

Appendices

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Appendix 1

Standard normal distribution areas

z	$P(Z < z)$	$P(Z > z)$	$P(-z < Z < z)$	$P(Z < -z \text{ or } Z > z)$
0.00	0.50000	0.50000	0.00000	1.00000
0.01	0.50399	0.49601	0.00798	0.99202
0.02	0.50798	0.49202	0.01596	0.98404
0.03	0.51197	0.48803	0.02393	0.97607
0.04	0.51595	0.48405	0.03191	0.96809
0.05	0.51994	0.48006	0.03988	0.96012
0.06	0.52392	0.47608	0.04784	0.95216
0.07	0.52790	0.47210	0.05581	0.94419
0.08	0.53188	0.46812	0.06376	0.93624
0.09	0.53586	0.46414	0.07171	0.92829
0.10	0.53983	0.46017	0.07966	0.92034
0.11	0.54380	0.45620	0.08759	0.91241
0.12	0.54776	0.45224	0.09552	0.90448
0.13	0.55172	0.44828	0.10343	0.89657
0.14	0.55567	0.44433	0.11134	0.88866
0.15	0.55962	0.44038	0.11924	0.88076
0.16	0.56356	0.43644	0.12712	0.87288
0.17	0.56749	0.43251	0.13499	0.86501
0.18	0.57142	0.42858	0.14285	0.85715
0.19	0.57535	0.42465	0.15069	0.84931
0.20	0.57926	0.42074	0.15852	0.84148
0.21	0.58317	0.41683	0.16633	0.83367
0.22	0.58706	0.41294	0.17413	0.82587
0.23	0.59095	0.40905	0.18191	0.81809
0.24	0.59483	0.40517	0.18967	0.81033
0.25	0.59871	0.40129	0.19741	0.80259
0.26	0.60257	0.39743	0.20514	0.79486
0.27	0.60642	0.39358	0.21284	0.78716
0.28	0.61026	0.38974	0.22052	0.77948
0.29	0.61409	0.38591	0.22818	0.77182
0.30	0.61791	0.38209	0.23582	0.76418
0.31	0.62172	0.37828	0.24344	0.75656
0.32	0.62552	0.37448	0.25103	0.74897
0.33	0.62930	0.37070	0.25860	0.74140
0.34	0.63307	0.36693	0.26614	0.73386
0.35	0.63683	0.36317	0.27366	0.72634
0.36	0.64058	0.35942	0.28115	0.71885
0.37	0.64431	0.35569	0.28862	0.71138
0.38	0.64803	0.35197	0.29605	0.70395

z	$P(Z < z)$	$P(Z > z)$	$P(-z < Z < z)$	$P(Z < -z \text{ or } Z > z)$
0.39	0.65173	0.34827	0.30346	0.69654
0.40	0.65542	0.34458	0.31084	0.68916
0.41	0.65910	0.34090	0.31819	0.68181
0.42	0.66276	0.33724	0.32551	0.67449
0.43	0.66640	0.33360	0.33280	0.66720
0.44	0.67003	0.32997	0.34006	0.65994
0.45	0.67364	0.32636	0.34729	0.65271
0.46	0.67724	0.32276	0.35448	0.64552
0.47	0.68082	0.31918	0.36164	0.63836
0.48	0.68439	0.31561	0.36877	0.63123
0.49	0.68793	0.31207	0.37587	0.62413
0.50	0.69146	0.30854	0.38292	0.61708
0.51	0.69497	0.30503	0.38995	0.61005
0.52	0.69847	0.30153	0.39694	0.60306
0.53	0.70194	0.29806	0.40389	0.59611
0.54	0.70540	0.29460	0.41080	0.58920
0.55	0.70884	0.29116	0.41768	0.58232
0.56	0.71226	0.28774	0.42452	0.57548
0.57	0.71566	0.28434	0.43132	0.56868
0.58	0.71904	0.28096	0.43809	0.56191
0.59	0.72240	0.27760	0.44481	0.55519
0.60	0.72575	0.27425	0.45149	0.54851
0.61	0.72907	0.27093	0.45814	0.54186
0.62	0.73237	0.26763	0.46474	0.53526
0.63	0.73565	0.26435	0.47131	0.52869
0.64	0.73891	0.26109	0.47783	0.52217
0.65	0.74215	0.25785	0.48431	0.51569
0.66	0.74537	0.25463	0.49075	0.50925
0.67	0.74857	0.25143	0.49714	0.50286
0.68	0.75175	0.24825	0.50350	0.49650
0.69	0.75490	0.24510	0.50981	0.49019
0.70	0.75804	0.24196	0.51607	0.48393
0.71	0.76115	0.23885	0.52230	0.47770
0.72	0.76424	0.23576	0.52848	0.47152
0.73	0.76730	0.23270	0.53461	0.46539
0.74	0.77035	0.22965	0.54070	0.45930
0.75	0.77337	0.22663	0.54675	0.45325
0.76	0.77637	0.22363	0.55275	0.44725
0.77	0.77935	0.22065	0.55870	0.44130
0.78	0.78230	0.21770	0.56461	0.43539
0.79	0.78524	0.21476	0.57047	0.42953
0.80	0.78814	0.21186	0.57629	0.42371
0.81	0.79103	0.20897	0.58206	0.41794
0.82	0.79389	0.20611	0.58778	0.41222
0.83	0.79673	0.20327	0.59346	0.40654
0.84	0.79955	0.20045	0.59909	0.40091
0.85	0.80234	0.19766	0.60467	0.39533
0.86	0.80511	0.19489	0.61021	0.38979
0.87	0.80785	0.19215	0.61570	0.38430

z	$P(Z < z)$	$P(Z > z)$	$P(-z < Z < z)$	$P(Z < -z \text{ or } Z > z)$
0.88	0.81057	0.18943	0.62114	0.37886
0.89	0.81327	0.18673	0.62653	0.37347
0.90	0.81594	0.18406	0.63188	0.36812
0.91	0.81859	0.18141	0.63718	0.36282
0.92	0.82121	0.17879	0.64243	0.35757
0.93	0.82381	0.17619	0.64763	0.35237
0.94	0.82639	0.17361	0.65278	0.34722
0.95	0.82894	0.17106	0.65789	0.34211
0.96	0.83147	0.16853	0.66294	0.33706
0.97	0.83398	0.16602	0.66795	0.33205
0.98	0.83646	0.16354	0.67291	0.32709
0.99	0.83891	0.16109	0.67783	0.32217
1.00	0.84134	0.15866	0.68269	0.31731
1.01	0.84375	0.15625	0.68750	0.31250
1.02	0.84614	0.15386	0.69227	0.30773
1.03	0.84849	0.15151	0.69699	0.30301
1.04	0.85083	0.14917	0.70166	0.29834
1.05	0.85314	0.14686	0.70628	0.29372
1.06	0.85543	0.14457	0.71086	0.28914
1.07	0.85769	0.14231	0.71538	0.28462
1.08	0.85993	0.14007	0.71986	0.28014
1.09	0.86214	0.13786	0.72429	0.27571
1.10	0.86433	0.13567	0.72867	0.27133
1.11	0.86650	0.13350	0.73300	0.26700
1.12	0.86864	0.13136	0.73729	0.26271
1.13	0.87076	0.12924	0.74152	0.25848
1.14	0.87286	0.12714	0.74571	0.25429
1.15	0.87493	0.12507	0.74986	0.25014
1.16	0.87698	0.12302	0.75395	0.24605
1.17	0.87900	0.12100	0.75800	0.24200
1.18	0.88100	0.11900	0.76200	0.23800
1.19	0.88298	0.11702	0.76595	0.23405
1.20	0.88493	0.11507	0.76986	0.23014
1.21	0.88686	0.11314	0.77372	0.22628
1.22	0.88877	0.11123	0.77754	0.22246
1.23	0.89065	0.10935	0.78130	0.21870
1.24	0.89251	0.10749	0.78502	0.21498
1.25	0.89435	0.10565	0.78870	0.21130
1.26	0.89617	0.10383	0.79233	0.20767
1.27	0.89796	0.10204	0.79592	0.20408
1.28	0.89973	0.10027	0.79945	0.20055
1.29	0.90147	0.09853	0.80295	0.19705
1.30	0.90320	0.09680	0.80640	0.19360
1.31	0.90490	0.09510	0.80980	0.19020
1.32	0.90658	0.09342	0.81316	0.18684
1.33	0.90824	0.09176	0.81648	0.18352
1.34	0.90988	0.09012	0.81975	0.18025
1.35	0.91149	0.08851	0.82298	0.17702
1.36	0.91309	0.08691	0.82617	0.17383

z	$P(Z < z)$	$P(Z > z)$	$P(-z < Z < z)$	$P(Z < -z \text{ or } Z > z)$
1.37	0.91466	0.08534	0.82931	0.17069
1.38	0.91621	0.08379	0.83241	0.16759
1.39	0.91774	0.08226	0.83547	0.16453
1.40	0.91924	0.08076	0.83849	0.16151
1.41	0.92073	0.07927	0.84146	0.15854
1.42	0.92220	0.07780	0.84439	0.15561
1.43	0.92364	0.07636	0.84728	0.15272
1.44	0.92507	0.07493	0.85013	0.14987
1.45	0.92647	0.07353	0.85294	0.14706
1.46	0.92785	0.07215	0.85571	0.14429
1.47	0.92922	0.07078	0.85844	0.14156
1.48	0.93056	0.06944	0.86113	0.13887
1.49	0.93189	0.06811	0.86378	0.13622
1.50	0.93319	0.06681	0.86639	0.13361
1.51	0.93448	0.06552	0.86896	0.13104
1.52	0.93574	0.06426	0.87149	0.12851
1.53	0.93699	0.06301	0.87398	0.12602
1.54	0.93822	0.06178	0.87644	0.12356
1.55	0.93943	0.06057	0.87886	0.12114
1.56	0.94062	0.05938	0.88124	0.11876
1.57	0.94179	0.05821	0.88358	0.11642
1.58	0.94295	0.05705	0.88589	0.11411
1.59	0.94408	0.05592	0.88817	0.11183
1.60	0.94520	0.05480	0.89040	0.10960
1.61	0.94630	0.05370	0.89260	0.10740
1.62	0.94738	0.05262	0.89477	0.10523
1.63	0.94845	0.05155	0.89690	0.10310
1.64	0.94950	0.05050	0.89899	0.10101
1.65	0.95053	0.04947	0.90106	0.09894
1.66	0.95154	0.04846	0.90309	0.09691
1.67	0.95254	0.04746	0.90508	0.09492
1.68	0.95352	0.04648	0.90704	0.09296
1.69	0.95449	0.04551	0.90897	0.09103
1.70	0.95543	0.04457	0.91087	0.08913
1.71	0.95637	0.04363	0.91273	0.08727
1.72	0.95728	0.04272	0.91457	0.08543
1.73	0.95818	0.04182	0.91637	0.08363
1.74	0.95907	0.04093	0.91814	0.08186
1.75	0.95994	0.04006	0.91988	0.08012
1.76	0.96080	0.03920	0.92159	0.07841
1.77	0.96164	0.03836	0.92327	0.07673
1.78	0.96246	0.03754	0.92492	0.07508
1.79	0.96327	0.03673	0.92655	0.07345
1.80	0.96407	0.03593	0.92814	0.07186
1.81	0.96485	0.03515	0.92970	0.07030
1.82	0.96562	0.03438	0.93124	0.06876
1.83	0.96638	0.03362	0.93275	0.06725
1.84	0.96712	0.03288	0.93423	0.06577
1.85	0.96784	0.03216	0.93569	0.06431

z	$P(Z < z)$	$P(Z > z)$	$P(-z < Z < z)$	$P(Z < -z \text{ or } Z > z)$
1.86	0.96856	0.03144	0.93711	0.06289
1.87	0.96926	0.03074	0.93852	0.06148
1.88	0.96995	0.03005	0.93989	0.06011
1.89	0.97062	0.02938	0.94124	0.05876
1.90	0.97128	0.02872	0.94257	0.05743
1.91	0.97193	0.02807	0.94387	0.05613
1.92	0.97257	0.02743	0.94514	0.05486
1.93	0.97320	0.02680	0.94639	0.05361
1.94	0.97381	0.02619	0.94762	0.05238
1.95	0.97441	0.02559	0.94882	0.05118
1.96	0.97500	0.02500	0.95000	0.05000
1.97	0.97558	0.02442	0.95116	0.04884
1.98	0.97615	0.02385	0.95230	0.04770
1.99	0.97670	0.02330	0.95341	0.04659
2.00	0.97725	0.02275	0.95450	0.04550
2.01	0.97778	0.02222	0.95557	0.04443
2.02	0.97831	0.02169	0.95662	0.04338
2.03	0.97882	0.02118	0.95764	0.04236
2.04	0.97932	0.02068	0.95865	0.04135
2.05	0.97982	0.02018	0.95964	0.04036
2.06	0.98030	0.01970	0.96060	0.03940
2.07	0.98077	0.01923	0.96155	0.03845
2.08	0.98124	0.01876	0.96247	0.03753
2.09	0.98169	0.01831	0.96338	0.03662
2.10	0.98214	0.01786	0.96427	0.03573
2.11	0.98257	0.01743	0.96514	0.03486
2.12	0.98300	0.01700	0.96599	0.03401
2.13	0.98341	0.01659	0.96683	0.03317
2.14	0.98382	0.01618	0.96765	0.03235
2.15	0.98422	0.01578	0.96844	0.03156
2.16	0.98461	0.01539	0.96923	0.03077
2.17	0.98500	0.01500	0.96999	0.03001
2.18	0.98537	0.01463	0.97074	0.02926
2.19	0.98574	0.01426	0.97148	0.02852
2.20	0.98610	0.01390	0.97219	0.02781
2.21	0.98645	0.01355	0.97289	0.02711
2.22	0.98679	0.01321	0.97358	0.02642
2.23	0.98713	0.01287	0.97425	0.02575
2.24	0.98745	0.01255	0.97491	0.02509
2.25	0.98778	0.01222	0.97555	0.02445
2.26	0.98809	0.01191	0.97618	0.02382
2.27	0.98840	0.01160	0.97679	0.02321
2.28	0.98870	0.01130	0.97739	0.02261
2.29	0.98899	0.01101	0.97798	0.02202
2.30	0.98928	0.01072	0.97855	0.02145
2.31	0.98956	0.01044	0.97911	0.02089
2.32	0.98983	0.01017	0.97966	0.02034
2.33	0.99010	0.00990	0.98019	0.01981
2.34	0.99036	0.00964	0.98072	0.01928

z	$P(Z < z)$	$P(Z > z)$	$P(-z < Z < z)$	$P(Z < -z \text{ or } Z > z)$
2.35	0.99061	0.00939	0.98123	0.01877
2.36	0.99086	0.00914	0.98173	0.01827
2.37	0.99111	0.00889	0.98221	0.01779
2.38	0.99134	0.00866	0.98269	0.01731
2.39	0.99158	0.00842	0.98315	0.01685
2.40	0.99180	0.00820	0.98360	0.01640
2.41	0.99202	0.00798	0.98405	0.01595
2.42	0.99224	0.00776	0.98448	0.01552
2.43	0.99245	0.00755	0.98490	0.01510
2.44	0.99266	0.00734	0.98531	0.01469
2.45	0.99286	0.00714	0.98571	0.01429
2.46	0.99305	0.00695	0.98611	0.01389
2.47	0.99324	0.00676	0.98649	0.01351
2.48	0.99343	0.00657	0.98686	0.01314
2.49	0.99361	0.00639	0.98723	0.01277
2.50	0.99379	0.00621	0.98758	0.01242
2.51	0.99396	0.00604	0.98793	0.01207
2.52	0.99413	0.00587	0.98826	0.01174
2.53	0.99430	0.00570	0.98859	0.01141
2.54	0.99446	0.00554	0.98891	0.01109
2.55	0.99461	0.00539	0.98923	0.01077
2.56	0.99477	0.00523	0.98953	0.01047
2.57	0.99492	0.00508	0.98983	0.01017
2.58	0.99506	0.00494	0.99012	0.00988
2.59	0.99520	0.00480	0.99040	0.00960
2.60	0.99534	0.00466	0.99068	0.00932
2.61	0.99547	0.00453	0.99095	0.00905
2.62	0.99560	0.00440	0.99121	0.00879
2.63	0.99573	0.00427	0.99146	0.00854
2.64	0.99585	0.00415	0.99171	0.00829
2.65	0.99598	0.00402	0.99195	0.00805
2.66	0.99609	0.00391	0.99219	0.00781
2.67	0.99621	0.00379	0.99241	0.00759
2.68	0.99632	0.00368	0.99264	0.00736
2.69	0.99643	0.00357	0.99285	0.00715
2.70	0.99653	0.00347	0.99307	0.00693
2.71	0.99664	0.00336	0.99327	0.00673
2.72	0.99674	0.00326	0.99347	0.00653
2.73	0.99683	0.00317	0.99367	0.00633
2.74	0.99693	0.00307	0.99386	0.00614
2.75	0.99702	0.00298	0.99404	0.00596
2.76	0.99711	0.00289	0.99422	0.00578
2.77	0.99720	0.00280	0.99439	0.00561
2.78	0.99728	0.00272	0.99456	0.00544
2.79	0.99736	0.00264	0.99473	0.00527
2.80	0.99744	0.00256	0.99489	0.00511
2.81	0.99752	0.00248	0.99505	0.00495
2.82	0.99760	0.00240	0.99520	0.00480
2.83	0.99767	0.00233	0.99535	0.00465

z	$P(Z < z)$	$P(Z > z)$	$P(-z < Z < z)$	$P(Z < -z \text{ or } Z > z)$
2.84	0.99774	0.00226	0.99549	0.00451
2.85	0.99781	0.00219	0.99563	0.00437
2.86	0.99788	0.00212	0.99576	0.00424
2.87	0.99795	0.00205	0.99590	0.00410
2.88	0.99801	0.00199	0.99602	0.00398
2.89	0.99807	0.00193	0.99615	0.00385
2.90	0.99813	0.00187	0.99627	0.00373
2.91	0.99819	0.00181	0.99639	0.00361
2.92	0.99825	0.00175	0.99650	0.00350
2.93	0.99831	0.00169	0.99661	0.00339
2.94	0.99836	0.00164	0.99672	0.00328
2.95	0.99841	0.00159	0.99682	0.00318
2.96	0.99846	0.00154	0.99692	0.00308
2.97	0.99851	0.00149	0.99702	0.00298
2.98	0.99856	0.00144	0.99712	0.00288
2.99	0.99861	0.00139	0.99721	0.00279
3.00	0.99865	0.00135	0.99730	0.00270
3.01	0.99869	0.00131	0.99739	0.00261
3.02	0.99874	0.00126	0.99747	0.00253
3.03	0.99878	0.00122	0.99755	0.00245
3.04	0.99882	0.00118	0.99763	0.00237
3.05	0.99886	0.00114	0.99771	0.00229
3.06	0.99889	0.00111	0.99779	0.00221
3.07	0.99893	0.00107	0.99786	0.00214
3.08	0.99896	0.00104	0.99793	0.00207
3.09	0.99900	0.00100	0.99800	0.00200
3.10	0.99903	0.00097	0.99806	0.00194
3.11	0.99906	0.00094	0.99813	0.00187
3.12	0.99910	0.00090	0.99819	0.00181
3.13	0.99913	0.00087	0.99825	0.00175
3.14	0.99916	0.00084	0.99831	0.00169
3.15	0.99918	0.00082	0.99837	0.00163
3.16	0.99921	0.00079	0.99842	0.00158
3.17	0.99924	0.00076	0.99848	0.00152
3.18	0.99926	0.00074	0.99853	0.00147
3.19	0.99929	0.00071	0.99858	0.00142
3.20	0.99931	0.00069	0.99863	0.00137
3.21	0.99934	0.00066	0.99867	0.00133
3.22	0.99936	0.00064	0.99872	0.00128
3.23	0.99938	0.00062	0.99876	0.00124
3.24	0.99940	0.00060	0.99880	0.00120
3.25	0.99942	0.00058	0.99885	0.00115
3.26	0.99944	0.00056	0.99889	0.00111
3.27	0.99946	0.00054	0.99892	0.00108
3.28	0.99948	0.00052	0.99896	0.00104
3.29	0.99950	0.00050	0.99900	0.00100
3.30	0.99952	0.00048	0.99903	0.00097
3.31	0.99953	0.00047	0.99907	0.00093
3.32	0.99955	0.00045	0.99910	0.00090

z	$P(Z < z)$	$P(Z > z)$	$P(-z < Z < z)$	$P(Z < -z \text{ or } Z > z)$
3.33	0.99957	0.00043	0.99913	0.00087
3.34	0.99958	0.00042	0.99916	0.00084
3.35	0.99960	0.00040	0.99919	0.00081
3.36	0.99961	0.00039	0.99922	0.00078
3.37	0.99962	0.00038	0.99925	0.00075
3.38	0.99964	0.00036	0.99928	0.00072
3.39	0.99965	0.00035	0.99930	0.00070
3.40	0.99966	0.00034	0.99933	0.00067
3.41	0.99968	0.00032	0.99935	0.00065
3.42	0.99969	0.00031	0.99937	0.00063
3.43	0.99970	0.00030	0.99940	0.00060
3.44	0.99971	0.00029	0.99942	0.00058
3.45	0.99972	0.00028	0.99944	0.00056
3.46	0.99973	0.00027	0.99946	0.00054
3.47	0.99974	0.00026	0.99948	0.00052
3.48	0.99975	0.00025	0.99950	0.00050
3.49	0.99976	0.00024	0.99952	0.00048
3.50	0.99977	0.00023	0.99953	0.00047
3.51	0.99978	0.00022	0.99955	0.00045
3.52	0.99978	0.00022	0.99957	0.00043
3.53	0.99979	0.00021	0.99958	0.00042
3.54	0.99980	0.00020	0.99960	0.00040
3.55	0.99981	0.00019	0.99961	0.00039
3.56	0.99981	0.00019	0.99963	0.00037
3.57	0.99982	0.00018	0.99964	0.00036
3.58	0.99983	0.00017	0.99966	0.00034
3.59	0.99983	0.00017	0.99967	0.00033
3.60	0.99984	0.00016	0.99968	0.00032
3.80	0.99993	0.00007	0.99986	0.00014
3.82	0.99993	0.00007	0.99987	0.00013
3.84	0.99994	0.00006	0.99988	0.00012
3.86	0.99994	0.00006	0.99989	0.00011
3.88	0.99995	0.00005	0.99990	0.00010
3.90	0.99995	0.00005	0.99990	0.00010
3.92	0.99996	0.00004	0.99991	0.00009
3.94	0.99996	0.00004	0.99992	0.00008
3.96	0.99996	0.00004	0.99993	0.00007
3.98	0.99997	0.00003	0.99993	0.00007
4.00	0.99997	0.00003	0.99994	0.00006
4.02	0.99997	0.00003	0.99994	0.00006
4.04	0.99997	0.00003	0.99995	0.00005
4.06	0.99998	0.00002	0.99995	0.00005
4.08	0.99998	0.00002	0.99995	0.00005
4.10	0.99998	0.00002	0.99996	0.00004
4.12	0.99998	0.00002	0.99996	0.00004
4.14	0.99998	0.00002	0.99997	0.00003
4.16	0.99998	0.00002	0.99997	0.00003
4.18	0.99999	0.00001	0.99997	0.00003
4.20	0.99999	0.00001	0.99997	0.00003

z	$P(Z < z)$	$P(Z > z)$	$P(-z < Z < z)$	$P(Z < -z \text{ or } Z > z)$
4.22	0.99999	0.00001	0.99998	0.00002
4.24	0.99999	0.00001	0.99998	0.00002
4.26	0.99999	0.00001	0.99998	0.00002
4.28	0.99999	0.00001	0.99998	0.00002
4.30	0.99999	0.00001	0.99998	0.00002
4.32	0.99999	0.00001	0.99998	0.00002
4.34	0.99999	0.00001	0.99999	0.00001
4.36	0.99999	0.00001	0.99999	0.00001
4.38	0.99999	0.00001	0.99999	0.00001
4.40	0.99999	0.00001	0.99999	0.00001
4.42	1.00000	0.00000	0.99999	0.00001
4.44	1.00000	0.00000	0.99999	0.00001
4.46	1.00000	0.00000	0.99999	0.00001
4.48	1.00000	0.00000	0.99999	0.00001
4.50	1.00000	0.00000	0.99999	0.00001
4.52	1.00000	0.00000	0.99999	0.00001
4.54	1.00000	0.00000	0.99999	0.00001
4.56	1.00000	0.00000	0.99999	0.00001
4.58	1.00000	0.00000	1.00000	0.00000
4.60	1.00000	0.00000	1.00000	0.00000

Appendix 2

Percentiles of t distributions

Degrees of freedom (df)	Area in the symmetric central region $P(-t < T < t)$				
	0.80	0.90	0.95	0.99	0.999
	Area to the left of t : $P(T < t)$				
	0.90	0.95	0.975	0.995	0.9995
1	3.078	6.314	12.71	63.66	636.6
2	1.886	2.920	4.303	9.925	31.60
3	1.638	2.353	3.182	5.841	12.92
4	1.533	2.132	2.776	4.604	8.610
5	1.476	2.015	2.571	4.032	6.869
6	1.440	1.943	2.447	3.707	5.959
7	1.415	1.895	2.365	3.499	5.408
8	1.397	1.860	2.306	3.355	5.041
9	1.383	1.833	2.262	3.250	4.781
10	1.372	1.812	2.228	3.169	4.587
11	1.363	1.796	2.201	3.106	4.437
12	1.356	1.782	2.179	3.055	4.318
13	1.350	1.771	2.160	3.012	4.221
14	1.345	1.761	2.145	2.977	4.140
15	1.341	1.753	2.131	2.947	4.073
16	1.337	1.746	2.120	2.921	4.015
17	1.333	1.740	2.110	2.898	3.965
18	1.330	1.734	2.101	2.878	3.922
19	1.328	1.729	2.093	2.861	3.883
20	1.325	1.725	2.086	2.845	3.850
21	1.323	1.721	2.080	2.831	3.819
22	1.321	1.717	2.074	2.819	3.792
23	1.319	1.714	2.069	2.807	3.768
24	1.318	1.711	2.064	2.797	3.745
25	1.316	1.708	2.060	2.787	3.725
26	1.315	1.706	2.056	2.779	3.707
27	1.314	1.703	2.052	2.771	3.690
28	1.313	1.701	2.048	2.763	3.674
29	1.311	1.699	2.045	2.756	3.659
30	1.310	1.697	2.042	2.750	3.646
31	1.309	1.696	2.040	2.744	3.633
32	1.309	1.694	2.037	2.738	3.622
33	1.308	1.692	2.035	2.733	3.611
34	1.307	1.691	2.032	2.728	3.601
35	1.306	1.690	2.030	2.724	3.591

Degrees of freedom (df)	Area in the symmetric central region $P(-t < T < t)$					0.999
	0.80	0.90	0.95	0.99	0.9995	
	Area to the left of t : $P(T < t)$					
	0.90	0.95	0.975	0.995	0.9995	
36	1.306	1.688	2.028	2.719	3.582	
37	1.305	1.687	2.026	2.715	3.574	
38	1.304	1.686	2.024	2.712	3.566	
39	1.304	1.685	2.023	2.708	3.558	
40	1.303	1.684	2.021	2.704	3.551	
45	1.301	1.679	2.014	2.690	3.520	
50	1.299	1.676	2.009	2.678	3.496	
60	1.296	1.671	2.000	2.660	3.460	
70	1.294	1.667	1.994	2.648	3.435	
80	1.292	1.664	1.990	2.639	3.416	
90	1.291	1.662	1.987	2.632	3.402	
100	1.290	1.660	1.984	2.626	3.390	
120	1.289	1.658	1.980	2.617	3.373	
140	1.288	1.656	1.977	2.611	3.361	
160	1.287	1.654	1.975	2.60	3.352	
180	1.286	1.653	1.973	2.603	3.345	
200	1.286	1.653	1.972	2.601	3.340	
220	1.285	1.652	1.971	2.598	3.335	
240	1.285	1.651	1.970	2.596	3.332	
260	1.285	1.651	1.969	2.595	3.328	
280	1.285	1.650	1.968	2.594	3.326	
300	1.284	1.650	1.968	2.592	3.323	

Appendix 3

Percentiles of χ^2 distributions

Degrees of freedom (df)	Area to the left of X^2 : $P(X < X^2)$			
	0.90	0.95	0.99	0.999
1	2.706	3.841	6.635	10.828
2	4.605	5.991	9.210	13.816
3	6.251	7.815	11.345	16.266
4	7.779	9.488	13.277	18.467
5	9.236	11.070	15.086	20.515
6	10.645	12.592	16.812	22.458
7	12.017	14.067	18.475	24.322
8	13.362	15.507	20.090	26.124
9	14.684	16.919	21.666	27.877
10	15.987	18.307	23.209	29.588
11	17.275	19.675	24.725	31.264
12	18.549	21.026	26.217	32.909
13	19.812	22.362	27.688	34.528
14	21.064	23.685	29.141	36.123
15	22.307	24.996	30.578	37.697
16	23.542	26.296	32.000	39.252
17	24.769	27.587	33.409	40.790
18	25.989	28.869	34.805	42.312
19	27.204	30.144	36.191	43.820
20	28.412	31.410	37.566	45.315
21	29.615	32.671	38.932	46.797
22	30.813	33.924	40.289	48.268
23	32.007	35.172	41.638	49.728
24	33.196	36.415	42.980	51.179
25	34.382	37.652	44.314	52.620
26	35.563	38.885	45.642	54.052
27	36.741	40.113	46.963	55.476
28	37.916	41.337	48.278	56.892
29	39.087	42.557	49.588	58.301
30	40.256	43.773	50.892	59.703
35	46.059	49.802	57.342	66.619
40	51.805	55.758	63.691	73.402
45	57.505	61.656	69.957	80.077
50	63.167	67.505	76.154	86.661
55	68.796	73.311	82.292	93.168
60	74.397	79.082	88.379	99.607
70	85.527	90.531	100.43	112.32

Degrees of freedom (df)	Area to the left of X^2 : $P(X < X^2)$			
	0.90	0.95	0.99	0.999
80	96.578	101.88	112.33	124.84
90	107.57	113.15	124.12	137.21
100	118.50	124.34	135.81	149.45
110	129.39	135.48	147.41	161.58
120	140.23	146.57	158.95	173.62
130	151.05	157.61	170.42	185.57
140	161.83	168.61	181.84	197.45
150	172.58	179.58	193.21	209.26
160	183.31	190.52	204.53	221.02
170	194.02	201.42	215.81	232.72
180	204.70	212.30	227.06	244.37
190	215.37	223.16	238.27	255.98
200	226.02	233.99	249.45	267.54

Appendix 4

Percentiles of F distributions ($\alpha = 0.05$)

(ddf)	Numerator degrees of freedom (ndf)								
	1	2	3	4	5	6	7	8	9
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12
50	4.03	3.18	2.79	2.56	2.40	2.29	2.20	2.13	2.07
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04
70	3.98	3.13	2.74	2.50	2.35	2.23	2.14	2.07	2.02
80	3.96	3.11	2.72	2.49	2.33	2.21	2.13	2.06	2.00
90	3.95	3.10	2.71	2.47	2.32	2.20	2.11	2.04	1.99
100	3.94	3.09	2.70	2.46	2.31	2.19	2.10	2.03	1.97
110	3.93	3.08	2.69	2.45	2.30	2.18	2.09	2.02	1.97
120	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96

(ddf)	Numerator degrees of freedom (ndf)										
	10	12	15	20	25	30	40	60	80	100	120
1	241.9	243.9	245.9	248.0	249.3	250.1	251.1	252.2	252.7	253.0	253.3
2	19.40	19.41	19.43	19.45	19.46	√19.46	19.47	19.48	19.48	19.49	19.49
3	8.79	8.74	8.70	8.66	8.63	8.62	8.59	8.57	8.56	8.55	8.55
4	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.67	5.66	5.66
5	4.74	4.68	4.62	4.56	4.52	4.50	4.46	4.43	4.41	4.41	4.40
6	4.06	4.00	3.94	3.87	3.83	3.81	3.77	3.74	3.72	3.71	3.70
7	3.64	3.57	3.51	3.44	3.40	3.38	3.34	3.30	3.29	3.27	3.27
8	3.35	3.28	3.22	3.15	3.11	3.08	3.04	3.01	2.99	2.97	2.97
9	3.14	3.07	3.01	2.94	2.89	2.86	2.83	2.79	2.77	2.76	2.75
10	2.98	2.91	2.85	2.77	2.73	2.70	2.66	2.62	2.60	2.59	2.58
11	2.85	2.79	2.72	2.65	2.60	2.57	2.53	2.49	2.47	2.46	2.45
12	2.75	2.69	2.62	2.54	2.50	2.47	2.43	2.38	2.36	2.35	2.34
13	2.67	2.60	2.53	2.46	2.41	2.38	2.34	2.30	2.27	2.26	2.25
14	2.60	2.53	2.46	2.39	2.34	2.31	2.27	2.22	2.20	2.19	2.18
15	2.54	2.48	2.40	2.33	2.28	2.25	2.20	2.16	2.14	2.12	2.11
16	2.49	2.42	2.35	2.28	2.23	2.19	2.15	2.11	2.08	2.07	2.06
17	2.45	2.38	2.31	2.23	2.18	2.15	2.10	2.06	2.03	2.02	2.01
18	2.41	2.34	2.27	2.19	2.14	2.11	2.06	2.02	1.99	1.98	1.97
19	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.96	1.94	1.93
20	2.35	2.28	2.20	2.12	2.07	2.04	1.99	1.95	1.92	1.91	1.90
21	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.89	1.88	1.87
22	2.30	2.23	2.15	2.07	2.02	1.98	1.94	1.89	1.86	1.85	1.84
23	2.27	2.20	2.13	2.05	2.00	1.96	1.91	1.86	1.84	1.82	1.81
24	2.25	2.18	2.11	2.03	1.97	1.94	1.89	1.84	1.82	1.80	1.79
25	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.80	1.78	1.77
26	2.22	2.15	2.07	1.99	1.94	1.90	1.85	1.80	1.78	1.76	1.75
27	2.20	2.13	2.06	1.97	1.92	1.88	1.84	1.79	1.76	1.74	1.73
28	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.74	1.73	1.71
29	2.18	2.10	2.03	1.94	1.89	1.85	1.81	1.75	1.73	1.71	1.70
30	2.16	2.09	2.01	1.93	1.88	1.84	1.79	1.74	1.71	1.70	1.68
40	2.08	2.00	1.92	1.84	1.78	1.74	1.69	1.64	1.61	1.59	1.58
50	2.03	1.95	1.87	1.78	1.73	1.69	1.63	1.58	1.54	1.52	1.51
60	1.99	1.92	1.84	1.75	1.69	1.65	1.59	1.53	1.50	1.48	1.47
70	1.97	1.89	1.81	1.72	1.66	1.62	1.57	1.50	1.47	1.45	1.44
80	1.95	1.88	1.79	1.70	1.64	1.60	1.54	1.48	1.45	1.43	1.41
90	1.94	1.86	1.78	1.69	1.63	1.59	1.53	1.46	1.43	1.41	1.39
100	1.93	1.85	1.77	1.68	1.62	1.57	1.52	1.45	1.41	1.39	1.38
110	1.92	1.84	1.76	1.67	1.61	1.56	1.50	1.44	1.40	1.38	1.36
120	1.91	1.83	1.75	1.66	1.60	1.55	1.50	1.43	1.39	1.37	1.35

Appendix 5

Values of q for Tukey's HSD test ($\alpha = 0.05$)

v	2	3	α	4	5	6
4	3.92649	5.04024		5.75706	6.28702	6.70644
5	3.63535	4.60166		5.21848	5.67312	6.03290
6	3.46046	4.33902		4.89559	5.30494	5.62855
7	3.34392	4.16483		4.68124	5.06007	5.35909
8	3.26115	4.04101		4.52880	4.88575	5.16723
9	3.19906	3.94850		4.41490	4.75541	5.02352
10	3.15106	3.87676		4.32658	4.65429	4.91202
11	3.11265	3.81952		4.25609	4.57356	4.82295
12	3.08132	3.77278		4.19852	4.50760	4.75015
13	3.05529	3.73414		4.15087	4.45291	4.68970
14	3.03319	3.70139		4.11051	4.40661	4.63854
15	3.01432	3.67338		4.07597	4.36699	4.59474
16	2.99800	3.64914		4.04609	4.33269	4.55681
17	2.98373	3.62796		4.01999	4.30271	4.52365
18	2.97115	3.60930		3.99698	4.27629	4.49442
19	2.95998	3.59274		3.97655	4.25283	4.46846
20	2.95000	3.57794		3.95829	4.23186	4.44524
21	2.94102	3.56463		3.94188	4.21300	4.42436
22	2.93290	3.55259		3.92704	4.19594	4.40547
23	2.92553	3.54167		3.91356	4.18045	4.38831
24	2.91880	3.53170		3.90126	4.16632	4.37265
25	2.91263	3.52257		3.89000	4.15337	4.35831
26	2.90697	3.51417		3.87964	4.14146	4.34511
27	2.90174	3.50643		3.87009	4.13047	4.33294
28	2.89690	3.49918		3.86125	4.12030	4.32167
29	2.89240	3.49263		3.85304	4.11087	4.31121
30	2.88822	3.48651		3.84540	4.10208	4.30147
31	2.88432	3.48065		3.83828	4.09389	4.29238
32	2.88068	3.47525		3.83162	4.08622	4.28389
33	2.87726	3.47019		3.82537	4.07904	4.27592
34	2.87405	3.46544		3.81951	4.07230	4.26844
35	2.87103	3.46097		3.81400	4.06595	4.26141
36	2.86818	3.45676		3.80880	4.05997	4.25477
37	2.86550	3.45278		3.80389	4.05432	4.24851
38	2.86296	3.44902		3.79925	4.04898	4.24258
39	2.86055	3.44546		3.79486	4.04392	4.23697
40	2.85827	3.44208		3.79069	4.03913	4.23165
41	2.85610	3.43888		3.78673	4.03457	4.22659

v	2	3	α	4	5	6
42	2.85404	3.43582		3.78296	4.03024	4.22179
43	2.85208	3.43292		3.77938	4.02611	4.21721
44	2.85020	3.43015		3.77596	4.02217	4.21284
45	2.84842	3.42751		3.77270	4.01842	4.20868
46	2.84671	3.42499		3.76958	4.01483	4.20469
47	2.84508	3.42257		3.76660	4.01140	4.20089
48	2.84352	3.42026		3.76375	4.00812	4.19724
49	2.84203	3.41805		3.76102	4.00497	4.19375
50	2.84059	3.41592		3.75839	4.00195	4.19040
51	2.83921	3.41389		3.75588	3.99906	4.18719
52	2.83789	3.41193		3.75346	3.99627	4.18410
53	2.83662	3.41005		3.75104	3.99360	4.18113
54	2.83540	3.40824		3.74886	3.99103	4.17827
55	2.83422	3.40649		3.74677	3.98855	4.17552
56	2.83308	3.40482		3.74475	3.98616	4.17287
57	2.83199	3.40320		3.74268	3.98386	4.17031
58	2.83093	3.40163		3.74075	3.98164	4.16785
59	2.82992	3.40013		3.73889	3.97949	4.16547
60	2.82893	3.39867		3.73709	3.97742	4.16317
61	2.82798	3.39726		3.73535	3.97542	4.16094
62	2.82706	3.39590		3.73367	3.97348	4.15879
63	2.82617	3.39458		3.73204	3.97161	4.15671
64	2.82531	3.39331		3.73047	3.96979	4.15470
65	2.82448	3.39207		3.72894	3.96804	4.15275
66	2.82367	3.39088		3.72746	3.96633	4.15085
67	2.82288	3.38971		3.72603	3.96468	4.14902
68	2.82212	3.38859		3.72464	3.96308	4.14724
69	2.82138	3.38750		3.72329	3.96152	4.14552
70	2.82067	3.38644		3.72198	3.96001	4.14384
71	2.81997	3.38540		3.72071	3.95855	4.14221
72	2.81929	3.38440		3.71947	3.95712	4.14063
73	2.81864	3.38343		3.71827	3.95574	4.13909
74	2.81800	3.38248		3.71710	3.95439	4.13759
75	2.81738	3.38156		3.71596	3.95308	4.13614
76	2.81665	3.38067		3.71485	3.95181	4.13472
77	2.81606	3.37979		3.71377	3.95056	4.13334
78	2.81548	3.37894		3.71273	3.94935	4.13200
79	2.81492	3.37812		3.71170	3.94818	4.13069
80	2.81437	3.37731		3.71071	3.94703	4.12941
81	2.81384	3.37652		3.70973	3.94591	4.12817
82	2.81332	3.37575		3.70879	3.94481	4.12696
83	2.81281	3.37501		3.70786	3.94375	4.12577
84	2.81232	3.37428		3.70696	3.94271	4.12462
85	2.81184	3.37356		3.70608	3.94169	4.12349
86	2.81136	3.37287		3.70522	3.94070	4.12239
87	2.81090	3.37219		3.70438	3.93974	4.12132
88	2.81045	3.37152		3.70356	3.93879	4.12027
89	2.81001	3.37087		3.70276	3.93778	4.11924

v	2	3	α	4	5	6
90	2.80958	3.37024		3.70197	3.93691	4.11824
91	2.80916	3.36962		3.70121	3.93607	4.11725
92	2.80875	3.36901		3.70046	3.93524	4.11630
93	2.80835	3.36842		3.69972	3.93443	4.11536
94	2.80795	3.36784		3.69901	3.93363	4.11444
95	2.80757	3.36727		3.69830	3.93274	4.11354
96	2.80719	3.36671		3.69762	3.93194	4.11266
97	2.80682	3.36617		3.69694	3.93117	4.11180
98	2.80646	3.36564		3.69628	3.93041	4.11095
99	2.80611	3.36511		3.69564	3.92967	4.11013
100	2.80576	3.36460		3.69501	3.92894	4.10932
101	2.80542	3.36410		3.69439	3.92822	4.10853
102	2.80509	3.36361		3.69378	3.92752	4.10775
103	2.80476	3.36313		3.69318	3.92684	4.10699
104	2.80444	3.36266		3.69260	3.92616	4.10624
105	2.80412	3.36219		3.69203	3.92550	4.10550
106	2.80382	3.36174		3.69147	3.92486	4.10478
107	2.80351	3.36129		3.69092	3.92422	4.10408
108	2.80322	3.36085		3.69038	3.92360	4.10339
109	2.80293	3.36043		3.68984	3.92299	4.10271
110	2.80264	3.36000		3.68932	3.92239	4.10204
111	2.80236	3.35959		3.68881	3.92180	4.10139
112	2.80208	3.35918		3.68831	3.92122	4.10074
113	2.80181	3.35878		3.68782	3.92065	4.10011
114	2.80155	3.35839		3.68733	3.92009	4.09949
115	2.80129	3.35801		3.68686	3.91954	4.09888
116	2.80103	3.35763		3.68639	3.91900	4.09828
117	2.80078	3.35726		3.68593	3.91847	4.09769
118	2.80053	3.35689		3.68548	3.91795	4.09711
119	2.80028	3.35653		3.68503	3.91744	4.09655
120	2.80004	3.35618		3.68460	3.91694	4.09599
121	2.79981	3.35583		3.68417	3.91644	4.09544
122	2.79958	3.35549		3.68375	3.91596	4.09490
123	2.79935	3.35516		3.68333	3.91548	4.09436
124	2.79913	3.35482		3.68292	3.91501	4.09384
125	2.79890	3.35450		3.68252	3.91454	4.09333
126	2.79869	3.35418		3.68213	3.91409	4.09282
127	2.79847	3.35387		3.68174	3.91364	4.09232
128	2.79826	3.35356		3.68135	3.91320	4.09183
129	2.79806	3.35325		3.68098	3.91276	4.09135
130	2.79785	3.35295		3.68061	3.91234	4.09087
131	2.79765	3.35265		3.68024	3.91192	4.09040
132	2.79745	3.35236		3.67988	3.91150	4.08994
133	2.79726	3.35208		3.67953	3.91109	4.08949
134	2.79707	3.35179		3.67918	3.91069	4.08904
135	2.79688	3.35152		3.67883	3.91029	4.08860
136	2.79669	3.35124		3.67849	3.90990	4.08817
137	2.79651	3.35097		3.67816	3.90952	4.08774

v	2	3	α	4	5	6
138	2.79633	3.35071		3.67783	3.90914	4.08723
139	2.79615	3.35045		3.67751	3.90877	4.08683
140	2.79598	3.35019		3.67719	3.90840	4.08644
141	2.79580	3.34993		3.67687	3.90804	4.08606
142	2.79563	3.34968		3.67656	3.90768	4.08562
143	2.79547	3.34943		3.67626	3.90732	4.08538
144	2.79530	3.34919		3.67596	3.90698	4.08495
145	2.79514	3.34895		3.67566	3.90663	4.08459
146	2.79498	3.34871		3.67537	3.90630	4.08423
147	2.79482	3.34848		3.67508	3.90596	4.08388
148	2.79466	3.34825		3.67479	3.90563	4.08342
149	2.79451	3.34802		3.67451	3.90531	4.08306
150	2.79435	3.34780		3.67423	3.90499	4.08271

Review exercise solutions by chapter

Chapter 5

1.
 - a nominal
 - b ratio
 - c ratio
 - d ratio
 - e ratio
 - f ordinal
3.
 - a 63
 - b 53
 - c 72

Chapter 6

1.
 - a $100/200 = 0.5$
 - b $30/200 = 0.15$
 - c $45/200 = 0.225$
 - d $30/45 = 0.67$
3.
 - a 0.00135
 - b 0.5
 - c 0.05
 - d 0.00003
9.
 - a $t < -1.833$ or $t > 1.833$
 - b $t < -3.250$ or $t > 3.250$
 - c $t < -2.045$ or $t > 2.045$
 - d $t < -3.659$ or $t > 3.659$

10.
 - a not reject
 - b reject
 - c reject
 - d not reject

Chapter 8

2.
 - a (0.04, 0.21)
 - b (0.08, 0.16)
3.
 - a (0.10, 0.22)
 - b (0.08, 0.24)
 - c $Z = 0.74$ therefore we would be 54% confident.
4.
 - a (0.005, 0.15)
 - b (-0.01, 0.16)
 - c (-0.04, 0.19)

Chapter 9

2.
 - a (-0.745, 1.425)
 - b (-0.963, 1.643)
 - c (-1.405, 2.085)
3.
 - a The difference between groups is not statistically significant.

- b The difference between groups is statistically significant and the treatment appears to increase SBP.
- c The difference between groups is statistically significant and the treatment appears to lower SBP.

Chapter 10

- 3.
- a not rejected
- b rejected
- c rejected
- d rejected
- e not rejected
- f not rejected
- g rejected
- h not rejected

- 4.
- a 0.119
- b 0.008
- c 0.001
- d 0.317

5.

a

	Placebo	Test
Responder	117	152
Non-responder	385	346
	502	498

- b $H_0: p_1 - p_2 = 0$
 $H_A: p_1 - p_2 \neq 0$
- c Chi-square test, Fisher's exact test, or z approximation
- d Yes, there is sufficient evidence to reject the null hypothesis ($\alpha = 0.05$). Using the chi-square test the assumptions are that the two groups are independent; responses are mutually exclusive; and the expected cell counts are at least 5 in $>80\%$ of the cells. The value of the chi-square test statistic is 6.62.
- e The odds ratio = $\frac{(152)(385)}{(117)(346)} = 1.45$

Participants exposed to the test treatment are 1.45 times more likely to respond than participants in the placebo group.

Chapter 11

1.

- a $H_0: \mu_{\text{TEST}} - \mu_{\text{PLACEBO}} = 0$
 $H_A: \mu_{\text{TEST}} - \mu_{\text{PLACEBO}} \neq 0$
- b $t < -2.0423$ or $t > 2.042$
- c Independent samples; outcome approximately normally distributed; equal unknown variance
- d -2.26
- e Do not reject H_0 since $-2.042 < -0.68 < 2.042$. The mean pain scores are not significantly different between the two groups.

2.

- a $SS_{\text{error}} = 238.67896$
 $MS_{\text{Drug}} = 49.947295$
 $MS_{\text{Error}} = 7.95597$
 $F = 6.28$
- b 3
- c $H_0: \mu_1 = \mu_2 = \mu_3$
 $H_A: \text{at least one pair of population means are unequal}$
- d 33
- e $F > 3.32$
- f Reject H_0 since $6.28 > 3.32$. At least one pair of population means is unequal.

3.

- a $H_0: \mu_P = \mu_L = \mu_M = \mu_H$
 $H_A: \text{at least one pair of population means are unequal}$
- b Each group represents a simple random sample from relevant populations; observations are independent; outcome is approximately normally distributed; the variance is equal across the populations
- c Placebo vs. low; placebo vs. medium; placebo vs. high; low vs. medium; low vs. high; medium vs. high
- d To control the overall Type I error
- e $MSD_T = 3.68639 \sqrt{\frac{20}{30}} = 3.01$

Chapter 12

4.

a 80% power: 64/group
90% power: 86/group

b 80% power: 143/group
90% power: 191/group

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