6.1 Introduction to Random Variables and Probability Distributions

Essential Question:

What is the difference between discrete and continuous variables?

What is a probability distribution?

FOCUS POINTS:

- Distinguish between discrete and continuous random variables.
- Graph discrete probability distribution.
- Compute mu and sigma for a discrete probability distribution, linear function of a random variable x, and linear combination of two independent random variables.

Nov 28-10:16 AM

A quantitative variable, x, is a **random variable** if the value that x takes on in a given experiment or observation is a chance or random outcome.

A **discrete random variable** can take on only a finite number of values or a countable number of values.

ie: a count of students in a class

A **continuous random variable** can take on any of the countless number of values in a line interval.

ie: a continuous scale like air pressure in a tire

Nov 28-10:22 AM

Practice 1:

Which of the following random variables are discrete and which are continuous?

a) *Measure* the time it takes a student selected at random to register for the fall term. CONTINUOUS

b) *Count* the number of bad checks drawn on Upright Bank on a day selected a random. DISCRETE

c) *Measure* the amount of gasoline needed to drive your car 200 miles. CONTINUOUS

d) Pick a random sample of 50 registered voters in a district and find the number who voted in the last county election. DISCRETE

DISCRETE CONTINUOUS

Nov 28-10:24 AM

A random variable has a probability distribution whether it is discrete or continuous.

A **probability distribution** is an assignment of probabilities to each distinct value of a discrete random variable or to each interval of values of a continuous random variable.

Nov 28-10:30 AM

FEATURE OF THE PROBABILITY DISTRIBUTION OF A DISCRETE RANDOM VARIABLE

1) The probability distribution has a probability assigned to *each distinct* value of the random variable.

2) The sum of all the assigned probabilities must be 1.

Nov 28-10:31 AM

Example 1: Boredom

Dr. Mendoza developed a test to measure boredom tolerance. He administered it to a group of 20,000 adults between the ages of 25 and 35. The possible scores were 0, 1, 2, 3, 4, 5, and 6, with 6 indicating the highest tolerance for boredom.

a) If a subject is chosen at random from this group, the probability that he or she will have a score of 3 is $\frac{6000}{20000}$ or 0.30. In a similar way, we can use relative frequencies to compute the probabilities for the other scores.

%

Score x	Number of Subjects
0	1400
1	2600
2	3600
3	6000
4	4400
5	1600
6	400

total 20,000

Score, x	Probability, P(x)
0	.07
1	.13
2	.18
3	.3
4	.22
5	.08
6	.02

total 1

Find each probability for each score, x.

$P(1) = \frac{2600}{20{,}000} \approx .13$

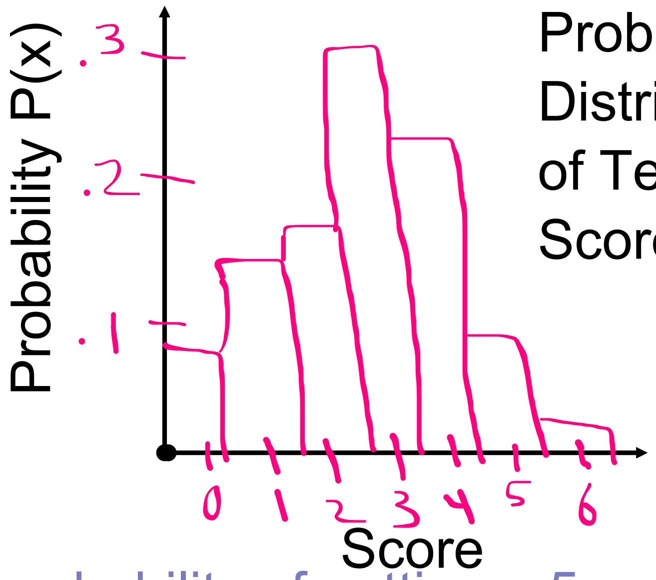
What should the total probability add up to? 1

or 100%

Nov 28-10:32 AM

b) Graph a relative frequency histogram from part a.

Score, x	Probability, P(x)
0	0.07
1	0.13
2	0.18
3	0.30
4	0.22
5	0.08
6	0.02



Probability Distribution of Test Scores

c) What is the probability of getting a 5 or a 6?

$P(5 \cup 6) = .08 + .02 = \boxed{.1}$

Nov 28-10:41 AM

The mean and the standard deviation of a discrete population probability distribution are found by using these formulas:

$\mu = \sum xP(x)$; μ is called the expected value of x

$\sigma = \sqrt{\sum (x - \mu)^2 P(x)}$; σ is called the standard deviation of x

where x is the value of a random variable, P(x) is the probability of that variable, and the sum Σ is taken for all the values of the random variable.

Nov 28-10:59 AM

Example 2: TV Infomercials

Are we influenced to buy a product by an ad we saw on TV? National Infomercial Marketing Association determined the number of times buyers of a product had watched a TV infomercial before purchasing the product. (Results below)

We can treat the information shown as an estimate of the probability distribution because events are mutually exclusive and the sum of the %'s are 100%. Compute the mean (μ) and the standard deviation (σ). disjoint

# of Times Buyers Saw Infomercials	1	2	3	4	5*
% of Buyers	27%	31%	18%	9%	15%

Check with your calculator!

x	$P(x)$	$xP(x)$	$(x - \mu)^2$	$(x - \mu)^2 P(x)$
1	0.27	.27	2.372	.640
2	0.31	.62	.292	.091
3	0.18	.54	.212	.038
4	0.09	.36	2.132	.192
5	0.15	.75	6.052	.908

$\mu = \Sigma x P(x) =$ 2.54 $\sigma = (x - \mu)^2 P(x) =$ 1.869

Nov 28-2:02 PM

What does a discrete probability distribution tell us?

A discrete probability distribution tell us

- the complete sample space on which the distribution is based.
- the corresponding probability of each event in the sample space.

In addition formulas tell us how to find the expected value μ and the standard deviation σ of the distribution.

Nov 28-2:19 PM

HW: p. 248: 1, 3, 5, 7, 13

1. a) discrete

   b) continuous

   c) continuous

   d) discrete

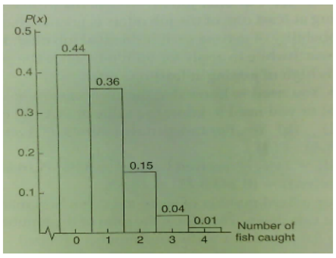
   e) continuous

3. a) Yes. b) No, probabilities total to more than 1.

5. No. Even though the outcomes in the sample space are the same, the individual probabilities may differ in a way that produces the same μ but a different standard deviation.

7. Expected value = 0.9. $\sigma \approx 0.6245$

13. a) Fishing Trout in Paiute Indian Nation, Pyramid Lake, Nevada b) 0.56 c) 0.20 d) 0.82 e) 0.899



Nov 28-2:22 PM