9 Sample Exam

This sample exam consists of 40 multiple choice questions. It is intended to be completed within 2.5 hours. The answers to the sample exam questions are provided in Appendix C. You are allowed a calculator and access to the tables found in Appendix A.

1. A random sample of the annual salaries of twelve doctors is taken. The following results were obtained:

{ $127,309, $210,100, $215,152, $122,152, $131,040, $137,115, $162,144, $366,565, $138,023, $244,055, $251,123, $259,824 }.

You are given that the average of these twelve salaries is $180,383.50.

Using the method of moments, find an estimate for α, using the following CDF to model this data: $F(x) = 1 - (100,000/x)^{\alpha}$, for $x \geq 100,000$.

(a) 2.044
(b) 2.144
(c) 2.244
(d) 2.344
(e) 2.444

2. Following Question 1, suppose you have the annual salaries of 4 other doctors: { $127,500, $140,200, $215,000, $231,500 }. You again are interested in fitting the following CDF to this data set: $F(x) = 1 - (100,000/x)^{\alpha}$, for $x \geq 100,000$. Determine the value of the Kolmogorov-Smirnov test statistic to test the goodness-of-fit at $\alpha = 2$.

(a) 0.201
(b) 0.241
(c) 0.284
(d) 0.304
(e) 0.385

3. Four models are fit to a sample of $n = 100$ observations with the following results:

Model	# of Parameters	Max Loglikelihood
I	1	-314
II	2	-310
III	3	-308
IV	4	-306

Determine the model favored by the Schwarz Bayesian Criterion.

(a) Model I
(b) Model II
(c) Model III
(d) Model IV
(e) Impossible to determine without more information

4. You are given the following contingency table for categorical data:

	Group 1	**Group 2**
Present	50	80
Absent	40	90

Find the value of the Chi-Square statistic and whether we can reject the null hypothesis (independent row and column variables) at $\alpha = .10$.

(a) 1.7, and yes, reject H_0
(b) 1.7, and no, do not reject H_0
(c) 2.6, and yes, reject H_0
(d) 2.6, and no, do not reject H_0
(e) 3.8, and yes, reject H_0

5. Suppose that from a sample of size 16, a 95% confidence interval for μ is (12, 18). Determine $\bar{x}$ and s, respectively.

(a) 12, 15.1
(b) 15, 22.3
(c) 15, 5.6
(d) 31.4, 15
(e) 15, 18.6

6. A sample of 30 black bears is taken in an attempt to model the head length of black bears. Based on the sample taken, it was determined that $\bar{x} = 45.5cm$, and $s^2 = 130.4cm$. From this information, a 98% confidence interval for the true population standard deviation, σ, can be found to be equal to which of the following?

(a) (8.73, 16.29)
(b) (8.42, 14.42)
(c) (7.71, 17.21)
(d) (6.67, 20.54)
(e) (11.67, 13.93)

7. A horticultural researcher is investigating the mean height of a certain type of plant. In making inferences about the mean height of this plant, the error of estimation, d can be no larger than $3cm$. Given that it is known that $\sigma = 16cm$, how large of a sample is necessary for the error of estimation to be no larger than $3cm$ if the horticulturalist requires a 92% confidence on μ?

(a) 86
(b) 87
(c) 88
(d) 89
(e) 96

8. Suppose that from a random sample a 90% confidence interval for the population mean has been found to be (12.8, 14.3). Would H_0: $\mu = 15$ be rejected in favor of H_1: $\mu \neq 15$ at $\alpha = .10$? Choose the best answer.

(a) definitely yes
(b) possibly yes
(c) definitely no
(d) possibly no
(e) impossible to tell without more information

9. The F distribution can be sampled from the following:

$$F = \frac{X_1/n_1}{X_2/n_2},$$

where X_1 and X_2 are random variables on n_1 and n_2 degrees of freedom respectively. What probability distribution do X_1 and X_2 follow?

The random variables X_1 and X_2 follow a

(a) Normal distribution
(b) T distribution
(c) χ^2 distribution
(d) F distribution
(e) Binomial distribution

10. If $X \sim \chi^2(5)$, determine the 90th percentile of X.

(a) 1.61
(b) 9.236
(c) 11.070
(d) 12.833
(e) 16.750

11. A Type I error ensues when

(a) H_1 is rejected when it is actually false
(b) H_0 is rejected when it is actually false
(c) H_1 is rejected when it is actually true
(d) H_0 is rejected when it is actually true
(e) none of the above

12. A Type II error ensues when

(a) a hypothesis test fails to reject H_1 when H_0 is true
(b) a hypothesis test fails to reject H_1 when H_0 is true
(c) a hypothesis test fails to reject H_0 when H_1 is false
(d) a hypothesis test fails to reject H_0 when H_1 is true
(e) none of the above

13. The *power* of a statistical test is

(a) P[not rejecting H_0 when H_1 is in fact true]
(b) P[not rejecting H_0 when H_0 is in fact true]
(c) P[rejecting H_0 when H_0 is in fact true]
(d) P[rejecting H_0 when H_1 is in fact true]
(e) none of the above

14. Suppose that the annual income for secretaries follows a normal distribution with μ=\$48,000 and σ=\$3,500. If 30 secretaries are randomly selected, what is the probability that the average income of these 30 secretaries is between \$47,000 and \$49,000?

(a) 0.6787
(b) 0.7244
(c) 0.7601
(d) 0.8812
(e) 0.9454

15. Suppose a die is rolled 200 times. Let X represent the average result obtained from all 200 rolls. Determine $Var(X)$.

(a) .01458
(b) .25979
(c) .60212
(d) .10775
(e) .12076

16. Suppose a die is rolled 200 times. Then, using the Central Limit Theorem, approximate the probability that the average result from all 200 rolls exceeds 3.7.

(a) .0485
(b) .0565
(c) .0625
(d) .0775
(e) .0815

17. Suppose $X \sim N(10, 2)$. Then, according to Chebychev's inequality, $P(|X - 10| \geq 5)$ is

(a) less than 0.32
(b) less than 0.28
(c) less than 0.24
(d) less than 0.20
(e) less than 0.16

Use the following information for Questions 18 to 21: You are given the following data set, the length of 28 ants (in mm):

6.1 7.5 7.2 7.5 8.0 8.1 5.2 8.2 7.0 7.0 7.3 6.9 6.2 5.4
5.0 7.9 7.8 6.5 6.4 6.5 6.9 7.1 8.3 6.5 6.2 7.1 7.5 7.6

Assume that this sample of ant lengths is taken from a normal population. You are also given the following:

Pertinent summary statistics: $\bar{x} = 6.96071, s = 0.882479.$

18. What is a 95% confidence interval for μ?

(a) (6.6185, 7.3029)
(b) (6.4820, 7.4394)
(c) (6.3620, 7.5594)
(d) (6.2607, 7.6607)
(e) (6.1063, 7.8151)

19. What is a 95% upper-bound confidence interval for μ?

(a) $(-\infty$, 7.9890)
(b) $(-\infty$, 7.8245)
(c) $(-\infty$, 7.6219)
(d) $(-\infty$, 7.4912)
(e) $(-\infty$, 7.2447)

20. What is a 90% confidence interval for σ?

(a) (0.7933, 0.9812)
(b) (0.7526, 1.1176)
(c) (0.7240, 1.1410)
(d) (0.6911, 1.1898)
(e) (0.6379, 1.2524)

21. What is a 90% upper-bound confidence interval for σ?

(a) (0, 0.6127)
(b) (0, 0.6454)
(c) (0, 0.9803)
(d) (0, 1.0774)
(e) (0, 1.2285)

Use the following information for Questions 22 to 26: Consider the weights of 12 female and 18 male university students, in pounds. The data is as follows:

Female		Male		
133	161	175	215	182
132	144	220	183	178
156	168	185	245	175
126	150	165	162	179
108	161	171	170	163
132	135	185	166	170

Female: $\bar{x} = 142.667, s^2 = 309.42424$ Male: $\bar{x} = 182.722, s^2 = 491.15359$

22. Determine a 90% confidence interval for $(\mu_1 - \mu_2)$, the difference between the mean weights of female and male university students.

(a) (-52.962, -28.149)
(b) (-54.962, -26.149)
(c) (-56.962, -24.149)
(d) (-58.962, -22.149)
(e) (-60.962, -20.149)

23. Consider now only the male students. Let us test the hypothesis that $H_0 : \mu = 180$ lbs vs $H_1 : \mu > 180$ lbs at $\alpha = .1$. Performing the hypothesis test using critical values, what is the value of c, the critical value of the test? (*Hint: note that this is "small" sample*).

(a) 174.2
(b) 178.9
(c) 180.3
(d) 187.0
(e) 188.3

24. Considering only male students again, and again considering the test $H_0 : \mu = 180$ lbs vs $H_1 : \mu > 180$ lbs at $\alpha = .1$, what would be the resulting p-value?

(a) between .35 and .30
(b) between .30 and .25
(c) between .25 and .20
(d) between .20 and .15
(e) between .15 and .10

25. Consider now only the female students. Let us test the hypothesis that $H_0 : \mu = 140$ lbs vs $H_1 : \mu \neq 140$ lbs at $\alpha = .05$. Performing the hypothesis test using critical values, what is the value of t, the test statistic for the test? (*Hint: note again that this is "small" sample*).

(a) .41668
(b) .42668
(c) .43668
(d) .44668
(e) .45668

26. Considering only the female students again, and again considering the test $H_0 : \mu = 140$ lbs vs $H_1 : \mu \neq 140$ lbs at $\alpha = .05$, what would be the resulting p-value?

(a) between .2 and .3
(b) between .3 and .4
(c) between .4 and .5
(d) between .5 and .6
(e) between .6 and .7

27. Suppose that, in a random sample of 80 people, 12 of these people were smokers and 68 of them were non-smokers. What is a 95% confidence interval for the proportion of the population this sample was drawn from who are non-smokers?

(a) $(0.70, 1.00)$
(b) $(0.71, 0.99)$
(c) $(0.73, 0.97)$
(d) $(0.75, 0.95)$
(e) $(0.77, 0.93)$

28. Suppose that, in a random sample of 80 people, 12 of these people were smokers and 68 of them were non-smokers. What is an 80% lower-bound confidence interval for the proportion of the population this sample was drawn from who are non-smokers?

(a) $(0.74, \infty)$
(b) $(0.76, \infty)$
(c) $(0.78, \infty)$
(d) $(0.80, \infty)$
(e) $(0.82, \infty)$

29. Suppose that sampling is from a Weibull population, with CDF $F(x) = 1 - e^{-(\frac{x}{\theta})^{\tau}}$, $x \geq 0$. Furthermore, suppose that the empirical 20^{th} and 80^{th} percentiles from a sample are 5 and 12 respectively. Determine an estimate for τ using the method of percentile matching.

(a) 1.7533
(b) 1.9831
(c) 2.2569
(d) 2.6198
(e) 2.9117

30. Consider the inverse Pareto Distribution, with CDF:

$$F(x) = \left(\frac{x}{x+\theta}\right)^2, \quad x > 0.$$

Supposing that the median from sample data was 32. Determine an estimate for $P(X > 50)$ using the method of percentile matching.

(a) 0.185
(b) 0.205
(c) 0.248
(d) 0.297
(e) 0.375

31. Suppose that sampling is from a population following a Normal, $N(\mu, \sigma)$, distribution. We have a sample of values: $\{11, 17, 2, 5, -5\}$. Determine the method of moments estimate for σ.

(a) 5.81
(b) 6.45
(c) 7.12
(d) 7.54
(e) 8.43

32. Suppose that sampling is from a population following a single-parameter Pareto distribution, with $f(x) = \alpha x^{-\alpha-1}, x > 1,\ \alpha > 0$. We have sample values: $\{13, 7, 12, 5, 2\}$. Determine the maximum likelihood estimate for α.

(a) 0.138

(b) 0.238
(c) 0.338
(d) 0.438
(e) 0.538

33. You are given that insurance losses follow an exponential distribution, with CDF $F(x) = 1 - e^{-x/\theta}$, $x > 0$. All you know about these losses is that 10 of them exceeded $500.00, and 1 of them was less than $7500.00. Based on this information, determine the maximum likelihood estimate of θ.

(a) 6,125
(b) 7,825
(c) 8,185
(d) 10,225
(e) 14,895

34. Consider the estimator $\hat{\theta} = \frac{3}{16}X$ where X is the mean of the continuous probability distribution with density $f(x) = \frac{1}{8}(1+\theta x)$, $-4 < x < 4$. Determine bias$(\hat{\theta})$.

(a) 0
(b) θ
(c) -4θ
(d) $\frac{3}{16}\theta$
(e) Cannot be determined without more information

35. Let $X_1, X_2, \ldots, X_8$ denote a random sample from a population having mean μ and variance μ^2. Consider the following estimator of μ:

$$\hat{\mu} = \frac{X_1 + X_2 + \cdots + X_9}{8}.$$

Determine the MSE$(\hat{\mu})$.

(a) $3\mu^2/32$
(b) $5\mu^2/32$
(c) $7\mu^2/32$
(d) $9\mu^2/32$
(e) $11\mu^2/32$

36. Let X_i be sampled from a continuous uniform distribution over the range $X_i \in [0, \theta]$. Let the estimator for θ be $\hat{\theta} = \max\{X_i\}, i = 1, ..., n$, the largest order statistic (the largest value in the sample). If the sample size is n, determine $E[\hat{\theta}^2]$.

(a) $\theta^2/(n+2)$
(b) $n/(n+2)$
(c) $n\theta^2/(n+2)$
(d) $n\theta^2/(n+4)$
(e) $(n+1)\theta^2/n$

37. Suppose that claim sizes are uniformly distributed over the interval $[0, \theta]$. A sample of n claims, denoted by $X_1, X_2, \ldots, X_n$ was observed and an estimate of θ was obtained using $\hat{\theta} = \frac{n+1}{n}\max\{X_1, X_2, \ldots, X_n\}$. Which of the following statements is true?

(a) The estimator is biased and consistent
(b) The estimator is biased and not consistent
(c) The estimator is unbiased and consistent
(d) The estimator is unbiased and not consistent
(e) None of the above

For Questions 38 to 40, use the following information: The following table illustrates the frequency of motorcycle claims for 500 policyholders in one year:

Number of Claims	Number of Policyholders
0	414
1	71
2^+	15

38. What is the Chi-Square goodness-of-fit statistic for a postulated Poisson distribution with parameter $\lambda = 0.25$?

(a) The test statistic is 4.33
(b) The test statistic is 5.17
(c) The test statistic is 6.50
(d) The test statistic is 7.43
(e) The test statistic is 8.92

39. What is the critical value for the Chi-Square goodness-of-fit test for a postulated Poisson distribution with parameter $\lambda = 0.25$, assuming $\alpha = 5\%$?

(a) The test statistic is 3.841
(b) The test statistic is 5.024
(c) The test statistic is 5.991
(d) The test statistic is 7.378
(e) The test statistic is 7.815

40. What is the conclusion for the Chi-Square goodness-of-fit test for a postulated Poisson distribution with parameter $\lambda = 0.25$, assuming $\alpha = 5\%$?

(a) Reject the null hypothesis that the Poisson($\lambda = 0.25$) distribution is a good fit
(b) Reject the null hypothesis that the Poisson($\lambda = 0.25$) distribution is a bad fit
(c) Fail to reject the null hypothesis that the Poisson($\lambda = 0.25$) distribution is a good fit
(d) Fail to reject the null hypothesis that the Poisson($\lambda = 0.25$) distribution is a bad fit
(e) None of the above

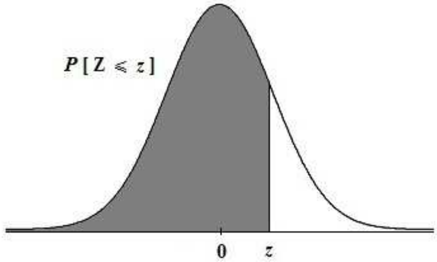
End of Sample Exam

A Statistical Tables

In this appendix we provide four statistical tables: two for the standard normal distribution, one for the T distribution, and one for the chi-squared distribution.

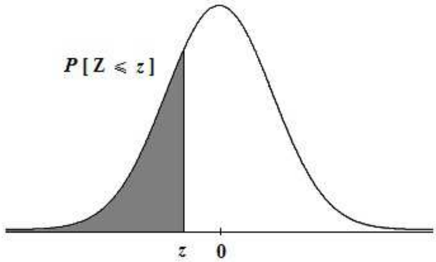
The convention we will employ in this textbook is to choose the value from the table that is nearest to the exact value you seek. The examples in this book, as well as the solutions found in Appendix C, should be consistent with this convention as well.

Standard Normal Distribution: $\Phi(z)$ for Positive z Values



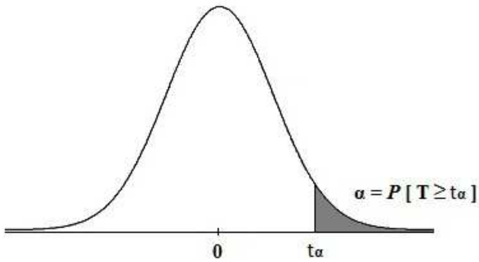
z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	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
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
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999

Standard Normal Distribution: $\Phi(z)$ for Negative z Values



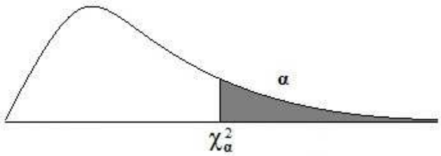
z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
-0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
-0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
-0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
-0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
-1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
-2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
-3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
-3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
-3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
-3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
-3.5	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
-3.6	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

T Distribution: Tail Probability



d.f. \ α	0.350	0.300	0.250	0.200	0.150	0.100	0.050	0.025	0.010	0.005
1	0.510	0.727	1.000	1.376	1.963	3.078	6.314	12.706	31.821	63.657
2	0.445	0.617	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925
3	0.424	0.584	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841
4	0.414	0.569	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604
5	0.408	0.559	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032
6	0.404	0.553	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707
7	0.402	0.549	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499
8	0.399	0.546	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355
9	0.398	0.543	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250
10	0.397	0.542	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169
11	0.396	0.540	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106
12	0.395	0.539	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055
13	0.394	0.538	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012
14	0.393	0.537	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977
15	0.393	0.536	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947
16	0.392	0.535	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921
17	0.392	0.534	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898
18	0.392	0.534	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878
19	0.391	0.533	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861
20	0.391	0.533	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845
21	0.391	0.532	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831
22	0.390	0.532	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819
23	0.390	0.532	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807
24	0.390	0.531	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797
25	0.390	0.531	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787
26	0.390	0.531	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779
27	0.389	0.531	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771
28	0.389	0.530	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763
29	0.389	0.530	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756
30	0.389	0.530	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750
40	0.388	0.529	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704
50	0.388	0.528	0.679	0.849	1.047	1.299	1.676	2.009	2.403	2.678
60	0.387	0.527	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660
70	0.387	0.527	0.678	0.847	1.044	1.294	1.667	1.994	2.381	2.648
80	0.387	0.526	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639
115	0.386	0.526	0.677	0.845	1.041	1.289	1.658	1.981	2.359	2.619
∞	0.385	0.524	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576

χ^2 Distribution: Right Tail Probability



d.f. \ α	0.990	0.975	0.950	0.900	0.500	0.100	0.050	0.025	0.010	0.005
1	0.000	0.001	0.004	0.016	0.455	2.706	3.841	5.024	6.635	7.879
2	0.020	0.051	0.103	0.211	1.386	4.605	5.991	7.378	9.210	10.597
3	0.115	0.216	0.352	0.584	2.366	6.251	7.815	9.348	11.345	12.838
4	0.297	0.484	0.711	1.064	3.357	7.779	9.488	11.143	13.277	14.860
5	0.554	0.831	1.145	1.610	4.351	9.236	11.070	12.833	15.086	16.750
6	0.872	1.237	1.635	2.204	5.348	10.645	12.592	14.449	16.812	18.548
7	1.239	1.690	2.167	2.833	6.346	12.017	14.067	16.013	18.475	20.278
8	1.646	2.180	2.733	3.490	7.344	13.362	15.507	17.535	20.090	21.955
9	2.088	2.700	3.325	4.168	8.343	14.684	16.919	19.023	21.666	23.589
10	2.558	3.247	3.940	4.865	9.342	15.987	18.307	20.483	23.209	25.188
11	3.053	3.816	4.575	5.578	10.341	17.275	19.675	21.920	24.725	26.757
12	3.571	4.404	5.226	6.304	11.340	18.549	21.026	23.337	26.217	28.300
13	4.107	5.009	5.892	7.042	12.340	19.812	22.362	24.736	27.688	29.819
14	4.660	5.629	6.571	7.790	13.339	21.064	23.685	26.119	29.141	31.319
15	5.229	6.262	7.261	8.547	14.339	22.307	24.996	27.488	30.578	32.801
16	5.812	6.908	7.962	9.312	15.338	23.542	26.296	28.845	32.000	34.267
17	6.408	7.564	8.672	10.085	16.338	24.769	27.587	30.191	33.409	35.718
18	7.015	8.231	9.390	10.865	17.338	25.989	28.869	31.526	34.805	37.156
19	7.633	8.907	10.117	11.651	18.338	27.204	30.144	32.852	36.191	38.582
20	8.260	9.591	10.851	12.443	19.337	28.412	31.410	34.170	37.566	39.997
21	8.897	10.283	11.591	13.240	20.337	29.615	32.671	35.479	38.932	41.401
22	9.542	10.982	12.338	14.041	21.337	30.813	33.924	36.781	40.289	42.796
23	10.196	11.689	13.091	14.848	22.337	32.007	35.172	38.076	41.638	44.181
24	10.856	12.401	13.848	15.659	23.337	33.196	36.415	39.364	42.980	45.559
25	11.524	13.120	14.611	16.473	24.337	34.382	37.652	40.646	44.314	46.928
26	12.198	13.844	15.379	17.292	25.336	35.563	38.885	41.923	45.642	48.290
27	12.879	14.573	16.151	18.114	26.336	36.741	40.113	43.195	46.963	49.645
28	13.565	15.308	16.928	18.939	27.336	37.916	41.337	44.461	48.278	50.993
29	14.256	16.047	17.708	19.768	28.336	39.087	42.557	45.722	49.588	52.336
30	14.953	16.791	18.493	20.599	29.336	40.256	43.773	46.979	50.892	53.672
35	18.509	20.569	22.465	24.797	34.336	46.059	49.802	53.203	57.342	60.275
40	22.164	24.433	26.509	29.051	39.335	51.805	55.758	59.342	63.691	66.766
50	29.707	32.357	34.764	37.689	49.335	63.167	67.505	71.420	76.154	79.490
60	37.485	40.482	43.188	46.459	59.335	74.397	79.082	83.298	88.379	91.952
70	45.442	48.758	51.739	55.329	69.334	85.527	90.531	95.023	100.425	104.215
80	53.540	57.153	60.391	64.278	79.334	96.578	101.879	106.629	112.329	116.321
90	61.754	65.647	69.126	73.291	89.334	107.565	113.145	118.136	124.116	128.299

4. For an unbiased estimator, the mean squared error is always equal to the variance.

5. One computational advantage of using mean squared error is that it is not a function of the true value of the parameter.

Answer: (4) - For an unbiased estimator, the mean squared error is always equal to the variance.

Sample Exam

1. (c)
2. (e)
3. (b)
4. (b)
5. (c)
6. (a)
7. (b)
8. (a)
9. (c)
10. (b)
11. (d)
12. (d)
13. (d)
14. (d)
15. (a)
16. (a)
17. (e)
18. (a)
19. (e)
20. (c)
21. (d)
22. (a)
23. (d)
24. (a)
25. (b)
26. (e)
27. (e)

28. (e)
29. (c)
30. (e)
31. (d)
32. (e)
33. (c)
34. (a)
35. (b)
36. (c)
37. (c)
38. (e)
39. (a)
40. (a)