[This question paper contains 10+6 printed pages.]

Sr. No. of Question Paper : 7563 **F-7** **Your Roll No...............**

Unique Paper Code : 2271303

Name of the Paper : Statistical Methods in Economics - II

Name of the Course : **B.A. (Hons.) Economics**

Semester : III

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. All questions within each section are to be answered in a continuous manner on the answer sheet. Start each question on a new page and all subparts of a question should follow one after the other.
3. Use of simple calculator is permitted.
4. Required statistical tables are attached with this question paper.
5. This paper contains four sections. Attempt all sections.
6. Answers may be written either in English or Hindi; but the same medium should be used throughout the paper.

छात्रों के लिए निर्देश

1. इस प्रश्न-पत्र के मिलते ही ऊपर दिए गए निर्धारित स्थान पर अपना अनुक्रमांक लिखिए ।
2. प्रत्येक भाग के सभी प्रश्न के उत्तर एक साथ उत्तर पुस्तिका पर दें। प्रत्येक प्रश्न नये पेज पर और उपभागों का एक के बाद क्रम से प्रश्नों के उत्तर दीजिए।
3. साधारण कैलकुलेटर का उपयोग मान्य है।
4. इस प्रश्न पत्र के साथ स्टेटिकल टेबल संलग्न की गई है।
5. इस प्रश्न पत्र में चार खंड हैं। सभी खंडों के उत्तर दीजिए।
6. इस प्रश्न-पत्र का उत्तर अंग्रेजी या हिंदी किसी एक भाषा में दीजिए, लेकिन सभी उत्तरों का माध्यम एक ही होना चाहिए ।

Section I

Q1 is compulsory. Attempt any one From Q2 and Q3.

भाग I

प्रश्न संख्या 1 अनिवार्य है।

किन्हीं एक प्रश्न संख्या 2 और 3 को हल कीजिए।

(a) A confectionary shop sells three types of candies priced at Rs 3.00, Rs 3.20, and Rs 3.40 per piece, respectively. Let X_1, X_2 and X_3 denote the number of these candies sold on a particular day. Suppose the X_i's are independent with μ_1, μ_2 and μ_3 equal to 1000, 500 and 300, respectively and σ_1, σ_2 and σ_3 equal to 100, 80 and 50, respectively.

(i) What is the expected daily revenue of the shop from the sale of these candies?

(ii) Calculate the standard deviation of the revenue from the sale of these candies.

(iii) Would your answers be correct if the X_i's were not independent? Explain. (4)

(b) For the following sample data on variables x and y:

X	112.3	97.0	92.7	86.0	102.0	99.2	95.8	103.5	89.0	86.7
Y	75.0	71.0	57.7	48.7	74.3	73.3	68.0	59.3	57.8	48.5

(i) Obtain the equation of the least squares line and interpret its slope.

(ii) Calculate and interpret the coefficient of determination. (6)

(क) एक मिठाई की दुकान तीन प्रकार की मिठाइयाँ बेचती है जिनका मूल्य क्रमश: 3.00 रु., 3.20 रु, एवं 3.40 रु. प्रति नग है। माना कि X_1, X_2, और X_3 किसी विशिष्ट, दिन बेची गयी मिठाइयों की संख्या को व्यक्त करते हैं। माना कि X_i के मान μ_1, μ_2, और μ_3 से स्वतंत्र हैं एवं क्रमश: 1000, 500 एवं 300 के बराबर हैं एवं σ_1, σ_2, और σ_3 क्रमश: 100, 80 एवं 50 के बराबर हैं।

(i) इन मिठाइयों की बिक्री से दुकान की अनुमानित दैनिक आय क्या है?

(ii) इन मिठाइयों की बिक्री से होने वाली आय के मानक विचलन का परिकलन कीजिए।

(iii) यदि X_i के मान स्वतंत्र नहीं होते तो क्या आपके उत्तर सही होते? व्याख्या कीजिए।

(ग) x एवं y के चरों हेतु निम्नलिखित प्रतिदर्श आंकड़ों के लिए:

X	112.3	97.0	92.7	86.0	102.0	99.2	95.8	103.5	89.0	86.7
Y	75.0	71.0	57.7	48.7	74.3	73.3	68.0	59.3	57.8	48.5

(i) least squares line का समीकरण ज्ञात कीजिए एवं उसकी प्रवणता की व्याख्या कीजिए।

(ii) निर्धारण गुणांक का परिकलन कीजिए एवं उसकी व्याख्या कीजिए।

2. (a) The time take by a randomly selected student to fill a form has a normal distribution with mean value 10 min and standard deviation 2 min. If five students fill a form on one day and six on another day, what is the probability that the sample average amount of time taken on each day is at most 11min? (5)

(b) For the following summary statistics:

$$n=15,\ \sum x_i=1640.1,\ \sum y_i=299.8,\ \sum x_i^2=179{,}849.73$$

$$\sum y_i^2=6430.06,\ \sum x_i y_i=32{,}308.59$$

(i) Obtain the equation of the estimated regression line of y on x.

(ii) Use the estimated line used to predict y when x is 135.

(iii) Calculate and interpret a point estimate of σ.

(iv) What are the values of SSE and SST?

(v) What proportion of observed variation in y can be attributed to the approximate linear relationship between x and y? (10)

(क) यादृच्छिक रूप से चयनित किए गए छात्रों द्वारा एक प्रपत्र को भरने में लिया गया समय 10 मिनट के माध्य मान एवं 2 मिनट के मानक विचलन के साथ प्रसामान्य बंटन को प्रदर्शित करता है। यदि एक दिन पांच छात्र प्रपत्र भरते हैं एवं दूसरे दिन छ: छात्र प्रपत्र भरते हैं तो, प्रपत्र भरन में प्रतिदिन लिए गए समय की प्रतिदर्श औसत मात्र अधिकतम 11 मिनट होने की प्राविकता क्या है?

(ख) निम्नलिखित सारांशीकृत आँकड़ों के लिए:

$n = 15, \sum x_i = 1640.1, \sum y_i = 299.8, \sum x_i^2 = 179{,}849.73$

$\sum y_i^2 = 6430.06, \sum x_i y_i = 32{,}308.59$

(i) x पर y की अनुमानित समाश्रयण रेखा का समीकरण प्राप्त कीजिए।

(ii) y का अनुमान लगाने के लिए अनुमानित रेखा का उपयोग कीजिए जब कि x का मान 135 है।

(iii) σ के बिंदु आकल का परिकलन कीजिए एवं व्याख्या कीजिए।

(iv) SSE एवं SST के मान क्या हैं?

(v) y में प्रेक्षित विचरण के किस अनुपात को x एवं y के बीच अनुमानित रैखिक संबंध के लिए जिम्मेदार ठहराया जा सकता है?

3. (a) A College has three administrative departments each having two employees. Information regarding their monthly salaries (thousands of Rs) is as follows:

Department	1	1	2	2	3	3
Employee	1	2	3	4	5	6
Salary	30	34	28	32	42	22

Suppose one of the three departments is randomly selected. Let X_1 and X_2 denote the salaries of the two employees. Determine the sampling distribution of $\bar{X}$. Where is this distribution centered? (5)

(b) Following summary statistics are given to explain the relationship between y and x:

$\sum x_i = 659, \sum x_i^2 = 28{,}967.50, \bar{x} = 36.6111, S_{xx} = 4840.7778,$

$$\sum y_i = 293.2, \quad \sum x_i y_i = 9293.95, \quad \sum y_i^2 = 5335.76,$$
$$\widehat{\beta_1} = -0.2976, \widehat{\beta_0} = 27.183, \quad SSE = 131.2402,$$
$$r^2 = 0.766, \; s = 2.8640$$

Calculate a prediction interval for y with a prediction level of 95% when x is 45. (5)

(c) Show that the "point of averages" $(\bar{x}, \bar{y})$ lies on the estimated regression line. (5)

(क) एक कॉलेज में तीन प्रशासनिक विभाग हैं जिनमें से प्रत्येक में दो कर्मचारी हैं। उनके मासिक वेतनों (हजार रुपयों में) के संबंध में जानकारी इस प्रकार है:

विभाग	1	1	2	2	3	3
कर्मचारी	1	2	3	4	5	6
वेतन	30	34	28	32	42	22

माना कि तीन में से एक विभाग का यादृच्छिक रूप से चयन किया जाता है। माना कि X_1 और X_2 दो कर्मचारियों के वेतन को व्यक्त करते हैं। $\bar{X}$ के प्रतिचयन बंटन को निर्धारित कीजिए। यह बंटन कहाँ केन्द्रित है?

(ख) y एवं x के बीच संबंध की व्याख्या करने के लिए निम्नलिखित सारांश आंकड़े दिए गए हैं:

$\sum x_i = 659, \sum x_i^2 = 28{,}967.50, \bar{x} = 36.6111, S_{xx} = 4840.7778,$

$$\sum y_i = 293.2, \quad \sum x_i y_i = 9293.95, \quad \sum y_i^2 = 5335.76,$$
$$\widehat{\beta_1} = -0.2976, \widehat{\beta_0} = 27.183, \quad SSE = 131.2402,$$
$$r^2 = 0.766, \; s = 2.8640$$

95% के प्रागुक्ति स्तर के साथ ल के लिए प्रागुक्ति अंतराल का परिकलन कीजिए जबकि x का मान 45 है।

(ग) प्रदर्शित कीजिए कि "औसत बिंदु (point of averages) $(\bar{x}, \bar{y})$ अनुमानित समाश्रयण रेखा (regression line) पर अवस्थित हैं।

SECTION II

ATTEMPT ALL QUESTIONS

भाग II

सभी प्रश्नों को हल कीजिए

4. (a) Explain properties of a good estimator. Consider a random sample $(X_1, X_2, X_3 \ldots X_n)$ from a population from a probability distribution function f (x; θ) If Expected value of an estimator $\hat{\theta}$ is equal to (n/n+1)* θ, what is the bias of this estimator? Find an estimator that is unbiased. (3+2)

(b) Consider a random sample $(X_1, X_2, X_3 \ldots X_n)$ from a population from a probability distribution function

f(x; θ) = 0.5(1 +x* θ). Where $-1 \le x \le 1$.

(i) Show that $\hat{\theta}$ = 3*sample mean is an unbiased estimator for σ.

(ii) If a sample size is 3 and the sample is (-1, 0, 2) give point estimate for θ. (4+1)

(c) Let $(x_1, x_2 \ldots \ldots x_n)$ be a random sample from a population with mean μ and standard deviation σ. Show that $S^2 = \frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}$ is unbiased estimator of population variance, denoted by σ^2.

(5)

(d) From a survey of 500 families, 340 were reported to like Star Plus channel.

Find a 90% confidence interval for the proportion of families that like Star Plus channel. What is the required sample size if we want to be 95% confident that our estimate of the proportion of families that like Star plus channel is within 0.02 of the true proportion? (5)

(e) Let X be a continuous random variable that is uniformly distributed over (0, A). Find the moment estimator of A. (3+2)

(क) अच्छे प्राक्कलक के गुणों की व्याख्या कीजिए। प्रायिकता वितरण फलन (x; θ) से एक समष्टि के याण्च्छिक प्रतिदर्श ($X_1, X_2, X_3 \ldots X_n$) पर विचार कीजिए। यदि प्राक्कलक $\hat{\theta}$ का अपेक्षित मान (n/n+1)* θ के समतुल्य है, तो इस प्राक्कलक की अभिनति क्या है? ऐसा प्राक्कलक ज्ञात कीजिए जो अनभिनत है।

(ख) एक समष्टि के यादृच्छिक प्रतिदर्श ($X_1, X_2, X_3 \ldots X_n$) पर विचार कीजिए जिसका प्रायिकता वितरण फलन इस प्रकार है:

f(x; θ) = 0.5(1 +x* θ). जहाँ $-1 \le x \le 1$.

(i) प्रदर्शित कीजिए कि $\hat{\theta}$=3* प्रतिदर्श माध्य θ के लिए अनभिनत प्राक्कलक है।

(ii) यदि प्रतिदर्श आकार 3 है एवं प्रतिदर्श (-1, 0, 2) है, तो θ के लिए बिंदु आकल प्रदान कीजिए।

(ग) माना कि माध्य – एवं मानक विचलन σ की समष्टि से लिया गया एक यादृच्छिक प्रतिदर्श (x_1, $x_2 \ldots\ldots x_n$) है। प्रदर्शित कीजिए कि $S^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}$ ऐसे समष्टि प्रसरण (population variance) का अनभिनत प्राक्कलक है जिसे σ^2 से व्यक्त किया जाता है।

(घ) 500 परिवारों के सर्वेक्षण से यह रिपोर्ट प्राप्त हुई कि 340 परिवार स्टार प्लस को पसंद करते थे। स्टार प्लस चैनल को पसंद करने वाले परिवारों के लिए 90% विश्वास्यता अंतराल को ज्ञात कीजिए। यदि हम 95% सुनिश्चित होना चाहते हैं कि स्टार प्लस चैनल को पसंद करने वाले परिवारों का हमारा अनुमान वास्तविक अनुपात के 0.02 के अंतर्गत है तो वांछित प्रतिदर्श आकार क्या है?

(ङ) माना कि X संतत याणक्षिक चर है जो (0, A) पर समान रूप से वितरित है। । का आघूर्ण प्राक्कलक (moment estimator) ज्ञात कीजिए।

SECTION III

Q5 IS COMPULSORY. ATTEMPT ANY TWO QUESTIONS OUT OF Q6, Q7 AND Q8.

भाग III

प्रश्न 5 अनिवार्य है। प्र.6, प्र.7 एवं प्र.8 में से

कोई दो प्रश्न हल कीजिए।

5. What are the two types of errors in hypothesis testing? For a given sample size, can both errors be simultaneously reduced? Explain with the help of diagram. (5)

परिकल्पना परीक्षण (hypothesis testing) में दो प्रकार की त्रुटियाँ कौन सी हैं? क्या दिए गए प्रतिदर्श आकार के लिए दोनों त्रुटियों को एक साथ कम किया जा सकता है? आरेख की सहायता से समझाइए।

6. (a) A professor believes that a standard deviation of about 13 points on a hundred point exam indicates that the exam does a good job. He gave an exam to his class of 31 students. The mean score was 72.7 and standard deviation was 15.9. Does this exam meet the goodness criterion? Use $\alpha = 0.10$.

(b) For each of the following pairs of hypothesis indicate if the rules of setting up hypothesis are followed. If not, give reasons.

(i) Ho: $\mu = 100$ H1: $\mu \leq 100$

(ii) Ho: $\mu \neq 21$ H1: $\mu < 21$

(iii) Ho: $\mu = 12.5$ H1: $\mu < 12.8$

(iv) Ho: $\mu > 100$ H1: $\mu \neq 100$

(v) Ho: $\mu > 100$ H1: $\mu = 100$ (5+5)

(क) एक प्रोफेसर का विश्वास है कि 100 अंकों की परीक्षा में लगभग 13 अंकों का मानक विचलन यह इंगित करता है कि परीक्षा अच्छा कार्य करती है। उसने 31 छात्रों की अपनी कक्षा की एक परीक्षा ली। माध्य प्राप्तांक 72.7 थे एवं मानक विचलन 15.9 था। क्या यह परीक्षा अच्छाई के मानदण्ड (goodness criterion) को पूरा करती है। $\alpha = 0.10$ का प्रयोग कीजिए।

(ख) निम्नलिखित में से परिकल्पना के प्रत्येक युग्म के लिए इंगित कीजिए कि क्या परिकल्पना की स्थापना के नियमों का पालन किया जाता है। यदि नहीं तो कारण बताइए।

(i) Ho: $\mu = 100$ H1: $\mu \leq 100$

(ii) Ho: $\mu \neq 21$ H1: $\mu < 21$

(iii) Ho: $\mu = 12.5$ H1: $\mu < 12.8$

(iv) Ho: $\mu > 100$ H1: $\mu \neq 100$

(v) Ho: $\mu > 100$ H1: $\mu = 100$

7. (a) A quality inspector picks up 100 masks from the market to note that 14 do not work as they are unable to filter out air impurities. The manufacturer claims that only 10% of masks are unable to filter out air impurities. Using a significance level of 98% can the manufacturer's claim be supported? What is the p value of your test?

(b) A consultant needs to compare two populations, but he needs to know if the variances are same for them before he proceeds. He collects samples of size 10 from both populations to get standard deviations of 12.2 and 15.4. Using a 95% confidence level test for equality of variances in both populations. (5+5)

(क) एक गुणवत्ता निरीक्षक बाजार से 100 मास्क उठाता है और उसे ज्ञात होता है कि उनमें से 14 मास्क कार्य नहीं कर रहे हैं क्योंकि वे वायु की अशुद्धियों का निस्पंदन करने में असमर्थ हैं। विनिर्माता का दावा है कि केवल 10% मास्क ही वायु की अशुद्धियों का निस्पंदन करने में असमर्थ हैं। 98% के सार्थकता स्तर का उपयोग कर क्या विनिर्माता के दावे का समर्थन किया जा सकता है? आपके परीक्षण का p मान क्या है?

(ख) एक सलाहकार को दो समष्टियों की तुलना करने की आवश्यकता है, किन्तुं यह कार्य आरम्भ करने से पहले वह ज्ञात करना चाहता है कि क्या उनके लिए प्रसरण समान हैं। वह 12.2 और 15.4 का मानक विचलन प्राप्त करने के लिए दोनों समष्टियों से 10 के आकार के प्रतिदर्श एकत्रित करता है। 95% विश्वास स्तर का प्रयोग कर दोनों समष्टियों में प्रसरणों की समानता का परीक्षण कीजिए।

8. (a) A consultancy firm wants to check if average wages across males and females are different. They took samples that reveal the following information:

Males	Females
Mean = 62.5	Mean = 39.7
Standard deviation = 23.7	Standard deviation = 8.9
Size = 175	Size = 168

(i) Using a 90% confidence level can we argue that there is no difference in wages across males and females? Assume equal population variances.

(ii) Can we argue that males earn more than females, using a 98% confidence level?

(b) The CEO and HR head of a company argue over the no of yearly holidays taken by employees. The HR head argues that on average employees take more than 40 holidays in a year. To test this claim a sample of 15 employees is taken and sample average is found to be 41.17 with standard deviation is 4.71. Test the HR head's claim that employees take more than 40 yearly holidays ata 0.05 level of significance. (5+5)

(क) एक कंसल्टेंसी फर्म यह जाँच करना चाहती है कि क्या पुरुषों और महिलाओं के बीच औसत पारिश्रमिक भिन्न हैं। वे प्रतिदर्श ग्रहण करते हैं जो निम्नलिखित जानकारी प्रकट करते हैं:

पुरुष	महिला
माध्य = 62.5	माध्य = 39.7
मानक विचलन = 23.7	मानक विचलन = 8.9
आकार = 175	आकार = 168

(i) 90% विश्वास स्तर का प्रयोग कर क्या हम यह तर्क कर सकते हैं कि पुरुषों एवं महिलाओं के पारिश्रमिक में कोई अंतर नहीं है। समष्टि प्रसरणों को समतुल्य मान लीजिए।

(ii) 98% विश्वास स्तर का प्रयोग कर क्या हम यह तर्क कर सकते हैं कि पुरुष महिलाओं की तुलना में अधिक अर्जित करते हैं?

(ख) कम्पनी के मुख्य कार्यकारी अधिकारी (CEO) एवं कम्पानी के एच.आर. प्रमुख कर्मचारियों द्वारा लिए गए वार्षिक अवकाशों के संबंध में तर्क करते हैं। एच.आर. प्रमुख का तर्क है कि औसत रूप से कर्मचारी वर्ष में 40 से अधिक अवकाश लेते हैं। इस दावे का परीक्षण करने के लिए 15 कर्मचारियों का एक प्रतिदर्श लिया जाता है एवं प्रतिदर्श का औसत 4.71 के मानक विचलन के साथ 41.17 पाया जाता है। एच.आर. प्रमुख के दावे का परीक्षण कीजिए कि कर्मचारी 0.05 के सार्थकता स्तर पर 40 से अधिक अवकाश लेते हैं।

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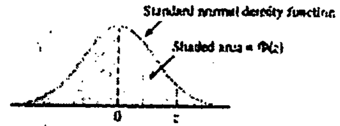
Table A.3 Standard Normal Curve Areas

$\Phi(z) = P(Z \le z)$



z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
−3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
−3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
−3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
−3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
−3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
−2.9	.0019	.0018	.0017	.0017	.0016	.0016	.0015	.0015	.0014	.0014
−2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
−2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
−2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
−2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
−2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
−2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
−2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
−2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
−2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
−1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
−1.8	.0359	.0352	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
−1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
−1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
−1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
−1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0722	.0708	.0694	.0681
−1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
−1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
−1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
−1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
−0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
−0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
−0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
−0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
−0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
−0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
−0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
−0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
−0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
−0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641

(continued)

Appendix Tables 569

Table A.3 Standard Normal Curve Areas (cont.)

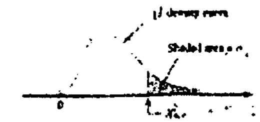
$\Phi(z) = P(Z \le z)$

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9278	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998

Table A.5 Critical Values for t Distributions

ν \ α	.10	.05	.025	.01	.005	.001	.0005
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
32	1.309	1.694	2.037	2.449	2.738	3.365	3.622
34	1.307	1.691	2.032	2.441	2.728	3.348	3.601
36	1.306	1.688	2.028	2.434	2.719	3.333	3.582
38	1.304	1.686	2.024	2.429	2.712	3.319	3.566
40	1.303	1.684	2.021	2.423	2.704	3.307	3.551
50	1.299	1.676	2.009	2.403	2.678	3.262	3.496
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

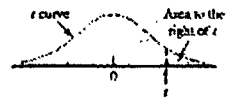
Table A.7 Critical Values for Chi-Squared Distributions



ν \ α	.995	.99	.975	.95	.90	.10	.05	.025	.01	.005
1	0.000	0.000	0.001	0.004	0.016	2.706	3.843	5.025	6.637	7.882
2	0.010	0.020	0.051	0.103	0.211	4.605	5.992	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.344	12.837
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.832	15.085	16.748
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.440	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.012	18.474	20.276
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.534	20.090	21.954
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.022	21.665	23.587
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.578	17.275	19.675	21.920	24.724	26.755
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.041	19.812	22.362	24.735	27.687	29.817
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.600	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.577	32.799
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.407	7.564	8.682	10.085	24.769	27.587	30.190	33.408	35.716
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.843	7.632	8.906	10.117	11.651	27.203	30.143	32.852	36.190	38.580
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.033	8.897	10.283	11.591	13.240	29.615	32.670	35.478	38.930	41.399
22	8.643	9.542	10.982	12.338	14.042	30.813	33.924	36.781	40.289	42.796
23	9.260	10.195	11.688	13.090	14.848	32.007	35.172	38.075	41.637	44.179
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.558
25	10.519	11.523	13.120	14.611	16.473	34.381	37.652	40.646	44.313	46.925
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.807	12.878	14.573	16.151	18.114	36.741	40.113	43.194	46.962	49.642
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.120	14.256	16.147	17.708	19.768	39.087	42.557	45.772	49.586	52.333
30	13.787	14.954	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672
31	14.457	15.655	17.538	19.280	21.433	41.422	44.985	48.231	52.190	55.000
32	15.134	16.362	18.291	20.072	22.271	42.585	46.194	49.480	53.486	56.328
33	15.814	17.073	19.046	20.866	23.110	43.745	47.400	50.724	54.774	57.646
34	16.501	17.789	19.806	21.664	23.952	44.903	48.602	51.966	56.061	58.964
35	17.191	18.508	20.569	22.465	24.796	46.059	49.802	53.203	57.340	60.272
36	17.887	19.233	21.336	23.269	25.643	47.212	50.998	54.437	58.619	61.581
37	18.584	19.960	22.105	24.075	26.492	48.363	52.192	55.667	59.891	62.880
38	19.289	20.691	22.878	24.884	27.343	49.513	53.384	56.896	61.162	64.181
39	19.994	21.425	23.654	25.695	28.196	50.660	54.572	58.119	62.426	65.473
40	20.706	22.164	24.433	26.509	29.050	51.805	55.758	59.342	63.691	66.766

For $\nu > 40$, $\chi^2_{\alpha,\nu} \approx \nu\left(1 - \frac{2}{9\nu} + z_\alpha\sqrt{\frac{2}{9\nu}}\right)^3$

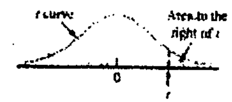
Table A.8 t Curve Tail Areas



t \ ν	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
0.0	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500
0.1	.468	.465	.463	.463	.462	.462	.462	.461	.461	.461	.461	.461	.461	.461	.461	.461	.461	.461
0.2	.437	.430	.427	.426	.425	.424	.424	.423	.423	.423	.423	.422	.422	.422	.422	.422	.422	.422
0.3	.407	.396	.392	.390	.388	.387	.386	.386	.386	.385	.385	.385	.384	.384	.384	.384	.384	.384
0.4	.379	.364	.358	.355	.353	.352	.351	.350	.349	.349	.348	.348	.348	.347	.347	.347	.347	.347
0.5	.352	.333	.326	.322	.319	.317	.316	.315	.315	.314	.313	.313	.313	.312	.312	.312	.312	.312
0.6	.328	.305	.295	.290	.287	.285	.284	.283	.282	.281	.280	.280	.279	.279	.279	.278	.278	.278
0.7	.306	.278	.267	.261	.258	.255	.253	.252	.251	.250	.249	.249	.248	.247	.247	.247	.247	.246
0.8	.285	.254	.241	.234	.230	.227	.225	.223	.222	.221	.220	.220	.219	.218	.218	.218	.217	.217
0.9	.267	.232	.217	.210	.205	.201	.199	.197	.196	.195	.194	.193	.192	.191	.191	.191	.190	.190
1.0	.250	.211	.196	.187	.182	.178	.175	.173	.172	.170	.169	.169	.168	.167	.167	.166	.166	.165
1.1	.235	.193	.176	.167	.162	.157	.154	.152	.150	.149	.147	.146	.146	.144	.144	.144	.143	.143
1.2	.221	.177	.158	.148	.142	.138	.135	.132	.130	.129	.128	.127	.126	.124	.124	.124	.123	.123
1.3	.209	.162	.142	.132	.125	.121	.117	.115	.113	.111	.110	.109	.108	.107	.107	.106	.105	.105
1.4	.197	.148	.128	.117	.110	.106	.102	.100	.098	.096	.095	.093	.092	.091	.091	.090	.090	.089
1.5	.187	.136	.115	.104	.097	.092	.089	.086	.084	.082	.081	.080	.079	.077	.077	.077	.076	.075
1.6	.178	.125	.104	.092	.085	.080	.077	.074	.072	.070	.069	.068	.067	.065	.065	.065	.064	.064
1.7	.169	.116	.094	.082	.075	.070	.065	.064	.062	.060	.059	.057	.056	.055	.055	.054	.054	.053
1.8	.161	.107	.085	.073	.066	.061	.057	.055	.053	.051	.050	.049	.048	.046	.046	.045	.045	.044
1.9	.154	.099	.077	.065	.058	.053	.050	.047	.045	.043	.042	.041	.040	.038	.038	.038	.037	.037
2.0	.148	.092	.070	.058	.051	.046	.043	.040	.038	.037	.035	.034	.033	.032	.032	.031	.031	.030
2.1	.141	.085	.063	.052	.045	.040	.037	.034	.033	.031	.030	.029	.028	.027	.027	.026	.025	.025
2.2	.136	.079	.058	.046	.040	.035	.032	.029	.028	.026	.025	.024	.023	.022	.022	.021	.021	.021
2.3	.131	.074	.052	.041	.035	.031	.027	.025	.023	.022	.021	.020	.019	.018	.018	.018	.017	.017
2.4	.126	.069	.048	.037	.031	.027	.024	.022	.020	.019	.018	.017	.016	.015	.015	.014	.014	.014
2.5	.121	.065	.044	.033	.027	.023	.020	.018	.017	.016	.015	.014	.013	.012	.012	.012	.011	.011
2.6	.117	.061	.040	.030	.024	.020	.018	.016	.014	.013	.012	.012	.011	.010	.010	.010	.009	.009
2.7	.113	.057	.037	.027	.021	.018	.015	.014	.012	.011	.010	.010	.009	.008	.008	.008	.008	.007
2.8	.109	.054	.034	.024	.019	.016	.013	.012	.010	.009	.009	.008	.008	.007	.007	.006	.006	.006
2.9	.106	.051	.031	.022	.017	.014	.011	.010	.009	.008	.007	.007	.006	.005	.005	.005	.005	.005
3.0	.102	.048	.029	.020	.015	.012	.010	.009	.007	.007	.006	.006	.005	.004	.004	.004	.004	.004
3.1	.099	.045	.027	.018	.013	.011	.009	.007	.006	.006	.005	.005	.004	.004	.004	.003	.003	.003
3.2	.096	.043	.025	.016	.012	.009	.008	.006	.005	.005	.004	.004	.003	.003	.003	.003	.003	.002
3.3	.094	.040	.023	.015	.011	.008	.007	.005	.005	.004	.004	.003	.003	.002	.002	.002	.002	.002
3.4	.091	.038	.021	.014	.010	.007	.006	.005	.004	.003	.003	.002	.002	.002	.002	.002	.002	.002
3.5	.089	.036	.020	.012	.009	.006	.005	.004	.003	.003	.002	.002	.002	.002	.002	.001	.001	.001
3.6	.086	.035	.018	.011	.008	.006	.004	.004	.003	.002	.002	.002	.002	.001	.001	.001	.001	.001
3.7	.084	.033	.017	.010	.007	.005	.004	.003	.002	.002	.002	.002	.001	.001	.001	.001	.001	.001
3.8	.082	.031	.016	.010	.006	.004	.003	.003	.002	.002	.001	.001	.001	.001	.001	.001	.001	.001
3.9	.080	.030	.015	.009	.006	.004	.003	.002	.002	.001	.001	.001	.001	.001	.001	.001	.001	.001
4.0	.078	.029	.014	.008	.005	.004	.003	.002	.002	.001	.001	.001	.001	.001	.001	.001	.000	.000

(continued)

Table A.8 t Curve Tail Areas (cont.)



t \ ν	19	20	21	22	23	24	25	26	27	28	29	30	35	40	60	120	∞(= z)
0.0	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500	.500
0.1	.461	.461	.461	.461	.461	.461	.461	.461	.461	.461	.461	.461	.460	.460	.460	.460	.460
0.2	.422	.422	.422	.422	.422	.422	.422	.422	.421	.421	.421	.421	.421	.421	.421	.421	.421
0.3	.384	.384	.384	.383	.383	.383	.383	.383	.383	.383	.383	.383	.383	.383	.383	.382	.382
0.4	.347	.347	.347	.347	.346	.346	.346	.346	.346	.346	.346	.346	.346	.346	.345	.345	.345
0.5	.311	.311	.311	.311	.311	.311	.311	.311	.311	.310	.310	.310	.310	.310	.309	.309	.309
0.6	.278	.278	.278	.277	.277	.277	.277	.277	.277	.277	.277	.277	.276	.276	.275	.275	.274
0.7	.246	.246	.246	.246	.245	.245	.245	.245	.245	.245	.245	.245	.244	.244	.243	.243	.242
0.8	.217	.217	.216	.216	.216	.216	.216	.215	.215	.215	.215	.215	.215	.214	.213	.213	.212
0.9	.190	.189	.189	.189	.189	.189	.188	.188	.188	.188	.188	.188	.187	.187	.186	.185	.184
1.0	.165	.165	.164	.164	.164	.164	.163	.163	.163	.163	.163	.163	.162	.162	.161	.160	.159
1.1	.143	.142	.142	.142	.141	.141	.141	.141	.141	.140	.140	.140	.139	.139	.138	.137	.136
1.2	.122	.122	.122	.121	.121	.121	.121	.120	.120	.120	.120	.120	.119	.119	.117	.116	.115
1.3	.105	.104	.104	.104	.103	.103	.103	.103	.102	.102	.102	.102	.101	.101	.099	.098	.097
1.4	.089	.089	.088	.088	.087	.087	.087	.087	.086	.086	.086	.086	.085	.085	.083	.082	.081
1.5	.075	.075	.074	.074	.074	.073	.073	.073	.073	.072	.072	.072	.071	.071	.069	.068	.067
1.6	.063	.063	.062	.062	.062	.061	.061	.061	.061	.060	.060	.060	.059	.059	.057	.056	.055
1.7	.053	.052	.052	.052	.051	.051	.051	.051	.050	.050	.050	.050	.049	.048	.047	.046	.045
1.8	.044	.043	.043	.043	.042	.042	.042	.042	.042	.041	.041	.041	.040	.040	.038	.037	.036
1.9	.036	.036	.036	.035	.035	.035	.035	.034	.034	.034	.034	.034	.033	.032	.031	.030	.029
2.0	.030	.030	.029	.029	.029	.028	.028	.028	.028	.028	.027	.027	.027	.026	.025	.024	.023
2.1	.025	.024	.024	.024	.023	.023	.023	.023	.023	.022	.022	.022	.022	.021	.020	.019	.018
2.2	.020	.020	.020	.019	.019	.019	.019	.018	.018	.018	.018	.018	.017	.017	.016	.015	.014
2.3	.016	.016	.016	.016	.015	.015	.015	.015	.015	.015	.014	.014	.014	.013	.012	.012	.011
2.4	.013	.013	.013	.013	.012	.012	.012	.012	.012	.012	.012	.011	.011	.011	.010	.009	.008
2.5	.011	.011	.010	.010	.010	.010	.010	.010	.009	.009	.009	.009	.009	.008	.008	.007	.006
2.6	.009	.009	.008	.008	.008	.008	.008	.008	.007	.007	.007	.007	.007	.007	.006	.005	.005
2.7	.007	.007	.007	.007	.006	.006	.006	.006	.006	.006	.006	.006	.005	.005	.004	.004	.003
2.8	.006	.006	.005	.005	.005	.005	.005	.005	.005	.005	.005	.004	.004	.004	.003	.003	.003
2.9	.005	.004	.004	.004	.004	.004	.004	.004	.004	.004	.004	.003	.003	.003	.003	.002	.002
3.0	.004	.004	.003	.003	.003	.003	.003	.003	.003	.003	.003	.003	.002	.002	.002	.002	.001
3.1	.003	.003	.003	.003	.003	.002	.002	.002	.002	.002	.002	.002	.002	.002	.001	.001	.001
3.2	.002	.002	.002	.002	.002	.002	.002	.002	.002	.002	.002	.002	.001	.001	.001	.001	.001
3.3	.002	.002	.002	.002	.002	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.000
3.4	.002	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.000	.000
3.5	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.000	.000	.000
3.6	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.000	.000	.000	.000	.000
3.7	.001	.001	.001	.001	.001	.001	.001	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000
3.8	.001	.001	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
3.9	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
4.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000

Table A.9 Critical Values for F Distributions

ν_1 = numerator df; ν_2 = denominator df

ν_2	α	1	2	3	4	5	6	7	8	9
1	.100	39.86	49.50	53.59	55.83	57.24	58.20	58.91	59.44	59.86
	.050	161.45	199.50	215.71	224.58	230.16	233.99	236.77	238.88	240.54
	.010	4052.2	4999.5	5403.4	5624.6	5763.6	5859.0	5928.4	5981.1	6022.5
	.001	405284	500000	540379	562500	576405	585937	592873	598144	602284
2	.100	8.53	9.00	9.16	9.24	9.29	9.33	9.35	9.37	9.38
	.050	18.51	19.00	19.16	19.25	19.30	19.33	19.35	19.37	19.38
	.010	98.50	99.00	99.17	99.25	99.30	99.33	99.36	99.37	99.39
	.001	998.50	999.00	999.17	999.25	999.30	999.33	999.36	999.37	999.39
3	.100	5.54	5.46	5.39	5.34	5.31	5.28	5.27	5.25	5.24
	.050	10.13	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81
	.010	34.12	30.82	29.46	28.71	28.24	27.91	27.67	27.49	27.35
	.001	167.03	148.50	141.11	137.10	134.58	132.85	131.58	130.62	129.86
4	.100	4.54	4.32	4.19	4.11	4.05	4.01	3.98	3.95	3.94
	.050	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00
	.010	21.20	18.00	16.69	15.98	15.52	15.21	14.98	14.80	14.66
	.001	74.14	61.25	56.18	53.44	51.71	50.53	49.66	49.00	48.47
5	.100	4.06	3.78	3.62	3.52	3.45	3.40	3.37	3.34	3.32
	.050	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77
	.010	16.26	13.27	12.06	11.39	10.97	10.67	10.46	10.29	10.16
	.001	47.18	37.12	33.20	31.09	29.75	28.83	28.16	27.65	27.24
6	.100	3.78	3.46	3.29	3.18	3.11	3.05	3.01	2.98	2.96
	.050	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10
	.010	13.75	10.92	9.78	9.15	8.75	8.47	8.26	8.10	7.98
	.001	35.51	27.00	23.70	21.92	20.80	20.03	19.46	19.03	18.69
7	.100	3.59	3.26	3.07	2.96	2.88	2.83	2.78	2.75	2.72
	.050	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68
	.010	12.25	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72
	.001	29.25	21.69	18.77	17.20	16.21	15.52	15.02	14.63	14.33
8	.100	3.46	3.11	2.92	2.81	2.73	2.67	2.62	2.59	2.56
	.050	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39
	.010	11.26	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91
	.001	25.41	18.49	15.83	14.39	13.48	12.86	12.40	12.05	11.77
9	.100	3.36	3.01	2.81	2.69	2.61	2.55	2.51	2.47	2.44
	.050	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18
	.010	10.56	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35
	.001	22.86	16.39	13.90	12.56	11.71	11.13	10.70	10.37	10.11
10	.100	3.29	2.92	2.73	2.61	2.52	2.46	2.41	2.38	2.35
	.050	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02
	.010	10.04	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94
	.001	21.04	14.91	12.55	11.28	10.48	9.93	9.52	9.20	8.96
11	.100	3.23	2.86	2.66	2.54	2.45	2.39	2.34	2.30	2.27
	.050	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90
	.010	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63
	.001	19.69	13.81	11.56	10.35	9.58	9.05	8.66	8.35	8.12
12	.100	3.18	2.81	2.61	2.48	2.39	2.33	2.28	2.24	2.21
	.050	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80
	.010	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39
	.001	18.64	12.97	10.80	9.63	8.89	8.38	8.00	7.71	7.48

(continued)

Critical Values for F Distributions (cont.)

ν_1 = numerator df

ν_2	α	10	12	15	20	25	30	40	50	60	120	1000
1	.100	60.19	60.71	61.22	61.74	62.05	62.26	62.53	62.69	62.79	63.06	63.3
	.050	241.88	243.91	245.95	248.01	249.26	250.10	251.14	251.77	252.20	253.25	254.1
	.010	6055.8	6106.3	6157.3	6208.7	6239.8	6260.6	6286.8	6302.5	6313.0	6339.4	6362.7
	.001	605621	610668	615764	620908	624017	626099	628712	630285	631337	633972	63630
2	.100	9.39	9.41	9.42	9.44	9.45	9.46	9.47	9.47	9.47	9.48	9.4
	.050	19.40	19.41	19.43	19.45	19.46	19.46	19.47	19.48	19.48	19.49	19.4
	.010	99.40	99.42	99.43	99.45	99.46	99.47	99.47	99.48	99.48	99.49	99.5
	.001	999.40	999.42	999.43	999.45	999.46	999.47	999.47	999.48	999.48	999.49	999.5
3	.100	5.23	5.22	5.20	5.18	5.17	5.17	5.16	5.15	5.15	5.14	5.1
	.050	8.79	8.74	8.70	8.66	8.63	8.62	8.59	8.58	8.57	8.55	8.5
	.010	27.23	27.05	26.87	26.69	26.58	26.50	26.41	26.35	26.32	26.22	26.1
	.001	129.25	128.32	127.37	126.42	125.84	125.45	124.96	124.66	124.47	123.97	123.5
4	.100	3.92	3.90	3.87	3.84	3.83	3.82	3.80	3.80	3.79	3.78	3.7
	.050	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.70	5.69	5.66	5.6
	.010	14.55	14.37	14.20	14.02	13.91	13.84	13.75	13.69	13.65	13.56	13.4
	.001	48.05	47.41	46.76	46.10	45.70	45.43	45.09	44.88	44.75	44.40	44.0
5	.100	3.30	3.27	3.24	3.21	3.19	3.17	3.16	3.15	3.14	3.12	3.1
	.050	4.74	4.68	4.62	4.56	4.52	4.50	4.46	4.44	4.43	4.40	4.3
	.010	10.05	9.89	9.72	9.55	9.45	9.38	9.29	9.24	9.20	9.11	9.0
	.001	26.92	26.42	25.91	25.39	25.08	24.87	24.60	24.44	24.33	24.06	23.8
6	.100	2.94	2.90	2.87	2.84	2.81	2.80	2.78	2.77	2.76	2.74	2.7
	.050	4.06	4.00	3.94	3.87	3.83	3.81	3.77	3.75	3.74	3.70	3.6
	.010	7.87	7.72	7.56	7.40	7.30	7.23	7.14	7.09	7.06	6.97	6.8
	.001	18.41	17.99	17.56	17.12	16.85	16.67	16.44	16.31	16.21	15.98	15.7
7	.100	2.70	2.67	2.63	2.59	2.57	2.56	2.54	2.52	2.51	2.49	2.4
	.050	3.64	3.57	3.51	3.44	3.40	3.38	3.34	3.32	3.30	3.27	3.2
	.010	6.62	6.47	6.31	6.16	6.06	5.99	5.91	5.86	5.82	5.74	5.6
	.001	14.08	13.71	13.32	12.93	12.69	12.53	12.33	12.20	12.12	11.91	11.7
8	.100	2.54	2.50	2.46	2.42	2.40	2.38	2.36	2.35	2.34	2.32	2.3
	.050	3.35	3.28	3.22	3.15	3.11	3.08	3.04	3.02	3.01	2.97	2.9
	.010	5.81	5.67	5.52	5.36	5.26	5.20	5.12	5.07	5.03	4.95	4.8
	.001	11.54	11.19	10.84	10.48	10.26	10.11	9.92	9.80	9.73	9.53	9.3
9	.100	2.42	2.38	2.34	2.30	2.27	2.25	2.23	2.22	2.21	2.18	2.1
	.050	3.14	3.07	3.01	2.94	2.89	2.86	2.83	2.80	2.79	2.75	2.71
	.010	5.26	5.11	4.96	4.81	4.71	4.65	4.57	4.52	4.48	4.40	4.32
	.001	9.89	9.57	9.24	8.90	8.69	8.55	8.37	8.26	8.19	8.00	7.84
10	.100	2.32	2.28	2.24	2.20	2.17	2.16	2.13	2.12	2.11	2.08	2.06
	.050	2.98	2.91	2.85	2.77	2.73	2.70	2.66	2.64	2.62	2.58	2.54
	.010	4.85	4.71	4.56	4.41	4.31	4.25	4.17	4.12	4.08	4.00	3.92
	.001	8.75	8.45	8.13	7.80	7.60	7.47	7.30	7.19	7.12	6.94	6.78
11	.100	2.25	2.21	2.17	2.12	2.10	2.08	2.05	2.04	2.03	2.00	1.98
	.050	2.85	2.79	2.72	2.65	2.60	2.57	2.53	2.51	2.49	2.45	2.41
	.010	4.54	4.40	4.25	4.10	4.01	3.94	3.86	3.81	3.78	3.69	3.61
	.001	7.92	7.63	7.32	7.01	6.81	6.68	6.52	6.42	6.35	6.18	6.02
12	.100	2.19	2.15	2.10	2.06	2.03	2.01	1.99	1.97	1.96	1.93	1.91
	.050	2.75	2.69	2.62	2.54	2.50	2.47	2.43	2.40	2.38	2.34	2.30
	.010	4.30	4.16	4.01	3.86	3.76	3.70	3.62	3.57	3.54	3.45	3.37
	.001	7.29	7.00	6.71	6.40	6.22	6.09	5.93	5.83	5.76	5.59	5.44

(continued)

Critical Values for F Distributions (cont.)

ν_2 = denominator df

ν_2	α	1	2	3	4	5	6	7	8	9
		ν_1 = numerator df								
13	.100	3.14	2.76	2.56	2.43	2.35	2.28	2.23	2.20	2.16
	.050	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71
	.010	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19
	.001	17.82	12.31	10.21	9.07	8.35	7.86	7.49	7.21	6.98
14	.100	3.10	2.73	2.52	2.39	2.31	2.24	2.19	2.15	2.12
	.050	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65
	.010	8.86	6.51	5.56	5.04	4.60	4.46	4.28	4.14	4.03
	.001	17.14	11.78	9.73	8.62	7.92	7.44	7.08	6.80	6.58
15	.100	3.07	2.70	2.49	2.36	2.27	2.21	2.16	2.12	2.09
	.050	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59
	.010	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89
	.001	16.59	11.34	9.34	8.25	7.57	7.09	6.74	6.47	6.26
16	.100	3.05	2.67	2.46	2.33	2.24	2.18	2.13	2.09	2.06
	.050	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54
	.010	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78
	.001	16.12	10.97	9.01	7.94	7.27	6.80	6.46	6.19	5.98
17	.100	3.03	2.64	2.44	2.31	2.22	2.15	2.10	2.06	2.03
	.050	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49
	.010	8.40	6.11	5.19	4.67	4.34	4.10	3.93	3.79	3.68
	.001	15.72	10.66	8.73	7.68	7.02	6.56	6.22	5.96	5.75
18	.100	3.01	2.62	2.42	2.29	2.20	2.13	2.08	2.04	2.00
	.050	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46
	.010	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71	3.60
	.001	15.38	10.39	8.49	7.46	6.81	6.35	6.02	5.76	5.56
19	.100	2.99	2.61	2.40	2.27	2.18	2.11	2.06	2.02	1.98
	.050	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42
	.010	8.18	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52
	.001	15.08	10.16	8.28	7.27	6.62	6.18	5.85	5.59	5.39
20	.100	2.97	2.59	2.38	2.25	2.16	2.09	2.04	2.00	1.96
	.050	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39
	.010	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46
	.001	14.82	9.95	8.10	7.10	6.46	6.02	5.69	5.44	5.24
21	.100	2.96	2.57	2.36	2.23	2.14	2.08	2.02	1.98	1.95
	.050	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37
	.010	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51	3.40
	.001	14.59	9.77	7.94	6.95	6.32	5.88	5.56	5.31	5.11
22	.100	2.95	2.56	2.35	2.22	2.13	2.06	2.01	1.97	1.93
	.050	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34
	.010	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35
	.001	14.38	9.61	7.80	6.81	6.19	5.76	5.44	5.19	4.99
23	.100	2.94	2.55	2.34	2.21	2.11	2.05	1.99	1.95	1.92
	.050	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32
	.010	7.88	5.66	4.76	4.26	3.94	3.71	3.54	3.41	3.30
	.001	14.20	9.47	7.67	6.70	6.08	5.65	5.33	5.09	4.89
24	.100	2.93	2.54	2.33	2.19	2.10	2.04	1.98	1.94	1.91
	.050	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30
	.010	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26
	.001	14.03	9.34	7.55	6.59	5.98	5.55	5.23	4.99	4.80

(continued)

Table A.9 Critical Values for F Distributions (cont.)

10	12	15	20	25	30	40	50	60	120	1000
ν_1 = numerator df										
2.14	2.10	2.05	2.01	1.98	1.96	1.93	1.92	1.90	[illegible]	[illegible]
2.67	2.60	2.53	2.46	2.41	2.38	2.34	2.31	2.30	[illegible]	[illegible]
4.10	3.96	3.82	3.66	3.57	3.51	3.43	3.38	3.34	[illegible]	[illegible]
6.80	6.52	6.23	5.93	5.75	5.63	5.47	5.37	5.30	[illegible]	[illegible]
2.10	2.05	2.01	1.96	1.93	1.91	1.89	1.87	1.86	[illegible]	[illegible]
2.60	2.53	2.46	2.39	2.34	2.31	2.27	2.24	2.22	[illegible]	[illegible]
3.94	3.80	3.66	3.51	3.41	3.35	3.27	3.22	3.18	[illegible]	[illegible]
6.40	6.13	5.85	5.56	5.38	5.25	5.10	5.00	4.94	[illegible]	[illegible]
2.06	2.02	1.97	1.92	1.89	1.87	1.85	1.83	1.82	[illegible]	[illegible]
2.54	2.48	2.40	2.33	2.28	2.25	2.20	2.18	2.16	[illegible]	[illegible]
3.80	3.67	3.52	3.37	3.28	3.21	3.13	3.08	3.05	[illegible]	[illegible]
6.08	5.81	5.54	5.25	5.07	4.95	4.80	4.70	4.64	[illegible]	[illegible]
2.03	1.99	1.94	1.89	1.86	1.84	1.81	1.79	1.78	[illegible]	[illegible]
2.49	2.42	2.35	2.28	2.23	2.19	2.15	2.12	2.11	[illegible]	[illegible]
3.69	3.55	3.41	3.26	3.16	3.10	3.02	2.97	2.93	[illegible]	[illegible]
5.81	5.55	5.27	4.99	4.82	4.70	4.54	4.45	4.39	[illegible]	[illegible]
2.00	1.96	1.91	1.86	1.83	1.81	1.78	1.76	1.75	[illegible]	[illegible]
2.45	2.38	2.31	2.23	2.18	2.15	2.10	2.08	2.06	[illegible]	[illegible]
3.59	3.46	3.31	3.16	3.07	3.00	2.92	2.87	2.83	[illegible]	[illegible]
5.58	5.32	5.05	4.78	4.60	4.48	4.33	4.24	4.18	[illegible]	[illegible]
1.98	1.93	1.89	1.84	1.80	1.78	1.75	1.74	1.72	[illegible]	[illegible]
2.41	2.34	2.27	2.19	2.14	2.11	2.06	2.04	2.02	[illegible]	[illegible]
3.51	3.37	3.23	3.08	2.98	2.92	2.84	2.78	2.75	[illegible]	[illegible]
5.39	5.13	4.87	4.59	4.42	4.30	4.15	4.06	4.00	[illegible]	[illegible]
1.96	1.91	1.86	1.81	1.78	1.76	1.73	1.71	1.70	[illegible]	[illegible]
2.38	2.31	2.23	2.16	2.11	2.07	2.03	2.00	1.98	[illegible]	[illegible]
3.43	3.30	3.15	3.00	2.91	2.84	2.76	2.71	2.67	[illegible]	[illegible]
5.22	4.97	4.70	4.43	4.26	4.14	3.99	3.90	3.84	[illegible]	[illegible]
1.94	1.89	1.84	1.79	1.76	1.74	1.71	1.69	1.68	[illegible]	[illegible]
2.35	2.28	2.20	2.12	2.07	2.04	1.99	1.97	1.95	[illegible]	[illegible]
3.37	3.23	3.09	2.94	2.84	2.78	2.69	2.64	2.61	2.52	[illegible]
5.08	4.82	4.56	4.29	4.12	4.00	3.86	3.77	3.70	[illegible]	[illegible]
1.92	1.87	1.83	1.78	1.74	1.72	1.69	1.67	1.66	[illegible]	[illegible]
2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.94	1.92	[illegible]	[illegible]
3.31	3.17	3.03	2.88	2.79	2.72	2.64	2.58	2.55	2.46	[illegible]
4.95	4.70	4.44	4.17	4.00	3.88	3.74	3.64	3.58	3.42	[illegible]
1.90	1.86	1.81	1.76	1.73	1.70	1.67	1.65	1.64	[illegible]	[illegible]
2.30	2.23	2.15	2.07	2.02	1.98	1.94	1.91	1.89	[illegible]	[illegible]
3.26	3.12	2.98	2.83	2.73	2.67	2.58	2.53	2.50	[illegible]	[illegible]
4.83	4.58	4.33	4.06	3.89	3.78	3.63	3.54	3.48	[illegible]	[illegible]
1.89	1.84	1.80	1.74	1.71	1.69	1.66	1.64	1.62	[illegible]	[illegible]
2.27	2.20	2.13	2.05	2.00	1.96	1.91	1.88	1.86	[illegible]	[illegible]
3.21	3.07	2.93	2.78	2.69	2.62	2.54	2.48	2.45	[illegible]	[illegible]
4.73	4.48	4.23	3.96	3.79	3.68	3.53	3.44	3.38	[illegible]	[illegible]
1.88	1.83	1.78	1.73	1.70	1.67	1.64	1.62	1.61	[illegible]	[illegible]
2.25	2.18	2.11	2.03	1.97	1.94	1.89	1.86	1.84	[illegible]	[illegible]
3.17	3.03	2.89	2.74	2.64	2.58	2.49	2.44	2.40	[illegible]	[illegible]
4.64	4.39	4.14	3.87	3.71	3.59	3.45	3.36	3.29	[illegible]	[illegible]

(continued)

Table A.9 Critical Values for F Distributions (cont.)

ν_2 = denominator df	α	ν_1 = numerator df: 1	2	3	4	5	6	7	8	9
25	.100	2.92	2.53	2.32	2.18	2.09	2.02	1.97	1.93	1.89
	.050	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28
	.010	7.77	5.57	4.68	4.18	3.85	3.63	3.46	3.32	3.22
	.001	13.88	9.22	7.45	6.49	5.89	5.46	5.15	4.91	4.71
26	.100	2.91	2.52	2.31	2.17	2.08	2.01	1.96	1.92	1.88
	.050	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27
	.010	7.72	5.53	4.64	4.14	3.82	3.59	3.42	3.29	3.18
	.001	13.74	9.12	7.36	6.41	5.80	5.38	5.07	4.83	4.64
27	.100	2.90	2.51	2.30	2.17	2.07	2.00	1.95	1.91	1.87
	.050	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25
	.010	7.68	5.49	4.60	4.11	3.78	3.56	3.39	3.26	3.15
	.001	13.61	9.02	7.27	6.33	5.73	5.31	5.00	4.76	4.57
28	.100	2.89	2.50	2.29	2.16	2.06	2.00	1.94	1.90	1.87
	.050	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24
	.010	7.64	5.45	4.57	4.07	3.75	3.53	3.36	3.23	3.12
	.001	13.50	8.93	7.19	6.25	5.66	5.24	4.93	4.69	4.50
29	.100	2.89	2.50	2.28	2.15	2.06	1.99	1.93	1.89	1.86
	.050	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22
	.010	7.60	5.42	4.54	4.04	3.73	3.50	3.33	3.20	3.09
	.001	13.39	8.85	7.12	6.19	5.59	5.18	4.87	4.64	4.45
30	.100	2.88	2.49	2.28	2.14	2.05	1.98	1.93	1.88	1.85
	.050	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21
	.010	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07
	.001	13.29	8.77	7.05	6.12	5.53	5.12	4.82	4.58	4.39
40	.100	2.84	2.44	2.23	2.09	2.00	1.93	1.87	1.83	1.79
	.050	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12
	.010	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.89
	.001	12.61	8.25	6.59	5.70	5.13	4.73	4.44	4.21	4.02
50	.100	2.81	2.41	2.20	2.06	1.97	1.90	1.84	1.80	1.76
	.050	4.03	3.18	2.79	2.56	2.40	2.29	2.20	2.13	2.07
	.010	7.17	5.06	4.20	3.72	3.41	3.19	3.02	2.89	2.78
	.001	12.22	7.96	6.34	5.46	4.90	4.51	4.22	4.00	3.82
60	.100	2.79	2.39	2.18	2.04	1.95	1.87	1.82	1.77	1.74
	.050	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04
	.010	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72
	.001	11.97	7.77	6.17	5.31	4.76	4.37	4.09	3.86	3.69
100	.100	2.76	2.36	2.14	2.00	1.91	1.83	1.78	1.73	1.69
	.050	3.94	3.09	2.70	2.46	2.31	2.19	2.10	2.03	1.97
	.010	6.90	4.82	3.98	3.51	3.21	2.99	2.82	2.69	2.59
	.001	11.50	7.41	5.86	5.02	4.48	4.11	3.83	3.61	3.44
200	.100	2.73	2.33	2.11	1.97	1.88	1.80	1.75	1.70	1.66
	.050	3.89	3.04	2.65	2.42	2.26	2.14	2.06	1.98	1.93
	.010	6.76	4.71	3.88	3.41	3.11	2.89	2.73	2.60	2.50
	.001	11.15	7.15	5.63	4.81	4.29	3.92	3.65	3.43	3.26
1000	.100	2.71	2.31	2.09	1.95	1.85	1.78	1.72	1.68	1.64
	.050	3.85	3.00	2.61	2.38	2.22	2.11	2.02	1.95	1.89
	.010	6.66	4.63	3.80	3.34	3.04	2.82	2.66	2.53	2.43
	.001	10.89	6.96	5.46	4.65	4.14	3.78	3.51	3.30	3.13

(continued)

Table A.9 Critical Values for F Distributions (cont.)

ν_1 = numerator df: 10	12	15	20	25	30	40	50	60	120	1000
1.87	1.82	1.77	1.72	1.68	1.66	1.63	1.61	1.59	1.56	1.52
2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.84	1.82	1.77	1.72
3.13	2.99	2.85	2.70	2.60	2.54	2.45	2.40	2.36	2.27	2.18
4.56	4.31	4.06	3.79	3.63	3.52	3.37	3.28	3.22	3.06	2.91
1.86	1.81	1.76	1.71	1.67	1.65	1.61	1.59	1.58	1.54	1.51
2.22	2.15	2.07	1.99	1.94	1.90	1.85	1.82	1.80	1.75	1.70
3.09	2.96	2.81	2.66	2.57	2.50	2.42	2.36	2.33	2.23	2.14
4.48	4.24	3.99	3.72	3.56	3.44	3.30	3.21	3.15	2.99	2.84
1.85	1.80	1.75	1.70	1.66	1.64	1.60	1.58	1.57	1.53	1.50
2.20	2.13	2.06	1.97	1.92	1.88	1.84	1.81	1.79	1.73	1.68
3.05	2.93	2.78	2.63	2.54	2.47	2.33	2.33	2.29	2.20	2.11
4.41	4.17	3.92	3.66	3.49	3.38	3.23	3.14	3.08	2.92	2.78
1.84	1.79	1.74	1.69	1.66	1.63	1.59	1.57	1.56	1.52	1.48
2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.79	1.77	1.71	1.66
3.03	2.90	2.75	2.60	2.51	2.44	2.35	2.30	2.26	2.17	2.08
4.35	4.11	3.86	3.60	3.43	3.32	3.18	3.09	3.02	2.86	2.72
1.83	1.78	1.73	1.68	1.64	1.62	1.58	1.56	1.55	1.51	1.47
2.18	2.10	2.03	1.94	1.89	1.85	1.81	1.77	1.75	1.70	1.65
3.00	2.87	2.73	2.57	2.48	2.41	2.33	2.27	2.23	2.14	2.05
4.29	4.05	3.80	3.54	3.38	3.27	3.12	3.03	2.97	2.81	2.66
1.82	1.77	1.72	1.67	1.63	1.61	1.57	1.55	1.54	1.50	1.46
2.16	2.09	2.01	1.93	1.88	1.84	1.79	1.76	1.74	1.68	1.63
2.98	2.84	2.70	2.55	2.45	2.39	2.30	2.25	2.21	2.11	2.02
4.24	4.00	3.75	3.49	3.33	3.22	3.07	2.98	2.92	2.76	2.61
1.76	1.71	1.66	1.61	1.57	1.54	1.51	1.48	1.47	1.42	1.38
2.08	2.00	1.92	1.84	1.78	1.74	1.69	1.66	1.64	1.58	1.52
2.80	2.66	2.52	2.37	2.27	2.20	2.11	2.06	2.02	1.92	1.82
3.87	3.64	3.40	3.14	2.98	2.87	2.73	2.64	2.57	2.41	2.25
1.73	1.68	1.63	1.57	1.53	1.50	1.46	1.44	1.42	1.38	1.33
2.03	1.95	1.87	1.78	1.73	1.69	1.63	1.60	1.58	1.51	1.45
2.70	2.56	2.42	2.27	2.17	2.10	2.01	1.95	1.91	1.80	1.70
3.67	3.44	3.20	2.95	2.79	2.68	2.53	2.44	2.38	2.21	2.05
1.71	1.66	1.60	1.54	1.50	1.48	1.44	1.41	1.40	1.35	1.30
1.99	1.92	1.84	1.75	1.69	1.65	1.59	1.56	1.53	1.47	1.40
2.63	2.50	2.35	2.20	2.10	2.03	1.94	1.88	1.84	1.73	1.62
3.54	3.32	3.08	2.83	2.67	2.55	2.41	2.32	2.25	2.08	1.92
1.66	1.61	1.56	1.49	1.45	1.42	1.38	1.35	1.34	1.28	1.22
1.93	1.85	1.77	1.68	1.62	1.57	1.52	1.48	1.45	1.38	1.30
2.50	2.37	2.22	2.07	1.97	1.89	1.80	1.74	1.69	1.57	1.45
3.30	3.07	2.84	2.59	2.43	2.32	2.17	2.08	2.01	1.83	1.64
1.63	1.58	1.52	1.46	1.41	1.38	1.34	1.31	1.29	1.23	1.16
1.88	1.80	1.72	1.62	1.56	1.52	1.46	1.41	1.39	1.30	1.21
2.41	2.27	2.13	1.97	1.87	1.79	1.69	1.63	1.58	1.45	1.30
3.12	2.90	2.67	2.42	2.26	2.15	2.00	1.90	1.83	1.64	1.43
1.61	1.55	1.49	1.43	1.38	1.35	1.30	1.27	1.25	1.18	1.08
1.84	1.76	1.68	1.58	1.52	1.47	1.41	1.36	1.33	1.24	1.11
2.34	2.20	2.06	1.90	1.79	1.72	1.61	1.54	1.50	1.35	1.16
2.99	2.77	2.54	2.30	2.14	2.02	1.87	1.77	1.69	1.49	1.22