بسم الله الرحمن الرحيم

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College of Science, King Saud University

STAT 324 ---- Final Examination

First Semester --- (1431 – 1432 H)

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- Mobile Telephones are not allowed in the classrooms.
- Time allowed is **180 minutes**. * Answer all questions.
- Choose the nearest number to your answer.
- WARNING: Do not copy answers from your neighbors. They have different questions forms.
- For each question, put the code of the correct answer in the following table beneath the question number:

1	2	3	4	5	6	7	8	9	10
D	D	A	A	A	B	C	A	B	B

11	12	13	14	15	16	17	18	19	20
B	B	C	A	B	D	C	D	B	A

21	22	23	24	25	26	27	28	29	30
C	B	A	B	C	A	B	A	B	C

31	32	33	34	35	36	37	38	39	40
B	A	B	A	B	A	A	A	D	A

41	42	43	44	45	46	47	48	49	50
C	C	A	X	A	X	A	C	B	B

⏩⏩ Twenty percent of men in a certain population smoke. Six men are chosen randomly from the population. The probability that

(1) exactly two of the 6 men selected are smokers, is:

(A) 0.015 (B) 0.333 (C) 0.286 (D) 0.246

(2) at most two of the 6 men selected are smokers, is:

(A) 0.639 (B) 0.429 (C) 0.433 (D) 0.901

⏩⏩ Heights of 6 boys selected from the population of all boys in the age group 12-14 years from Riyadh gave mean of 120 cm and a standard deviation of 10 cm. Heights of 21 boys selected from the population of all boys in the age group 12-14 years from Jeddah gave mean of 112cm and a standard deviation of 14 cm. Assume that height of boys in both the populations follow normal distributions with equal variances. Let μ_R and μ_J be mean heights of the boys in Riyadh and Jeddah respectively.

(3) The standard error for estimating the difference $\mu_R - \mu_J$ equals

(A) 6.155 (B) 176.8 (C) 37.886 (D) 5.099

(4) To test $H_0 : \mu_R = \mu_J$ against $H_1 : \mu_R \neq \mu_J$, the value of the test statistic is:

(A) t = 1.300 (B) t = 1.569 (C) t = 0.602 (D) z = 1.569

While to test $H_0 : \mu_J = 107$ against $H_1 : \mu_J > 107$ at α =0.05,

(5) we reject the null hypothesis if the value of the test statistic is greater than

(A) 1.725 (B) 1.721 (C) 2.086 (D) 1.960

(6) To test $H_0 : \mu_J = 107$ against $H_1 : \mu_J > 107$, the computed value of test statistic is:

(A) z = 1.96 (B) t = 1.637 (C) t = 2.086 (D) t = 3.184

⏩⏩ From a box containing 6 red balls and 4 green balls, 3 balls are drawn in succession.

(7) The probability that all balls are green if selection is without replacement, is:

(A) 0.4000 (B) 0.6000 (C) 0.0333 (D) 0.0640

(8) The probability that all balls are green if selection is with replacement, is:

(A) 0.0640 (B) 0.0333 (C) 0.6667 (D) 0.4000

⏩⏩ Suppose that the number of faults in a fiber optic cable follows a Poisson distribution with an average of 0.6 per 1000 feet.

(9) The probability of 2 faults per 500 feet of such cable is:

(A) 0.0988 (B) 0.0333 (C) 0.061 (D) 0.5000

(10) The probability of at most one fault per 1000 feet of such cable is:

(A) 0.9631 (B) 0.8781 (C) 0.9769 (D) 0.2351

(11) The variance of the number of faults per 500 feet of such cable is:

(A) 0.36 (B) 0.3 (C) 0.09 (D) 0.6

⏩⏩ A random sample of size 25 is taken from a normal population having a mean (μ_1) of 80 and a standard deviation of 5. A second independent random sample of size 36 is selected from a different normal population having a mean (μ_2) of 75 and a standard deviation of 3. Then,

(12) The variance value of $(\overline{X}_1 - \overline{X}_2)$ is:

(A) 8 (B) 1.25 (C) 4 (D) 6.5

(13) $P(\overline{X}_1 - \overline{X}_2 > 2) =$

(A) 0.0037 (B) 0.8508 (C) 0.9963 (D) 0.9918

⏩⏩ The change in depth of a river from one day to the next, measured (in feet) at a specific location, is a continuous uniform random variable X with the following density function:

$f(x) = c \; ; -1 < x < 1$

(14) The value of c is:

(A) 0.50 (B) 0.00 (C) 0.75 (D) 0.25

(15) $P(X = 0.75)$ is:

(A) 0.25 (B) 0.00 (C) 0.75 (D) 0.50

⏩⏩ A random variable has a normal distribution with mean $\mu = 50$ and standard deviation $\sigma = 5.2$.

(16) The probabilities that the random variable will take a value greater than 60.3 will be

(A) 0.8601 (B) 0.9761 (C) 0.9769 (D) 0.0239

(17) The probabilities that the random variable will take a value between 52 and 57.2 is:

(A) 0.7318 (B) 0.2742 (C) 0.2682 (D) 0.5642

⏩⏩ The waiting time, **in hours**, between successive speeders spotted by a radar unit is a continuous random variable with cumulative distribution: $F(x) = 1 - e^{-8x}, x > 0$.

(18) Then the probability of waiting less than 12 minutes between successive speeders is:

(A) 0.2019 (B) 0.8971 (C) 0.7566 (D) 0.7981

(19) The expected value, in minutes, of the waiting time is:

(A) 8 (B) 7.5 (C) 0.125 (D) 12

⏩⏩ The heights of a random sample of 50 college students showed a mean of 174.5 centimeters and a standard deviation of 6.9 centimeters.

(20) The estimated standard error of the sample mean is:

(A) 0.9758 (B) 6.9 (C) 0.138 (D) 0.0242

(21) The maximum value of the estimation error in estimating the 95 % confidence interval for mean of all college students will be:

(A) 1.913 (B) 2.33 (C) 1.96 (D) 2.58

⏩⏩ Assume that the mean life of a machine is 6 years with a standard deviation of 1 year. Suppose that the life of such machines follows approximately a normal distribution. If a random sample of 4 is selected from these machines, then:

(22) $P(\bar{X} \le 5) =$

(A) 0 (B) 0.0228 (C) 0.4207 (D) 1

(23) If $P(\bar{X} \le c) = 0.8508$, then the value of c is:

(A) 6.52 (B) 0.8505 (C) 1.04 (D) 0.20

⏩⏩A man wants to paint his house in 3 colors. If he can choose 3 colors out of 6 colors, the number of different color settings he can make is:

(24) (A) 216 (B) 20 (C) 18 (D) 120

⏩⏩ Let A, B, and C be three events such that: P(A)=0.5, P(B)=0.4, $P(C \cap A^c)=0.6$, $P(C \cap A)=0.2$, and $P(A \cup B)=0.9$. Then

(25) P(C) =

(A) 0.1 (B) 0.6 (C) 0.8 (D) 0.2

(26) P (C|A) =

(A) 0.4 (B) 0.8 (C) 0.1 (D) 1.0

(27) $P(B^c \cap A^c) =$

(A) 0.3 (B) 0.1 (C) 0.2 (D) 1.1

⏩⏩Assume that $P(A) = 0.3$, $P(B) = 0.4$, $P(A \cap B \cap C) = 0.03$, and $P(\overline{A \cap B}) = 0.88$, then

(28) The events A and B are,

(A) Independent (B) Dependent (C) Disjoint (D) None of these.

(29) $P(C | A \cap B)$ is equal to,

(A) 0.65 (B) 0.25 (C) 0. 35 (D) 0.14

⏩⏩The probability that a factory will open a branch in Riyadh is 0.7, the probability that it will open a branch in Jeddah is 0.4, and the probability that it will open a branch in either Riyadh or Jeddah or both is 0.8.

(30) The probability that it will open a branch in both cities is:

(A) 0.1 (B) 0.9 (C) 0.3 (D) 0.8

⏩⏩200 adults are classified according to sex and their level of education in the following table:

Sex / Education	Male (M)	Female (F)
Elementary (E)	28	50
Secondary (S)	38	45
College (C)	22	17

If a person is selected at random from this group, then:

(31) The probability that the person is male given that the person has a secondary education, is:

(A) 0.4318 (B) 0.4578 (C) 0.19 (D) 0.415

(32) The probability that the person does not have a college degree given that the person is a female, is:

(A) 0.8482 (B) 0.1518 (C) 0.475 (D) 0.085

⏩⏩Two machines A and B make 80% and 20%, respectively, of the products in a certain factory. It is known that 5% and 10% of the products made by each machine, respectively, are defective. A finished product is randomly selected.

(33) The probability that the product is defective is:

(A) 0.15 (B) 0.06 (C) 0.85 (D) 0.04

(34) If the product was found to be defective, the probability that it was made by machine B is:

(A) 0.33 (B) 0.50 (C) 0.20 (D) 0.67

⏩⏩ Let X be a random variable with the following probability distribution:

X	−3	6	9
f(x)	0.1	0.5	0.4

(35) The variance of X, Var (X) = σ_X^2 is equal to :

(A) 3.41 (B) 11.61 (C) 39.69 (D) 51.30

(36) The value of E(2X+1) is equal to :

(A) 13.6 (B) 25 (C) 80.38 (D) 103.6

⏩⏩Suppose that the discrete random variable X has the following probability function: f(−1)=0.05, f(0)=0.25, f(1)=0.25, f(2)=0.45, then:

(37) P(X<1) is equal to:

(A) 0.30 (B) 0.05 (C) 0.55 (D) 0.50

⏩⏩ A random variable X has a mean μ=8, a variance σ_X^2=9, and an unknown probability distribution.

(38) The lower bound of the probability P (-4 < X < 20) is:

(A) 0.9375 (B) 0.75 (C) 0.8889 (D) 0.25

(39) The upper bound of the probability P (|X-8| ≥ 6) will be

(A) 0.9375 (B) 0.75 (C) 0.8889 (D) 0.25

▸▸ ▸▸Suppose that μ_A represents the mean heights of peoples in a certain population A and P_A represents the proportion of Diabetics in the same population, respectively. A random sample of size n_A=100 provides us the results:

$\overline{X}_A = 171.5\,cm$, $S_A = 8.5\,cm$, $\hat{p}_A = 0.23$ then:

(40) A good point estimate of μ_A is
(A) 171.5 (B) 8.5 cm (C) 0.23 (D) 100

(41) The lower bound (limit)of the 95 % confidence interval for P_A is equal to
(A) 0.23 (B) 0.16 (C) 0.1475 (D) 0.692

If we want to test $H_0 : \mu_A = 170\,cm$ vs $H_1 : \mu_A > 170\,cm$, with level $\alpha = 0.05$. Then

(42) the calculated value of the test statistic will be:
(A) t= 1.99 (B) z = -1.765 (C) z =1.765 (D) t = 2.3

(43) the decision is:
(A) reject H_0 (B) accept H_0 (C) none

Suppose that in a second population B, μ_B represents the mean heights of peoples and P_B represents the proportion of Diabetics in the population (B). A random sample of size n_B=121 is taken and provide us the results:

$\overline{X}_B = 173.4\,cm$, $S_B = 10.2\,cm$, $\hat{p}_B = 0.27$ then:

(44) The 90 % confidence interval for $\mu_B - \mu_A$ is
(A) (1.33 , 3.12) (B) (0.51 , 1.25) (C) (2.1 , 3.46) (D) (-0.17 , 3.97)

(45) The 90 % confidence interval for P_B - P_A is
(A) (-0.056 , 0.136) (B) (0.51 , 0.7) (C) (2.1 , 3.46) (D) (-017 , 3.97)

If we want to test $H_0 : \mu_B = \mu_A$ vs $H_1 : \mu_B > \mu_A$, with level $\alpha = 0.10$. Then:

(46) the calculated value of the test statistic will be:
(A) z = 1.84 (B) z = - 1.51 (C) t = 1.84 (D) z = 1.51

(47) the rejection area of the test is
(A) [1.28 , ∞[(B)] - ∞ , - 1.96] (C)] - ∞ , - 1.645] (D) [1.645 , ∞ [

While if we want to test $H_0 : P_B = P_A$ vs $H_1 : P_B > P_A$, with level $\alpha = 0.10$. Then:

(48) the test statistic equal to:
(A) -1.87 (B) – 0.68 (C) z = 0.682 (D) z = 0.9214

(49) the rejection area of the test is
(A) [1.96 , ∞[(B) [1.28 , ∞[(C)] - ∞ , - 1.645] (D) [1.645 , ∞ [

(50) the decision to be taken is to
(A) reject H_0 (B) accept H_0 (C) None of these

Good Luck

STAT 324 Final 1431/1432 Sem. 1

(1) $X \sim binomial\,(n, P)$ $n = 6$, $p = 0.2$

$q = 1 - 0.2 = 0.8$

$P(X=2) = \binom{6}{2}(0.2)^2(0.8)^4 = 0.246$

(2) $P(X \leq 2) = P(X=0) + P(X=1) + P(X=2)$

$= \binom{6}{0}(0.8)^6 + \binom{6}{1}(0.2)(0.8)^5 + \binom{6}{2}(0.2)^2(0.8)^4$

$= 0.262 + 0.393 + 0.246 = 0.901$

(3) $X_1 \sim N(\mu_1, \sigma)$ $X_2 \sim N(\mu_1, \sigma)$

$n_1 = 6$, $\bar{X}_1 = 120$, $S_1 = 10$ $n_2 = 21$, $\bar{X}_2 = 112$, $S_2 = 14$

pooled estimate for σ^2

$$S_p^2 = \frac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{n_1+n_2-2} = \frac{5(10)^2 + 20(14)^2}{6+21-2} = 176.8$$

$S_p = 13.3$ $S_p\sqrt{\frac{1}{n_1}+\frac{1}{n_2}} = 6.155$

(4) $H_0 : \mu_1 - \mu_2 = 0$

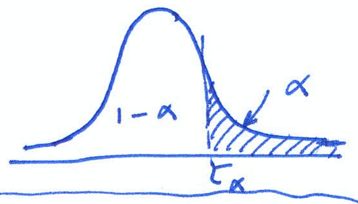
$H_1 : \mu_1 - \mu_2 \neq 0$

test statistic:

$$T = \frac{(\bar{X}_1 - \bar{X}_2) - 0}{S_p\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}} = 1.3$$

(5) $H_0 : \mu_2 = 107$

$H_1 : \mu_2 > 107$



$\alpha = 0.05$

$t_{0.05}(20) = 1.725$

reject H_0 if:

$T > t_\alpha$

$T > 1.725$

Test statistic

$$T = \frac{\bar{X}_2 - 107}{S_2/\sqrt{n_2}}$$

(6) $$T = \frac{112 - 107}{14/\sqrt{21}} = 1.637$$

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(7) $N = 10$, $K = 4$, $n = 3$ $X \sim$ hypegeometric

$$P(X=3) = \frac{\binom{4}{3}\binom{6}{0}}{\binom{10}{3}} = \frac{(4)(1)}{} = 0.0333$$

(8) $P(G1G2G3) = \frac{4}{10} * \frac{4}{10} * \frac{4}{10} = 0.064$

(9) $X \sim \text{Poisson}(\mu)$, $\mu = \lambda t$

$$f(x) = e^{-\mu} \cdot \frac{\mu^x}{x!} \quad ; \quad x = 0, 1, 2, \ldots$$

$$\mu = 0.6 * 0.5 = 0.3$$

$$f(2) = e^{-0.3} \cdot \frac{(0.3)^2}{2!} = 0.0333$$

(10) $\mu = 0.6 * 1 = 0.6$

$$P(X \leq 1) = f(0) + f(1)$$

$$= e^{-0.6} + e^{-0.6} \frac{(0.6)}{1!} = 0.8781$$

(11) $\mu = 0.6 * 0.5 = 0.3$, $\sigma^2 = \lambda t = 0.3$

(12) $X_1 \sim N(\mu_1, \sigma_1)$ $\quad$ $X_2 \sim N(\mu_2, \sigma_2)$

$\mu_1 = 80$, $\sigma_1 = 5$ $\quad$ $\mu_2 = 75$, $\sigma_2 = 3$

$n_1 = 25$ $\quad$ $n_2 = 36$

$$\bar{X}_1 - \bar{X}_2 \sim N\left(\mu_1 - \mu_2 , \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}\right)$$

$$\sigma^2_{\bar{X}_1 - \bar{X}_2} = \frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2} = 1.25$$

(13) $\bar{X}_1 - \bar{X}_2 \sim N(5, 1.118)$

$$P(\bar{X}_1 - \bar{X}_2 > 2) = 1 - P(\bar{X}_1 - \bar{X}_2 \leq 2)$$

$$= 1 - P\left(Z \leq \frac{2-5}{1.118}\right) = 1 - P(Z \leq -2.68)$$

$$= 1 - 0.0037$$

$$= 0.9963$$

(14) $X \sim U(a, b)$

$$f(x) = c \quad ; \quad -1 < x < 1$$

$$c = \frac{1}{b-a} = \frac{1}{1-(-1)} = 0.5$$

(15) $P(X = 0.75) = 0$ $\quad$ continuous distribution

(16) $X \sim N(\mu, \sigma)$ $\mu = 50$, $\sigma = 5.2$

$$P(X > 60.3) = 1 - P\left(Z \leq \frac{60.3 - 50}{5.2}\right)$$

$$= 1 - P(Z \leq 1.98) = 1 - 0.9761 = 0.0239$$

(17) $P(52 \leq X \leq 57.2) = P(X \leq 57.2) - P(X \leq 52)$

$$= P\left(Z \leq \frac{57.2 - 50}{5.2}\right) - P\left(Z \leq \frac{52 - 50}{5.2}\right)$$

$$= P(Z \leq 1.38) - P(Z \leq 0.38)$$

$$= 0.9162 - 0.6480 = 0.2682$$

(18) $F(x) = 1 - e^{-8x}$; $x > 0$ (in hours)

$f(x) = 8e^{-8x}$ $\frac{d}{dx} F(x)$

12 minutes $\longrightarrow$ 0.2 hour

$$P(X < 0.2) = \int_0^{0.2} 8e^{-8x}\,dx = -e^{-8x}\Big|_0^{0.2} =$$

$$-0.2019 - (-1) = 0.7981$$

(19) $E(X) = \int_0^{\infty} x.8e^{-8x}\,dx$

$$= -xe^{-8x}\Big|_0^{\infty} + \int_0^{\infty} e^{-8x}\,dx$$

$$= 0 + -\frac{e^{-8x}}{8}\Big|_0^{\infty} = 0 + \frac{1}{8} = 0.125 \text{ hrs}$$

$= 7.5$ min.s

(20) $n = 50$, $\bar{X} = 174.5$, $S = 6.9$

(estimate) $s.e.(\bar{X}) = \sigma_{\bar{X}} = \qquad = \frac{S}{\sqrt{n}} = \frac{6.9}{\sqrt{50}} = 0.9758$

(21) 95% C.I. for μ :

$1 - \alpha = 0.95$

$\alpha = 0.05$

$\frac{\alpha}{2} = 0.025$

$t_{0.025}(49) = \underline{2.021}$ $\underline{2.000}$

max error $= t_{\frac{\alpha}{2}} \frac{S}{\sqrt{n}}$

$$= (2.0)\frac{6.9}{\sqrt{50}}$$

$$= \underline{\underline{1.96}}$$

(22) $X \sim N(\mu, \sigma)$

$\mu = 6 \quad , \quad \sigma = 1$

sample $\boxed{n = 4}$ $\Rightarrow$ $\bar{X} \sim N(\mu, \frac{\sigma}{\sqrt{n}})$

$\bar{X} \sim N(6, 0.5)$

$P(\bar{X} \leq 5) = P(Z \leq \frac{5-6}{0.5}) = P(Z \leq -2) = 0.0228$

(23) $P(\bar{X} \leq c) = 0.8508$

$P(Z \leq \frac{c-6}{0.5}) = 0.8508$ $\qquad \frac{c-6}{0.5} = 1.04$

$c = 6.52$

(24) $\binom{6}{3} = \frac{6!}{3!\,3!} = 20$

(25) $P(A) = 0.5 \quad , \quad P(B) = 0.4 \quad , \quad P(C \cap A^c) = 0.6$

$P(A \cup B) = 0.9$ $\qquad P(C \cap A) = 0.2$

$P(C) = P(C \cap A) + P(C \cap A^c) = 0.8$

(26) $P(C \mid A) = \frac{P(C \cap A)}{P(A)} = \frac{0.2}{0.5} = 0.4$

(27) $P(B^c \cap A^c) = P((A \cup B)^c) = 1 - P(A \cup B)$

$= 1 - 0.9 = 0.1$

(28) $P(A) = 0.3 \quad , \quad P(B) = 0.4 \quad , \quad P(A \cap B \cap C) = 0.03$

$P(\overline{A \cap B}) = 0.88 \quad \Rightarrow \quad P(A \cap B) = 1 - 0.88 = 0.12$

$P(A \cap B) = P(A)\,P(B) \quad \Rightarrow$ A, B are independent

(29) $P(C \mid A \cap B) = \frac{P(A \cap B \cap C)}{P(A \cap B)} = \frac{0.03}{0.12} = 0.25$

(30) $P(R) = 0.7 \quad , \quad P(J) = 0.4 \quad , \quad P(R \cup J) = 0.8$

$P(R \cap J) = P(R) + P(J) - P(R \cup J)$

$= 0.7 + 0.4 - 0.8 = 0.3$

(31) $P(M \mid S) = \dfrac{P(M \cap S)}{P(S)}$

$= \dfrac{38/200}{83/200}$

$= 0.4578$

	M	F	
E	28	50	78
S	38	45	83
C	22	17	39
	88	112	200

(32) $P(\bar{C} \mid F) = \dfrac{P(\bar{C} \cap F)}{P(F)}$

$= \dfrac{(50+45)/200}{112/200} = 0.8482$

(33)

A → 80% → 5% defective

B → 20% → 10% defective

$P(D) = P(A) * P(D \mid A) + P(B) * P(D \mid B)$

$= 0.8 * 0.05 + 0.2 * 0.1 = 0.06$

(34) $P(B \mid D) = \dfrac{P(B)\ P(D \mid B)}{P(D)} = \dfrac{0.2 * 0.1}{0.06} = 0.33$

(35)

x	-3	6	9
f(x)	0.1	0.5	0.4

$Var(X) = E(x^2) - [E(x)]^2$

$= \sum x^2 f(x) - \left[\sum x f(x)\right]^2$

$= 51.3 - (6.3)^2 = \underline{11.61}$

(36) $E(2X+1) = 2E(X) + 1$

$= 2 * 6.3 + 1 = \underline{13.6}$

(37) $P(X < 1) = P(X = -1) + P(X = 0)$

$= f(-1) + f(0) = 0.05 + 0.25 = \underline{0.3}$

(38) $\mu_x = 8$, $\sigma_x^2 = 9$ $\quad \sigma_x = 3$

$P(-4 < X < 20)$

$= P(-12 < X - 8 < 12)$

$= P(-4\sigma_x < X - \mu_x < 4\sigma_x) \geq 1 - \frac{1}{4^2}$

≥ 0.9375

(39) $P(|X - 8| \geq 6)$

$= 1 - P(|X - 8| < 6)$

$= 1 - (1 - \frac{1}{2^2}) = 1 - 0.75 = 0.25$

(40) μ_A , P_A

$n = 100$ $\quad \bar{X} = 171.5$, $S = 8.5$, $\hat{P} = 0.23$

$\hat{\mu} = \bar{X} = 171.5$

(41) 95% C.I. for P

lower limit $\hat{P} - Z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{P}\hat{q}}{n}}$

$= 0.23 - 1.96 \sqrt{\frac{(0.23)(0.77)}{100}}$

$= 0.1475$

$1 - \alpha = 0.95$ $\quad \alpha = 0.05$

$\frac{\alpha}{2} = 0.025$

$P(Z > Z_{\frac{\alpha}{2}}) = 0.025$

$P(Z \leq Z_{\frac{\alpha}{2}}) = 0.975$

$Z_{\frac{\alpha}{2}} = 1.96$

(42) $H_0: \mu = 170$, $\alpha = 0.05$

$H_1: \mu > 170$

$T = \frac{\bar{X} - \mu_0}{S/\sqrt{n}} = \frac{171.5 - 170}{8.5/\sqrt{100}} = 1.765$

(43) $t_\alpha = t_{0.05}(99) = 1.658$

$T > t_\alpha \Rightarrow$ reject H_0

(44) $n_B = 121$ $n_A = 100$

$\overline{X}_B = 173.4$, $S_B = 10.2$ $\overline{X}_A = 171.5$, $S_A = 8.5$

$\hat{P}_B = 0.27$ $\hat{P}_A = 0.23$

90% C.I. for $\mu_B - \mu_A$ (σ_1, σ_2 unknown)

$$\left[(\overline{X}_B - \overline{X}_A) - t_{\frac{\alpha}{2}}\, S_p \sqrt{\frac{1}{n_B} + \frac{1}{n_A}} \,,\, (\overline{X}_B - \overline{X}_A) + t_{\frac{\alpha}{2}}\, S_p \sqrt{\frac{1}{n_B} + \frac{1}{n_A}}\right]$$

$$S_p^2 = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2} = \frac{120 * 10.2 + 99 * 8.5}{121 + 100 - 2}$$

$S_p^2 = 9.432$ $S_p = 3.071$

$$S_p \sqrt{\frac{1}{n_B} + \frac{1}{n_A}} = 0.415$$

$1 - \alpha = 0.9 \Rightarrow \alpha = 0.1$

$\frac{\alpha}{2} = 0.05$ $t_{\frac{\alpha}{2}} = 1.645$, $Z_{\frac{\alpha}{2}} = 1.65$

$\overline{X}_B - \overline{X}_A = 173.4 - 171.5 = 1.9$

C.I. $[1.9 - 1.645(0.415) \,,\, 1.9 + 1.645(0.415)]$

(45) 90% C.I. for $P_B - P_A$

$$\left[(\hat{P}_B - \hat{P}_A) - Z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{P}_B \hat{q}_B}{n_B} + \frac{\hat{P}_A \hat{q}_A}{n_A}} \,,\, (\hat{P}_B - \hat{P}_A) + Z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{P}_B \hat{q}_B}{n_B} + \frac{\hat{P}_A \hat{q}_A}{n_A}}\right]$$

$$\left[0.04 - 1.65\sqrt{0.0016 + 0.0017} \,,\, 0.04 - 1.65\sqrt{0.0016 + 0.0017}\right]$$

$$[-0.056 \,,\, 0.136]$$

(46) $H_0: \mu_B - \mu_A = 0$ $\alpha = 0.1$

$H_1: \mu_B - \mu_A > 0$

Test statistic $$T = \frac{(\overline{X}_B - \overline{X}_A) - 0}{S_p \sqrt{\frac{1}{n_B} + \frac{1}{n_A}}} = \frac{1.9}{0.415} = 4.578$$

(47) $t_\alpha = 1.282$ R.R. $[1.282, \infty)$

(48) $H_0: P_B - P_A = 0$ $\alpha = 0.1$

$H_1: P_B - P_A > 0$

Test statistic $Z = \dfrac{\hat{P}_B - \hat{P}_A}{\sqrt{\hat{P}\hat{q}\left(\frac{1}{n_B}+\frac{1}{n_A}\right)}} = \dfrac{0.04}{\sqrt{0.00344}}$

$= 0.6818$

$\hat{P} = \dfrac{n_B \hat{P}_B + n_A \hat{P}_A}{n_B + n_A} = 0.2519$

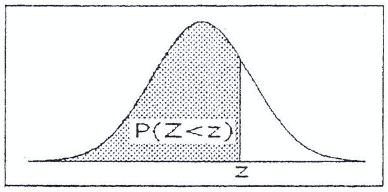
$\hat{q} = 0.7481$

(49) $Z_\alpha = 1.28$ $P(Z > Z_\alpha) = 0.1$

$P(Z \leq Z_\alpha) = 0.9$

R.R. $[1.28, \infty)$

(50) accept H_0



Areas Under The Standard Normal Curve

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
-3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
-3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
-3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
-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
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
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

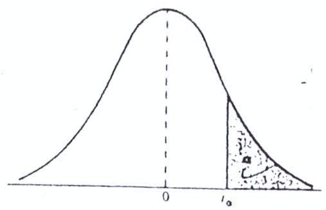


TABLE A.4 Critical Values of the t-Distribution

(*continued*) Critical Values of the t-Distribution

	α									α				
v	0.40	0.30	0.20	0.15	0.10	0.05	0.025	0.02	0.015	0.01	0.0075	0.005	0.0025	0.0005
1	0.325	0.727	1.376	1.963	3.078	6.314	12.706	15.895	21.205	31.821	42.434	63.657	127.322	636.590
2	0.289	0.617	1.061	1.386	1.886	2.920	4.303	4.849	5.643	6.965	8.073	9.925	14.089	31.598
3	0.277	0.584	0.978	1.250	1.638	2.353	3.182	3.482	3.896	4.541	5.047	5.841	7.453	12.924
4	0.271	0.569	0.941	1.190	1.533	2.132	2.776	2.999	3.298	3.747	4.088	4.604	5.598	8.610
5	0.267	0.559	0.920	1.156	1.476	2.015	2.571	2.757	3.003	3.365	3.634	4.032	4.773	6.869
6	0.265	0.553	0.906	1.134	1.440	1.943	2.447	2.612	2.829	3.143	3.372	3.707	4.317	5.959
7	0.263	0.549	0.896	1.119	1.415	1.895	2.365	2.517	2.715	2.998	3.203	3.499	4.029	5.408
8	0.262	0.546	0.889	1.108	1.397	1.860	2.306	2.449	2.634	2.896	3.085	3.355	3.833	5.041
9	0.261	0.543	0.883	1.100	1.383	1.833	2.262	2.398	2.574	2.821	2.998	3.250	3.690	4.781
10	0.260	0.542	0.879	1.093	1.372	1.812	2.228	2.359	2.527	2.764	2.932	3.169	3.581	4.587
11	0.260	0.540	0.876	1.088	1.363	1.796	2.201	2.328	2.491	2.718	2.879	3.106	3.497	4.437
12	0.259	0.539	0.873	1.083	1.356	1.782	2.179	2.303	2.461	2.681	2.836	3.055	3.428	4.318
13	0.259	0.537	0.870	1.079	1.350	1.771	2.160	2.282	2.436	2.650	2.801	3.012	3.372	4.221
14	0.258	0.537	0.868	1.076	1.345	1.761	2.145	2.264	2.415	2.624	2.771	2.977	3.326	4.140
15	0.258	0.536	0.866	1.074	1.341	1.753	2.131	2.249	2.397	2.602	2.746	2.947	3.286	4.073
16	0.258	0.535	0.865	1.071	1.337	1.746	2.120	2.235	2.382	2.583	2.724	2.921	3.252	4.015
17	0.257	0.534	0.863	1.069	1.333	1.740	2.110	2.224	2.368	2.567	2.706	2.898	3.222	3.965
18	0.257	0.534	0.862	1.067	1.330	1.734	2.101	2.214	2.356	2.552	2.689	2.878	3.197	3.922
19	0.257	0.533	0.861	1.066	1.328	1.729	2.093	2.205	2.346	2.539	2.674	2.861	3.174	3.883
20	0.257	0.533	0.860	1.064	1.325	1.725	2.086	2.197	2.336	2.528	2.661	2.845	3.153	3.849
21	0.257	0.532	0.859	1.063	1.323	1.721	2.080	2.189	2.328	2.518	2.649	2.831	3.135	3.819
22	0.256	0.532	0.858	1.061	1.321	1.717	2.074	2.183	2.320	2.508	2.639	2.819	3.119	3.792
23	0.256	0.532	0.858	1.060	1.319	1.714	2.069	2.177	2.313	2.500	2.629	2.807	3.104	3.768
24	0.256	0.531	0.857	1.059	1.318	1.711	2.064	2.172	2.307	2.492	2.620	2.797	3.091	3.745
25	0.256	0.531	0.856	1.058	1.316	1.708	2.060	2.167	2.301	2.485	2.612	2.787	3.078	3.725
26	0.256	0.531	0.856	1.058	1.315	1.706	2.056	2.162	2.296	2.479	2.605	2.779	3.067	3.707
27	0.256	0.531	0.855	1.057	1.314	1.703	2.052	2.158	2.291	2.473	2.598	2.771	3.057	3.690
28	0.256	0.530	0.855	1.056	1.313	1.701	2.048	2.154	2.286	2.467	2.592	2.763	3.047	3.674
29	0.256	0.530	0.854	1.055	1.311	1.699	2.045	2.150	2.282	2.462	2.586	2.756	3.038	3.659
30	0.256	0.530	0.854	1.055	1.310	1.697	2.042	2.147	2.278	2.457	2.581	2.750	3.030	3.646
40	0.255	0.529	0.851	1.050	1.303	1.684	2.021	2.125	2.250	2.423	2.542	2.704	2.971	3.551
60	0.254	0.527	0.848	1.045	1.296	1.671	2.000	2.099	2.223	2.390	2.504	2.660	2.915	3.460
120	0.254	0.526	0.845	1.041	1.289	1.658	1.980	2.076	2.196	2.358	2.468	2.617	2.860	3.373
∞	0.253	0.524	0.842	1.036	1.282	1.645	1.960	2.054	2.170	2.326	2.432	2.576	2.807	3.291