Instructions: Solve any 11 of the following 13 problems and write your solutions on the provided paper, clearly labeling each solution. Indicate which problems you have chosen to answer by checking the boxes next to those questions. Write your solutions clearly and use English words and sentences to explain your work where appropriate. Even a correct solution may receive little or no credit if a method of solution is not shown. You should use a calculator during the exam as well as the provided tables. You may also use your notes (up to 5 sheets of paper). You may not use a phone, your book, or any other resources.

☐ **1.** What is the probability that at least one of three cards dealt from the top of a well-shuffled deck is a heart? (A standard deck of cards has 52 cards, 13 of which are hearts).

☐ **2.** In a recent Economist/YouGov poll 37% were Democrats, 25% were Republicans, and 38% were independent. The poll found that 12% of Democrats thought Trump was "Honest and Trustworthy", 54% of Republicans thought Trump was "Honest and Trustworthy", and 22% of independent voters thought Trump was "Honest and Trustworthy". What percent thought Trump was "Honest and Trustworthy"?

☐ **3.** Person A is randomly chosen from a large population, of which 8% use marijuana. That person is then tested for marijuana use by a method that is positive for 95% marijuana users, but also positive for 2% of non-users. Given that Person A's test is positive, what is the probability that he is actually a marijuana user?

☐ **4.** A multiple choice quiz has 5 questions, each of which has 4 choices for the answer (a, b, c, or d), exactly one of which is correct. If you answer totally at random, what is the probability that you get 4 or more answers correct?

☐ **5.** A die has 6 faces numbered 1, 2, 2, 3, 3, 3. Assuming the die is fair and each face is equally likely to be rolled, what are the mean and variance of a roll of the die?

☐ **6.** A continuous random variable has the probability density function given below. Find the cumulative distribution function of the random variable.
$$f(x) = \begin{cases} 2xe^{-x^2} & \text{if } x > 0 \\ 0 & \text{otherwise} \end{cases}$$

☐ **7.** Let X be a normally distributed random variable with mean 2.2 and standard deviation 0.6.

a) Calculate $P(X = 1)$

b) Calculate $P(X \geq 1)$

☐ **8.** I have thought of a new way to test my hypothesis that 15% of all male Gonzaga students are named Michael. I will randomly ask male students their name until I find one named Michael. Let X be the total number of students I ask (including the last student, Michael). I will reject my hypothesis if $X \geq 19$. What is the probability I will reject my hypothesis when in fact it is true (type I error)? Hint: $\sum_{i=0}^{\infty} a^i = \frac{1}{1-a}$ if $|a| < 1$.

☐ **9.** An April SurveyUSA poll of 826 likely California Democratic Primary voters found that 57% planned to vote for Clinton. Calculate a 99% confidence interval for the true proportion of Clinton voters in the population.

☐ **10.** Observations on residual flame time (sec) for strips of treated childrens nightwear were given in the article "An Introduction to Some Precision and Accuracy of Measurement Problems" (*J. of Testing and Eval.*, 1982:132140). The results were $\bar{x} = 9.8525$ and $s = 0.0965$ with a sample size of $n = 20$.

a) Test $H_0 : \mu = 9.75$ against $H_1 : \mu > 9.75$ at a significance level of $\alpha = 0.05$. (A normal scores plot shows that it is reasonable to assume the population is normally distributed).

b) What null and alternative hypotheses would be most appropriate if the nightwear is acceptable only if significant evidence exists that the mean residual flame time is less than 10 seconds?

☐ **11.** The lifetime of a printer costing $200 is exponentially distributed with a mean of 2 years. The manufacturer will pay a full refund if the printer fails in its first year of operation. No refund is given for later failures. Calculate the mean refund for a printer.

☐ **12.** The temperature reading of a thermocouple (in °C) is a normally distributed random variable with mean equal to the actual temperature, and standard deviation σ. How small must σ be in order to ensure that 99% of all readings are within 0.5°C of the actual temperature?

☐ **13.** Discrete random variables X and Y have the joint probability distribution function, $f(x, y) = P(X = x, Y = y)$, given by the table below. Determine if the random variables are independent (you must have calculations or other reasoning to support your answer).

		y	
	0	1	2
x 1	0.1	0.1	0.2
5	0.1	0.2	0.3