※注意：請於答案卷上依序作答，並註明作答之題號。

第 1–20 題爲是非題，每題 1 分，共 20 分：

1. In the 21 century, infectious diseases epidemiology will become less important as almost all such diseases will be under control.
2. All the products from biotechnology industry must be evaluated for the safety, quality, and efficacy before they are approved for clinical use.
3. One must understand the detailed mechanism of an etiologic agent and its pathophysiology in order to implement effective prevention. Thus, it is very natural that epidemiological study will also focus on details of different major determinants for the disease.
4. In a case-control study conducted by density sampling, one needs to assume that the disease is rare and the exposure proportion is constant during the study period.
5. If the response rate of a population sample is below 50%, then one cannot draw any conclusion or inference at the end.
6. If one wants to recruit lung cancer patients from National Taiwan University Hospital (NTUH) for a case-control study to determine lung cancer's etiology, the controls should not be drawn from patients with other chronic lung diseases.
7. A limitation of conjecture and refutation is that one can only consider hypotheses that one can imagine. If the true etiological agent is not included in one's list of hypotheses, then one may end up with no answer after refuting all proposed hypotheses.
8. One still can not be sure that a theory will be forever true even after we have confirmed or proved it one thousand times.
9. If the proportions of mortality due to lung cancer in Hualien before and after the establishment of a cement factory in 2000 were 5% and 20 %, respectively; then we can conclude that the mortality rate due to lung cancer increases 4 times.
10. Case control study design can obtain the estimate of a morbidity odds ratio, if the controls are selected from patients with another disease.
11. Case-control study can be viewed as a follow-up study with the estimation of exposure proportion of population time at risk performed by random sampling and conducted prospectively.
12. In a study of hepatitis among synthetic leather workers, if one has not collected data on viral hepatitis, one cannot rule out the possibility of viral hepatitis as an alternative cause. Thus, one may have difficulty in drawing a conclusion.
13. Even if the response rate exceeds 85% or even 90%, one still cannot draw a definite inference on a divorce rate of 5% because many people who are divorced may not have responded.
14. In follow-up studies, any one fulfills the definition of cohort must be included; and once included, he must be always in the cohort.
15. There were 3 SMR studies of lung cancer among asbestos workers. The first one, reported from Sweden, had an SMR of 6, the second and third from the U.S. reported SMRs of 3 and 4.5, respectively. One can say that

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Swedish workers were exposed to a higher concentration of asbestos than those of Americans' because the SMR of Swedish asbestos workers was higher.

16. Suppose we have found that there is an association between the reduction of FEV1 and the level of air pollution in our statistical model, we still cannot draw any conclusion before other major determinants, including smoking, age, and height are put into the same model for control.

17. Odds ratio can be interpreted as a rate ratio under case-control design.

18. In one study there is a high correlation between lead levels and the IQ (intelligence quotient) among kindergarten children. We can conclude that the lead exposure results in impairment of IQ.

19. In one survey study for prevalence of pulmonary tuberculosis, one goes to a chosen township and ask villagers who are more than 20 years old come for a free chest roentgenography. It turns out that only 20 % of villagers go for the screening examination and there are about 9 % with suspected X-ray findings. We can conclude that the prevalence rates are likely lower than 9 %.

20. The only necessary factor for causal inference is appropriate temporal sequence, which implies that the event occurs before maximal latency period and after minimal induction time.

第 21–30 題爲選擇題（單選題，選出一個最適當的選項，每題 2 分，共 20 分，請於「選擇題作答區」依序作答。）

21.下列何者屬於盛行率？
(A) 母親死亡率。 (B) 嬰兒死亡率。 (C) 先天缺陷率。 (D) 以上皆非。

22.有一高壓電塔附近小學過去 10 年中共有 10 位女老師曾發生自然流產，下列何項流行病學研究設計最合適進行此調查？
(A) 描述性研究 (B) 病例對照研究 (C) 世代研究 (D) 臨床試驗

23.下列關於病例交叉研究法(case-crossover study)何者<u>有誤</u>？
(A) 適合進行急性疾病或健康效應的研究。
(B) 需有足夠病例數其暴露由高至低及由低至高交叉。
(C) 適合於短時間暴露改變的研究。
(D) 對照時段(control time periods)的選擇必須與暴露的一般趨勢有關。

24. 世代追蹤研究法最大的<u>缺點</u>爲何？(A) 暴露資料的回憶偏差。 (B) 研究對象的漏失追蹤。
(C) 不易找到合適的對照族群。 (D) 無法估計疾病發生率。

25. 下列何者<u>非</u>控制干擾因素的方法？
(A) 隨機抽樣。 (B) 隨機分配。 (C) 配對。 (D) 分層分析。

26. 下列關於一般族群的疾病篩檢敘述何者正確？
(A) 篩檢的疾病須爲稀有疾病。
(B) 篩檢的疾病不須有有效的早期治療。
(C) 篩檢的方法須有高度的特定度(specificity)。
(D) 篩檢的病人應爲隨機樣本。

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27. 下表爲一假設性乳癌篩檢結果，請計算其敏感度(sensitivity)、特定度(specificity)、陽性預測值(predictive value positive)、及陰性預測值(predictive value negative)。

		乳癌		
		確診	未確診	合計
篩檢（理學檢查	陽性	132	983	1,115
及乳房攝影）	陰性	45	63,650	63,695
合計		177	64,633	64,810

(A) 敏感度爲 98.5%。　(B) 特定度爲 74.6%。　(C) 陽性預測值爲 11.8%。
(D) 陰性預測值爲 1.2%。

28. 下表爲一石棉工人回溯性世代研究，這個族群 1948 至 1963 年共有 58 位癌症死亡個案，請計算其標準死亡比(standardized mortality ratio)。

		一般族群	
年齡年代分層	觀察人年	癌症死亡率（每十萬）	期望癌症死亡數
1948-1952			
15-24	1250	9.9	0.1
25-34	3423	17.7	0.6
35-44	3275	44.5	1.5
45-54	2028	150.8	3.1
55-64	1144	409.4	4.7
1953-1957			
15-24	544	11.2	0.1
25-34	3702	17.5	0.6
35-44	4382	44.2	1.9
45-54	2968	157.7	4.7
55-64	1552	432.0	6.7
1958-1963			
15-24	4	10.3	0.0
25-34	2206	18.8	0.4
35-44	4737	46.3	2.2
45-54	4114	164.1	6.8
55-64	2098	450.9	9.5

(A) 標準死亡比爲 105%。　(B)標準死亡比爲 115%。　(C) 標準死亡比爲 125%。
(D) 標準死亡比爲 135%。

29. 下列有關健康工人受雇效應(healthy worker hire effect)及健康工人存活效應(healthy worker survival effect)的敘述何者正確？
(A) 皆爲選樣偏差(selection bias)的例子。
(B) 不會影響世代內比較(within cohort comparisons)的結果。
(C) 不會影響劑量效應關係(dose-response relationship)。
(D) 不會影響病例對照研究(case-control studies)的結果。

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30. 下列有關迴歸模式(regression models)控制干擾因子(confounders)敘述何者有誤？
(A) 使用疾病的迴歸模式時，必須先確定疾病風險與每個自變項(包括干擾因子)的關係。
(B) 最好使用統計自動選取方式來決定何者是干擾因子。
(C) 若錯誤假定干擾因子與疾病關係，將會導致暴露效應估計的錯誤。
(D) 除使用迴歸模式控制干擾因子外，亦可以使用其他方法來控制干擾因子。

第 31--35 題背景說明：

三聚氰胺（melamine）毒奶事件引發軒然大波。請先閱讀下列期刊論文摘要及圖表後，再作答

Guan N, Fan Q, Ding J, Zhao Y, Liu J, Ai Y, et al. Melamine-contaminated powdered formula and urolithiasis in young children. N Engl J Med 2009; 360: 10.1056/NEJMoa0809550.

Abstract

Background: A recent epidemic of melamine contamination of baby formula in China has been associated with the development of urinary tract stones, though the clinical manifestations and predisposing factors are incompletely delineated.

Methods: We administered a questionnaire to the parents of children 36 months of age or younger who were being screened for a history of exposure to melamine and symptoms of, and possible predisposing factors for, urinary tract stones. In addition, we performed urinalysis, renal-function and liver-function tests, urinary tests for biochemical markers and the calcium:creatinine ratio, and ultrasonography. Powdered-milk infant formulas were classified as having a high melamine content (>500 ppm), a moderate melamine content (<150 ppm), or no melamine (0 ppm); no formulas contained between 150 and 500 ppm of melamine.

Results: Contaminated formula was ingested by 421 of 589 children. Fifty had urinary stones, including 8 who had not received melamine-contaminated formula; 112 were suspected to have stones; and 427 had no stones. Among children with stones, 5.9% had hematuria and 2.9% had leukocyturia, percentages that did not differ significantly from those among children who were suspected to have stones or those who did not have stones. Serum creatinine, urea nitrogen, and alanine aminotransferase levels were normal in the 22 children with stones who were tested. Four of the 41 children (9.8%) who had stones and in whom urinary markers of glomerular function were measured had evidence of abnormalities; none had tubular dysfunction. Children exposed to high-melamine formula were 7.0 times as likely to have stones as those exposed to no-melamine formula. Preterm infants were 4.5 times as likely to have stones as term infants.

Table 4. Predisposing Factors and Odds Ratios for the Development of Urinary Tract Stones.

Predisposing Factor	Model 1				Model 2			
	Children with Stones		Children with Suspected Stones		Children with Stones		Children with Suspected Stones	
	odds ratio (95% CI)	*P value*	*odds ratio (95% CI)*	*P value*	*odds ratio (95% CI)*	*P value*	*odds ratio (95% CI)*	*P value*
Increasing age — per yr	1.2 (0.7–1.9)	0.50	1.3 (0.9–1.8)	0.13	1.1 (0.7–1.6)	0.77	1.2 (0.9–1.6)	0.15
Sex								
Male	0.8 (0.4–1.8)	0.66	1.0 (0.6–1.6)	0.99	0.9 (0.5–1.7)	0.83	0.9 (0.6–1.5)	0.79
Female	1.0		1.0		1.0		1.0	
Birth type								
Preterm	4.5 (1.6–12.4)	0.003	0.9 (0.3–2.6)	0.88	3.7 (1.4–9.7)	0.009	1.2 (0.5–3.0)	0.66
Unknown					1.9 (0.9–3.9)	0.07	0.8 (0.5–1.4)	0.47
Term	1.0		1.0		1.0		1.0	
Melamine content in formula								
High	7.0 (2.1–23.0)	0.001	2.6 (1.2–5.4)	0.01	5.4 (2.2–12.9)	<0.001	2.3 (1.2–4.4)	0.008
Moderate	2.0 (0.6–6.2)	0.25	1.7 (0.9–3.2)	0.10	1.4 (0.6–3.3)	0.44	1.5 (0.9–2.5)	0.15
None	1.0		1.0		1.0		1.0	
Formula alone or with breast milk								
Formula with breast milk	1.4 (0.7–3.0)	0.39	1.3 (0.8–2.2)	0.26	1.0 (0.5–1.9)	0.10	1.4 (0.9–2.2)	0.16
Unknown					0.3 (0.1–1.0)	0.05	0.4 (0.2–0.9)	0.03
Formula alone	1.0		1.0		1.0		1.0	

（資料來源：New England Journal of Medicine 2009; 360: 10.1056/NEJMoa0809550）

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第 31–35 題爲單選題，請選出一個最適當的答案，每題 2 分，共 10 分，請於「選擇題作答區」依序作答。

31. 本研究的設計最接近下列何者?
(A) 病例世代研究（Case-Cohort study） (B) 世代研究（Cohort study）
(C) 病例對照研究(Case-Control study） (D) 生態性研究（Ecological study）

32. 本研究使用何種方法測定三聚氰胺（melamine）的暴露量（exposure）？
(A) 驗血中三聚氰胺濃度 (B) 驗尿中三聚氰胺濃度 (C) 超音波檢查 (D) 問卷調查

33. 由於部分參與本研究的家長對問卷中的某些問題留下空白，造成資料不全（missing data)。本論文採取兩種處理方式：Model 1 是將資料不全的個案排除不計，僅分析資料完整的個案；Model 2 則是將所有個案都納入分析。請問下列何者爲是？
(A) 由於部分家長不配合，本研究品質未達應有標準，結論無法採信。
(B) 資料不全（missing data）對研究品質完全沒有影響。
(C) Model 2 有 bias；Model 1 才是正確的分析方法，完全不會有 bias。
(D) Model 1 與 Model 2 都可能有 bias，因此論文中需要兩種分析方式並陳，供讀者比較。

34. 對 Table 4 中數據的判讀，何者爲誤？
(A) Preterm 是泌尿道結石的危險因子
(B) 食用遭三聚氰胺嚴重污染 (>500 ppm) 品牌的奶粉是泌尿道結石的危險因子
(C) 食用遭三聚氰胺中度污染 (<150 ppm) 品牌的奶粉與泌尿道結石的相關性並不顯著，因此證實這些品牌奶粉並不構成對人體健康的危害
(D) 食用遭三聚氰胺中度污染 (<150 ppm) 品牌的奶粉與泌尿道結石的相關性並不顯著，但是這些品牌奶粉仍然可能構成對人體健康的危害

35. 從上述研究摘要與圖表數據可獲得何種結論？
(A) 奶粉遭三聚氰胺污染達 500 ppm 以上才會對 人體健康造成危害。
(B) 奶粉遭三聚氰胺污染與嬰幼兒泌尿道結石有相關性。
(C) 抽檢發現含有三聚氰胺，但含量未達 150 ppm 的奶粉品牌，並不需要強迫下架。
(D) 三聚氰胺只對 Preterm baby 有危害。

第 36–40 題背景說明：

某研究討論持續運動是否對 35-59 歲婦女的血壓有影響，隨機抽樣 16 位有持續運動習慣的婦女，得知其平均血壓值爲 120mmHg，sample standard deviation 爲 15 mmHg。另外隨機抽取 25 沒有持續運動習慣的婦女得知平均值與 sample standard deviation 爲 132mmHg 與 18mmHg。假設不論是否有持續運動習慣，全體婦女的血壓呈標準差爲 16mmHg，期望值爲 μ 的常態分配，請回答以下問題：

第 36–40 題爲單選題，請選出一個最適當的答案，每小題 5 分，共 25 分，請於「選擇題作答區」依序作答。

36. 如果持續運動對 35-59 歲婦女的血壓沒有影響，請利用以上數據選出下列最接近 μ 的估計值：
(A) 120 (B) 132 (C) 126 (D) 127

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37. 如果持續運動對 35-59 歲婦女的血壓有影響，請利用以上數據選出下列最接近「有持續運動習慣婦女的平均血壓值」的估計值：(A) 120 (B) 132 (C) 126 (D) 127

38. 延續上一小題，請針對上一小題的估計值選出下列最適當的估計誤差：
(A) 4 (B) 2 (C) 0.64 (D) 0.8

39. 如果持續運動對 35-59 歲婦女的血壓有影響，而且持續運動能降低平均約 θ 血壓值，請選出下列最適當的θ的 95%信賴區間：(A) (11.3, 12.7) (B) (10.8, 13.2) (C) (10.7, 13.3) (D) (7.3, 16.7)

40. 如果持續運動對 35-59 歲婦女的血壓沒有影響，請利用以上數據選出下列最適當的 μ 的 95%信賴區間的寬度：(A) 2.4 (B) 9.8 (C) 15.7 (D) 62.7

第 41–45 題爲是非題（每小題 2 分）

41. 利用變異數分析來比較三種不同的降血壓藥物之平均降血壓量，如果答案爲顯著，則表示這三種降血壓藥物的藥效都不相同。

42. 如果某一檢定的 p 值爲 0.05，則代表這個檢定會錯誤拒絕虛無假設的機率爲 0.05。

43. 如果某一檢定的檢力（power）爲 0.8，則代表在對立假設爲真實，這個檢定能夠正確偵測且拒絕虛無假設的機率爲 0.8。

44. 迴歸模式分析的結果可以說明以自變項爲因，依變項爲果的因果關係。

45. 進行 t 檢定時，如果樣本數很大，例如達 200，那麼也可以利用常態分配的表來查出該 t 檢定的 p 值。

第 46 題計算題（5 分）：

46. 假設英文不及格的機率爲 0.3，數學不及格的機率爲 0.6，兩科都及格的機率僅爲 0.2，則兩科中有一科及格的機率爲多少？

第 47-48 題背景說明：

某醫師想觀察新藥 A 在控制高血壓的效果是否優於過去常用藥物 B，因此募集符合定義之受試者隨機分配到實驗組與對照組，實驗組中的受試者服用藥物 A，對照組受試者則服用藥物 B。參與該試驗的個案數與一年後的血壓收縮壓如下：

	收縮壓 (mm Hg)
A 藥	145, 132, 161, 170, 130, 135, 140, 142
B 藥	155, 163, 171, 143, 130, 170, 165

請在 5%顯著水準下，回答第 47-48 題：

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47. 檢定兩組受試者的血壓平均值是否相等（6分）

48. 檢定兩組受試者的變異數是否相等（4分）

Table A.1 Standard Normal Distribution

Let Z be a normal random variable with mean zero and variance 1. For selected values of Z, three values are tabled: (1) the two-sided p-value, or $P[|Z| \geq z]$; (2) the one-sided p-value, or $P[Z \geq z]$; and (3) the cumulative distribution function at Z, or $P[Z \leq z]$.

z	Two-sided	One-sided	Cum. dist.
0.00	1.0000	.5000	.5000
0.05	.9601	.4801	.5199
0.10	.9203	.4602	.5398
0.15	.8808	.4404	.5596
0.20	.8415	.4207	.5793
0.25	.8026	.4013	.5987
0.30	.7642	.3821	.6179
0.35	.7263	.3632	.6368
0.40	.6892	.3446	.6554
0.45	.6527	.3264	.6736
0.50	.6171	.3085	.6915
0.55	.5823	.2912	.7088
0.60	.5485	.2743	.7257
0.65	.5157	.2578	.7422
0.70	.4839	.2420	.7580
0.75	.4533	.2266	.7734
0.80	.4237	.2119	.7881
0.85	.3953	.1977	.8023
0.90	.3681	.1841	.8159
0.95	.3421	.1711	.8289
1.00	.3173	.1587	.8413
1.01	.3125	.1562	.8438
1.02	.3077	.1539	.8461
1.03	.3030	.1515	.8485
1.04	.2983	.1492	.8508
1.05	.2937	.1469	.8531
1.06	.2891	.1446	.8554
1.07	.2846	.1423	.8577
1.08	.2801	.1401	.8599
1.09	.2757	.1379	.8621
1.10	.2713	.1357	.8643
1.11	.2670	.1335	.8665
1.12	.2627	.1314	.8686
1.13	.2585	.1292	.8708
1.14	.2543	.1271	.8729
1.15	.2501	.1251	.8749
1.16	.2460	.1230	.8770
1.17	.2420	.1210	.8790
1.18	.2380	.1190	.8810
1.19	.2340	.1170	.8830
1.20	.2301	.1151	.8849
1.21	.2263	.1131	.8869
1.22	.2225	.1112	.8888
1.23	.2187	.1093	.8907
1.24	.2150	.1075	.8925
1.25	.2113	.1056	.8944
1.26	.2077	.1038	.8962
1.27	.2041	.1020	.8980
1.28	.2005	.1003	.8997
1.29	.1971	.0985	.9015
1.30	.1936	.0968	.9032
1.31	.1902	.0951	.9049
1.32	.1868	.0934	.9066
1.33	.1835	.0918	.9082
1.34	.1802	.0901	.9099
1.35	.1770	.0885	.9115
1.36	.1738	.0869	.9131
1.37	.1707	.0853	.9147
1.38	.1676	.0838	.9162
1.39	.1645	.0823	.9177
1.40	.1615	.0808	.9192
1.41	.1585	.0793	.9207
1.42	.1556	.0778	.9222
1.43	.1527	.0764	.9236
1.44	.1499	.0749	.9251
1.45	.1471	.0735	.9265
1.46	.1443	.0721	.9279
1.47	.1416	.0708	.9292
1.48	.1389	.0694	.9306
1.49	.1362	.0681	.9319
1.50	.1336	.0668	.9332
1.51	.1310	.0655	.9345
1.52	.1285	.0643	.9357
1.53	.1260	.0630	.9370
1.54	.1236	.0618	.9382
1.55	.1211	.0606	.9394
1.56	.1188	.0594	.9406
1.57	.1164	.0582	.9418
1.58	.1141	.0571	.9429
1.59	.1118	.0559	.9441
1.60	.1096	.0548	.9452
1.61	.1074	.0537	.9463
1.62	.1052	.0526	.9474
1.63	.1031	.0516	.9484
1.64	.1010	.0505	.9495
1.65	.0989	.0495	.9505
1.66	.0969	.0485	.9515
1.67	.0949	.0475	.9525
1.68	.0930	.0465	.9535
1.69	.0910	.0455	.9545
1.70	.0891	.0446	.9554
1.71	.0873	.0436	.9564
1.72	.0854	.0427	.9573
1.73	.0836	.0418	.9582
1.74	.0819	.0409	.9591
1.75	.0801	.0401	.9599
1.76	.0784	.0392	.9608
1.77	.0767	.0384	.9616
1.78	.0751	.0375	.9625
1.79	.0735	.0367	.9633
1.80	.0719	.0359	.9641
1.81	.0703	.0351	.9649
1.82	.0688	.0344	.9656
1.83	.0673	.0336	.9664
1.84	.0658	.0329	.9671
1.85	.0643	.0322	.9678
1.86	.0629	.0314	.9686
1.87	.0615	.0307	.9693
1.88	.0601	.0301	.9699
1.89	.0588	.0294	.9706
1.90	.0574	.0287	.9713
1.91	.0561	.0281	.9719
1.92	.0549	.0274	.9726
1.93	.0536	.0268	.9732
1.94	.0524	.0262	.9738
1.95	.0512	.0256	.9744
1.96	.0500	.0250	.9750
1.97	.0488	.0244	.9756
1.98	.0477	.0239	.9761
1.99	.0466	.0233	.9767
2.00	.0455	.0228	.9772
2.01	.0444	.0222	.9778
2.02	.0434	.0217	.9783
2.03	.0424	.0212	.9788
2.04	.0414	.0207	.9793
2.05	.0404	.0202	.9798
2.06	.0394	.0197	.9803
2.07	.0385	.0192	.9808
2.08	.0375	.0188	.9812
2.09	.0366	.0183	.9817
2.10	.0357	.0179	.9821
2.11	.0349	.0174	.9826
2.12	.0340	.0170	.9830
2.13	.0332	.0166	.9834
2.14	.0324	.0162	.9838
2.15	.0316	.0158	.9842
2.16	.0308	.0154	.9846
2.17	.0300	.0150	.9850
2.18	.0293	.0146	.9854
2.19	.0285	.0143	.9857
2.20	.0278	.0139	.9861
2.21	.0271	.0136	.9864
2.22	.0264	.0132	.9868
2.23	.0257	.0129	.9871
2.24	.0251	.0125	.9875
2.25	.0244	.0122	.9878
2.26	.0238	.0119	.9881
2.27	.0232	.0116	.9884
2.28	.0226	.0113	.9887
2.29	.0220	.0110	.9890

Table A.1 *(continued)*

z	Two-sided	One-sided	Cum. dist.
2.30	.0214	.0107	.9893
2.31	.0209	.0104	.9896
2.32	.0203	.0102	.9898
2.33	.0198	.0099	.9901
2.34	.0193	.0096	.9904
2.35	.0188	.0094	.9906
2.36	.0183	.0091	.9909
2.37	.0178	.0089	.9911
2.38	.0173	.0087	.9913
2.39	.0168	.0084	.9916
2.40	.0164	.0082	.9918
2.41	.0160	.0080	.9920
2.42	.0155	.0078	.9922
2.43	.0151	.0075	.9925
2.44	.0147	.0073	.9927
2.45	.0143	.0071	.9929
2.46	.0139	.0069	.9931
2.47	.0135	.0068	.9932
2.48	.0131	.0066	.9934
2.49	.0128	.0064	.9936
2.50	.0124	.0062	.9938
2.51	.0121	.0060	.9940
2.52	.0117	.0059	.9941
2.53	.0114	.0057	.9943
2.54	.0111	.0055	.9945
2.55	.0108	.0054	.9946
2.56	.0105	.0052	.9948
2.57	.0102	.0051	.9949
2.58	.0099	.0049	.9951
2.59	.0096	.0048	.9952
2.60	.0093	.0047	.9953
2.61	.0091	.0045	.9955
2.62	.0088	.0044	.9956
2.63	.0085	.0043	.9957
2.64	.0083	.0041	.9959
2.65	.0080	.0040	.9960
2.66	.0078	.0039	.9961
2.67	.0076	.0038	.9962
2.68	.0074	.0037	.9963
2.69	.0071	.0036	.9964
2.70	.0069	.0035	.9965
2.71	.0067	.0034	.9966
2.72	.0065	.0033	.9967
2.73	.0063	.0032	.9968
2.74	.0061	.0031	.9969
2.75	.0060	.0030	.9970
2.76	.0058	.0029	.9971
2.77	.0056	.0028	.9972
2.78	.0054	.0027	.9973
2.79	.0053	.0026	.9974
2.80	.0051	.0026	.9974
2.81	.0050	.0025	.9975
2.82	.0048	.0024	.9976
2.83	.0047	.0023	.9977
2.84	.0045	.0023	.9977
2.85	.0044	.0022	.9978
2.86	.0042	.0021	.9979
2.87	.0041	.0021	.9979
2.88	.0040	.0020	.9980
2.89	.0039	.0019	.9981
2.90	.0037	.0019	.9981
2.91	.0036	.0018	.9982
2.92	.0035	.0018	.9982
2.93	.0034	.0017	.9983
2.94	.0033	.0016	.9984
2.95	.0032	.0016	.9984
2.96	.0031	.0015	.9985
2.97	.0030	.0015	.9985
2.98	.0029	.0014	.9986
2.99	.0028	.0014	.9986
3.00	.0027	.0013	.9987
3.01	.0026	.0013	.9987
3.02	.0025	.0013	.9987
3.03	.0024	.0012	.9988
3.04	.0024	.0012	.9988
3.05	.0023	.0011	.9989
3.06	.0022	.0011	.9989
3.07	.0021	.0011	.9989
3.08	.0021	.0010	.9990
3.09	.0020	.0010	.9990
3.10	.0019	.0010	.9990
3.11	.0019	.0009	.9991
3.12	.0018	.0009	.9991
3.13	.0017	.0009	.9991
3.14	.0017	.0008	.9992
3.15	.0016	.0008	.9992
3.16	.0016	.0008	.9992
3.17	.0015	.0008	.9992
3.18	.0015	.0007	.9993
3.19	.0014	.0007	.9993
3.20	.0014	.0007	.9993
3.21	.0013	.0007	.9993
3.22	.0013	.0006	.9994
3.23	.0012	.0006	.9994
3.24	.0012	.0006	.9994
3.25	.0012	.0006	.9994
3.26	.0011	.0006	.9994
3.27	.0011	.0005	.9995
3.28	.0010	.0005	.9995
3.29	.0010	.0005	.9995
3.30	.0010	.0005	.9995
3.31	.0009	.0005	.9995
3.32	.0009	.0005	.9995
3.33	.0009	.0004	.9996
3.34	.0008	.0004	.9996
3.35	.0008	.0004	.9996
3.36	.0008	.0004	.9996
3.37	.0008	.0004	.9996
3.38	.0007	.0004	.9996
3.39	.0007	.0003	.9997
3.40	.0007	.0003	.9997
3.41	.0006	.0003	.9997
3.42	.0006	.0003	.9997
3.43	.0006	.0003	.9997
3.44	.0006	.0003	.9997
3.45	.0006	.0003	.9997
3.46	.0005	.0003	.9997
3.47	.0005	.0003	.9997
3.48	.0005	.0003	.9997
3.49	.0005	.0002	.9998
3.50	.0005	.0002	.9998
3.51	.0004	.0002	.9998
3.52	.0004	.0002	.9998
3.53	.0004	.0002	.9998
3.54	.0004	.0002	.9998
3.55	.0004	.0002	.9998
3.56	.0004	.0002	.9998
3.57	.0004	.0002	.9998
3.58	.0003	.0002	.9998
3.59	.0003	.0002	.9998
3.60	.0003	.0002	.9998
3.61	.0003	.0002	.9998
3.62	.0003	.0001	.9999
3.63	.0003	.0001	.9999
3.64	.0003	.0001	.9999
3.65	.0003	.0001	.9999
3.66	.0003	.0001	.9999
3.67	.0002	.0001	.9999
3.68	.0002	.0001	.9999
3.69	.0002	.0001	.9999
3.70	.0002	.0001	.9999
3.71	.0002	.0001	.9999
3.72	.0002	.0001	.9999
3.73	.0002	.0001	.9999
3.74	.0002	.0001	.9999
3.75	.0002	.0001	.9999
3.76	.0002	.0001	.9999
3.77	.0002	.0001	.9999
3.78	.0002	.0001	.9999
3.79	.0002	.0001	.9999

見背面

TABLE A.2
Poisson probabilities

k	μ = 0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
0	0.6065	0.3679	0.2231	0.1353	0.0821	0.0498	0.0302	0.0183	0.0111	0.0067
1	0.3033	0.3679	0.3347	0.2707	0.2052	0.1494	0.1057	0.0733	0.0500	0.0337
2	0.0758	0.1839	0.2510	0.2707	0.2565	0.2240	0.1850	0.1465	0.1125	0.0842
3	0.0126	0.0613	0.1255	0.1804	0.2138	0.2240	0.2158	0.1954	0.1687	0.1404
4	0.0016	0.0153	0.0471	0.0902	0.1336	0.1680	0.1888	0.1954	0.1898	0.1755
5	0.0002	0.0031	0.0141	0.0361	0.0668	0.1008	0.1322	0.1563	0.1708	0.1755
6	0.0000	0.0005	0.0035	0.0120	0.0278	0.0504	0.0771	0.1042	0.1281	0.1462
7	0.0000	0.0001	0.0008	0.0034	0.0099	0.0216	0.0385	0.0595	0.0824	0.1044
8	0.0000	0.0000	0.0001	0.0009	0.0031	0.0081	0.0169	0.0298	0.0463	0.0653
9	0.0000	0.0000	0.0000	0.0002	0.0009	0.0027	0.0066	0.0132	0.0232	0.0363
10	0.0000	0.0000	0.0000	0.0000	0.0002	0.0008	0.0023	0.0053	0.0104	0.0181
11	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0007	0.0019	0.0043	0.0082
12	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	0.0006	0.0016	0.0034
13	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	0.0006	0.0013
14	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	0.0005
15	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002
16	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

k	μ = 5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
0	0.0041	0.0025	0.0015	0.0009	0.0006	0.0003	0.0002	0.0001	0.0001	0.0000
1	0.0225	0.0149	0.0098	0.0064	0.0041	0.0027	0.0017	0.0011	0.0007	0.0005
2	0.0618	0.0446	0.0318	0.0223	0.0156	0.0107	0.0074	0.0050	0.0034	0.0023
3	0.1133	0.0892	0.0688	0.0521	0.0389	0.0286	0.0208	0.0150	0.0107	0.0076
4	0.1558	0.1339	0.1118	0.0912	0.0729	0.0573	0.0443	0.0337	0.0254	0.0189
5	0.1714	0.1606	0.1454	0.1277	0.1094	0.0916	0.0752	0.0607	0.0483	0.0378
6	0.1571	0.1606	0.1575	0.1490	0.1367	0.1221	0.1066	0.0911	0.0764	0.0631
7	0.1234	0.1377	0.1462	0.1490	0.1465	0.1396	0.1294	0.1171	0.1037	0.0901
8	0.0849	0.1033	0.1188	0.1304	0.1373	0.1396	0.1375	0.1318	0.1232	0.1126
9	0.0519	0.0688	0.0858	0.1014	0.1144	0.1241	0.1299	0.1318	0.1300	0.1251
10	0.0285	0.0413	0.0558	0.0710	0.0858	0.0993	0.1104	0.1186	0.1235	0.1251
11	0.0143	0.0225	0.0330	0.0452	0.0585	0.0722	0.0853	0.0970	0.1067	0.1137
12	0.0065	0.0113	0.0179	0.0263	0.0366	0.0481	0.0604	0.0728	0.0844	0.0948
13	0.0028	0.0052	0.0089	0.0142	0.0211	0.0296	0.0395	0.0504	0.0617	0.0729
14	0.0011	0.0022	0.0041	0.0071	0.0113	0.0169	0.0240	0.0324	0.0419	0.0521
15	0.0004	0.0009	0.0018	0.0033	0.0057	0.0090	0.0136	0.0194	0.0265	0.0347
16	0.0001	0.0003	0.0007	0.0014	0.0026	0.0045	0.0072	0.0109	0.0157	0.0217
17	0.0000	0.0001	0.0003	0.0006	0.0012	0.0021	0.0036	0.0058	0.0088	0.0128
18	0.0000	0.0000	0.0001	0.0002	0.0005	0.0009	0.0017	0.0029	0.0046	0.0071
19	0.0000	0.0000	0.0000	0.0001	0.0002	0.0004	0.0008	0.0014	0.0023	0.0037
20	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	0.0003	0.0006	0.0011	0.0019
21	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0003	0.0005	0.0009
22	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0002	0.0004
23	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002
24	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001
25	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Binomial probabilities

n	k	.05	.10	.15	.20	.25	.30	.35	.40	.45	.50
2	0	.9025	.8100	.7225	.6400	.5625	.4900	.4225	.3600	.3025	.2500
	1	.0950	.1800	.2550	.3200	.3750	.4200	.4550	.4800	.4950	.5000
	2	.0025	.0100	.0225	.0400	.0625	.0900	.1225	.1600	.2025	.2500
3	0	.8574	.7290	.6141	.5120	.4219	.3430	.2746	.2160	.1664	.1250
	1	.1354	.2430	.3251	.3840	.4219	.4410	.4436	.4320	.4084	.3750
	2	.0071	.0270	.0574	.0960	.1406	.1890	.2389	.2880	.3341	.3750
	3	.0001	.0010	.0034	.0080	.0156	.0270	.0429	.0640	.0911	.1250
4	0	.8145	.6561	.5220	.4096	.3164	.2401	.1785	.1296	.0915	.0625
	1	.1715	.2916	.3685	.4096	.4219	.4116	.3845	.3456	.2995	.2500
	2	.0135	.0486	.0975	.1536	.2109	.2646	.3105	.3456	.3675	.3750
	3	.0005	.0036	.0115	.0256	.0469	.0756	.1115	.1536	.2005	.2500
	4	.0000	.0001	.0005	.0016	.0039	.0081	.0150	.0256	.0410	.0625
5	0	.7738	.5905	.4437	.3277	.2373	.1681	.1160	.0778	.0503	.0313
	1	.2036	.3280	.3915	.4096	.3955	.3602	.3124	.2592	.2059	.1563
	2	.0214	.0729	.1382	.2048	.2637	.3087	.3364	.3456	.3369	.3125
	3	.0011	.0081	.0244	.0512	.0879	.1323	.1811	.2304	.2757	.3125
	4	.0000	.0004	.0022	.0064	.0146	.0283	.0488	.0768	.1128	.1563
	5	.0000	.0000	.0001	.0003	.0010	.0024	.0053	.0102	.0185	.0313
6	0	.7351	.5314	.3771	.2621	.1780	.1176	.0754	.0467	.0277	.0156
	1	.2321	.3543	.3993	.3932	.3560	.3025	.2437	.1866	.1359	.0938
	2	.0305	.0984	.1762	.2458	.2966	.3241	.3280	.3110	.2780	.2344
	3	.0021	.0146	.0415	.0819	.1318	.1852	.2355	.2765	.3032	.3125
	4	.0001	.0012	.0055	.0154	.0330	.0595	.0951	.1382	.1861	.2344
	5	.0000	.0001	.0004	.0015	.0044	.0102	.0205	.0369	.0609	.0938
	6	.0000	.0000	.0000	.0001	.0002	.0007	.0018	.0041	.0083	.0156
7	0	.6983	.4783	.3206	.2097	.1335	.0824	.0490	.0280	.0152	.0078
	1	.2573	.3720	.3960	.3670	.3115	.2471	.1848	.1306	.0872	.0547
	2	.0406	.1240	.2097	.2753	.3115	.3177	.2985	.2613	.2140	.1641
	3	.0036	.0230	.0617	.1147	.1730	.2269	.2679	.2903	.2918	.2734
	4	.0002	.0026	.0109	.0287	.0577	.0972	.1442	.1935	.2388	.2734
	5	.0000	.0002	.0012	.0043	.0115	.0250	.0466	.0774	.1172	.1641
	6	.0000	.0000	.0001	.0004	.0013	.0036	.0084	.0172	.0320	.0547
	7	.0000	.0000	.0000	.0000	.0001	.0002	.0006	.0016	.0037	.0078
8	0	.6634	.4305	.2725	.1678	.1001	.0576	.0319	.0168	.0084	.0039
	1	.2793	.3826	.3847	.3355	.2670	.1977	.1373	.0896	.0548	.0313

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Table A.3 Critical Values (Percentiles) for the Chi-Square Distribution

For each degree of freedom (d.f.) in the first column, the table entries are the critical values for the upper one-sided significance levels in the column headings or, equivalently, the percentiles for the corresponding percentages.

	Percentage								
	2.5	5	50	75	90	95	97.5	99	99.9
	Upper One-Sided α								
d.f.	.975	.95	.50	.25	.10	.05	.025	.01	.001
1	.001	.004	.455	1.32	2.71	3.84	5.02	6.63	10.83
2	.051	.103	1.39	2.77	4.61	5.99	7.38	9.21	13.82
3	.216	.352	2.37	4.11	6.25	7.82	9.35	11.34	16.27
4	.484	.711	3.36	5.39	7.78	9.49	11.14	13.28	18.47
5	.831	1.15	4.35	6.63	9.24	11.07	12.83	15.09	20.52
6	1.24	1.64	5.35	7.84	10.64	12.59	14.45	16.81	22.46
7	1.69	2.17	6.35	9.04	12.02	14.07	16.01	18.47	24.32
8	2.18	2.73	7.34	10.22	13.36	15.51	17.53	20.09	26.12
9	2.70	3.33	8.34	11.39	14.68	16.92	19.02	21.67	27.88
10	3.25	3.94	9.34	12.55	15.99	18.31	20.48	23.21	29.59
11	3.82	4.57	10.34	13.70	17.27	19.68	21.92	24.72	31.26
12	4.40	5.23	11.34	14.85	18.55	21.03	23.34	26.22	32.91
13	5.01	5.89	12.34	15.98	19.81	22.36	24.74	27.69	34.53
14	5.63	6.57	13.34	17.12	21.06	23.68	26.12	29.14	36.12
15	6.26	7.26	14.34	18.25	22.31	25.00	27.49	30.58	37.70
16	6.91	7.96	15.34	19.37	23.54	26.30	28.85	32.00	39.25
17	7.56	8.67	16.34	20.49	24.77	27.59	30.19	33.41	40.79
18	8.23	9.39	17.34	21.60	25.99	28.87	31.53	34.81	42.31
19	8.91	10.12	18.34	22.72	27.20	30.14	32.85	36.19	43.82
20	9.59	10.85	19.34	23.83	28.41	31.41	34.17	37.57	45.31
21	10.28	11.59	20.34	24.93	29.62	32.67	35.48	38.93	46.80
22	10.98	12.34	21.34	26.04	30.81	33.92	36.78	40.29	48.27
23	11.69	13.09	22.34	27.14	32.01	35.17	38.08	41.64	49.73
24	12.40	13.85	23.34	28.24	33.20	36.42	39.36	42.98	51.18
25	13.12	14.61	24.34	29.34	34.38	37.65	40.65	44.31	52.62
26	13.84	15.38	25.34	30.43	35.56	38.89	41.92	45.64	54.05
27	14.57	16.15	26.34	31.53	36.74	40.11	43.19	46.96	55.48
28	15.31	16.93	27.34	32.62	37.92	41.34	44.46	48.28	56.89
29	16.05	17.71	28.34	33.71	39.09	42.56	45.72	49.59	58.30
30	16.79	18.49	29.34	34.80	40.26	43.77	46.98	50.89	59.70
35	20.57	22.47	34.34	40.22	46.06	49.80	53.20	57.34	66.62
40	24.43	26.51	39.34	45.62	51.81	55.76	59.34	63.69	73.40
45	28.37	30.61	44.34	50.98	57.51	61.66	65.41	69.96	80.08
50	32.36	34.76	49.33	56.33	63.17	67.50	71.42	76.15	86.66
55	36.40	38.96	54.33	61.66	68.80	73.31	77.38	82.29	93.17
60	40.48	43.19	59.33	66.98	74.40	79.08	83.30	88.38	99.61
65	44.60	47.45	64.33	72.28	79.97	84.82	89.18	94.42	105.99
70	48.76	51.74	69.33	77.58	85.53	90.53	95.02	100.43	112.32
75	52.94	56.05	74.33	82.86	91.06	96.22	100.84	106.39	118.60
80	57.15	60.39	79.33	88.13	96.58	101.88	106.63	112.33	124.84
85	61.39	64.75	84.33	93.39	102.08	107.52	112.39	118.24	131.04
90	65.65	69.13	89.33	98.65	107.57	113.15	118.14	124.12	137.21
95	69.92	73.52	94.33	103.90	113.04	118.75	123.86	129.97	143.34
100	74.22	77.93	99.33	109.14	118.50	124.34	129.56	135.81	149.45

For more than 100 degrees of freedom chi-square critical values may be found in terms of the degrees of freedom and the corresponding two-sided critical value for a standard normal deviate Z by the equation $X^2 = 0.5 \cdot (Z + \sqrt{2 \cdot D - 1})^2$.

Table A.4 Critical Values (Percentiles) for the *t*-Distribution

The table entries are the critical values (percentiles) for the *t*-distribution. The column headed d.f. (degrees of freedom) gives the degrees of freedom for the values in that row. The columns are labeled by "percent," "one-sided," and "two-sided." "Percent" is 100 × cumulative distribution function—the table entry is the corresponding percentile. "One-sided" is the significance level for the one-sided upper critical value—the table entry is the critical value. "Two-sided" gives the two-sided significance level—the table entry is the corresponding two-sided critical value.

	Percent											
	75	90	95	97.5	99	99.5	99.75	99.9	99.95	99.975	99.99	99.995
	One-Sided α											
	.25	.10	.05	.025	.01	.005	.0025	.001	.0005	.00025	.0001	.00005
	Two-Sided α											
d.f.	.50	.20	.10	.05	.02	.01	.005	.002	.001	.0005	.0002	.0001
1	1.00	3.08	6.31	12.71	31.82	63.66	127.32	318.31	636.62	1273.24	3183.10	6366.20
2	.82	1.89	2.92	4.30	6.96	9.22	14.09	22.33	31.60	44.70	70.70	99.99
3	.76	1.64	2.35	3.18	4.54	5.84	7.45	10.21	12.92	16.33	22.20	28.00
4	.74	1.53	2.13	2.78	3.75	4.60	5.60	7.17	8.61	10.31	13.03	15.54
5	.73	1.48	2.02	2.57	3.37	4.03	4.77	5.89	6.87	7.98	9.68	11.18
6	.72	1.44	1.94	2.45	3.14	3.71	4.32	5.21	5.96	6.79	8.02	9.08
7	.71	1.42	1.90	2.37	3.00	3.50	4.03	4.79	5.41	6.08	7.06	7.88
8	.71	1.40	1.86	2.31	2.90	3.36	3.83	4.50	5.04	5.62	6.44	7.12
9	.70	1.38	1.83	2.26	2.82	3.25	3.69	4.30	4.78	5.29	6.01	6.59
10	.70	1.37	1.81	2.23	2.76	3.17	3.58	4.14	4.59	5.05	5.69	6.21
11	.70	1.36	1.80	2.20	2.72	3.11	3.50	4.03	4.44	4.86	5.45	5.92
12	.70	1.36	1.78	2.18	2.68	3.06	3.43	3.93	4.32	4.72	5.26	5.69
13	.69	1.35	1.77	2.16	2.65	3.01	3.37	3.85	4.22	4.60	5.11	5.51
14	.69	1.35	1.76	2.15	2.63	2.98	3.33	3.79	4.14	4.50	4.99	5.36
15	.69	1.34	1.75	2.13	2.60	2.95	3.29	3.73	4.07	4.42	4.88	5.24
16	.69	1.34	1.75	2.12	2.58	2.92	3.25	3.69	4.02	4.35	4.79	5.13
17	.69	1.33	1.74	2.11	2.57	2.90	3.22	3.65	3.97	4.29	4.71	5.04
18	.69	1.33	1.73	2.10	2.55	2.88	3.20	3.61	3.92	4.23	4.65	4.97
19	.69	1.33	1.73	2.09	2.54	2.86	3.17	3.58	3.88	4.19	4.59	4.90
20	.69	1.33	1.73	2.09	2.53	2.85	3.15	3.55	3.85	4.15	4.54	4.84
21	.69	1.32	1.72	2.08	2.52	2.83	3.14	3.53	3.82	4.11	4.49	4.78
22	.69	1.32	1.72	2.07	2.51	2.82	3.12	3.51	3.79	4.08	4.45	4.74
23	.68	1.32	1.71	2.07	2.50	2.81	3.10	3.49	3.77	4.05	4.42	4.69
24	.68	1.32	1.71	2.06	2.49	2.80	3.09	3.47	3.75	4.02	4.38	4.65
25	.68	1.32	1.71	2.06	2.49	2.79	3.08	3.45	3.73	4.00	4.35	4.62
26	.68	1.32	1.71	2.06	2.48	2.78	3.07	3.44	3.71	3.97	4.32	4.59
27	.68	1.31	1.70	2.05	2.47	2.77	3.06	3.42	3.69	3.95	4.30	4.56
28	.68	1.31	1.70	2.05	2.47	2.76	3.05	3.41	3.67	3.94	4.28	4.53
29	.68	1.31	1.70	2.05	2.46	2.76	3.04	3.40	3.66	3.92	4.25	4.51
30	.68	1.31	1.70	2.04	2.46	2.75	3.03	3.39	3.65	3.90	4.23	4.48
35	.68	1.31	1.69	2.03	2.44	2.72	3.00	3.34	3.59	3.84	4.15	4.39
40	.68	1.30	1.68	2.02	2.42	2.70	2.97	3.31	3.55	3.79	4.09	4.32
45	.68	1.30	1.68	2.01	2.41	2.69	2.95	3.28	3.52	3.75	4.05	4.27
50	.68	1.30	1.68	2.01	2.40	2.68	2.94	3.26	3.50	3.72	4.01	4.23
55	.68	1.30	1.67	2.00	2.40	2.67	2.93	3.25	3.48	3.70	3.99	4.20
60	.68	1.30	1.67	2.00	2.39	2.66	2.91	3.23	3.46	3.68	3.96	4.17
65	.68	1.29	1.67	2.00	2.39	2.65	2.91	3.22	3.45	3.66	3.94	4.15
70	.68	1.29	1.67	1.99	2.38	2.65	2.90	3.21	3.44	3.65	3.93	4.13
75	.68	1.29	1.67	1.99	2.38	2.64	2.89	3.20	3.43	3.64	3.91	4.11
80	.68	1.29	1.66	1.99	2.37	2.64	2.89	3.20	3.42	3.63	3.90	4.10
85	.68	1.29	1.66	1.99	2.37	2.64	2.88	3.19	3.41	3.62	3.89	4.08
90	.68	1.29	1.66	1.99	2.37	2.63	2.88	3.18	3.40	3.61	3.88	4.07
95	.68	1.29	1.66	1.99	2.37	2.63	2.87	3.18	3.40	3.60	3.87	4.06
100	.68	1.29	1.66	1.98	2.36	2.63	2.87	3.17	3.39	3.60	3.86	4.05
200	.68	1.29	1.65	1.97	2.35	2.60	2.84	3.13	3.34	3.54	3.79	3.97
500	.68	1.28	1.65	1.97	2.33	2.59	2.82	3.11	3.31	3.50	3.75	3.92
∞	.67	1.28	1.65	1.96	2.33	2.58	2.81	3.10	3.30	3.49	3.73	3.91

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Table A.5 Critical Values (Percentiles) for the F-Distribution

Upper one-sided 0.05 significance levels; two-sided 0.10 significance levels; 95% percentiles. Tabulated are critical values for the F-distribution. The column headings give the numerator degrees of freedom and the row headings *the denominator degrees of freedom.* Lower one-sided critical values may be found from these tables by reversing the degrees of freedom and using the reciprocal of the tabled value at the same significance level (100 minus the percent for the percentile).

	Numerator Degrees of Freedom																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	161.4	199.5	215.7	224.6	230.2	234.0	236.8	238.9	240.5	241.9	243.9	245.9	248.0	249.1	250.1	251.1	252.2	253.3	254.3
2	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38	19.40	19.41	19.43	19.45	19.45	19.46	19.47	19.48	19.49	19.50
3	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.36
6	6.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.15	2.07	1.99	1.95	1.90	1.85	1.80	1.75	1.69
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20	2.13	2.06	1.97	1.93	1.88	1.84	1.79	1.73	1.67
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.71	1.65
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18	2.10	2.03	1.94	1.90	1.85	1.81	1.75	1.70	1.64
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120	3.92	3.07	2.68	2.45	2.29	2.17	2.09	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00

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