

21. T.8 · Conditioning, Bayesian inference and sampling error

Starter Quiz ·

GRE Subject Test · GRE Mathematics

Name: _____ Score: _____

1. $P(A \cap B) = 0.12$ and $P(B) = 0.3$. Find $P(A \mid B)$.

2. Prevalence 10%, sensitivity 80%, specificity 90%. Find $P(D \mid +)$ to three decimal places.

3. Each of 100 independent observations has standard deviation $\sigma = 20$. What is the standard error of their mean?

4. If $P(A) = 0.5$, $P(B) = 0.4$ and $P(A \cap B) = 0.2$, then A and B are independent.

☐ True ☐ False

5. Holding the common observation variance fixed for independent observations, multiplying the sample size by 4 changes the mean standard error by a factor of

☐ 2

☐ $1/2$

☐ $1/4$

☐ 4

6. A first card drawn from a standard 52-card deck is an ace and is not replaced. Find the probability the second is an ace, to three decimal places.

7. Two disjoint events, each with positive probability, can be independent.

☐ True ☐ False

8. In the original hypothetical 2% model, 20 of the 9,330 negative results have the condition. Find the probability of the condition given a negative result, to six decimal places.

9. When can two test false-positive rates of 0.05 be multiplied to obtain a joint false-positive rate of 0.0025?

☐ Whenever the same test is used twice.

☐ Whenever the condition is rare.

☐ Whenever the two results are taken on different days.

☐ When the results are independent conditional on absence of the condition.

10. The mean of any finite iid sample with finite variance has an exactly normal distribution.

☐ True ☐ False

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Answers ·

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1. **0.4**

$$P(A \mid B) = P(A \cap B) / P(B) = 0.12 / 0.3 = 0.4.$$

2. **0.471**

The positive routes are $0.10 \times 0.80 = 0.08$ and $0.90 \times 0.10 = 0.09$, so the posterior is $0.08 / (0.08 + 0.09) = 8/17 \approx 0.471$.

3. **2**

The standard error of the mean is $\sigma / \sqrt{n} = 20 / \sqrt{100} = 20/10 = 2$.

4. **True**

True. A and B are independent exactly when $P(A \cap B) = P(A)P(B)$, and $0.5 \times 0.4 = 0.2$.

5. **1/2**

$\sqrt{4} = 2$ in the denominator.

6. **0.059**

Three aces remain among 51 cards, so the conditional probability is $3/51 = 1/17 \approx 0.059$.

7. **False**

Their intersection has probability zero but the product of their probabilities is positive.

8. **0.002144**

The negative result defines the denominator: $20/9330 \approx 0.002144$. This is not the false-negative rate $20/200$.

9. **When the results are independent conditional on absence of the condition.**

The multiplication is within the group without the condition, so independence must hold conditional on absence, with each conditional rate 0.05. Merely using the same test on a new day does not establish it.

10. **False**

For Bernoulli observations a finite sample mean is discrete. The standard error identity can be exact while a normal approximation is only approximate.