KOLEJ UNIVERSITI TEKNOLOGI TUN HUSSEIN ONN

PEPERIKSAAN AKHIR
SEMESTER II
SESI 2004/2005

NAMA MATA PELAJARAN	:	STATISTIK UNTUK PENYELIDIKAN
KOD MATA PELAJARAN	:	MBE 1223
KURSUS	:	SARJANA PENDIDIKAN TEKNIK DAN VOKASIONAL
TARIKH PEPERIKSAAN	:	MAC 2005
JANGKA MASA	:	2 JAM 30 MINIT

ARAHAN :

1. JAWAB SEMUA SOALAN DARIPADA BAHAGIAN A DALAM BORANG OMR.
2. JAWAB SEMUA SOALAN DARIPADA BAHAGIAN B DALAM BUKU JAWAPAN.
3. KERTAS SOALAN HENDAKLAH DIKEMBALIKAN BERSAMA-SAMA DENGAN KERTAS JAWAPAN.

KERTAS SOALAN INI MENGANDUNGI 10 MUKA SURAT

BAHAGIAN A

S1 Yang manakah benar di antara pernyataan berikut mengenai statistik deskriptif ?

A Statistik deskriptif digunakan untuk meringkaskan (summarize) data
B Statistik deskriptif digunakan untuk membuat inferensi ciri-ciri populasi.
C Statistik deskriptif tidak diperlukan untuk mengintepretasikan statistik inferensi.
D Pilihan statistik deskriptif adalah bergantung pada tujuan penyelidikan serta saiz sampel.

S2 Skor persentil adalah contoh tahap pengukuran yang di panggil

A nominal
B sela (Interval)
C ordinal
D nisbah (ratio)

S3 Zamri telah mendapat skor yang lebih tinggi dari 15 orang pelajar di dalam kelas beliau. Bilangan pelajar dalam kelas beliau ialah 25 orang. Apakah kedudukan persentil pelajar A?

A Ke-10
B Ke-15
C Ke-40
D Ke-60

S4 Markah kuiz yang didapati oleh sekumpulan pelajar adalah seperti berikut: 4, 7, 7, 8, 10, 12, 12, 12, 18; min adalah.....; median adalah ..... dan mod adalah.....

A 8,12,10
B 8, 10, 12
C 10,10, 12
D 10, 10, 10

S5 Median satu taburan yang mengandungi 8 skor adalah 18. Jika skor yang paling tinggi ditambah dengan 4 mata, median taburan tersebut akan menjadi .....

A 18
B 18.5
C 22
D Tidak dapat ditentukan tanpa maklumat tambahan

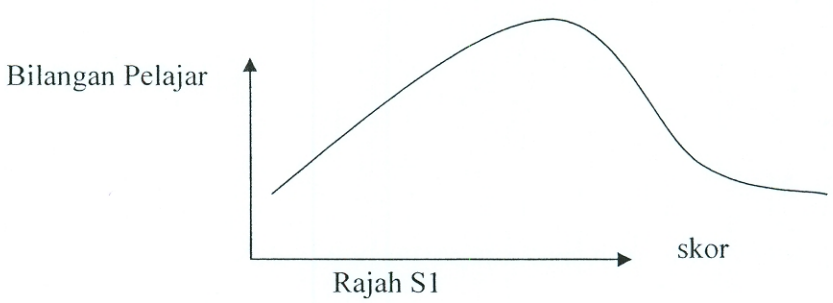
S6 Kirakan varians bagi 3, 8, 2, 6, 0, 5

A 7
B 8.4
C 7.1
D 4.0

S7 Syarikat Komponen United telah menghantar ke Pusat Teknologi Maklumat KUiTTHO satu kotak yang mengandungi 12 modem komputer yang mana 3 adalah rosak. Jika anda memilih 5 komputer secara rawak dan mengujinya, tentukan kebarangkalian untuk mendapatkan secara tepat bahawa terdapat 2 yang rosak?

A 0.423
B 0.318
C 0.014
D 0.100

S8 Lengkung kekerapan di dalam Rajah S1 menunjukkan



Rajah S1

A mod < median < min
B min < median < mod
C min < mod < median
D mod < min < median

S9 Pernyataan manakah yang benar mengenai tahap kesignifikanan?

A 0.05 < 0.01
B 0.001 adalah lebih baik daripada 0.01
C 0.03 bermakna membuat 3 kali kesilapan dalam setiap 100 kali penolakan hipotesis nul.
D 0.03 bermakna tahap keyakinan bahawa penolakan hipotesis nul itu benar adalah 3%.

S10 Dalam ujian-*t* berpasangan yang menggunakan sampel $n_1 = 15$ dan $n_2 = 9$, nilai $t_{kritikal}$ dari jadual di dapati dengan melihat pada darjah kebebasan *df* yang bersamaan

A 9
B 15
C 23
D 24

S11 Kesemua yang berikut adalah digunakan untuk menunjukkan tahap kesignifikanan melainkan

A p
B α
C t
D alpha

S12 Ralat piawai bagi taburan persampelan min (standard error of the mean, S.E.M) bagi n = 16 yang diambil dari populasi yang mempunyai sisihan piawai σ=5 ialah

A 0.31
B 1.25
C 3.20
D 0.8

S13 Satu kajian mengenai permintaan minuman cola berbanding dengan kalori minuman tersebut. Jadual 1 menunjukkan data kekerapan berdasarkan pemerhatian dan jangkaan yang didapati dari satu kajian. Dapatkan nilai χ^2 bagi data tersebut.

Jadual 1

Kekerapan berdasarkan pemerhatian (*O*)	Kekerapan jangkaan (*E*)
50	60
65	60
45	60
70	60
70	60

A 15.000
B 7.692
C 9.168
D 1.830

S14 Ujian –t adalah satu ujian statistik untuk:

A mengenalpasti samaada min untuk dua atau lebih kumpulan adalah berbeza.
B mendapat nisbah untuk min kuasa dua (square mean) antara kumpulan dan dalam kumpulan.
C mengenalpasti samaada terdapat perbezaan antara dua min.
D mengenalpasti sampel yang kurang daripada 20 di mana sisihan piawainya tidak diketahui.

S15 Seorang penasihat akademik ingin mengetahui samaada penasihatan melalui kaedah '*developmental*' lebih berkesan dari kaedah preskriptif. Dengan jumlah saiz sampel seramai 150 pelajar, ujian-z telah digunakan dan z kiraan yang didapati ialah 1.08. Pada tahap signifikan 0.05, apakah yang harus beliau lakukan?

A Hipotesis kajian harus ditolak dan hipotesis nol harus ditolak.
B Hipotesis alternatif harus diterima dan hipotesis kajian harus ditolak.
C Hipotesis nol harus diterima dan hipotesis alternatif harus ditolak.
D Hipotesis nol harus ditolak dan hipotesis kajian harus diterima.

S16 Persamaan ujian tak berparameter (non-parametric equivalent) kepada ujian-t bagi sampel tidak bersandar (independent samples) dipanggil

A Ujian Wilcoxen
B Ujian Mann-Whitney U
C Analisis regresi
D Koefisien korelasi Pearson

S17 Antara senarai ujian di bawah yang manakah anda gunakan untuk membandingkan berat bayi sebelum dan selepas diberi makan?

A Analisis regresi (Regression Analysis)
B Ujian t-berpasangan (Paired *t*-test)
C Chi-squared
D Ujian t tidak bersandar (Independent *t*-test)

S18 Satu kajian telah dijalankan untuk menentukan kesan jenis pemakanan ke atas kecerdasan otak di mana tiga kumpulan pelajar telah dipilih secara rawak. Kirakan nilai statistik-*F* berdasarkah Jadual 2 di bawah.

Jadual 2

	SS	*df*
Antara kumpulan (*Between*)	62	2
Dalam kumpulan (*Within*)	16.4	15

A 3.78
B 7.50
C 14.50
D 30.00

S19 Satu tinjauan dilakukan ke atas 12 pensyarah secara rawak di Kolej komuniti X mengenai latihan dan prestasi kerja. Koefisyen korelasi *Spearman rank* antara latihan dan prestasi kerja didapati sebagai $r_s = 0.636$ Berpandukan jadual koefisyen Spearman, kesimpulan yang anda boleh buat ialah,

A terdapat hubungan antara latihan dan prestasi dengan 10% kemungkinan yang keputusan pengujian statistik ini adalah tidak benar.
B terdapat hubungan antara latihan dan prestasi dengan 5% kemungkinan yang keputusan pengujian statistik ini adalah tidak benar.
C terdapat hubungan antara latihan dan prestasi dengan 2.5% kemungkinan yang keputusan pengujian statistik ini adalah tidak benar.
D terdapat hubungan antara latihan dan prestasi dengan 1% kemungkinan yang keputusan pengujian statistik ini adalah benar.

S20 Di antara senarai berikut, yang manakah bukan ujian berparameter?

I Ujian Mann-Whitney U
II Ujian Wilcoxen Rank sum
III Ujian Kruskal-Wallis H
IV Korelasi Spearman Rank
V Korelasi Pearson

A I, II, and III
B IV and V
C I, II, III, and IV
D I, II, III and V

S21 Berikan 3 pengukuran utama untuk kecenderungsn memusat (central tendency) ?

I Mod
II Min
III Varians
IV Median

A I and II
B II and III
C I, II and IV
D 1, II, III and IV

S22 Marina mendapat 87% untuk ujian lukisan kejuruteraan dan and 76% untuk ujian Matematik. Gunakan data dalam Jadual 3 berikut dan pilih skor z yang betul bagi ujian-ujian tersebut.

Jadual 3

	Min	Sisihan piawai (Standard deviation)	Skor z (Z scores)
I Ujian lukisan kejuruteraan	85	2	1
II Ujian lukisan kejuruteraan	83	15	0.5
III Ujian Matematik	75	2	1.2
IV Ujian Matematik	70	4	1.5

A I and II
B II and III
C I and IV
D II and IV

S23 Antara berikut pilih syarat-syarat yang menepati penggunaan ujian-*t* berpasangan (paired *t-test*) dengan varian terkumpul. Syarat-syarat tersebut ialah;

I Data telah dikumpul dari sampel yg berkaitan.
II Tiap sampel adalah kurang dari 10 orang pelajar.
III Sampel mempunyai varian yang hampir sama.
IV Data sampel menepati taburan normal.

A I, II dan III sahaja.
B I dan IV sahaja.
C II, III dan IV sahaja.
D II dan III sahaja.

S24 Satu analisis kajian untuk menentukan samada perbezaan gaji antara dua bidang pekerjaan adalah berbeza atau tidak telah menggunakan ujian Mann-Whitney U di mana n_1= 8 dan n_2 = 12. Didapati U_1 = 40.5 dan U_2 = 13.5. Berdasarkan maklumat tersebut pilih kenyataan yang benar dari senarai kenyataan di bawah.

I Nilai U = 40.5 akan dibandingkan dengan U kritikal
II U kritikal ialah adalah U_2 = 13.5
III Perbezaan adalah tidak signifikan secara statistik pada tahap signifikan 5%
IV Nilai U = 13.5 akan dibandingkan dengan U kritikal.
V U kritikal ialah $U_1 + U_2 /2$

A I dan III sahaja.
B I, III dan V sahaja.
C II, IV dan V sahaja.
D I, IV dan V sahaja.

S25 Pilih kenyataan yang benar mengenai Ujian Kruskall Wallis

I Ujian tak-berparameter yang digunakan untuk menggantikan ANOVA bagi sampel bebas.
II Ianya adalah lanjutan dari Ujian Mann-Whitney.
III Ianya boleh digantikan dengan Ujian Friedman
IV Ujian berparameter untuk tiga kumpulan bebas
V Ujian tak berparameter untuk tiga kumpulan bebas

A I dan V sahaja.
B II, III, dan IV sahaja.
C III, IV dan V sahaja.
D IV dan V sahaja.

BAHAGIAN B

S26 KUiTTHO telah melancarkan program kecergasan 2005 pada bulan Januari dan seterusnya membuat kajian mengenai pengamalan diet ke atas 6 orang staf yang menghidap penyakit darah tinggi. Ketua Pusat Sukan KUiTTHO ingin menilai sejauh mana keberkesanan diet yang di amalkan oleh keenam-enam orang staf (dipilih secara rawak) dapat mengurangkan tahap kolesterol staf yang menghidap darah tinggi pada tahap keyakinan 99%. Tahap kolesterol untuk setiap staf diukur sebelum dan selepas diet tersebut seperti yang ditunjukkan di Jadual 4.

Jadual 4

Sebelum diet	Selepas diet
196	174
212	160
254	151
207	121
221	275
223	118

Berdasarkan Jadual 4,

(a) Lakukan ujian signifikan menggunakan Ujian-t berpasangan pada tahap 0.01. untuk menguji samaada terdapat pengurangan yang signifikan dalam tahap kolesterol selepas mengamalkan diet yang diterapkan.

(b) Tafsirkan dapatan anda.

(15 markah)

S27 Satu kajian telah dibuat untuk mengetahui kekerapan kemalangan di jalanraya Batu Pahat oleh Jabatan Jalanraya, Fakulti Kejuruteraan Awam KUiTTHO dengan kerjasama Belia 4B. Data yang diperolehi telah diringkaskan di dalam jadual 5 dibawah. Uji dakwaan bahawa kebarangkalian berlaku kemalangan untuk setiap minggu dalam sebulan adalah sama, serta tafsirkan dapatan anda berdasarkan jadual 5 di bawah;

Jadual 5

Minggu	Pertama	Kedua	Ketiga	Keempat
Bil. Kemalangan	33	40	19	22

(15 markah)

S28 Pengerusi Alumni Politeknik Johor Bahru telah mengumpulkan data biografikal alumni yang telah graduat 10 tahun lepas. Beliau ingin mengetahui samada graduan diploma kejuruteraan elektrikal mendapat pendapatan tahunan yang lebih berbanding dengan graduan diploma mekanikal pada tahap keyakinan 99%. Jadual 6 di bawah menunjukkan data pendapatan daripada lapan graduan mekanikal dan 12 graduan elektrik.

Jadual 6

Pendapatan Tahunan Bidang kejuruteraan Mekanikal (RM '000)	**Pendapatan Tahunan Bidang Kejuruteraan Elektrik (RM '00)**
44.8	43.8
35.6	33.6
53.0	56.0
38.6	39.0
36.4	36.4
42.2	35.8
39.4	71.6
87.0	41.0
	37.4
	38.8
	34.6
	65.8

Lakukan ujian signifikan menggunakan Ujian Mann-Whitney pada tahap 0.01. untuk menguji samaada graduan diploma kejuruteraan elektrikal mendapat pendapatan tahunan yang lebih berbanding dengan graduan diploma mekanikal secara signifikan. Tafsirkan dapatan anda.

(15 markah)

S29 Satu kajian telah dijalankan untuk membandingkan kemahiran berfikir secara kritis di kalangan pelajar dari tiga buah sekolah. Sekolah A terdiri dari lima orang pelajar, sekolah B terdiri dari empat orang pelajar dan sekolah C terdiri dari enam orang pelajar. Skor bagi ujian kemahiran berfikir adalah seperti dalam Jadual di bawah. Lakukan Ujian ANOVA ke atas data dari Jadual 7 untuk menentukan samada terdapat perbezaan antara kumpulan berdasarkan tahap keyakinan 99 peratus.

Jadual 7. Markah pelajar mengikut kaedah.

Sekolah A	**Sekolah B**	**Sekolah C**
17	12	13
9	10	14
13	15	14
16	13	15
12		15
		14

(15 markah)

S30 Seorang pengajar Pusat Kemahiran Batu Pahat ingin menentukan samada terdapat perkaitan antara keputusan ujian aptitud dan hasilan (output) dalam unit dozen bagi satu tempoh masa. Beliau telah memilih lapan orang pelatih sebagai sampel. Jadual 8 di bawah menunjukkan senarai skor ujian aptitud dan hasilan kerja bagi pelatih tersebut.

Jadual 8. Hasilan Kerja dan Keputusan Ujian Aptitud bagi lapan pelatih pusat kemahiran Batu Pahat

Pelajar	Keputusan Ujian Aptitude	Hasilan Kerja (unit dozen)
A	6	30
B	9	49
C	3	18
D	8	42
E	7	39
F	5	25
G	8	41
H	10	52

(a) Berdasarkan Jadual 8, lakarkan data yang diberikan dalam bentuk plot serakan (scatter-plot) dan tafsirkan plot tersebut.

(7 Markah)

(b) Kirakan korelasi Pearson bagi data yang diberikan, lakukan ujian signifikan dan seterusnya tafsirkan dapatan tersebut.

(8 Markah)

STATISTIK DALAM PENYELIDIKAN MTT1503
RUMUS STATISTIK

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

$$s = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}}$$

$$F = \frac{S^2_{between}}{S^2_{within}}$$

$$S^2_{between} = \frac{\sum_{j=1}^{k} n_j \left(\bar{x}_j - \bar{X}\right)^2}{k-1}$$

$$S^2_{within} = \frac{\sum_{j=1}^{k} n_j s_j^2}{\sum_{j=1}^{k} n_j}$$

$$z = \frac{(x - \bar{x})}{(s)}$$

$$S.E.M = \frac{s}{\sqrt{n}}$$

$$t = \frac{\sum d}{\sqrt{\frac{n\sum d^2 - (\sum d)^2}{n-1}}}$$

d is difference between two scores
n is the number of subjects

$$t = \frac{\bar{x} - \mu}{s / \sqrt{n}}$$

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

O is observed frequency
E is expected frequency

$$t = r\sqrt{\frac{(n-2)}{1-r^2}}$$

r is correlation coeficient

$$U = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1$$

R is sum of ranks

$$U = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2$$

U =

$$r_{ab} = \frac{\sum_{i=1}^{n} \left[\left(x_{ai} - \bar{x}_a \right) \left(x_{bi} - \bar{x}_b \right) \right]}{n s_a s_b}$$

$$r_s = 1 - \frac{6 \sum d^2}{n^3 - n^n}$$ d is difference between ranks

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$$P(x) = \binom{n}{x} p^x (1-p)^{n-x}$$ $P(x)$ probability of x successes in n trials

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$$P(x) = \frac{e^{-m} m^x}{x!}$$ m is mean

TABLE D.1 CUMULATIVE BINOMIAL PROBABILITIES

The table gives the probability of obtaining *r or more* successes in *n* independent trials, where p = probability of success in a single trial.

Where there is no entry for a particular pair of values of n and p, this indicates that the appropriate probability is less than 0.00005. Similarly, except for the case $r = 0$, when the entry is exact, a tabulated value of 1.0000 represents a probability greater than 0.99995.

	$p =$	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
$n = 2$	$r = 0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.0199	.0396	.0591	.0784	.0975	.1164	.1351	.1536	.1719
	2	.0001	.0004	.0009	.0016	.0025	.0036	.0049	.0064	.0081
$n = 5$	$r = 0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.0490	.0961	.1413	.1846	.2262	.2661	.3043	.3409	.3760
	2	.0010	.0038	.0085	.0148	.0226	.0319	.0425	.0544	.0674
	3		.0001	.0003	.0006	.0012	.0020	.0031	.0045	.0063
	4						.0001	.0001	.0002	.0003
$n = 10$	$r = 0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.0956	.1829	.2626	.3352	.4013	.4614	.5160	.5656	.6106
	2	.0043	.0162	.0345	.0582	.0861	.1176	.1517	.1879	.2254
	3	.0001	.0009	.0028	.0062	.0115	.0188	.0283	.0401	.0540
	4			.0001	.0004	.0010	.0020	.0036	.0058	.0088
	5					.0001	.0002	.0003	.0006	.0010
	6									.0001
$n = 20$	$r = 0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.1821	.3324	.4562	.5580	.6415	.7099	.7658	.8113	.8484
	2	.0169	.0599	.1198	.1897	.2642	.3395	.4131	.4831	.5484
	3	.0010	.0071	.0210	.0439	.0755	.1150	.1610	.2121	.2666
	4		.0006	.0027	.0074	.0159	.0290	.0471	.0706	.0993
	5			.0003	.0010	.0026	.0056	.0107	.0183	.0290
	6				.0001	.0003	.0009	.0019	.0038	.0068
	7						.0001	.0003	.0006	.0013
	8								.0001	.0002

continued

TABLE D.1 *contd.*

	$p =$	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
$n = 50$	$r = 0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.3950	.6358	.7819	.8701	.9231	.9547	.9734	.9845	.9910
	2	.0894	.2642	.4447	.5995	.7206	.8100	.8735	.9173	.9468
	3	.0138	.0784	.1892	.3233	.4595	.5838	.6892	.7740	.8395
	4	.0016	.0178	.0628	.1391	.2396	.3527	.4673	.5747	.6697
	5	.0001	.0032	.0168	.0490	.1036	.1794	.2710	.3710	.4723
	6		.0005	.0037	.0144	.0378	.0776	.1350	.2081	.2928
	7		.0001	.0007	.0036	.0118	.0289	.0583	.1019	.1596
	8			.0001	.0008	.0032	.0094	.0220	.0438	.0768
	9				.0001	.0008	.0027	.0073	.0167	.0328
	10					.0002	.0007	.0022	.0056	.0125
	11						.0002	.0006	.0017	.0043
	12							.0001	.0005	.0013
	13								.0001	.0004
	14									.0001
$n = 100$	$r = 0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.6340	.8674	.9524	.9831	.9941	.9979	.9993	.9998	.9999
	2	.2642	.5967	.8054	.9128	.9629	.9848	.9940	.9977	.9991
	3	.0794	.3233	.5802	.7679	.8817	.9434	.9742	.9887	.9952
	4	.0184	.1410	.3528	.5705	.7422	.8570	.9256	.9633	.9827
	5	.0034	.0508	.1821	.3711	.5640	.7232	.8368	.9097	.9526
	6	.0005	.0155	.0808	.2116	.3840	.5593	.7086	.8201	.8955
	7	.0001	.0041	.0312	.1064	.2340	.3936	.5557	.6968	.8060
	8		.0009	.0106	.0475	.1280	.2517	.4012	.5529	.6872
	9		.0002	.0032	.0190	.0631	.1463	.2660	.4074	.5506
	10			.0009	.0068	.0282	.0775	.1620	.2780	.4125
	11			.0002	.0022	.0115	.0376	.0908	.1757	.2882
	12				.0007	.0043	.0168	.0469	.1028	.1876
	13				.0002	.0015	.0069	.0224	.0559	.1138
	14					.0005	.0026	.0099	.0282	.0645
	15					.0001	.0009	.0041	.0133	.0341
	16						.0003	.0016	.0058	.0169
	17						.0001	.0006	.0024	.0078
	18							.0002	.0009	.0034
	19							.0001	.0003	.0014
	20								.0001	.0005
	21									.0002
	22									.0001

TABLE D.1 *contd.*

	$p=$	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
$n=2$	$r=0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.1900	.2775	.3600	.4375	.5100	.5775	.6400	.6975	.7500
	2	.0100	.0225	.0400	.0625	.0900	.1225	.1600	.2025	.2500
$n=5$	$r=0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.4095	.5563	.6723	.7627	.8319	.8840	.9222	.9497	.9688
	2	.0815	.1648	.2627	.3672	.4718	.5716	.6630	.7438	.8125
	3	.0086	.0266	.0579	.1035	.1631	.2352	.3174	.4069	.5000
	4	.0005	.0022	.0097	.0156	.0308	.0840	.0870	.1312	.1875
	5		.0001	.0003	.0010	.0024	.0053	.0102	.0185	.0313
$n=10$	$r=0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.6513	.8031	.8926	.9437	.9718	.9865	.9940	.9975	.9990
	2	.2639	.4557	.6242	.7560	.8507	.9140	.9536	.9767	.9893
	3	.0702	.1798	.3222	.4744	.6172	.7384	.8327	.9004	.9453
	4	.0128	.0500	.1209	.2241	.3504	.4862	.6177	.7430	.8281
	5	.0016	.0099	.0328	.0781	.1503	.2485	.3669	.4956	.6230
	6	.0001	.0014	.0064	.0197	.0473	.0949	.1662	.2616	.3770
	7		.0001	.0009	.0035	.0106	.0260	.0548	.1020	.1719
	8			.0001	.0004	.0016	.0048	.0123	.0274	.0547
	9					.0001	.0005	.0017	.0045	.0107
	10							.0001	.0003	.0010
$n=20$	$r=0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.8784	.9612	.9885	.9968	.9992	.9998	1.0000	1.0000	1.0000
	2	.6083	.8244	.9308	.9757	.9924	.9979	.9995	.9999	1.0000
	3	.3231	.5951	.7939	.9087	.9645	.9879	.9964	.9991	.9998
	4	.1330	.3523	.5886	.7748	.8929	.9556	.9840	.9951	.9987
	5	.0432	.1702	.3704	.5852	.7625	.8818	.9490	.9811	.9941
	6	.0113	.0673	.1958	.3828	.5838	.7546	.8744	.9447	.9793
	7	.0024	.0219	.0867	.2142	.3920	.5834	.7500	.8701	.9423
	8	.0004	.0059	.0321	.1018	.2277	.3990	.5841	.7480	.8684
	9	.0001	.0013	.0100	.0409	.1133	.2376	.4044	.5857	.7483
	10		.0002	.0026	.0139	.0480	.1218	.2447	.4086	.5881
	11			.0006	.0039	.0171	.0532	.1275	.2493	.4119
	12			.0001	.0009	.0051	.0196	.0565	.1308	.2517
	13				.0002	.0013	.0060	.0210	.0580	.1316
	14					.0003	.0015	.0065	.0214	.0577
	15						.0003	.0016	.0064	.0207
	16							.0003	.0015	.0059
	17								.0003	.0013
	18									.0002

TABLE D.1 *contd.*

	$p=$	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
$n=50$	$r=0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	.9948	.9997	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	2	.9662	.9971	.9998	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	3	.8883	.9858	.9987	.9999	1.0000	1.0000	1.0000	1.0000	1.0000
	4	.7497	.9540	.9943	.9995	1.0000	1.0000	1.0000	1.0000	1.0000
	5	.5688	.8879	.9815	.9979	.9998	1.0000	1.0000	1.0000	1.0000
	6	.3839	.7806	.9520	.9930	.9993	.9999	1.0000	1.0000	1.0000
	7	.2298	.6387	.8966	.9806	.9975	.9998	1.0000	1.0000	1.0000
	8	.1221	.4812	.8096	.9547	.9927	.9992	.9999	1.0000	1.0000
	9	.0579	.3319	.6927	.9084	.9817	.9975	.9998	1.0000	1.0000
	10	.0245	.2089	.5563	.8363	.9598	.9933	.9992	.9999	1.0000
	11	.0094	.1199	.4164	.7378	.9211	.9840	.9978	.9998	1.0000
	12	.0032	.0628	.2893	.6184	.8610	.9658	.9943	.9994	1.0000
	13	.0010	.0301	.1861	.4890	.7771	.9339	.9867	.9982	.9998
	14	.0003	.0132	.1106	.3630	.6721	.8837	.9720	.9955	.9995
	15	.0001	.0053	.0607	.2519	.5532	.8122	.9460	.9896	.9987
	16		.0019	.0308	.1631	.4308	.7199	.9045	.9780	.9967
	17		.0007	.0144	.0983	.3161	.6111	.8439	.9573	.9923
	18		.0002	.0063	.0551	.2178	.4940	.7631	.9235	.9836
	19		.0001	.0025	.0287	.1406	.3784	.6644	.8727	.9675
	20			.0009	.0139	.0848	.2736	.5535	.8026	.9405
	21			.0003	.0063	.0478	.1861	.4390	.7138	.8987
	22			.0001	.0026	.0251	.1187	.3299	.6100	.8389
	23				.0010	.0123	.0710	.2340	.4981	.7601
	24				.0004	.0056	.0396	.1562	.3866	.6641
	25				.0001	.0024	.0207	.0978	.2840	.5561
	26					.0009	.0100	.0573	.1966	.4439
	27					.0003	.0045	.0314	.1279	.3359
	28					.0001	.0019	.0160	.0780	.2399
	29						.0007	.0076	.0444	.1611
	30						.0003	.0034	.0235	.1013
	31						.0001	.0014	.0116	.0595
	32							.0005	.0053	.0325
	33							.0002	.0022	.0164
	34							.0001	.0009	.0077
	35								.0003	.0033
	36								.0001	.0013
	37									.0005
	38									.0002

continued

TABLE D.1 *contd.*

$p=$		0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
$n=100$	$r=0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	2	.9997	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	3	.9981	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	4	.9922	.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	5	.9763	.9996	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	6	.9424	.9984	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	7	.8828	.9953	.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	8	.7939	.9878	.9997	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	9	.6791	.9725	.9991	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	10	.5487	.9449	.9977	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
	11	.4168	.9006	.9943	.9999	1.0000	1.0000	1.0000	1.0000	1.0000
	12	.2970	.8365	.9874	.9996	1.0000	1.0000	1.0000	1.0000	1.0000
	13	.1982	.7527	.9747	.9990	1.0000	1.0000	1.0000	1.0000	1.0000
	14	.1239	.6526	.9531	.9975	.9999	1.0000	1.0000	1.0000	1.0000
	15	.0726	.5428	.9196	.9946	.9998	1.0000	1.0000	1.0000	1.0000
	16	.0399	.4317	.8715	.9889	.9996	1.0000	1.0000	1.0000	1.0000
	17	.0206	.3275	.8077	.9789	.9990	1.0000	1.0000	1.0000	1.0000
	18	.0100	.2367	.7288	.9624	.9978	.9999	1.0000	1.0000	1.0000
	19	.0046	.1628	.6379	.9370	.9955	.9999	1.0000	1.0000	1.0000
	20	.0020	.1065	.5398	.9005	.9911	.9997	1.0000	1.0000	1.0000
	21	.0008	.0663	.4405	.8512	.9835	.9992	1.0000	1.0000	1.0000
	22	.0003	.0393	.3460	.7886	.9712	.9983	1.0000	1.0000	1.0000
	23	.0001	.0221	.2611	7136	.9521	.9966	.9999	1.0000	1.0000
	24		.0119	.1891	.6289	.9245	.9934	.9997	1.0000	1.0000
	25		.0061	.1314	.5383	.8864	.9879	.9994	1.0000	1.0000
	26		.0030	.0875	.4465	.8369	.9789	.9988	1.0000	1.0000
	27		.0014	.0558	.3583	.7756	.9649	.9976	.9999	1.0000
	28		.0006	.0342	.2776	.7036	.9442	.9954	.9998	1.0000
	29		.0003	.0200	.2075	.6232	.9152	.9916	.9996	1.0000
	30		.0001	.0112	.1495	.5377	.8764	.9852	.9992	1.0000
	31			.0061	.1038	.4509	.8270	.9752	.9985	1.0000
	32			.0031	.0693	.3669	.7669	.9602	.9970	.9999
	33			.0016	.0446	.2893	.6971	.9385	.9945	.9998
	34			.0007	.0276	.2207	.6197	.9087	.9902	.9996
	35			.0003	.0164	.1629	.5376	.8697	.9834	.9991
	36			.0001	.0094	.1161	.4542	.8205	.9728	.9982
	37			.0001	.0052	.0799	.3731	.7614	.9571	.9967
	38				.0027	.0530	.2976	.6932	.9349	.9940
	39				.0014	.0340	.2301	.6178	.9049	.9895

TABLE D.1 *contd.*

$p=$		0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.45	0.50
$n=100$	$r=40$				.0007	.0210	.1724	.5379	.8657	.9824
	41				.0003	.0125	.1250	.4567	.8169	.9716
	42				.0001	.0072	.0877	.3775	.7585	.9557
	43				.0001	.0040	.0594	.3033	.6913	.9334
	44					.0021	.0389	.2365	.6172	.9033
	45					.0011	.0246	.1789	.5387	.8644
	46					.0005	.0150	.1311	.4587	.8159
	47					.0003	.0088	.0930	.3804	.7579
	48					.0001	.0050	.0638	.3069	.6914
	49					.0001	.0027	.0423	.2404	.6178
	50						.0015	.0271	.1827	.5398
	51						.0007	.0168	.1346	.4602
	52						.0004	.0100	.0960	.3822
	53						.0002	.0058	.0662	.3086
	54						.0001	.0032	.0441	.2421
	55							.0017	.0284	.1841
	56							.0009	.0176	.1356
	57							.0004	.0106	.0967
	58							.0002	.0061	.0666
	59							.0001	.0034	.0443
	60								.0018	.0284
	61								.0009	.0176
	62								.0005	.0105
	63								.0002	.0060
	64								.0001	.0033
	65									.0018
	66									.0009
	67									.0004
	68									.0002
	69									.0001

Table D.1 gives binomial probabilities only for a limited range of values of n and p since, in practice, either the more compact tabulation of the Poisson distribution (Table D.2) or that of the normal distribution (Table D.3) can usually be used to give an adequate approximation. As a reasonable working rule,

(a) Use the Poisson approximation if $p < 0.1$, putting $m = np$.

(b) Use the normal approximation if $0.1 \leqslant p \leqslant 0.9$ and $np > 5$, putting $\mu = np$ and $\sigma = \sqrt{np(1-p)}$.

TABLE D.2 CUMULATIVE POISSON PROBABILITIES

The table gives the probability of *r or more* random events per unit time or space, when the average number of such events is *m*.

Where there is no entry for a particular pair of values of *r* and *m*, this indicates that the appropriate probability is less than 0.00005. Similarly, except for the case $r = 0$, when the entry is exact, a tabulated value of 1.0000 represents a probability greater than 0.99995.

$m =$	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
$r = 0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	.0952	.1813	.2592	.3297	.3935	.4512	.5034	.5507	.5934	.6321
2	.0047	.0175	.0369	.0616	.0902	.1219	.1558	.1912	.2275	.2642
3	.0002	.0011	.0036	.0079	.0144	.0231	.0341	.0474	.0629	.0803
4		.0001	.0003	.0008	.0018	.0034	.0058	.0091	.0135	.0190
5				.0001	.0002	.0004	.0008	.0014	.0023	.0037
6							.0001	.0002	.0003	.0006
7										.0001

$m =$	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
$r = 0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	.6671	.6988	.7275	.7534	.7769	.7981	.8173	.8347	.8504	.8647
2	.3010	.3374	.3732	.4082	.4422	.4751	.5068	.5372	.5663	.5940
3	.0996	.1205	.1429	.1665	.1912	.2166	.2428	.2694	.2963	.3233
4	.0257	.0338	.0431	.0537	.0656	.0788	.0932	.1087	.1253	.1429
5	.0054	.0077	.0107	.0143	.0186	.0237	.0296	.0364	.0441	.0527
6	.0010	.0015	.0022	.0032	.0045	.0060	.0080	.0104	.0132	.0166
7	.0001	.0003	.0004	.0006	.0009	.0013	.0019	.0026	.0034	.0045
8			.0001	.0001	.0002	.0003	.0004	.0006	.0008	.0011
9							.0001	.0001	.0002	.0002

$m =$	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0
$r = 0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	.8775	.8892	.8997	.9093	.9179	.9257	.9328	.9392	.9450	.9502
2	.6204	.6454	.6691	.6916	.7127	.7326	.7513	.7689	.7854	.8009
3	.3504	.3773	.4040	.4303	.4562	.4816	.5064	.5305	.5540	.5768
4	.1614	.1806	.2007	.2213	.2424	.2640	.2859	.3081	.3304	.3528
5	.0621	.0725	.0838	.0959	.1088	.1226	.1371	.1523	.1682	.1847
6	.0204	.0249	.0300	.0357	.0420	.0490	.0567	.0651	.0742	.0839
7	.0059	.0075	.0094	.0116	.0142	.0172	.0206	.0244	.0287	.0335
8	.0015	.0020	.0026	.0033	.0042	.0053	.0066	.0081	.0099	.0119
9	.0003	.0005	.0006	.0009	.0011	.0015	.0019	.0024	.0031	.0038
10	.0001	.0001	.0001	.0002	.0003	.0004	.0005	.0007	.0009	.0011
11					.0001	.0001	.0001	.0002	.0002	.0003
12									.0001	.0001

TABLE D.2 *contd.*

$m =$	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	4.0
$r = 0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	.9550	.9592	.9631	.9666	.9698	.9727	.9753	.9776	.9798	.9817
2	.8153	.8288	.8414	.8532	.8641	.8743	.8838	.8926	.9008	.9084
3	.5988	.6201	.6406	.6603	.6792	.6973	.7146	.7311	.7469	.7619
4	.3752	.3975	.4197	.4416	.4634	.4848	.5058	.5265	.5468	.5665
5	.2018	.2194	.2374	.2558	.2746	.2936	.3128	.3322	.3516	.3712
6	.0943	.1054	.1171	.1295	.1424	.1559	.1699	.1844	.1994	.2149
7	.0388	.0446	.0510	.0579	.0653	.0733	.0818	.0909	.1005	.1107
8	.0142	.0168	.0198	.0231	.0267	.0308	.0352	.0401	.0454	.0511
9	.0047	.0057	.0069	.0083	.0099	.0117	.0137	.0160	.0185	.0214
10	.0014	.0018	.0022	.0027	.0033	.0040	.0048	.0058	.0069	.0081
11	.0004	.0005	.0006	.0008	.0010	.0013	.0016	.0019	.0023	.0028
12	.0001	.0001	.0002	.0002	.0003	.0004	.0005	.0006	.0007	.0009
13				.0001	.0001	.0001	.0001	.0002	.0002	.0003
14									.0001	.0001

$m =$	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0
$r = 0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	.9834	.9850	.9864	.9877	.9889	.9899	.9909	.9918	.9926	.9933
2	.9155	.9220	.9281	.9337	.9389	.9437	.9482	.9523	.9561	.9596
3	.7762	.7898	.8026	.8149	.8264	.8374	.8477	.8575	.8667	.8753
4	.5858	.6046	.6228	.6406	.6577	.6743	.6903	.7058	.7207	.7350
5	.3907	.4102	.4296	.4488	.4679	.4868	.5054	.5237	.5418	.5595
6	.2307	.2469	.2633	.2801	.2971	.3142	.3316	.3490	.3665	.3840
7	.1214	.1325	.1442	.1564	.1689	.1820	.1954	.2092	.2233	.2378
8	.0573	.0639	.0710	.0786	.0866	.0951	.1040	.1133	.1231	.1334
9	.0245	.0279	.0317	.0358	.0403	.0451	.0503	.0558	.0618	.0681
10	.0095	.0111	.0129	.0149	.0171	.0195	.0222	.0251	.0283	.0318
11	.0034	.0041	.0048	.0057	.0067	.0078	.0090	.0104	.0120	.0137
12	.0011	.0014	.0017	.0020	.0024	.0029	.0034	.0040	.0047	.0055
13	.0003	.0004	.0005	.0007	.0008	.0010	.0012	.0014	.0017	.0020
14	.0001	.0001	.0002	.0002	.0003	.0003	.0004	.0005	.0006	.0007
15				.0001	.0001	.0001	.0001	.0001	.0002	.0002
16									.0001	.0001

continued

TABLE D.2 *contd.*

$m =$	5.2	5.4	5.6	5.8	6.0	6.2	6.4	6.6	6.8	7.0
$r = 0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	.9945	.9955	.9963	.9970	.9975	.9980	.9983	.9986	.9989	.9991
2	.9658	.9711	.9756	.9794	.9826	.9854	.9877	.9897	.9913	.9927
3	.8912	.9052	.9176	.9285	.9380	.9464	.9537	.9600	.9656	.9704
4	.7619	.7867	.8094	.8300	.8488	.8658	.8811	.8948	.9072	.9182
5	.5939	.6267	.6579	.6873	.7149	.7408	.7649	.7873	.8080	.8270
6	.4191	.4539	.4881	.5217	.5543	.5859	.6163	.6453	.6730	.6993
7	.2676	.2983	.3297	.3616	.3937	.4258	.4577	.4892	.5201	.5503
8	.1551	.1783	.2030	.2290	.2560	.2840	.3127	.3419	.3715	.4013
9	.0819	.0974	.1143	.1328	.1528	.1741	.1967	.2204	.2452	.2709
10	.0397	.0488	.0591	.0708	.0839	.0984	.1142	.1314	.1498	.1695
11	.0177	.0225	.0282	.0349	.0426	.0514	.0614	.0726	.0849	.0985
12	.0073	.0096	.0125	.0160	.0201	.0250	.0307	.0373	.0448	.0534
13	.0028	.0038	.0051	.0068	.0088	.0113	.0143	.0179	.0221	.0270
14	.0010	.0014	.0020	.0027	.0036	.0048	.0063	.0080	.0102	.0128
15	.0003	.0005	.0007	.0010	.0014	.0019	.0026	.0034	.0044	.0057
16	.0001	.0002	.0002	.0004	.0005	.0007	.0010	.0014	.0018	.0024
17		.0001	.0001	.0001	.0002	.0003	.0004	.0005	.0007	.0010
18					.0001	.0001	.0001	.0002	.0003	.0004
19								.0001	.0001	.0001

continued

TABLE D.2 *contd.*

$m =$	7.2	7.4	7.6	7.8	8.0	8.2	8.4	8.6	8.8	9.0
$r = 0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	.9993	.9994	.9995	.9996	.9997	.9997	.9998	.9998	.9998	.9999
2	.9939	.9949	.9957	.9964	.9970	.9975	.9979	.9982	.9985	.9988
3	.9745	.9781	.9812	.9839	.9862	.9882	.9900	.9914	.9927	.9938
4	.9281	.9368	.9446	.9515	.9576	.9630	.9677	.9719	.9756	.9788
5	.8445	.8605	.8751	.8883	.9004	.9113	.9211	.9299	.9379	.9450
6	.7241	.7474	.7693	.7897	.8088	.8264	.8427	.8578	.8716	.8843
7	.5796	.6080	.6354	.6616	.6866	.7104	.7330	.7543	.7744	.7932
8	.4311	.4607	.4900	.5188	.5470	.5746	.6013	.6272	.6522	.6761
9	.2973	.3243	.3518	.3796	.4075	.4353	.4631	.4906	.5177	.5443
10	.1904	.2123	.2351	.2589	.2834	.3085	.3341	.3600	.3863	.4126
11	.1133	.1293	.1465	.1648	.1841	.2045	.2257	.2478	.2706	.2940
12	.0629	.0735	.0852	.0980	.1119	.1269	.1429	.1600	.1780	.1970
13	.0327	.0391	.0464	.0546	.0638	.0739	.0850	.0971	.1102	.1242
14	.0159	.0195	.0238	.0286	.0342	.0405	.0476	.0555	.0642	.0739
15	.0073	.0092	.0114	.0141	.0173	.0209	.0251	.0299	.0353	.0415
16	.0031	.0041	.0052	.0066	.0082	.0102	.0125	.0152	.0184	.0220
17	.0013	.0017	.0022	.0029	.0037	.0047	.0059	.0074	.0091	.0111
18	.0005	.0007	.0009	.0012	.0016	.0021	.0027	.0034	.0043	.0053
19	.0002	.0003	.0004	.0005	.0006	.0009	.0011	.0015	.0019	.0024
20	.0001	.0001	.0001	.0002	.0003	.0003	.0005	.0006	.0008	.0011
21				.0001	.0001	.0001	.0002	.0002	.0003	.0004
22							.0001	.0001	.0001	.0002
23										.0001

continued

TABLE D.2 *contd.*

$m =$	9.2	9.4	9.6	9.8	10.0	11.0	12.0	13.0	14.0	15.0
$r = 0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	.9999	.9999	.9999	.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	.9990	.9991	.9993	.9994	.9995	.9998	.9999	1.0000	1.0000	1.0000
3	.9947	.9955	.9962	.9967	.9972	.9988	.9995	.9998	.9999	1.0000
4	.9816	.9840	.9862	.9880	.9897	.9951	.9977	.9990	.9995	.9998
5	.9514	.9571	.9622	.9667	.9707	.9849	.9924	.9963	.9982	.9991
6	.8959	.9065	.9162	.9250	.9329	.9625	.9797	.9893	.9945	.9972
7	.8108	.8273	.8426	.8567	.8699	.9214	.9542	.9741	.9858	.9924
8	.6990	.7208	.7416	.7612	.7798	.8568	.9105	.9460	.9684	.9820
9	.5704	.5958	.6204	.6442	.6672	.7680	.8450	.9002	.9379	.9626
10	.4389	.4651	.4911	.5168	.5421	.6595	.7576	.8342	.8906	.9301
11	.3180	.3424	.3671	.3920	.4170	.5401	.6528	.7483	.8243	.8815
12	.2168	.2374	.2588	.2807	.3032	.4207	.5384	.6468	.7400	.8152
13	.1393	.1552	.1721	.1899	.2084	.3113	.4240	.5369	.6415	.7324
14	.0844	.0958	.1081	.1214	.1355	.2187	.3185	.4270	.5356	.6368
15	.0483	.0559	.0643	.0735	.0835	.1460	.2280	.3249	.4296	.5343
16	.0262	.0309	.0362	.0421	.0487	.0926	.1556	.2364	.3306	.4319
17	.0135	.0162	.0194	.0230	.0270	.0559	.1013	.1645	.2441	.3359
18	.0066	.0081	.0098	.0119	.0143	.0322	.0630	.1095	.1728	.2511
19	.0031	.0038	.0048	.0059	.0072	.0177	.0374	.0698	.1174	.1805
20	.0014	.0017	.0022	.0028	.0035	.0093	.0213	.0427	.0765	.1248
21	.0006	.0008	.0010	.0012	.0016	.0047	.0116	.0250	.0479	.0830
22	.0002	.0003	.0004	.0005	.0007	.0023	.0061	.0141	.0288	.0531
23	.0001	.0001	.0002	.0002	.0003	.0010	.0030	.0076	.0167	.0327
24			.0001	.0001	.0001	.0005	.0015	.0040	.0093	.0195
25						.0002	.0007	.0020	.0050	.0112
26						.0001	.0003	.0010	.0026	.0062
27							.0001	.0005	.0013	.0033
28							.0001	.0002	.0006	.0017
29								.0001	.0003	.0009
30									.0001	.0004
31									.0001	.0002
32										.0001

continued

TABLE D.2 *contd.*

$m =$	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0
$r = 0$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	.9996	.9998	.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	.9986	.9993	.9997	.9998	.9999	1.0000	1.0000	1.0000	1.0000	1.0000
7	.9960	.9979	.9990	.9995	.9997	.9999	.9999	1.0000	1.0000	1.0000
8	.9900	.9946	.9971	.9985	.9992	.9996	.9998	.9999	1.0000	1.0000
9	.9780	.9874	.9929	.9961	.9979	.9989	.9994	.9997	.9998	.9999
10	.9567	.9739	.9846	.9911	.9950	.9972	.9985	.9992	.9996	.9998
11	.9226	.9509	.9696	.9817	.9892	.9937	.9965	.9980	.9989	.9994
12	.8730	.9153	.9451	.9653	.9786	.9871	.9924	.9956	.9975	.9986
13	.8069	.8650	.9083	.9394	.9610	.9755	.9849	.9909	.9946	.9969
14	.7255	.7991	.8574	.9016	.9339	.9566	.9722	.9826	.9893	.9935
15	.6325	.7192	.7919	.8503	.8951	.9284	.9523	.9689	.9802	.9876
16	.5333	.6285	.7133	.7852	.8435	.8889	.9231	.9480	.9656	.9777
17	.4340	.5323	.6249	.7080	.7789	.8371	.8830	.9179	.9437	.9623
18	.3407	.4360	.5314	.6216	.7030	.7730	.8310	.8772	.9129	.9395
19	.2577	.3450	.4378	.5305	.6186	.6983	.7675	.8252	.8717	.9080
20	.1878	.2637	.3491	.4394	.5297	.6157	.6940	.7623	.8197	.8664
21	.1318	.1945	.2693	.3528	.4409	.5290	.6131	.6899	.7574	.8145
22	.0892	.1385	.2009	.2745	.3563	.4423	.5284	.6106	.6861	.7527
23	.0582	.0953	.1449	.2069	.2794	.3595	.4436	.5277	.6083	.6825
24	.0367	.0633	.1011	.1510	.2125	.2840	.3626	.4449	.5272	.6061
25	.0223	.0406	.0683	.1067	.1568	.2178	.2883	.3654	.4460	.5266
26	.0131	.0252	.0446	.0731	.1122	.1623	.2229	.2923	.3681	.4471
27	.0075	.0152	.0282	.0486	.0779	.1174	.1676	.2277	.2962	.3706
28	.0041	.0088	.0173	.0313	.0525	.0825	.1225	.1726	.2323	.2998
29	.0022	.0050	.0103	.0195	.0343	.0564	.0871	.1274	.1775	.2366
30	.0011	.0027	.0059	.0118	.0218	.0374	.0602	.0915	.1321	.1821
31	.0006	.0014	.0033	.0070	.0135	.0242	.0405	.0640	.0958	.1367
32	.0003	.0007	.0018	.0040	.0081	.0152	.0265	.0436	.0678	.1001
33	.0001	.0004	.0010	.0022	.0047	.0093	.0169	.0289	.0467	.0715
34	.0001	.0002	.0005	.0012	.0027	.0055	.0105	.0187	.0314	.0498
35		.0001	.0002	.0006	.0015	.0032	.0064	.0118	.0206	.0338
36			.0001	.0003	.0008	.0018	.0038	.0073	.0132	.0225
37			.0001	.0002	.0004	.0010	.0022	.0044	.0082	.0146
38				.0001	.0002	.0005	.0012	.0026	.0050	.0092
39					.0001	.0003	.0007	.0015	.0030	.0057

TABLE D.2 *contd.*

$m =$	16.0	17.0	18.0	19.0	20.0	21.0	22.0	23.0	24.0	25.0
40					.0001	.0001	.0004	.0008	.0017	.0034
41						.0001	.0002	.0004	.0010	.0020
42							.0001	.0002	.0005	.0012
43								.0001	.0003	.0007
44								.0001	.0002	.0004
45									.0001	.0002
46										.0001

$m =$	26.0	27.0	28.0	29.0	30.0	32.0	34.0	36.0	38.0	40.0
$r = 9$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
10	.9999	.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
11	.9997	.9998	.9999	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
12	.9992	.9996	.9998	.9999	.9999	1.0000	1.0000	1.0000	1.0000	1.0000
13	.9982	.9990	.9994	.9997	.9998	1.0000	1.0000	1.0000	1.0000	1.0000
14	.9962	.9978	.9987	.9993	.9996	.9999	1.0000	1.0000	1.0000	1.0000
15	.9924	.9954	.9973	.9984	.9991	.9997	.9999	1.0000	1.0000	1.0000
16	.9858	.9912	.9946	.9967	.9981	.9993	.9998	.9999	1.0000	1.0000
17	.9752	.9840	.9899	.9937	.9961	.9986	.9995	.9998	1.0000	1.0000
18	.9580	.9726	.9821	.9885	.9927	.9972	.9990	.9997	.9999	1.0000
19	.9354	.9555	.9700	.9801	.9871	.9948	.9980	.9993	.9998	.9999
20	.9032	.9313	.9522	.9674	.9781	.9907	.9963	.9986	.9995	.9998
21	.8613	.8985	.9273	.9489	.9647	.9841	.9932	.9973	.9990	.9996
22	.8095	.8564	.8940	.9233	.9456	.9740	.9884	.9951	.9981	.9993
23	.7483	.8048	.8517	.8896	.9194	.9594	.9809	.9915	.9965	.9986
24	.6791	.7441	.8002	.8471	.8854	.9390	.9698	.9859	.9938	.9974
25	.6041	.6758	.7401	.7958	.8428	.9119	.9540	.9776	.9897	.9955
26	.5261	.6021	.6728	.7363	.7916	.8772	.9326	.9655	.9834	.9924
27	.4481	.5256	.6003	.6699	.7327	.8344	.9047	.9487	.9741	.9877
28	.3730	.4491	.5251	.5986	.6671	.7838	.8694	.9264	.9611	.9807
29	.3033	.3753	.4500	.5247	.5969	.7259	.8267	.8977	.9435	.9706
30	.2407	.3065	.3774	.4508	.5243	.6620	.7765	.8621	.9204	.9568
31	.1866	.2447	.3097	.3794	.4516	.5939	.7196	.8194	.8911	.9383
32	.1411	.1908	.2485	.3126	.3814	.5235	.6573	.7697	.8552	.9145
33	.1042	.1454	.1949	.2521	.3155	.4532	.5911	.7139	.8125	.8847
34	.0751	.1082	.1495	.1989	.2556	.3850	.5228	.6530	.7635	.8486

continued

TABLE D.2 *contd.*

$m =$	26.0	27.0	28.0	29.0	30.0	32.0	34.0	36.0	38.0	40.0
35	.0528	.0787	.1121	.1535	.2027	.3208	.4546	.5885	.7086	.8061
36	.0363	.0559	.0822	.1159	.1574	.2621	.3883	.5222	.6490	.7576
37	.0244	.0388	.0589	.0856	.1196	.2099	.3256	.4558	.5862	.7037
38	.0160	.0263	.0413	.0619	.0890	.1648	.2681	.3913	.5216	.6453
39	.0103	.0175	.0283	.0438	.0648	.1268	.2166	.3301	.4570	.5840
40	.0064	.0113	.0190	.0303	.0463	.0956	.1717	.2737	.3941	.5210
41	.0039	.0072	.0125	.0205	.0323	.0707	.1336	.2229	.3343	.4581
42	.0024	.0045	.0080	.0136	.0221	.0512	.1019	.1783	.2789	.3967
43	.0014	.0027	.0050	.0089	.0148	.0364	.0763	.1401	.2288	.3382
44	.0008	.0016	.0031	.0056	.0097	.0253	.0561	.1081	.1845	.2838
45	.0004	.0009	.0019	.0035	.0063	.0173	.0404	.0819	.1462	.2343
46	.0002	.0005	.0011	.0022	.0040	.0116	.0286	.0609	.1139	.1903
47	.0001	.0003	.0006	.0013	.0025	.0076	.0199	.0445	.0872	.1521
48	.0001	.0002	.0004	.0008	.0015	.0049	.0136	.0320	.0657	.1196
49		.0001	.0002	.0004	.0009	.0031	.0091	.0225	.0486	.0925
50			.0001	.0002	.0005	.0019	.0060	.0156	.0353	.0703
51			.0001	.0001	.0003	.0012	.0039	.0106	.0253	.0526
52				.0001	.0002	.0007	.0024	.0071	.0178	.0387
53					.0001	.0004	.0015	.0047	.0123	.0281
54					.0001	.0002	.0009	.0030	.0084	.0200
55						.0001	.0006	.0019	.0056	.0140
56						.0001	.0003	.0012	.0037	.0097
57							.0002	.0007	.0024	.0066
58							.0001	.0005	.0015	.0044
59							.0001	.0003	.0010	.0029
60								.0002	.0006	.0019
61								.0001	.0004	.0012
62								.0001	.0002	.0008
63									.0001	.0005
64									.0001	.0003
65										.0002
66										.0001
67										.0001

For values of m greater than 30 use Table D.3 to obtain approximate Poisson probabilities, putting $\mu = m$ and $\sigma = \sqrt{m}$.

TABLE D.3 AREAS IN TAIL OF THE NORMAL DISTRIBUTION

For a normal distribution with a mean, μ, and standard deviation, σ, and a particular value x, calculate $z = (x - \mu)/\sigma$. The table gives the tail-area to the right of x if z is positive, or the tail-area to the left of x if z is negative. See Fig. D.1.

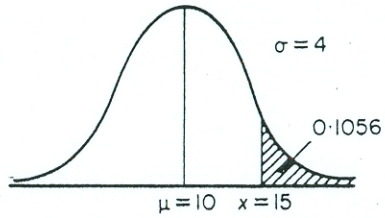

Fig. D.1 $z = \left(\frac{x-\mu}{\sigma}\right) = \frac{15-10}{4} = 1.25.$

$z = \frac{(x-\mu)}{\sigma}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641
0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233

continued

TABLE D.3 *contd.*

$z = \frac{(x-\mu)}{\sigma}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2.0	.02275	.02222	.02169	.02118	.02068	.02018	.01970	.01923	.01876	.01831
2.1	.01786	.01743	.01700	.01659	.01618	.01578	.01539	.01500	.01463	.01426
2.2	.01390	.01355	.01321	.01287	.01255	.01222	.01191	.01160	.01130	.01101
2.3	.01072	.01044	.01017	.00990	.00964	.00939	.00914	.00889	.00866	.00842
2.4	.00820	.00798	.00776	.00755	.00734	.00714	.00695	.00676	.00657	.00639
2.5	.00621	.00604	.00587	.00570	.00554	.00539	.00523	.00508	.00494	.00480
2.6	.00466	.00453	.00440	.00427	.00415	.00402	.00391	.00379	.00368	.00357
2.7	.00347	.00336	.00326	.00317	.00307	.00298	.00289	.00280	.00272	.00264
2.8	.00256	.00248	.00240	.00233	.00226	.00219	.00212	.00205	.00199	.00193
2.9	.00187	.00181	.00175	.00169	.00164	.00159	.00154	.00149	.00144	.00139
3.0	.00135									
3.1	.00097									
3.2	.00069									
3.3	.00048									
3.4	.00034									
3.5	.00023									
3.6	.00016									
3.7	.00011									
3.8	.00007									
3.9	.00005									
4.0	.00003									

TABLE D.4 RANDOM NUMBERS

28 89 65 87 08	13 50 63 04 23	25 47 57 91 13	52 62 24 19 94	91 67 48 57 10
30 29 43 65 42	78 66 28 55 80	47 46 41 90 08	55 98 78 10 70	49 92 05 12 07
95 74 62 60 53	51 57 32 22 27	12 72 72 27 77	44 67 32 23 13	67 95 07 76 30
01 85 54 96 72	66 86 65 64 60	56 59 75 36 75	46 44 33 63 71	54 50 06 44 75
10 91 46 96 86	19 83 52 47 53	65 00 51 93 51	30 80 05 19 29	56 23 27 19 03
05 33 18 08 51	51 78 57 26 17	34 87 96 23 95	89 99 93 39 79	11 28 94 15 52
04 43 13 37 00	79 68 96 26 60	70 39 83 66 56	62 03 55 86 57	77 55 33 62 02
05 85 40 25 24	73 52 93 70 50	48 21 47 74 63	17 27 27 51 26	35 96 29 00 45
84 90 90 65 77	63 99 25 69 02	09 04 03 35 78	19 79 95 07 21	02 84 48 51 97
28 55 53 09 48	86 28 30 02 35	71 30 32 06 47	93 74 21 86 33	49 90 21 69 74
89 83 40 69 80	97 96 47 59 97	56 33 24 87 36	17 18 16 90 46	75 27 28 52 13
73 20 96 05 68	93 41 69 96 07	97 50 81 79 59	42 37 13 81 83	82 42 85 04 31
10 89 07 76 21	40 24 74 36 42	40 33 04 46 24	35 63 02 31 61	34 59 43 36 96
91 50 27 78 37	06 06 16 25 98	17 78 80 36 85	26 41 77 63 37	71 63 94 94 33
03 45 44 66 88	97 81 26 03 89	39 46 67 21 17	98 10 39 33 15	61 63 00 25 92
89 41 58 91 63	65 99 59 97 84	90 14 79 61 55	56 16 88 87 60	32 15 99 67 43
13 43 00 97 26	16 91 21 32 41	60 22 66 72 17	31 85 33 69 07	68 49 20 43 29
71 71 00 51 72	62 03 89 26 32	35 27 99 18 25	78 12 03 09 70	50 93 19 35 56
19 28 15 00 41	92 27 73 40 38	37 11 05 75 16	98 81 99 37 29	92 20 32 39 67
56 38 30 92 30	45 51 94 69 04	00 84 14 36 37	95 66 39 01 09	21 68 40 95 79
39 27 52 89 11	00 81 06 28 48	12 08 05 75 26	03 35 63 05 77	13 81 20 67 58
73 13 28 58 01	05 06 42 24 07	60 60 29 99 93	72 93 78 04 36	25 76 01 54 03
81 60 84 51 57	12 68 46 55 89	60 09 71 87 89	70 81 10 95 91	83 79 68 20 66
05 62 98 07 85	07 79 26 69 61	67 85 72 37 41	85 79 76 84 23	61 58 87 08 05
62 97 16 29 18	52 16 16 23 56	62 95 80 97 63	32 25 34 03 36	48 84 60 37 65
31 13 63 21 08	16 01 92 58 21	48 79 74 73 72	08 64 80 91 38	07 28 66 61 59
97 38 35 34 19	89 84 05 34 47	88 09 31 54 88	97 96 86 01 69	46 13 95 65 96
32 11 78 33 82	51 99 98 44 39	12 75 10 60 36	80 66 39 94 97	42 36 31 16 59
81 99 13 37 05	08 12 60 39 23	61 73 84 89 18	26 02 04 37 95	96 18 69 06 30
45 74 00 03 05	69 99 47 26 52	48 06 30 00 18	03 30 28 55 59	66 10 71 44 05
11 84 13 69 01	88 91 28 79 50	71 42 14 96 55	98 59 96 01 36	88 77 90 45 59
14 66 12 87 22	59 45 27 08 51	85 64 23 85 41	64 72 08 59 44	67 98 56 65 56
40 25 67 87 82	84 27 17 30 37	48 69 49 02 58	98 02 50 58 11	95 39 06 35 63
44 48 97 49 43	65 45 53 41 07	14 83 46 74 11	76 66 63 60 08	90 54 33 65 84
41 94 54 06 57	48 28 01 83 84	09 11 21 91 73	97 28 44 74 06	22 30 95 69 72
07 12 15 58 84	93 18 31 83 45	54 52 62 29 91	53 58 54 66 05	47 19 63 92 75
64 27 90 43 52	18 26 32 96 83	50 58 45 27 57	14 96 39 64 85	73 87 96 76 23
80 71 86 41 03	45 62 63 40 88	35 69 34 10 94	32 22 52 04 74	69 63 21 83 41
27 06 08 09 92	26 22 59 28 27	38 58 22 14 79	24 32 12 38 42	33 56 90 92 57
54 68 97 20 54	33 26 74 03 30	74 22 19 13 48	30 28 01 92 49	58 61 52 27 03
02 92 65 68 99	05 53 15 26 70	04 69 22 64 07	04 73 25 74 82	78 35 22 21 88
83 52 57 78 62	98 61 70 48 22	68 50 64 55 75	42 70 32 09 60	58 70 61 43 97
82 82 76 31 33	85 13 41 38 10	16 47 61 43 77	83 27 19 70 41	34 78 77 60 25
38 61 34 09 49	04 41 66 09 76	20 50 73 40 95	24 77 95 73 20	47 42 80 61 03
01 01 11 88 38	03 10 16 82 24	39 58 20 12 39	82 77 02 18 88	33 11 49 15 16

TABLE D.5 PERCENTAGE POINTS OF THE *t*-DISTRIBUTION

For a *t*-distribution with ν degrees of freedom, the table gives the values of t which are exceeded with probability α. The figure below shows a t distribution with $\nu = 10$ df.

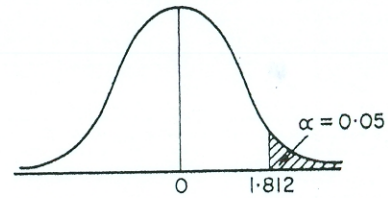

Fig. D.2 t distribution with $\nu = 10$ df.

$\alpha =$	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
$\nu = 1$	3.078	6.314	12.706	31.821	63.657	318.31	636.62
2	1.886	2.920	4.303	6.965	9.925	22.326	31.598
3	1.638	2.353	3.182	4.541	5.841	10.213	12.924
4	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	1.319	1.714	2.069	2.500	2.807	3.485	3.767
24	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	1.296	1.671	2.000	2.390	2.660	3.232	3.460
120	1.289	1.658	1.980	2.358	2.617	3.160	3.373
∞	1.282	1.645	1.960	2.326	2.576	3.090	3.291

TABLE D.6 VALUES OF T FOR THE WILCOXON SIGNED RANK TEST

	Level of significance for one-sided H_1			
	0.05	0.025	0.01	0.005
	Level of significance for two-sided H_1			
n	0.10	0.05	0.02	0.01
5	0		–	–
6	2	0	–	–
7	3	2	0	–
8	5	3	1	0
9	8	5	3	1
10	10	8	5	3
11	13	10	7	5
12	17	13	9	7
13	21	17	12	9
14	25	21	15	12
15	30	25	19	15
16	35	29	23	19
17	41	34	27	23
18	47	40	32	27
19	53	46	37	32
20	60	52	43	37
21	67	58	49	42
22	75	65	55	48
23	83	73	62	54
24	91	81	69	61
25	100	89	76	68

TABLE D.7 VALUES OF U FOR THE MANN–WHITNEY U TEST

Critical values of U for the Mann-Whitney test for 0.05 (first value) and 0.01 (second value) significance levels for two-sided H_1, and for 0.025 and 0.005 levels for one-sided H_1.

n_2 \ n_1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
2	–	–	–	–	–	–	–	0	0	0	0	1	1	1	1	1	2	2	2	2
	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	0	0
3	–	–	–	–	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8
	–	–	–	–	–	–	–	–	0	0	0	1	1	1	2	2	2	2	3	3
4	–	–	–	0	1	2	3	4	4	5	6	7	8	9	10	11	11	12	13	14
	–	–	–	–	–	0	0	1	1	2	2	3	3	4	5	5	6	6	7	8
5	–	–	0	1	2	3	5	6	7	8	9	11	12	13	14	15	17	18	19	20
	–	–	–	–	0	1	1	2	3	4	5	6	7	7	8	9	10	11	12	13
6	–	–	1	2	3	5	6	8	10	11	13	14	16	17	19	21	22	24	25	27
	–	–	–	0	1	2	3	4	5	6	7	9	10	11	12	13	15	16	17	18
7	–	–	1	3	5	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34
	–	–	–	0	1	3	4	6	7	9	10	12	13	15	16	18	19	21	22	24
8	–	0	2	4	6	8	10	13	15	17	19	22	24	26	29	31	34	36	38	41
	–	–	–	1	2	4	6	7	9	11	13	15	17	18	20	22	24	26	28	30
9	–	0	2	4	7	10	12	15	17	20	23	26	28	31	34	37	39	42	45	48
	–	–	0	1	3	5	7	9	11	13	16	18	20	22	24	27	29	31	33	36
10	–	0	3	5	8	11	14	17	20	23	26	29	33	36	39	42	45	48	52	55
	–	–	0	2	4	6	9	11	13	16	18	21	24	26	29	31	34	37	39	42

Continued

TABLE D.7 *contd.*

n_2 \ n_1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
11	–	0	3	6	9	13	16	19	23	26	30	33	37	40	44	47	51	55	58	62
	–	–	0	2	5	7	10	13	16	18	21	24	27	30	33	36	39	42	45	48
12	–	1	4	7	11	14	18	22	26	29	33	37	41	45	49	53	57	61	65	69
	–	–	1	3	6	9	12	15	18	21	24	27	31	34	37	41	44	47	51	54
13	–	1	4	8	12	16	20	24	28	33	37	41	45	50	54	59	63	67	72	76
	–	–	1	3	7	10	13	17	20	24	27	31	34	38	42	45	49	53	57	60
14	–	1	5	9	13	17	22	26	31	36	40	45	50	55	59	64	69	74	78	83
	–	–	1	4	7	11	15	18	22	26	30	34	38	42	46	50	54	58	63	67
15	–	1	5	10	14	19	24	29	34	39	44	49	54	59	64	70	75	80	85	90
	–	–	2	5	8	12	16	20	24	29	33	37	42	46	51	55	60	64	69	73
16	–	1	6	11	15	21	26	31	37	42	47	53	59	64	70	75	81	86	92	98
	–	–	2	5	9	13	18	22	27	31	36	41	45	50	55	60	65	70	74	79
17	–	2	6	11	17	22	28	34	39	45	51	57	63	69	75	81	87	93	99	105
	–	–	2	6	10	15	19	24	29	34	39	44	49	54	60	65	70	75	81	86
18	–	2	7	12	18	24	30	36	42	48	55	61	67	74	80	86	93	99	106	112
	–	–	2	6	11	16	21	26	31	37	42	47	53	58	64	70	75	81	87	92
19	–	2	7	13	19	25	32	38	45	52	58	65	72	78	85	92	99	106	113	119
	–	0	3	7	12	17	22	28	33	39	45	51	57	63	69	74	81	87	93	99
20	–	2	8	14	20	27	34	41	48	55	62	69	76	83	90	98	105	112	119	127
	–	0	3	8	13	18	24	30	36	42	48	54	60	67	73	79	86	92	99	105

TABLE D.8 PERCENTAGE POINTS OF THE χ^2 DISTRIBUTION

For a χ^2 distribution with ν degrees of freedom, the table gives the values of χ^2 which are exceeded with probability α. See Fig. D.3.

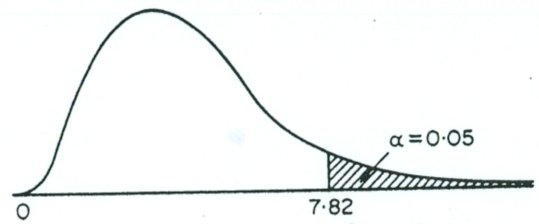

Fig. D.3 χ^2 distribution with $\nu = 3$ df.

$\alpha =$	0.50	0.10	0.05	0.025	0.01	0.001
$\nu = 1$	0.45	2.71	3.84	5.02	6.64	10.8
2	1.39	4.61	5.99	7.38	9.21	13.8
3	2.37	6.25	7.82	9.35	11.3	16.3
4	3.36	7.78	9.49	11.1	13.3	18.5
5	4.35	9.24	11.1	12.8	15.1	20.5
6	5.35	10.6	12.6	14.5	16.8	22.5
7	6.35	12.0	14.1	16.0	18.5	24.3
8	7.34	13.4	15.5	17.5	20.1	26.1
9	8.34	14.7	16.9	19.0	21.7	27.9
10	9.34	16.0	18.3	20.5	23.2	29.6
12	11.3	18.5	21.0	23.3	26.2	32.9
15	14.3	22.3	25.0	27.5	30.6	37.7
20	19.3	28.4	31.4	34.2	37.6	45.3
24	23.3	33.2	36.4	39.4	43.0	51.2
30	29.3	40.3	43.8	47.0	50.9	59.7
40	39.3	51.8	55.8	59.3	63.7	73.4
60	59.3	74.4	79.1	83.3	88.4	99.6

TABLE D.9 VALUES OF SPEARMAN'S r_s.

	Level of significance for one-sided H_1			
	0.05	0.025	0.01	0.005
	Level of significance for two-sided H_1			
n	0.1	0.05	0.02	0.01
5	0.900	1.000	1.000	–
6	0.829	0.886	0.943	1.000
7	0.714	0.786	0.893	0.929
8	0.643	0.738	0.833	0.881
9	0.600	0.683	0.783	0.833
10	0.564	0.648	0.746	0.794
12	0.506	0.591	0.712	0.777
14	0.456	0.544	0.645	0.715
16	0.425	0.506	0.601	0.665
18	0.399	0.475	0.564	0.625
20	0.377	0.450	0.534	0.591
22	0.359	0.428	0.508	0.562
24	0.343	0.409	0.485	0.537
26	0.329	0.392	0.465	0.515
28	0.317	0.377	0.448	0.496
30	0.306	0.364	0.432	0.478

Appendix E

FURTHER READING

The following books are mainly aimed at specific subject areas:

Allard, R.J. (1974) *An Approach to Econometrics*, Philip Allan, Oxford.

Armitage, P. (1971) *Statistical Methods in Medical Research*, Blackwell Scientific Publications, Oxford.

Bailey, N.T.J. (1969) *Statistical Methods in Biology*, Hodder, London.

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Mead, R. and Curnow, R.N. (1983) *Statistical Methods in Agriculture and Experimental Biology*, Chapman and Hall, London.

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Sumner, J.R. (1972) *Statistics for Hotels and Catering*, Edward Arnold, London.

Till, R. (1974) *Statistical Methods for the Earth Scientist*, Macmillan, London.