

INSTRUCTIONS: Read the questions carefully and completely. Answer each question and show work in the space provided. Partial credit will not be given if work is not shown. When asked to explain, describe, or comment, do so within the context of the problem. Be sure to include units when dealing with quantitative variables.

1. [15 pts] Short answer.

a) [3] Statistics is about ... _____. (Fill in the blank with one word.)

Use the following information for the next 2 questions. 14.3% of all undergraduate students enrolled at ISU in fall 2010 were in the College of Agriculture and Life Sciences. 24.5% of all undergraduate students enrolled at ISU in fall 2010 were freshmen. 3.2% of all undergraduate students enrolled at ISU in fall 2010 were freshmen **and** in the College of Agriculture and Life Sciences.

b) [3] If a student is selected at random from all undergraduate students enrolled at ISU in fall 2010 what is the chance that student selected was a freshman **or** in the College of Agriculture and Life Sciences? In order to receive credit you must show your work.

c) [3] Given a freshman was selected at random from all undergraduate students enrolled at ISU in fall 2010 what is the chance that student was in the College of Agriculture and Life Sciences? In order to receive credit you must show your work.

Use the following information for the next 3 questions. On a multiple choice test each question has 4 choices, only one of which is the correct answer.

d) [2] If a student is guessing at the answer for a question, choosing an answer at random from the 4 choices, what is the chance that the student answers that question correctly?

- e) [2] If a student guesses on all 40 questions on the test, choosing an answer at random from the 4 choices for each question, what is the average number of questions the student answers correctly?
- f) [2] If a student guesses on all 40 questions on the test, choosing an answer at random from the 4 choices, what is the standard deviation of the number of questions the student answers correctly?
2. [20 pts] A sample of 327 students in grades 4 – 6 in selected schools in Michigan were asked the following question about their school goals, specifically “What would you most like to do at school?” The students could choose either “make good grades,” “be good at sports” or “be popular.” It was also noted whether the student was from a rural school or an urban school. A summary of how many students from each type of school and their answers to the question is given in the table below.

	Grades	Popular	Sports	
Rural	57	50	42	149
Urban	103	49	26	178
	160	99	68	327

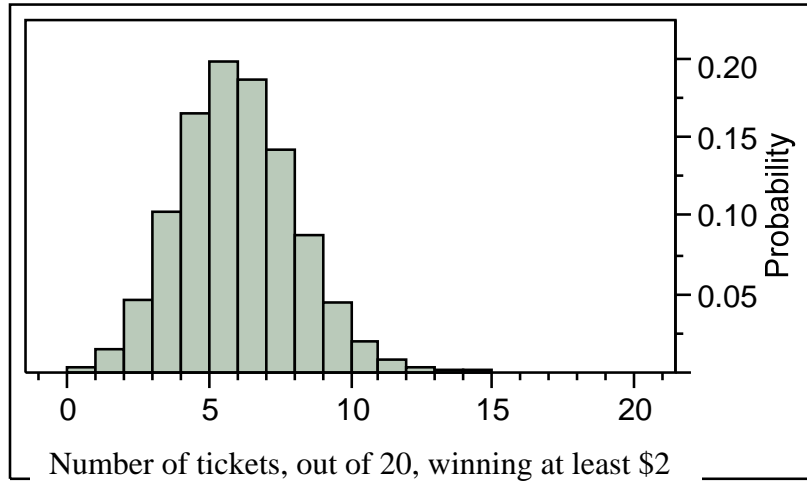
One student is selected at random from the 327.

- a) [2] What is the probability the student selected wants to be good at sports?
- b) [2] What is the probability the student selected is from a rural school?
- c) [4] What is the probability the student selected wants to be good at sports or is from a rural school?

- d) [4] What is the probability the student selected wants to be good at sports **given** the student is from a rural school?
- e) [3] Are the events “wants to be good at sports” and “rural school” disjoint events, i.e. mutually exclusive? Explain briefly.
- f) [5] Are the events “wants to be good at sports” and “rural school” independent events? Support your answer with appropriate probability calculations.
3. [20 pts] On September 19, 2011 the Iowa Lottery started a new scratch ticket game called Spooky Loot®. A Spooky Loot® scratch ticket costs \$2 and you can win up to \$13,000. The Iowa Lottery has printed 1,080,000 Spooky Loot® scratch tickets. The probability that you win at least \$2 on any one Spooky Loot® scratch ticket is 0.274.
- a) [5] If you buy 4 tickets, what is the probability that you win at least \$2 on 3 of the 4?

Below are a table and a histogram of probabilities for the binomial random variable, x , the number of tickets where you win at least \$2 out of 20 tickets purchased.

x	P(x)	x	P(x)	x	P(x)
0	0.0017	7	0.1399	14	0.0001
1	0.0125	8	0.0858	15	0.0000
2	0.0448	9	0.0432	16	0.0000
3	0.1014	10	0.0179	17	0.0000
4	0.1627	11	0.0062	18	0.0000
5	0.1964	12	0.0017	19	0.0000
6	0.1854	13	0.0004	20	0.0000



- b) [3] Describe the shape of the distribution of the number of tickets winning at least \$2.
- c) [2] What is the probability that only 1 of the 20 tickets win at least \$2?
- d) [3] What is the probability that 10 or more tickets, out of 20, win at least \$2?
- e) [3] What is the mean number of tickets, out of 20, that win at least \$2?
- f) [4] What is the probability that 15 or more tickets, out of 20, do not win at least \$2.

4. [15 pts] The yield of corn (bushels per acre) in Iowa counties in 2009 could be described by a normal distribution with mean $\mu = 177.7$ and standard deviation $\sigma = 16.2$.
- a) [4] If a county in Iowa is selected at random what is the chance that the corn yield for that county in 2009 is less than 170 bushels per acre?
- b) [5] If a county in Iowa is selected at random what is the chance that the corn yield for that county in 2009 is greater than 200 bushels per acre?
- c) [6] If a county wants to claim that for 2009 it was in the top 2% in terms of corn yield, how many bushels per acre are needed?

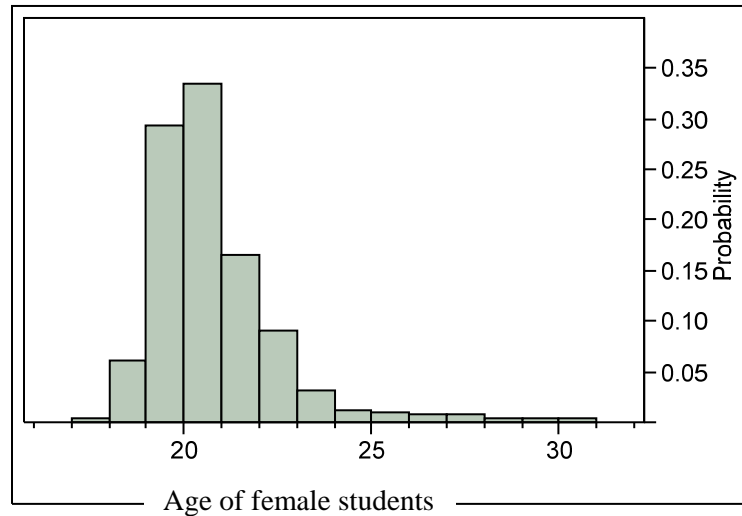
5. [15 pts] Students in introductory statistics classes were asked their age, in years. Below is the distribution of age x for females in the introductory statistics classes.

Age	Prob	Age	Prob	Age	Prob	Age	Prob
17	0.003	21	0.163	25	0.008	29	0.001
18	0.059	22	0.088	26	0.005	30	0.003
19	0.292	23	0.029	27	0.007		
20	0.332	24	0.009	28	0.001		

- a) [3] What is the probability that a randomly selected female student will be 25 or older?

The mean of this distribution is 20.2 and the standard deviation is 1.60.

- b) [4] What is the probability that a randomly selected female student will have an age within 2 standard deviations of the mean?



- c) [2] Describe the shape of the distribution of the age of female students x .
- d) [6] A random sample of $n = 100$ female students is selected from introductory statistics classes. Describe the **sampling distribution** of the sample mean age of female students \bar{x} .
- Shape
 - Center (Mean)
 - Variability (Std Dev)

6. [10 pts] For the Spooky Loot® scratch ticket game (see problem 3), the proportion of winning tickets (tickets where you get a prize of at least \$2) is 0.274. Consider purchasing a random sample of 100 tickets from the population of 1,080,000 tickets available.
- a) [4] For random samples of 100 Spooky Loot® scratch tickets is the success/failure condition satisfied? You must show supporting work to get credit for this question.
- b) [6] For a random sample of 100 Spooky Loot® scratch tickets, describe the **sampling distribution of the sample proportion** of winning tickets? Note: Describe the shape and give the mean and the standard deviation.
- Shape
 - Center (Mean)
 - Variability (Std Dev)
7. [5 pts] Here is a probability problem for Trick or Treat on Halloween. A large plastic pumpkin contains 25 candy bars, 17 are Milky Way and 8 are Almond Joy. All the candy bars are the same size and weight so that each has an equally likely chance of being chosen. You really want an Almond Joy and you are allowed to pick up to 3 times from the pumpkin **without replacement**. Once you get an Almond Joy you cannot pick any more.
- a) [2] What is the probability that you select an Almond Joy on the first pick?
- b) [3] What is the probability that the first Almond Joy you get is on the second pick?

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Formulas

Probability Rules:

Complements A and A^C: $P(A^C) = 1 - P(A)$

$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$

$P(A \text{ and } B) = P(A) * P(B|A) = P(B) * P(A|B)$

A and B are disjoint events i.e. mutually exclusive if $P(A \text{ and } B) = 0$, they cannot occur at the same time.

A and B are independent events if $P(A) = P(A|B)$ or $P(B) = P(B|A)$

Discrete random variable: x

Probability distribution: $0 \leq P(x) \leq 1, \sum P(x) = 1$

Mean: $\mu = \sum xP(x)$

Binomial random variable: x counts the number of successes in n independent trials where the probability of success on any one trial is p

Probability function: $P(x) = \binom{n}{x} p^x (1-p)^{n-x} \quad x = 0, 1, 2, \dots, n$

Mean: $\mu = np$, Standard deviation: $\sigma = \sqrt{np(1-p)}$

Normal random variable, y :

Mean: μ , Standard deviation: σ

Standardize: $z = \frac{y - \mu}{\sigma}$

Distribution of the sample proportion, \hat{p} :

Shape: approximately normal, provided $np \geq 15$ & $n(1-p) \geq 15$

Mean: p , Standard deviation: $SD(\hat{p}) = \sqrt{\frac{p(1-p)}{n}}$

Standardize: $z = \frac{\hat{p} - p}{SD(\hat{p})}$

Distribution of the sample mean, \bar{y} :

Shape: approximately normal,

Mean: μ , Standard deviation: $SD(\bar{y}) = \frac{\sigma}{\sqrt{n}}$

Standardize: $z = \frac{\bar{y} - \mu}{SD(\bar{y})}$