Index No.:_____

UNIVERSITI SAINS MALAYSIA

Final Examination
2015/2016 Academic Session

May/June 2016

JKE 316E – Quantitative Economics
[Ekonomi Kuantitatif]

Time: 3 hours
[Masa: 3 jam]

Please ensure that this examination paper comprises of **TWENTY ONE** printed pages, including Appendix A (Formulae) and Appendix B (Z, t and F distribution tables), before you begin the examination.

Answer **ALL** questions in Section A and **FOUR** other questions from Section B. You may answer the question either in Bahasa Malaysia or in English. Unprogrammable scientific calculator can be used for computation.

All questions must be answered in the answer book.

Questions paper must be returned together with your answer book.

In the event of any discrepancies, the English version shall be used.

*Sila pastikan bahawa kertas peperiksaan ini mengandungi **DUA PULUH SATU** muka surat yang bercetak, termasuklah Lampiran A (Formula) dan Lampiran B (Jadual taburan Z, t dan F), sebelum anda memulakan peperiksaan ini.*

*Jawab **SEMUA** soalan dari Bahagian A dan **EMPAT** soalan lain dari Bahagian B. Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris. Alat pengiraan elektronik tak berprogram boleh digunakan untuk tujuan pengiraan.*

Semua soalan mesti dijawab dalam buku jawapan.

Kertas soalan mesti diserahkan bersama buku jawapan anda.

Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.

Section A (Question 1: 20 marks)
***Bahagian A (Soalan 1: 20 markah*)**

1. Which of the following probabilities is equal to the significance level, α?
Manakah antara kebarangkalian berikut adalah bersamaan dengan aras keertian, α?

A. Probability of making a Type I error.
Kebarangkalian melakukan ralat Jenis I.
B. Probability of making a Type II error.
Kebarangkalian melakukan ralat Jenis II.
C. Probability of rejecting H_0 when you are supposed to.
Kebarangkalian menolak H_0 apabila anda sepatutnya menolak H_0.
D. Probability of not rejecting H_0 when you shouldn't.
Kebarangkalian gagal menolak H_0 apabila anda tidak sepatutnya menolak H_0.

2. A guy suspects that the average amount of money given as Chinese New Year angpow for immediate family members is above RM1,200. The correct set of hypotheses is _____.
Seorang lelaki mengesyaki bahawa purata jumlah wang yang dibelanjakan untuk pemberian angpow Tahun Baru Cina bagi ahli keluarga terdekat adalah melebihi RM1,200. Set hipotesis yang betul adalah _____.

A. $H_0: \mu = 1200$ vs. $H_1: \mu < 1200$
B. $H_0: \mu > 1200$ vs. $H_1: \mu = 1200$
C. $H_0: \mu = 1200$ vs. $H_1: \mu > 1200$
D. $H_0: \mu < 1200$ vs. $H_1: \mu = 1200$

3. Researchers claim that 40 tissues is the average number of tissues a person uses during the course of a cold. The company which makes XYZ brand tissues thinks that fewer than 40 tissues are needed. What are the null and alternative hypotheses?
Para penyelidik mendakwa bahawa 40 helaian tisu adalah purata bilangan tisu yang digunakan oleh seseorang semasa selesema. Syarikat yang membuat tisu berjenama XYZ berpendapat bahawa kurang daripada 40 tisu diperlukan. Apakah hipotesis nol dan alternatif mereka?

A. $H_0: \mu = 40$ vs. $H_1: \mu > 40$
B. $H_0: \mu = 40$ vs. $H_1: \mu < 40$
C. $H_0: \bar{X} = 40$ vs. $H_1: \bar{X} < 40$
D. $H_0: \mu < 40$ vs. $H_1: \mu = 40$

For both questions 4 and 5:
Untuk kedua-dua soalan 4 dan 5:

Researchers determined that 60 tissues XYZ is the average number of tissues used during a cold. Suppose a random sample of 100 XYZ users yielded the following data on the number of tissues used during a cold: $\bar{x} = 52$ and $s = 22$.
Seorang penyelidik menentukan bahawa 60 tisu berjenama XYZ adalah purata bilangan tisu yang digunakan semasa selesema. Katakan sampel rawak 100 pengguna tisu XYZ menghasilkan data berikut tentang bilangan tisu yang digunakan semasa selesema: $\bar{x} = 52$ dan $s = 22$.

4. Suppose the test statistic does not fall in the rejection region at $\alpha = 0.05$. Which of the following conclusions is CORRECT?
Katakan ujian statistik tidak jatuh dalam kawasan penolakan pada $\alpha = 0.05$. Manakah antara kesimpulan berikut adalah BENAR?

   A. At $\alpha = 0.05$, we do not reject H_0.
   Pada $\alpha = 0.05$, kita gagal menolak H_0.
   B. At $\alpha = 0.05$, we reject H_0.
   Pada $\alpha = 0.05$, kita menolak H_0.
   C. At $\alpha = 0.05$, we accept H_0.
   Pada $\alpha = 0.05$, kita menerima H_0.
   D. Both A and C.
   Kedua-dua A dan C.

5. Suppose the alternative we wanted to test was $H_1: \mu < 60$. The correct rejection region for $\alpha = 0.05$ is _____.
Katakan alternatif yang mahu diuji adalah $H_1: \mu < 60$. Kawasan penolakan yang betul untuk $\alpha = 0.05$ ialah _____.

   A. reject H_0 if $t > 1.6604$
   tolak H_0 jika $t > 1.6604$
   B. reject H_0 if $t < -1.6604$
   tolak H_0 jika $t < -1.6604$
   C. reject H_0 if $t > 1.9842$ or $Z < -1.9842$
   tolak H_0 jika $t > 1.9842$ atau $Z < -1.9842$
   D. reject H_0 if $t < -1.9842$
   tolak H_0 jika $t < -1.9842$

6. In one-way ANOVA, the amount of total variation that is unexplained is measured by the _____.
Untuk kes ANOVA sehala, bahagian daripada jumlah variasi yang tidak dapat dijelaskan diukur melalui _____.

   A. sum of squares for treatments
   jumlah kuasa dua untuk rawatan
   B. degrees of freedom
   darjah kebebasan
   C. total sum of squares
   jumlah hasil tambah kuasa dua
   D. sum of squares for error
   hasil tambah kuasa dua ralat

7. Which of the following is NOT a required condition for one-way ANOVA?
Manakah antara berikut BUKAN keadaan yang diperlukan untuk ANOVA sehala?

   A. All population means are equal.
   Semua min populasi adalah sama.
   B. All population means differ.
   Semua min populasi adalah berbeza.
   C. At least two population means are equal.
   Sekurang-kurangnya dua min populasi adalah sama.
   D. At least two population means differ.
   Sekurang-kurangnya dua min populasi adalah berbeza.

8. A regression analysis between weight (y in kilogram, kg) and height (x in centimeter, cm) resulted in the following least squares line: $\hat{y} = 120 + 5x$. This implies that if the height is increased by 1 cm; the weight, on average, is expected to _____.
Analisis regresi antara berat (y dalam kilogram, kg) dan tinggi (x dalam sentimeter, cm) menghasilkan garis kuasa dua terkecil berikut: $\hat{y} = 120 + 5x$. *Ini menunjukkan bahawa jika tinggi meningkat sebanyak 1 cm; secara purata, berat dijangka _____.*

   A. increase by 1 kg
   meningkat sebanyak 1 kg
   B. decrease by 1 kg
   berkurangan sebanyak 1 kg
   C. increase by 5 kg
   meningkat sebanyak 5 kg
   D. increase by 24 kg
   meningkat sebanyak 24 kg

9. In the simple linear regression model, the *y*-intercept represents the _____.
Dalam model regresi linear mudah, pintasan-y mewakili _____.

A. change in *y* per unit change in *x*
perubahan dalam y untuk setiap unit perubahan dalam x
B. change in *x* per unit change in *y*
perubahan dalam x untuk setiap unit perubahan dalam y
C. value of y when $x = 0$
nilai y apabila x = 0
D. value of *x* when $y = 0$
nilai x apabila y = 0

10. In the simple linear regression model, the slope represents the _____.
Dalam model regresi linear mudah, kecerunan garis mewakili _____.

A. value of *y* when $x = 0$
nilai y apabila x = 0
B. average change in *y* per unit change in *x*
perubahan purata y untuk setiap unit perubahan dalam x
C. value of *x* when $y = 0$
nilai x apabila y = 0
D. average change in *x* per unit change in *y*
perubahan purata x per unit perubahan dalam y

11. Given the least squares regression line $\hat{y} = 2.48 - 1.63x$ and a coefficient of determination of 0.81, the coefficient of correlation is _____.
Diberi garis kuasa dua regresi terkecil $\hat{y} = 2.48 - 1.63x$ *dan pekali penentu = 0.81, pekali korelasi adalah _____.*

A. –0.66
B. 0.81
C. –0.90
D. 0.90

12. The time series component that reflects a long-term, relatively smooth pattern or direction exhibited by a time series over a long time period (more than one year) is called _____.
Komponen siri masa yang menggambarkan tempoh jangka panjang, corak yang agak licin atau arah yang ditunjukkan oleh siri masa untuk tempoh masa yang lama (lebih daripada satu tahun) dipanggil _____.

A. random variation
variasi rawak
B. cyclical variation
variasi kitaran
C. seasonal variation
variasi bermusim
D. long-term trend
trend jangka panjang

13. The distribution of the test statistic for analysis of variance is the _____.
Taburan ujian statistik untuk analisis varians adalah _____.

A. normal distribution
taburan normal
B. student *t*-distribution
taburan t-pelajar
C. *F*-distribution
taburan F
D. None of these choices.
Tiada satupun daripada pilihan di atas.

14. One-way ANOVA is applied to independent samples taken from three normally distributed populations with equal variances. Which of the following is the null hypothesis for this procedure?
ANOVA sehala digunakan untuk sampel bebas yang diambil dari tiga populasi normal dengan varians yang sama. Manakah antara berikut adalah hipotesis nol untuk prosedur ini?

A. $\mu_1 + \mu_2 + \mu_3 = 0$
B. $\mu_1 + \mu_2 + \mu_3 \neq 0$
C. $\mu_1 = \mu_2 = \mu_3 = 0$
D. $\mu_1 = \mu_2 = \mu_3$

15. One-way ANOVA is applied to independent samples taken from four normally distributed populations with equal variances. If the null hypothesis is rejected, then we can infer that _____.
ANOVA sehala digunakan untuk sampel bebas yang diambil daripada empat populasi normal dengan varians yang sama. Jika hipotesis nol ditolak, maka kita boleh membuat kesimpulan bahawa _____.

    A. all population means are equal
    semua min populasi adalah sama
    B. all population means differ
    semua min populasi adalah berbeza
    C. at least two population means are equal
    sekurang-kurangnya dua min populasi adalah sama
    D. at least two population means differ
    sekurang-kurangnya dua min populasi berbeza

16. Which of the four-time series component is more likely to exhibit the changes in stock market prices at particular times during the course of one day?
Manakah antara komponen siri masa yang cenderung untuk mempamerkan perubahan dalam harga pasaran saham pada masa tertentu sepanjang satu hari?

    A. Long-term trend.
    Trend jangka panjang.
    B. Cyclical variation.
    Variasi kitaran.
    C. Seasonal variation.
    Variasi bermusim.
    D. Random variation.
    Variasi rawak.

17. Which of the following techniques is used to predict the value of one variable on the basis of other variables?
Manakah antara teknik berikut yang digunakan untuk meramalkan nilai satu pembolehubah berdasarkan pembolehubah yang lain?

    A. Correlation analysis.
    A*nalisis korelasi.*
    B. Coefficient of correlation
    Pekali korelasi.
    C. Covariance.
    Kovarians.
    D. Regression analysis
    Analisis regresi.

18. Which of the four time series components is more likely to exhibit the relative steady growth of the population of Malaysia from 1957 to 2015?
Manakah antara empat komponen siri masa berikut yang lebih cenderung untuk mempamerkan pertumbuhan yang relatif stabil bagi penduduk Malaysia untuk tempoh 1957-2015?

A. Long-term trend.
Trend jangka panjang.
B. Cyclical variation.
Variasi kitaran.
C. Seasonal variation.
Variasi bermusim.
D. Random variation.
Variasi rawak.

19. The formula $S_t = wy_t + (1 - w)S_{t-1}$ is used in time-series forecasting with exponential smoothing, where S_t is the exponentially smoothed time series at time t, y_t is the value of the time series at time t, and w is the smoothing constant. The forecasted value at time $t + 1$ where $w = 0.4$ is given by _____.
Formula $S_t = wy_t + (1 - w)S_{t-1}$ digunakan dalam peramalan siri masa dengan pelicinan eksponen, di mana S_t ialah siri masa yang telah melalui pelicinan eksponen pada masa t, y_t ialah nilai siri masa pada masa t, dan w adalah nilai pemalar pelicinan. Nilai diramalkan pada masa t + 1 di mana w = 0.4 diberikan oleh _____.

A. $F_{t+1} = 0.4y_{t+1} + 0.6S_{t+1}$
B. $F_{t+1} = 0.4y_t + 0.6S_t$
C. $F_{t+1} = 0.4y_t + 0.6S_{t-1}$
D. $F_{t+1} = 0.4y_{t-1} + 0.6S_t$

20. The effect of an unpredictable event will be contained in which component of the time series?
Manakah antara komponen siri masa berikut yang meliputi kesan yang tidak menentu?

A. Long-term trend.
Trend jangka panjang.
B. Cyclical variation.
Variasi kitaran.
C. Seasonal variation.
Variasi bermusim.
D. Random variation.
Variasi rawak.

Section B: Choose ANY 4 questions (20 marks each).
Bahagian B: Jawab MANA-MANA 4 SOALAN (20 markah setiap satu).

2. A researcher wants to study the average run (in kilometer, km) per day for marathon runners. In testing the hypotheses: H_0: $\mu = 25$ km vs. H_1: $\mu \neq 25$ km, a random sample of 36 marathon runners drawn from a normal population whose standard deviation is 10, produced a mean of 22.8 km weekly.

Seorang penyelidik ingin mengkaji purata larian (kilometer, km) sehari untuk para pelari maraton. Dalam menguji hipotesis: H_0: $\mu = 25$ km vs H_1: $\mu \neq 25$ km, sampel rawak 36 pelari marathon (yang diambil daripada populasi normal dengan sisihan piawai =10) menghasilkan purata larian sebanyak 22.8 km setiap minggu.

(a) Compute the value of the test statistic and specify the rejection region associated with 5% significance level.
Kirakan nilai statistik ujian dan tentukan kawasan penolakan yang berkait dengan aras keertian 5%.

(5 marks/*markah*)

(b) Compute the *p*-value.
Kirakan nilai-p.

(3 marks/*markah*)

(c) What can we conclude at the 5% significance level regarding the null hypothesis?
Apakah yang kita boleh simpulkan pada aras keertian 5% mengenai hipotesis nol?

(5 marks/*markah*)

(d) Develop a 95% confidence interval estimate of the population mean.
Bangunkan anggaran selang keyakinan 95% bagi min populasi.

(4 marks/*markah*)

(e) Explain briefly how to use the confidence interval to test the hypothesis.
Terangkan secara ringkas bagaimana untuk menggunakan selang keyakinan untuk menguji hipotesis.

(3 marks/*markah*)

3. A statistician employed by a television rating service wanted to determine if there were differences in television viewing habits among three different cities in Malaysia. She took a random sample of five adults in each of the cities and asked each to report the number of hours spent watching television in the previous week. The results are shown below. (Assume normal distributions with equal variances.)
Seorang ahli statistik yang berkhidmat dengan syarikat perkhidmatan penarafan televisyen ingin menentukan sama ada terdapat perbezaan tabiat menonton televisyen antara tiga bandar yang berbeza di Malaysia. Beliau mengambil sampel rawak lima orang dewasa daripada setiap bandar dan meminta mereka melaporkan bilangan jam dihabiskan dengan menonton televisyen pada minggu sebelumnya. Keputusan ditunjukkan di bawah. (Andaikan taburan normal dengan varians yang sama.)

Hours Spent Watching News on Television
(*Waktu dihabiskan dengan menonton berita di televisyen*)

Kuala Ketil	Kuala Lumpur	Kota Kinabalu
25	28	23
31	33	18
18	35	21
23	29	17
27	36	15

(a) Set up the ANOVA Table. Use $\alpha = 0.05$ to determine the critical value.
Sediakan Jadual ANOVA. Gunakan $\alpha = 0.05$ untuk menentukan nilai kritikal.
(16 marks/*markah*)

(b) Can we infer at the 5% significance level that differences in hours of television watching exist among the three cities?
Bolehkah kita membuat inferens pada aras keertian 5% bahawa wujud perbezaan dalam jam menonton televisyen antara ketiga bandar?
(4 marks/*markah*)

4. An ardent fan of television game shows has observed that, in general, the more educated the contestant, the less money he or she wins. To test her belief she gathers data about the last eight winners of her favorite game show. She records their winnings in dollars and the number of years of education. The results are as follows.
Seorang peminat setia rancangan permainan di televisyen telah memerhatikan bahawa, umumnya, semakin tinggi pendidikan peserta, semakin kurang wang yang dimenangi. Untuk menguji andaian tersebut, beliau telah mengumpulkan data mengenai lapan pemenang terakhir daripada rancangan permainan kegemarannya. Beliau juga merekodkan data kemenangan mereka dalam ribuan Ringgit Malaysia (RM'000) dan bilangan tahun pendidikan. Keputusan adalah seperti berikut.

Contestant/ *Peserta*	Years of Education/ *Tahun Pendidikan*	Winnings/ (RM'000) *Wang Kemenangan*
1	11	750
2	15	400
3	12	600
4	16	350
5	11	800
6	16	300
7	13	650
8	14	400

(a) Determine the least squares regression line.
Tentukan garis regresi kuasa dua terkecil.

(8 marks/*markah*)

(b) Interpret the value of the slope of the regression line.
Tafsirkan nilai kecerunan garis regresi.

(2 marks/*markah*)

(c) Estimate the game winnings for a contestant with 15 years of education.
Anggarkan nilai wang kemenangan permainan untuk peserta dengan 15 tahun pendidikan.

(2 marks/*markah*)

(d) Determine the coefficient of determination. What its value tells you about the two variables?
Tentukan pekali penentu. Apakah maksud nilai pekali penentu dalam menerangkan hubungan dua pembolehubah tersebut?

(4 marks/*markah*)

(e) Conduct a test of the population slope to determine at the 5% significance level whether a negative linear relationship exists between years of education and TV game shows' winnings.
Jalankan ujian terhadap cerun populasi untuk menentukan sama ada hubungan linear yang negatif wujud antara tahun pendidikan dan kemenangan rancangan permainan TV pada aras keertian 5%.

5. (a) Differentiate between Type I and Type II errors in hypothesis testing.
Bezakan ralat Jenis I dan ralat Jenis II dalam ujian hipotesis.
(4 marks/*markah*)

(b) The manager of a car service station is in the process of analyzing the number of times car owners change the oil in their cars. She believes that the average motorist changes his or her car's oil less frequently than recommended by the owner's manual (two times per year). In a preliminary survey she asked 14 car owners how many times they changed their cars' oil in the last 12 months. The results are 1, 1, 2, 0, 3, 3, 0, 1, 0, 1, 2, 3, 3, and 1.
Seorang pengurus syarikat perkhidmatan kereta ingin menganalisis kekerapan pemilik kereta menukar minyak enjin. Beliau percaya bahawa secara purata pemilik kenderaan menukar minyak enjin kurang kerap daripada yang disyorkan oleh manual pemilik (iaitu dua kali setahun). Dalam kaji selidik awal, beliau bertanya 14 pemilik kereta tentang kekerapan mereka menukar minyak enjin dalam tempoh 12 bulan yang lalu. Keputusannya: 1, 1, 2, 0, 3, 3, 0, 1, 0, 1, 2, 3, 3, dan 1.

Does this data provide sufficient evidence at the 5% significance level to indicate that the manager is correct?
Adakah data ini menyediakan bukti yang mencukupi pada aras keertian 5% untuk menunjukkan bahawa pengurus tersebut adalah betul?
(10 marks/*markah*)

(c) The air pumps at service stations come equipped with a gauge to regulate the air pressure of tires. A mechanic believes that the gauges are in error by at least 3 pounds per square inch. To test his belief he takes a random example of 50 air pump gauges and determines the difference between the true pressure (as measured by an accurate measuring device) and the pressure shown on the air pump gauge. The mean and the standard deviation of the sample are $\bar{x}$ = 3.4 and s = 1.2. Can the mechanic infer that he is correct at the 5% significance level? Assume tire pressures have a normal distribution.
Pam udara di stesen minyak dilengkapi dengan tolok untuk mengawal tekanan udara dalam tayar. Seorang mekanik percaya bahawa tolok berada dalam ralat sekurang-kurangnya 3 paun per inci persegi. Untuk menguji andaian tersebut beliau mengambil contoh rawak sebanyak 50 tolok pam udara dan menentukan perbezaan antara tekanan sebenar (seperti yang diukur oleh alat pengukur yang tepat) dan tekanan yang ditunjukkan pada tolok pam udara. Min dan sisihan piawai sampel adalah $\bar{x}$ = 3.4 dan s = 1.2. Bolehkah beliau simpulkan bahawa andaian awal tersebut adalah benar pada aras keertian 5%? Andaikan tekanan tayar mempunyai taburan normal.
(6 marks/*markah*)

6. (a) Briefly describe (with examples) the main components of a time series.
Huraikan dengan ringkas (beserta contoh-contoh) komponen-komponen utama siri masa.

(8 marks/*markah*)

(b) Given the following time series, compute the seasonal (quarterly) indexes, using the four-quarter centered moving averages.
Berdasarkan siri masa berikut, kirakan indeks bermusim (suku tahunan), dengan menggunakan empat suku purata bergerak berpusat.

(12 marks/*markah*)

	Year/*Tahun*				
Quarter/*Suku*	2011	2012	2013	2014	2015
1	62	48	50	43	57
2	51	45	46	39	32
3	53	44	46	37	31
4	46	37	42	32	29

7. At a recent K-Pop's concert, a survey was conducted that asked a random sample of 20 people their age and how many concerts they have attended since the beginning of this year. The following data were collected:
Pada satu konsert K-Pop baru-baru ini, kaji selidik dilakukan dengan sampel rawak terdiri daripada 20 orang tentang umur mereka dan berapa banyak konsert yang mereka telah hadiri sejak awal tahun ini. Berikut adalah data yang dikumpul:

Age (*Umur*)	62	57	40	49	67	54	43	65	54	41
No. of concerts (*Bil. konsert*)	6	5	4	3	5	5	2	6	3	1

Age (*Umur*)	44	48	55	60	59	63	69	40	38	52
No. of concerts (*Bil. konsert*)	3	2	4	5	4	5	4	2	1	3

An Excel output follows: *Output daripada Excel adalah seperti berikut:*

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.80203
R Square	0.64326
Adjusted R Square	0.62344
Standard Error	0.93965
Observations	20

DESCRIPTIVE STATISTICS

Age		*Concerts*	
Mean	53	Mean	3.65
Standard Error	2.1849	Standard Error	0.3424
Standard Deviation	9.7711	Standard Deviation	1.5313
Sample Variance	95.4737	Sample Variance	2.3447
Count	20	Count	20

SPEARMAN RANK CORRELATION COEFFICIENT=0.8306

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	28.65711	28.65711	32.45653	2.1082E-05
Residual	18	15.89289	0.88294		
Total	19	44.55			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	-3.01152	1.18802	-2.53491	0.02074	-5.50746	-0.5156
Age	0.12569	0.02206	5.69706	0.00002	0.07934	0.1720

(a) Determine the least squares regression line and test whether age of people determine the number of concerts they have attended.
Tentukan garis regresi kuasa dua terkecil dan uji sama ada umur adalah penting untuk menentukan bilangan konsert yang dihadiri.

(10 marks/*markah*)

(b) Interpret the value of the slope and R^2 of the regression line.
Tafsirkan nilai kecerunan dan R^2 garis regresi tersebut.

(6 marks/*markah*)

(c) Estimate the number of concerts attended by a 64 year old person.
Anggarkan bilangan konsert yang dihadiri oleh seseorang yang berusia 64 tahun. (4 marks/*markah*)

Formulae

Sample covariance

$$s_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{n-1}$$

Continuous Probability Distributions

F distribution

$$F_{1-A,\nu_1,\nu_2} = \frac{1}{F_{A,\nu_2,\nu_1}}$$

Introduction to Hypothesis Testing

Test statistic for μ

$$z = \frac{\bar{x} - \mu}{\sigma / \sqrt{n}}$$

Inference about One Population

Test statistic for μ

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

Confidence interval estimator of μ

$$\bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$$

Confidence interval Estimator of σ^2

LCL = $\frac{(n-1)s^2}{\chi^2_{\alpha/2}}$

UCL = $\frac{(n-1)s^2}{\chi^2_{1-\alpha/2}}$

Test statistic for p

$$z = \frac{\hat{p} - p}{\sqrt{p(1-p)/n}}$$

Confidence interval estimator of p

$$\hat{p} \pm z_{\alpha/2}\sqrt{\hat{p}(1-\hat{p})/n}$$

Sample size to estimate p

$$n = \left(\frac{z_{\alpha/2}\sqrt{\hat{p}(1-\hat{p})}}{W}\right)^2$$

Analysis of Variance

One-way analysis of variance

$$\text{SST} = \sum_{j=1}^{k} n_j(\bar{x}_j - \bar{\bar{x}})^2$$

$$\text{SSE} = \sum_{j=1}^{k}\sum_{i=1}^{n_j}(x_{ij} - \bar{x}_j)^2$$

$$\text{MST} = \frac{\text{SST}}{\text{k}-1}$$

$$\text{MSE} = \frac{\text{SSE}}{\text{n}-\text{k}}$$

$$\text{F} = \frac{\text{MST}}{\text{MSE}}$$

Simple Linear Regression

Sample slope

$$b_1 = \frac{s_{xy}}{s_x^2}$$

Sample y-intercept

$$b_0 = \bar{y} - b_1\bar{x}$$

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Sum of squares for error

$$\text{SSE} = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$

Standard error of estimate

$$s_\varepsilon = \sqrt{\frac{SSE}{n-2}}$$

Test statistic for the slope

$$t = \frac{b_1 - \beta_1}{s_{b_1}}$$

Standard error of b_1

$$s_{b_1} = \frac{s_\varepsilon}{\sqrt{(n-1)s_x^2}}$$

Coefficient of determination

$$R^2 = \frac{s_{xy}^2}{s_x^2 s_y^2} = 1 - \frac{SSE}{\sum (y_i - \bar{y})^2}$$

Sample coefficient of correlation

$$r = \frac{s_{xy}}{s_x s_y}$$

Test statistic for testing $\rho = 0$

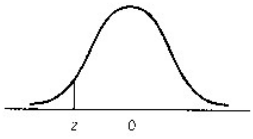
$$t = r\sqrt{\frac{n-2}{1-r^2}}$$

Time Series Analysis and Forecasting

$s_t = wy_t + (1 - w)\, s_{t-1}$

Lampiran B

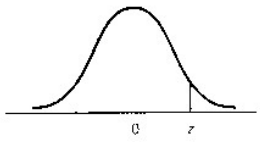
TABLE **3** Cumulative Standardized Normal Probabilities



$P(-\infty < Z < z)$

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
−3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
−2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
−2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
−2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
−2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
−2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
−2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
−2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
−2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
−2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
−2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
−1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
−1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
−1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
−1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
−1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
−1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
−1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
−1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
−1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
−1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
−0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
−0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
−0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
−0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
−0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
−0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
−0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
−0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
−0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
−0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

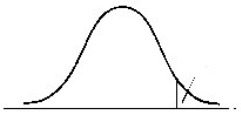
TABLE **3** *(Continued)*



$P(-\infty < Z < z)$.

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

TABLE **4**
Critical Values of the Student t Distribution



Degrees of Freedom	$t_{.100}$	$t_{.050}$	$t_{.025}$	$t_{.010}$	$t_{.005}$
1	3.078	6.314	12.706	31.821	63.657
2	1.886	2.920	4.303	6.965	9.925
3	1.638	2.353	3.182	4.541	5.841
4	1.533	2.132	2.776	3.747	4.604
5	1.476	2.015	2.571	3.365	4.032
6	1.440	1.943	2.447	3.143	3.707
7	1.415	1.895	2.365	2.998	3.499
8	1.397	1.860	2.306	2.896	3.355
9	1.383	1.833	2.262	2.821	3.250
10	1.372	1.812	2.228	2.764	3.169
11	1.363	1.796	2.201	2.718	3.106
12	1.356	1.782	2.179	2.681	3.055
13	1.350	1.771	2.160	2.650	3.012
14	1.345	1.761	2.145	2.624	2.977
15	1.341	1.753	2.131	2.602	2.947
16	1.337	1.746	2.120	2.583	2.921
17	1.333	1.740	2.110	2.567	2.898
18	1.330	1.734	2.101	2.552	2.878
19	1.328	1.729	2.093	2.539	2.861
20	1.325	1.725	2.086	2.528	2.845
21	1.323	1.721	2.080	2.518	2.831
22	1.321	1.717	2.074	2.508	2.819
23	1.319	1.714	2.069	2.500	2.807
24	1.318	1.711	2.064	2.492	2.797
25	1.316	1.708	2.060	2.485	2.787
26	1.315	1.706	2.056	2.479	2.779
27	1.314	1.703	2.052	2.473	2.771
28	1.313	1.701	2.048	2.467	2.763
29	1.311	1.699	2.045	2.462	2.756
30	1.310	1.697	2.042	2.457	2.750
35	1.306	1.690	2.030	2.438	2.724
40	1.303	1.684	2.021	2.423	2.704
45	1.301	1.679	2.014	2.412	2.690
50	1.299	1.676	2.009	2.403	2.678
55	1.297	1.673	2.004	2.396	2.668
60	1.296	1.671	2.000	2.390	2.660
65	1.295	1.669	1.997	2.385	2.654
70	1.294	1.667	1.994	2.381	2.648
75	1.293	1.665	1.992	2.377	2.643
80	1.292	1.664	1.990	2.374	2.639
85	1.292	1.663	1.988	2.371	2.635
90	1.291	1.662	1.987	2.368	2.632
95	1.291	1.661	1.985	2.366	2.629
100	1.290	1.660	1.984	2.364	2.626
110	1.289	1.659	1.982	2.361	2.621
120	1.289	1.658	1.980	2.358	2.617
130	1.288	1.657	1.978	2.355	2.614
140	1.288	1.656	1.977	2.353	2.611
150	1.287	1.655	1.976	2.351	2.609
160	1.287	1.654	1.975	2.350	2.607
170	1.287	1.654	1.974	2.348	2.605
180	1.286	1.653	1.973	2.347	2.603
190	1.286	1.653	1.973	2.346	2.602
200	1.286	1.653	1.972	2.345	2.601
∞	1.282	1.645	1.960	2.326	2.576

Table F distribution

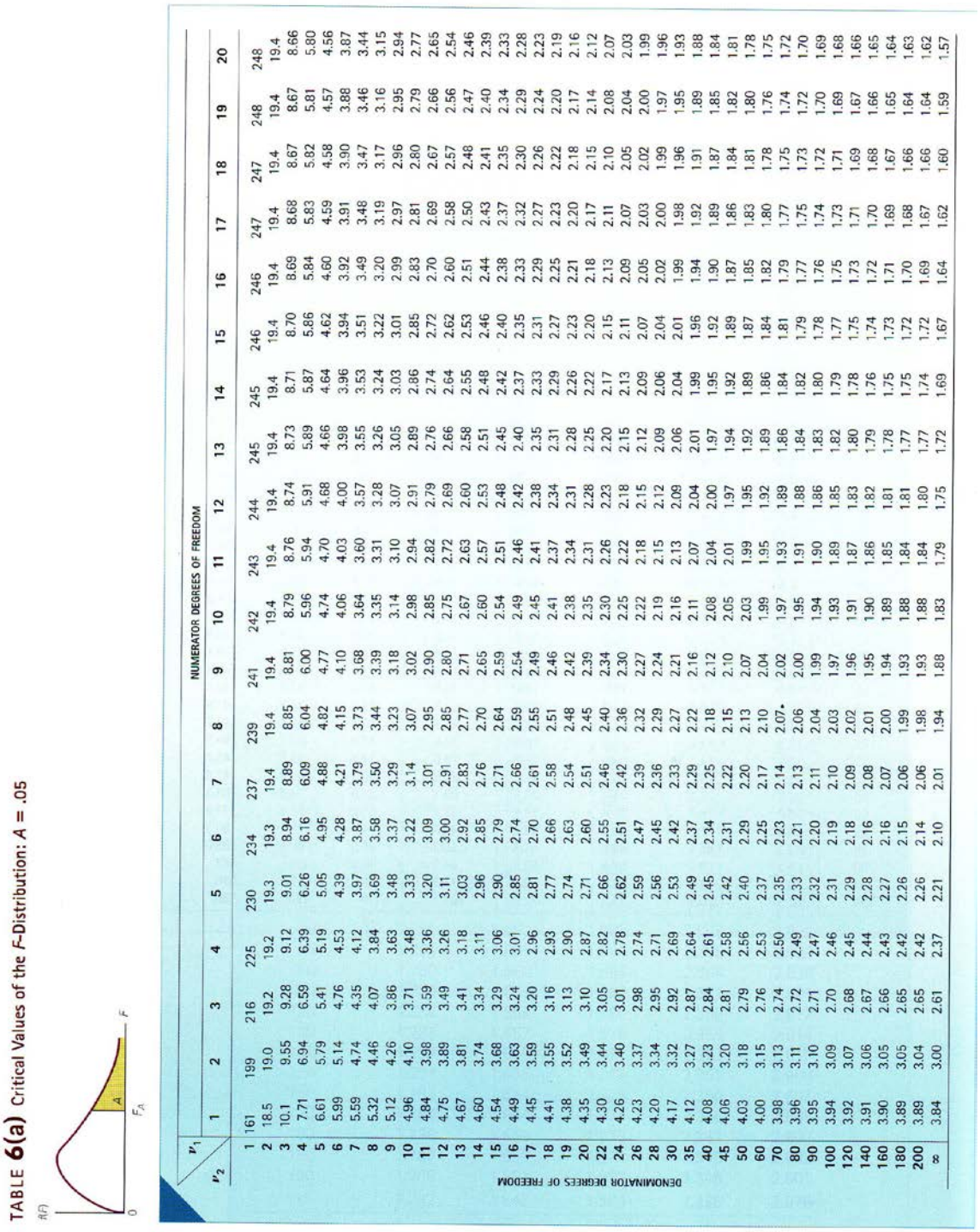
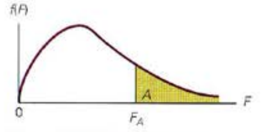


TABLE **6(a)** Critical Values of the *F*-Distribution: $A = .05$

ν_2 \ ν_1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	161	199	216	225	230	234	237	239	241	242	243	244	245	245	246	246	247	247	248	248
2	18.5	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4
3	10.1	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.76	8.74	8.73	8.71	8.70	8.69	8.68	8.67	8.67	8.66
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.94	5.91	5.89	5.87	5.86	5.84	5.83	5.82	5.81	5.80
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.70	4.68	4.66	4.64	4.62	4.60	4.59	4.58	4.57	4.56
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.03	4.00	3.98	3.96	3.94	3.92	3.91	3.90	3.88	3.87
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.60	3.57	3.55	3.53	3.51	3.49	3.48	3.47	3.46	3.44
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.31	3.28	3.26	3.24	3.22	3.20	3.19	3.17	3.16	3.15
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.10	3.07	3.05	3.03	3.01	2.99	2.97	2.96	2.95	2.94
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.94	2.91	2.89	2.86	2.85	2.83	2.81	2.80	2.79	2.77
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.82	2.79	2.76	2.74	2.72	2.70	2.69	2.67	2.66	2.65
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.72	2.69	2.66	2.64	2.62	2.60	2.58	2.57	2.56	2.54
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.63	2.60	2.58	2.55	2.53	2.51	2.50	2.48	2.47	2.46
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.57	2.53	2.51	2.48	2.46	2.44	2.43	2.41	2.40	2.39
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.51	2.48	2.45	2.42	2.40	2.38	2.37	2.35	2.34	2.33
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.46	2.42	2.40	2.37	2.35	2.33	2.32	2.30	2.29	2.28
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.41	2.38	2.35	2.33	2.31	2.29	2.27	2.26	2.24	2.23
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.37	2.34	2.31	2.29	2.27	2.25	2.23	2.22	2.20	2.19
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.34	2.31	2.28	2.26	2.23	2.21	2.20	2.18	2.17	2.16
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.31	2.28	2.25	2.22	2.20	2.18	2.17	2.15	2.14	2.12
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.26	2.23	2.20	2.17	2.15	2.13	2.11	2.10	2.08	2.07
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.22	2.18	2.15	2.13	2.11	2.09	2.07	2.05	2.04	2.03
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.18	2.15	2.12	2.09	2.07	2.05	2.03	2.02	2.00	1.99
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.15	2.12	2.09	2.06	2.04	2.02	2.00	1.99	1.97	1.96
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.13	2.09	2.06	2.04	2.01	1.99	1.98	1.96	1.95	1.93
35	4.12	3.27	2.87	2.64	2.49	2.37	2.29	2.22	2.16	2.11	2.07	2.04	2.01	1.99	1.96	1.94	1.92	1.91	1.89	1.88
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.04	2.00	1.97	1.95	1.92	1.90	1.89	1.87	1.85	1.84
45	4.06	3.20	2.81	2.58	2.42	2.31	2.22	2.15	2.10	2.05	2.01	1.97	1.94	1.92	1.89	1.87	1.86	1.84	1.82	1.81
50	4.03	3.18	2.79	2.56	2.40	2.29	2.20	2.13	2.07	2.03	1.99	1.95	1.92	1.89	1.87	1.85	1.83	1.81	1.80	1.78
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.95	1.92	1.89	1.86	1.84	1.82	1.80	1.78	1.76	1.75
70	3.98	3.13	2.74	2.50	2.35	2.23	2.14	2.07	2.02	1.97	1.93	1.89	1.86	1.84	1.81	1.79	1.77	1.75	1.74	1.72
80	3.96	3.11	2.72	2.49	2.33	2.21	2.13	2.06	2.00	1.95	1.91	1.88	1.84	1.82	1.79	1.77	1.75	1.73	1.72	1.70
90	3.95	3.10	2.71	2.47	2.32	2.20	2.11	2.04	1.99	1.94	1.90	1.86	1.83	1.80	1.78	1.76	1.74	1.72	1.70	1.69
100	3.94	3.09	2.70	2.46	2.31	2.19	2.10	2.03	1.97	1.93	1.89	1.85	1.82	1.79	1.77	1.75	1.73	1.71	1.69	1.68
120	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96	1.91	1.87	1.83	1.80	1.78	1.75	1.73	1.71	1.69	1.67	1.66
140	3.91	3.06	2.67	2.44	2.28	2.16	2.08	2.01	1.95	1.90	1.86	1.82	1.79	1.76	1.74	1.72	1.70	1.68	1.66	1.65
160	3.90	3.05	2.66	2.43	2.27	2.16	2.07	2.00	1.94	1.89	1.85	1.81	1.78	1.75	1.73	1.71	1.69	1.67	1.65	1.64
180	3.89	3.05	2.65	2.42	2.26	2.15	2.06	1.99	1.93	1.88	1.84	1.81	1.77	1.75	1.72	1.70	1.68	1.66	1.64	1.63
200	3.89	3.04	2.65	2.42	2.26	2.14	2.06	1.98	1.93	1.88	1.84	1.80	1.77	1.74	1.72	1.69	1.67	1.66	1.64	1.62
∞	3.84	3.00	2.61	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.79	1.75	1.72	1.69	1.67	1.64	1.62	1.60	1.59	1.57

TABLE **6(c)** Values of the *F*-Distribution: $A = .01$



ν_2 \ ν_1 (NUMERATOR DEGREES OF FREEDOM)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	4052	4999	5403	5625	5764	5859	5928	5981	6022	6056	6083	6106	6126	6143	6157	6170	6181	6192	6201	6209
2	98.5	99.0	99.2	99.2	99.3	99.3	99.4	99.4	99.4	99.4	99.4	99.4	99.4	99.4	99.4	99.4	99.4	99.4	99.4	99.4
3	34.1	30.8	29.5	28.7	28.2	27.9	27.7	27.5	27.3	27.2	27.1	27.1	27.0	26.9	26.9	26.8	26.8	26.8	26.7	26.7
4	21.2	18.0	16.7	16.0	15.5	15.2	15.0	14.8	14.7	14.5	14.5	14.4	14.3	14.2	14.2	14.2	14.1	14.1	14.0	14.0
5	16.3	13.3	12.1	11.4	11.0	10.7	10.5	10.3	10.2	10.1	9.96	9.89	9.82	9.77	9.72	9.68	9.64	9.61	9.58	9.55
6	13.7	10.9	9.78	9.15	8.75	8.47	8.26	8.10	7.98	7.87	7.79	7.72	7.66	7.60	7.56	7.52	7.48	7.45	7.42	7.40
7	12.2	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72	6.62	6.54	6.47	6.41	6.36	6.31	6.28	6.24	6.21	6.18	6.16
8	11.3	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91	5.81	5.73	5.67	5.61	5.56	5.52	5.48	5.44	5.41	5.38	5.36
9	10.6	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35	5.26	5.18	5.11	5.05	5.01	4.96	4.92	4.89	4.86	4.83	4.81
10	10.0	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94	4.85	4.77	4.71	4.65	4.60	4.56	4.52	4.49	4.46	4.43	4.41
11	9.65	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63	4.54	4.46	4.40	4.34	4.29	4.25	4.21	4.18	4.15	4.12	4.10
12	9.33	6.93	5.95	5.41	5.06	4.82	4.64	4.50	4.39	4.30	4.22	4.16	4.10	4.05	4.01	3.97	3.94	3.91	3.88	3.86
13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19	4.10	4.02	3.96	3.91	3.86	3.82	3.78	3.75	3.72	3.69	3.66
14	8.86	6.51	5.56	5.04	4.69	4.46	4.28	4.14	4.03	3.94	3.86	3.80	3.75	3.70	3.66	3.62	3.59	3.56	3.53	3.51
15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89	3.80	3.73	3.67	3.61	3.56	3.52	3.49	3.45	3.42	3.40	3.37
16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78	3.69	3.62	3.55	3.50	3.45	3.41	3.37	3.34	3.31	3.28	3.26
17	8.40	6.11	5.18	4.67	4.34	4.10	3.93	3.79	3.68	3.59	3.52	3.46	3.40	3.35	3.31	3.27	3.24	3.21	3.19	3.16
18	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71	3.60	3.51	3.43	3.37	3.32	3.27	3.23	3.19	3.16	3.13	3.10	3.08
19	8.18	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52	3.43	3.36	3.30	3.24	3.19	3.15	3.12	3.08	3.05	3.03	3.00
20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46	3.37	3.29	3.23	3.18	3.13	3.09	3.05	3.02	2.99	2.96	2.94
22	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35	3.26	3.18	3.12	3.07	3.02	2.98	2.94	2.91	2.88	2.85	2.83
24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26	3.17	3.09	3.03	2.98	2.93	2.89	2.85	2.82	2.79	2.76	2.74
26	7.72	5.53	4.64	4.14	3.82	3.59	3.42	3.29	3.18	3.09	3.02	2.96	2.90	2.86	2.81	2.78	2.75	2.72	2.69	2.66
28	7.64	5.45	4.57	4.07	3.75	3.53	3.36	3.23	3.12	3.03	2.96	2.90	2.84	2.79	2.75	2.72	2.68	2.65	2.63	2.60
30	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07	2.98	2.91	2.84	2.79	2.74	2.70	2.66	2.63	2.60	2.57	2.55
35	7.42	5.27	4.40	3.91	3.59	3.37	3.20	3.07	2.96	2.88	2.80	2.74	2.69	2.64	2.60	2.56	2.53	2.50	2.47	2.44
40	7.31	5.18	4.31	3.83	3.51	3.29	3.12	2.99	2.89	2.80	2.73	2.66	2.61	2.56	2.52	2.48	2.45	2.42	2.39	2.37
45	7.23	5.11	4.25	3.77	3.45	3.23	3.07	2.94	2.83	2.74	2.67	2.61	2.55	2.51	2.46	2.43	2.39	2.36	2.34	2.31
50	7.17	5.06	4.20	3.72	3.41	3.19	3.02	2.89	2.78	2.70	2.63	2.56	2.51	2.46	2.42	2.38	2.35	2.32	2.29	2.27
60	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72	2.63	2.56	2.50	2.44	2.39	2.35	2.31	2.28	2.25	2.22	2.20
70	7.01	4.92	4.07	3.60	3.29	3.07	2.91	2.78	2.67	2.59	2.51	2.45	2.40	2.35	2.31	2.27	2.23	2.20	2.18	2.15
80	6.96	4.88	4.04	3.56	3.26	3.04	2.87	2.74	2.64	2.55	2.48	2.42	2.36	2.31	2.27	2.23	2.20	2.17	2.14	2.12
90	6.93	4.85	4.01	3.53	3.23	3.01	2.84	2.72	2.61	2.52	2.45	2.39	2.33	2.29	2.24	2.21	2.17	2.14	2.11	2.09
100	6.90	4.82	3.98	3.51	3.21	2.99	2.82	2.69	2.59	2.50	2.43	2.37	2.31	2.27	2.22	2.19	2.15	2.12	2.09	2.07
120	6.85	4.79	3.95	3.48	3.17	2.96	2.79	2.66	2.56	2.47	2.40	2.34	2.28	2.23	2.19	2.15	2.12	2.09	2.06	2.03
140	6.82	4.76	3.92	3.46	3.15	2.93	2.77	2.64	2.54	2.45	2.38	2.31	2.26	2.21	2.17	2.13	2.10	2.07	2.04	2.01
160	6.80	4.74	3.91	3.44	3.13	2.92	2.75	2.62	2.52	2.43	2.36	2.30	2.24	2.20	2.15	2.11	2.08	2.05	2.02	1.99
180	6.78	4.73	3.89	3.43	3.12	2.90	2.74	2.61	2.51	2.42	2.35	2.28	2.23	2.18	2.14	2.10	2.07	2.04	2.01	1.98
200	6.76	4.71	3.88	3.41	3.11	2.89	2.73	2.60	2.50	2.41	2.34	2.27	2.22	2.17	2.13	2.09	2.06	2.03	2.00	1.97
∞	6.64	4.61	3.78	3.32	3.02	2.80	2.64	2.51	2.41	2.32	2.25	2.19	2.13	2.08	2.04	2.00	1.97	1.94	1.91	1.88

(ν_2: DENOMINATOR DEGREES OF FREEDOM)

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