STAT 3332 Statistics for Life Sciences

Spring 2007

Midterm Test 2

- Do **not** turn in the question sheets. **Only the answer sheet** will be accepted.
- There are **12** questions, with **8** points per question. Also, **4** points are allocated for *neatness of name and signature on the answer sheet.* Total points: **100**.
- Allotted time: **45** minutes.
- For each question, choose or give the **best answer**. Explanations for any question (clearly indicate which) may be provided **neatly** on the margin or back of the answer sheet and may count for **partial credit** in the case of a wrong answer.

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1. Let random variable X have a continuous probability distribution with density function $f(x)$. Then $P(1 \leq X \leq 10) =$

(A) $f(10) - f(1)$ $\boxed{\text{(B)}}$ $\int_1^{10} f(x)\,dx$ (C) $f(1) \times f(10)$ (D) none of these

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2. (Continuation) The mean of X is given by

(A) $\int_1^{10} f(x)\,dx$ $\boxed{\text{(B)}}$ $\int_{-\infty}^{\infty} x\, f(x)\,dx$ (C) $\int_{-\infty}^{\infty} f(x)\,dx$ (D) $\int_{-\infty}^{\infty} x\,dx$

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3. The standard normal distribution, $N(0,1)$, satisfies

(A) $P(N(0,1) \leq 0) = 0.50$
(B) $P(N(0,1) \leq -1) = P(N(0,1) \geq +1)$
(C) the density is symmetric about 0
$\boxed{\text{(D)}}$ each of (A), (B), (C)
(E) none of (A), (B), (C)

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4. Let $X_1, \ldots, X_{200}$ be a random sample from a population having mean 3 and variance 25, and let $\overline{X}$ denote the sample mean. The Central Limit Theorem lets us approximate $P(2 \leq \overline{X} \leq 6)$ by

(A) 0 $\boxed{\text{(B)}}$ $P\left(2 \leq N(3, \frac{25}{200}) \leq 6\right)$ (C) $P(2 \leq N(0,1) \leq 6)$ (D) none of these

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5. (Continuation) If the population mean μ is unknown, but the variance is known to be 25, then an approximate 95% Confidence Interval for μ based on $\overline{X}$ is given by

$$\overline{X} \quad \pm \quad K \times \frac{5}{\sqrt{200}},$$

where K

(A) $= 0$ (B) $= 1$ $\boxed{\text{(C)}}$ satisfies $P(N(0,1) \geq K) = 0.025$ (D) $= 1000$

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6. (Continuation) If the population is actually Normal and the mean is known to be $\mu = 3$ but the variance σ^2 is unknown and estimated by the sample variance s^2, an approximate 95% Confidence Interval for σ^2 is given by

$$\left(\frac{Q}{\chi^2_{199,0.975}} \ , \ \frac{Q}{\chi^2_{199,0.025}} \right),$$

where Q

(A) $= 0$ (B) $= 1$ $\boxed{\text{(C)}}$ $= 199\, s^2$ (D) $= 1000$

Over for Questions 7-12

7. Let X_1 and X_2 be any random variables. Then $E(3X_1 + 4X_2) =$

[(A)] $3E(X_1) + 4E(X_2)$ (B) $9E(X_1) + 16E(X_2)$ (C) $\frac{3E(X_1)}{4E(X_2)}$ (D) $12 \times E(X_1) \times E(X_2)$

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8. For large n, the Binomial$(n, 0.7)$ distribution may be approximated by

(A) Poisson(0.7) (B) t with $0.7n$ degrees of freedom [(C)] Normal$(np, np(1-p))$.

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9. Consider testing the null hypothesis $H_0 : \mu = 10$ versus the *one-sided* alternative $H_1 : \mu > 10$, for a population with mean μ and variance 25. Let the data be a sample $X_1, \ldots, X_{200}$ from this population, and suppose that the test statistic to be used is

$$T = \frac{\overline{X} - 10}{5/\sqrt{200}}.$$

If for the given data T comes out to be $T_0 = 1.65$, then the relevant p-value is

[(A)] $P(N(0,1) > 1.65)$ (B) $P(t_{199} > 1.65)$ (C) $P(N(10, 25) > 1.65)$

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10. (Continuation) If instead $H_0 : \mu = 10$ is tested against the *two-sided* alternative $H_1 : \mu \neq 10$, then the p-value based on the outcome $T_0 = 1.65$ is

(A) the same as (B) half [(C)] twice

the p-value for the above one-sided testing problem.

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11. (Continuation) If the testing decision is made using the rejection region

"Reject H_0 if $\overline{X} > 12$",

then the associated Type I error probability is

[(A)] $P(\overline{X} > 12 \mid H_0 \text{ true})$ (B) $P(\overline{X} \leq 12 \mid H_0 \text{ false})$ (C) neither of these

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12. (Continuation) The associated Type II error probability, for the alternative value $\mu = 13$, is

(A) $P(\overline{X} > 12 \mid \mu = 13)$ [(B)] $P(\overline{X} \leq 12 \mid \mu = 13)$ (C) neither of these

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- When you are finished, *please hand in* **only** *the answer sheet.*
- *KEEP THE QUESTION SHEETS.*
- Please **depart quietly**, and *leave the vicinity before discussing the test.*

Thank you for your attention to these details.