# AP® Statistics
2003 Sample Student Responses

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3. Men's shirt sizes are determined by their neck sizes. Suppose that men's neck sizes are approximately normally distributed with mean 15.7 inches and standard deviation 0.7 inch. A retailer sells men's shirts in sizes S, M, L, XL, where the shirt sizes are defined in the table below.

Shirt size	Neck size
S	$14 \leq$ neck size < 15
M	$15 \leq$ neck size < 16
L	$16 \leq$ neck size < 17
XL	$17 \leq$ neck size < 18

(a) Because the retailer only stocks the sizes listed above, what proportion of customers will find that the retailer does not carry any shirts in their sizes? Show your work.
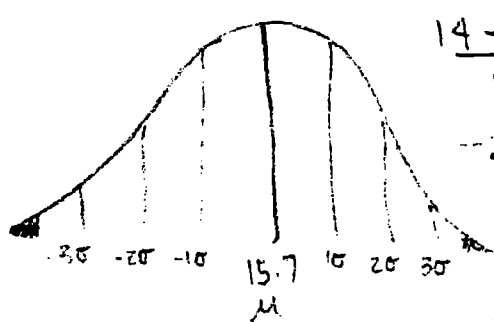
$$\frac{14-15.7}{0.7} < z < \frac{18-15.7}{0.7}$$

$$-2.43 < z < 3.29$$

$$P = .9995 - .0075 = .992$$

$1 - P = $ shirts not carried $= \boxed{.008}$

(b) Using a sketch of a normal curve, illustrate the proportion of men whose shirt size is M. Calculate this proportion.

14.3   15   15.7   16.4   17.1
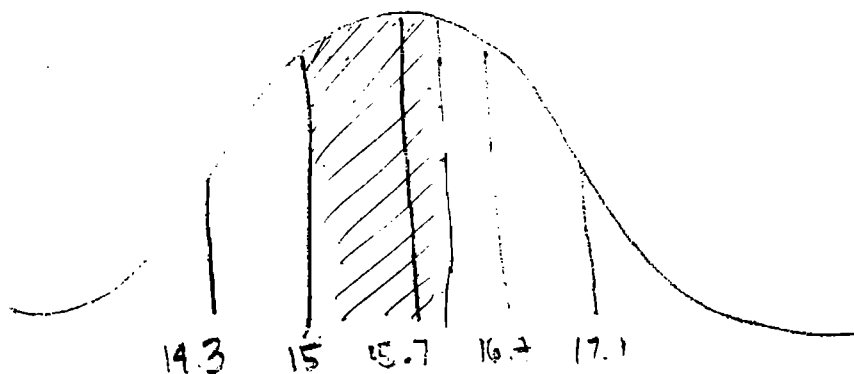
$$\frac{15-15.7}{0.7} < z < \frac{16-15.7}{0.7}$$

$$-1 < z < .4286$$

$$P = .6628 - .1587$$

$$P = .5041$$

(c) Of 12 randomly selected customers, what is the probability that exactly 4 will request size M ? Show your work.

$$P(X=4) = \binom{12}{4}(.5041)^4(.4959)^8$$

$$= 495(.06457)(.003657)$$

$$= .1169$$

$$\boxed{P = .12}$$

Binomial setting

1. all observations are independent
2. either success or failure
3. all observations have probability, P, of success
4. fixed number for n

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B

Shirt size	Neck size
S	$14 \leq$ neck size < 15
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(a) Because the retailer only stocks the sizes listed above, what proportion of customers will find that the retailer does not carry any shirts in their sizes? Show your work.

$1 - \text{normalcdf}(14, 18, 15.7, 0.7) \cong \boxed{0.0081} = 0.81\%$

I found the proportion of people within the neck size 14 to 18 because that is what retailers carry. Subtracting from one to obtain the proportion that retailers do not carry, I found that .0081 of population of customers are out of the range of shirt sizes that retailer carries.

(b) Using a sketch of a normal curve, illustrate the proportion of men whose shirt size is M. Calculate this proportion.
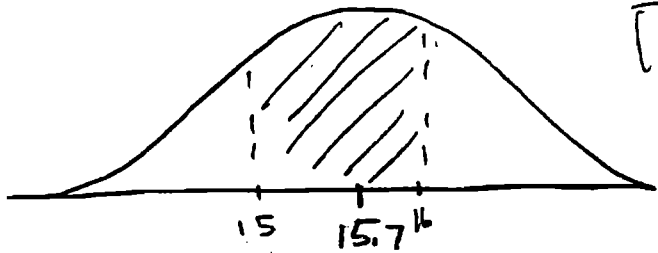
$\text{normalcdf}(15, 16, 15.7, 0.7) = \boxed{.5072}$

$\boxed{\text{or}}$

$P(x < 16) = P\left(z < \frac{16-15.7}{.7}\right) = P(z < .429)$
$= .6664$

$P(x \leq 15) = P\left(z < \frac{15-15.7}{.7}\right) = P(z < -1)$
$= .1587$

$P(x < 16) - P(x < 15) = P(15 \leq x < 16)$
$.6664 - .1587 = \boxed{.5077}$

-Scores   −1   0 .429

(c) Of 12 randomly selected customers, what is the probability that exactly 4 will request size M? Show your work.

$_{12}C_4 (.5072)^4 (.4928)^8 \cong \boxed{.11394} = 11.394\%$

This is a binomial distribution with success probability of .5072, 12 trials, and expect exactly 4 successes.

$\text{binompdf}(12, .5072, 4) = .11394$