + \cos\beta} = \tan\frac{1}{2}(\alpha - \beta)$

 $\sin \alpha - \sin \beta$

 $\frac{\sin \alpha + \sin \beta}{\cos \alpha + \cos \beta} = \tan \frac{1}{2}(\alpha + \beta),$

$\pm \sqrt{\frac{1+\cos\alpha}{2}}$	sin a	$1 + \cos \alpha$	sin a	$1 - \cos \alpha$	3
$\cos \frac{\alpha}{2} =$	$1 - \cos \alpha$	sin a	$1 + \cos \alpha$	sin a	
$\sqrt{\frac{1-\cos\alpha}{2}},$	$\sqrt{1-\cos\alpha}$	$/1 + \cos \alpha$	$\sqrt{1 + \cos \alpha}$	$/1 - \cos \alpha$	
- + =	+	1	+		1
$\sin \frac{\alpha}{2}$	$\tan \frac{\alpha}{\alpha}$	5	cot a		

Power relations

 $\cos^3 \alpha = \frac{1}{4}(3\cos \alpha + \cos 3\alpha)$ $\sin^3 \alpha = \frac{1}{4} (3 \sin \alpha - \sin 3\alpha)$ $1 + \cos 2\alpha$ $-\cos 2\alpha$ $\cot^2 \alpha = \sin^4 \alpha = \frac{1}{8}(3 - 4\cos 2\alpha + \cos 4\alpha)$ $\cos^4 \alpha = \frac{1}{8}(3 + 4\cos 2\alpha + \cos 4\alpha)$ $\cos^2 \alpha = \frac{1}{2}(1 + \cos 2\alpha),$ $\sin^2 \alpha = \frac{1}{2}(1 - \cos 2\alpha),$ $\frac{1-\cos 2\alpha}{1+\cos 2\alpha},$ $\tan^2 \alpha = \frac{1}{2}$

Exponential relations (α in radians), Euler's equation

 $\cos \alpha = \frac{e^{l\alpha}}{l\alpha} + e^{-l\alpha}$ $e^{i\alpha} = \cos \alpha + i \sin \alpha, \quad i = \sqrt{-1}$ $e^{i\alpha} - e^{-i\alpha}$ $\sin \alpha =$ $\tan \alpha =$

FOURIER TRANSFORM PAIRS

1

Pair Number x(t)	X(f)
1. $\Pi\left(\frac{t}{\tau}\right)$	$\tau \operatorname{sinc}(\tau f)$
2. $2W \operatorname{sinc}(2Wt)$	$\Pi\left(\frac{f}{2W}\right)$
3. $\Lambda\left(\frac{t}{\tau}\right)$	$\tau \operatorname{sinc}^2(\tau f)$
4. $\exp(-\alpha t)u(t), \alpha > 0$	$\frac{1}{\alpha + j2\pi f}$
5. $t \exp(-\alpha t)u(t), \ \alpha > 0$	$\frac{1}{(\alpha + j2\pi f)^2}$
6. $\exp(-\alpha t), \alpha > 0$	$\frac{2\alpha}{\alpha^2 + (2\pi f)^2}$
7. $\exp(-\alpha t^2)$	$\sqrt{\frac{\pi}{lpha}}\exp\left(-\frac{\pi^2 f^2}{lpha}\right)$
8. $\delta(t)$	1
9. 1	$\delta(f)$
0. $\delta(t-t_0)$	$\exp(-j 2\pi f t_0)$
1. $\exp(j2\pi f_0 t)$	$\delta(f-f_0)$
2. $\cos 2\pi f_0 t$	$\frac{1}{2}\delta(f-f_0) + \frac{1}{2}\delta(f+f_0)$
3. $\sin 2\pi f_0 t$	$\frac{1}{2j}\delta(f-f_0)-\frac{1}{2j}\delta(f+f_0)$
4. $u(t)$	$(j2\pi f)^{-1} + \tfrac{1}{2}\delta(f)$
5. $\operatorname{sgn}(t)$	$(j\pi f)^{-1}$
6. $\frac{1}{\pi t}$	$-j \operatorname{sgn}(f)$
7. $\hat{x}(t) = \frac{1}{\pi} \int_{-\infty}^{\infty} \frac{x(\lambda)}{t - \lambda} d\lambda$	$-j \operatorname{sgn}(f) X(f)$
8. $\sum_{m=-\infty}^{\infty} \delta(t-mT_s)$	$f_s \sum_{m=-\infty}^{\infty} \delta(f - mf_s), f_s = T_s^{-1}$
Note: sinc $u = \frac{\sin \pi u}{\pi u}$	
$\Pi(u) = \begin{cases} 1, u \le 1/2\\ 0, \text{ otherwise} \end{cases}$	
$\Lambda(u) = \begin{cases} 1 - u , & u \le \\ 0, \text{ otherwise} \end{cases}$	

	Name of Theorem	Signal	Transform
1.	Superposition $(a_1 \text{ and } a_2 \text{ arbitrary constants})$	$a_1 x_1(t) + a_2 x_2(t)$	$a_1X_1(f) + a_2X_2(f)$
2.	Time delay	$x(t-t_0)$	$X(f) \exp(-j 2\pi f t_0)$
a.	Scale change	x(at)	$ a ^{-1}X\left(rac{f}{a} ight)$
b.	Time reversal ¹	x(-t)	$X(-f) = X^*(f)$
ŀ.	Duality	X(t)	x(-f)
5a.	Frequency translation	$x(t) \exp\left(j2\pi f_0 t\right)$	$X(f-f_0)$
öb.	Modulation	$x(t)\cos 2\pi f_0 t$	$\frac{1}{2}X(f-f_0) + \frac{1}{2}X(f+f_0)$
5.	Differentiation	$\frac{d^n x(t)}{dt^n}$	$(j2\pi f)^n X(f)$
<i>.</i>	Integration	$\int_{-\infty}^{t} x(t') dt'$	$(j2\pi f)^{-1}X(f) + \frac{1}{2}X(0)\delta(f)$
3.	Convolution	$\int_{-\infty}^{\infty} x_1(t-t') x_2(t') dt'$	$X_1(f)X_2(f)$
		$= \int_{-\infty}^{\infty} x_1(t') x_2(t-t') dt'$	
€.	Multiplication	$x_1(t)x_2(t)$	$\int_{-\infty}^{\infty} X_1(f-f') X_2(f') df'$
			$= \int_{-\infty}^{\infty} X_1(f') X_2(f-f') df'$

FOURIER TRANSFORM THEOREMS

Georgia Institute of Technology School of Electrical and Computer Engineering

ECE6604 Personal & Mobile Communications

Final Exam

Fall 2012

Monday December 10, 2:50pm - 5:40pm

- Attempt all questions.
- All questions are of equal value.
- Open book, open notes, exam.

1) Consider a linear *time-invariant* channel having the impulse response

$$g(t,\tau) = \delta(\tau) + 2\delta(\tau - \tau_1) + \delta(\tau - 2\tau_1) \quad .$$

- a) (4 points) Derive a closed-form expression for magnitude response of the channel |T(f,t)| and sketch showing all important points.
- **b)** (2 points) Repeat part a) for the phase response of the channel $\angle T(f, t)$.
- c) (4 points) What is the mean delay and rms delay spread of the channel.

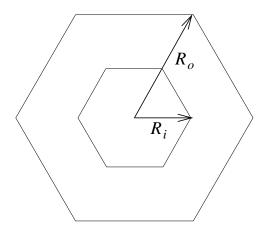
- 2) A flat Rayleigh fading signal at 5.9 GHz is received by a vehicle traveling at 80 km/hr. Assume a 2-D isotropic scattering environment.
 - a) (5 points) Determine the number of positive-going zero crossings about the rms value that occur over a 5 s interval.
 - b) (3 points) Determine the average duration of a fade below the rms level.
 - c) (2 points) Determine the level crossing rate and average fade duration at a level of 10 dB below the rms value.

3) Suppose that an uncorrelated binary data sequence is transmitted by using BPSK with a root-Gaussian amplitude shaping pulse

$$H_a(f) = \left(\tau e^{-\pi (f\tau)^2}\right)^{1/2}$$

- a) (4 points) What is the transmitted power density spectrum?
- b) (3 points) Find the value of τ so that the power density spectrum is 20 dB below its peak value at the Nyquist frequency 1/2T, where T is the baud duration.
- c) (2 points) What is the corresponding time domain pulse $h_a(t)$?
- d) (1 points) Assuming that a filter matched to $h_a(t)$ is used at the receiver, will this pulse result in intersymbol interference? Why?

4) One method for improving the capacity of a cellular system is to employ a twochannel bandwidth scheme, where a hexagonal cell is divided into two concentric hexagons as shown below. The inner hexagon is serviced by half-rate channels, while the outer hexagon is serviced by full-rate channels. When a mobile station crosses the boundary between the inner and outer portions of a cell a handoff occurs.



Suppose that the full-rate channels require C/I = 7 dB to maintain an acceptable radio link quality, while the half-rate channels require C/I = 10 dB.

Assume a fourth-law path loss model and suppose that the effects of envelope fading and shadowing can be ignored. Consider the reverse link and suppose that there are 6 co-channel interferers at distance D from the serving base station. It follows that the worst case C/I when a mobile station is located at distance d from the base station is $C/I = (D/d)^4/6$.

Hence, a C/I = 7 dB requires a 7-cell reuse cluster with $D/R_o = 4.6$, where R_o is the radius of the outer cell.

- a) 2 marks: Find the required value of D/R_o so that C/I = 7 dB in the outer cell, where R_i is the radii of the outer cell.
- a) 2 marks: Find the required value of D/R_i so that C/I = 10 dB in the inner cell, where R_i is the radii of the inner cell.
- c) 3 marks: Use the values of D/R_i and D/R_o to determine the ratio of the inner and outer cell areas, A_i/A_o . Use the exact area of a hexagon in terms of its radius.
- d) 3 marks: Let N_i and N_o be the number of channels that are allocated to the inner and outer areas of each cell, and assume that the channels are assigned such that $N_i/N_o = A_i/A_o$. Determine the increase in cell capacity (as measured in channels per cell) over a conventional *one-channel bandwidth* system that uses only full-rate channels.

- 5) Consider a communication link operating over a channel with propagation path loss exponent $\beta = 3.5$ and a shadow standard deviation $\sigma_{\Omega} = 8$ dB.
 - a) 4 marks: Consider the case of two adjacent cells. A mobile station is transmitting at its maximum power and is located exactly on the cell boundary between the two base stations. In the absence of shadowing, the received power level would be equal to the receiver sensitivity, $S_{\rm RX}$, i.e., the mobile station is located at distance $d_{\rm max}$ from each base station.

Now assume that shadowing *is* present and a soft handoff algorithm is used, such that the least attenuation link is always selected. The shadows experienced on the two possible links are independent. If an outage probability of 10% is desired for the given mobile station location (averaged over a large ensemble of realizations), what is the required margin $(M_{\rm shad} - G_{\rm HO})$, where $M_{\rm shad}$ is the required shadow margin for a single isolated cell and $G_{\rm HO}$ is the soft handoff gain?

- **b) 2 marks:** What is the value of $G_{\rm HO}$?
- c) 4 marks: Repeat parts (a) and (b) assuming that the mobile is located on the boundaries of and equidistant from three base stations, i.e., the mobile station is located at distance d_{max} from three base stations.