Chapter 6
The Normal Distribution

Chapter Outline

6.1 Introducing Normally Distributed Variables

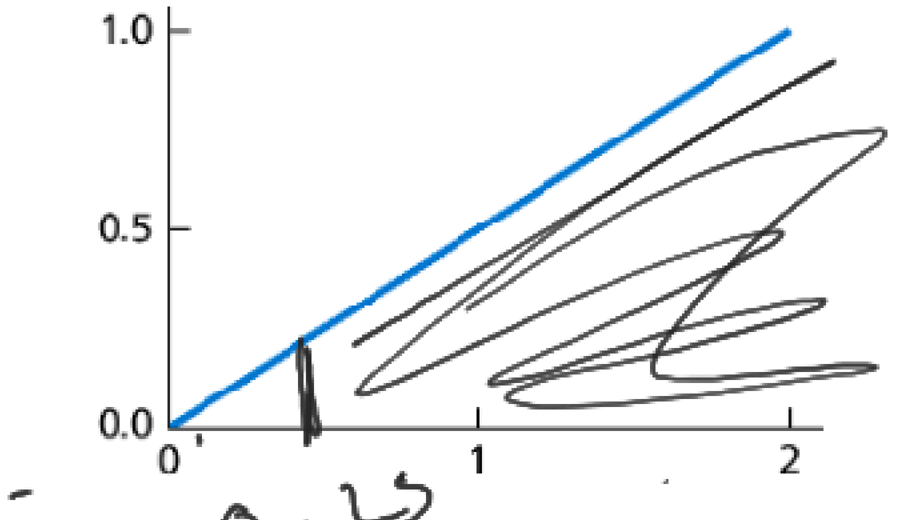
6.2 Areas under the Standard Normal Curve

6.3 Working with Normally Distributed Variables

6.5 Normal Approximation to the Binomial Distribution (Optional)

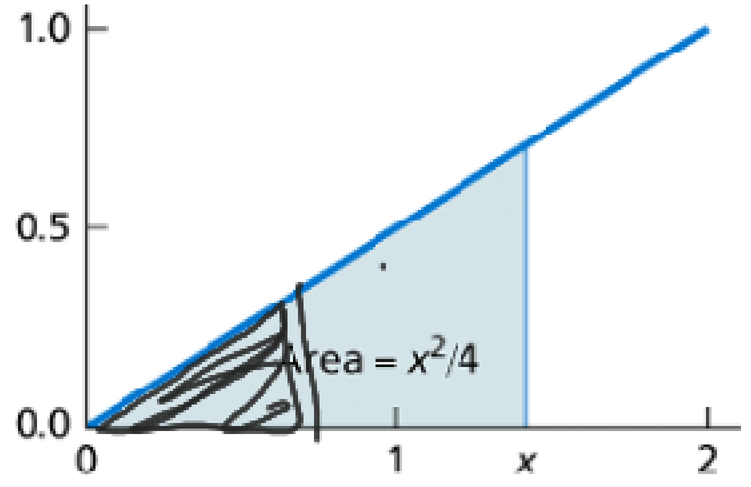
Crystal size The crystals of a certain mineral are cubes. The length of the sides is a variable that has the density curve shown in Fig. 6.3(a), where length is measured in millimeters (mm). Using the facts that the equation of this density curve is $y = x/2$ for $0 < x < 2$ and that the area of a triangle equals one-half its base times its height, we see that the area under this density curve to the left of any number x between 0 and 2 equals $x^2/4$, as shown in Fig. 6.3(b).

Figure 6.3



(a)

(a) Density curve for crystal side length, in mm



(b)

(b) Area under the density curve to the left of x

Determine the percentage of these crystals that have side lengths

a. less than 0.5 mm.

b. between 1 mm and 1.5 mm.

c. at least 0.25 mm.

a) $\frac{x^2}{4}$ $\frac{(0.5)^2}{4} = \frac{0.25}{4} = 0.0625$

6.25%

b) $\frac{(1)^2}{4} = \frac{1}{4} = 0.25$ $\frac{(1.5)^2}{4} = 0.5625$

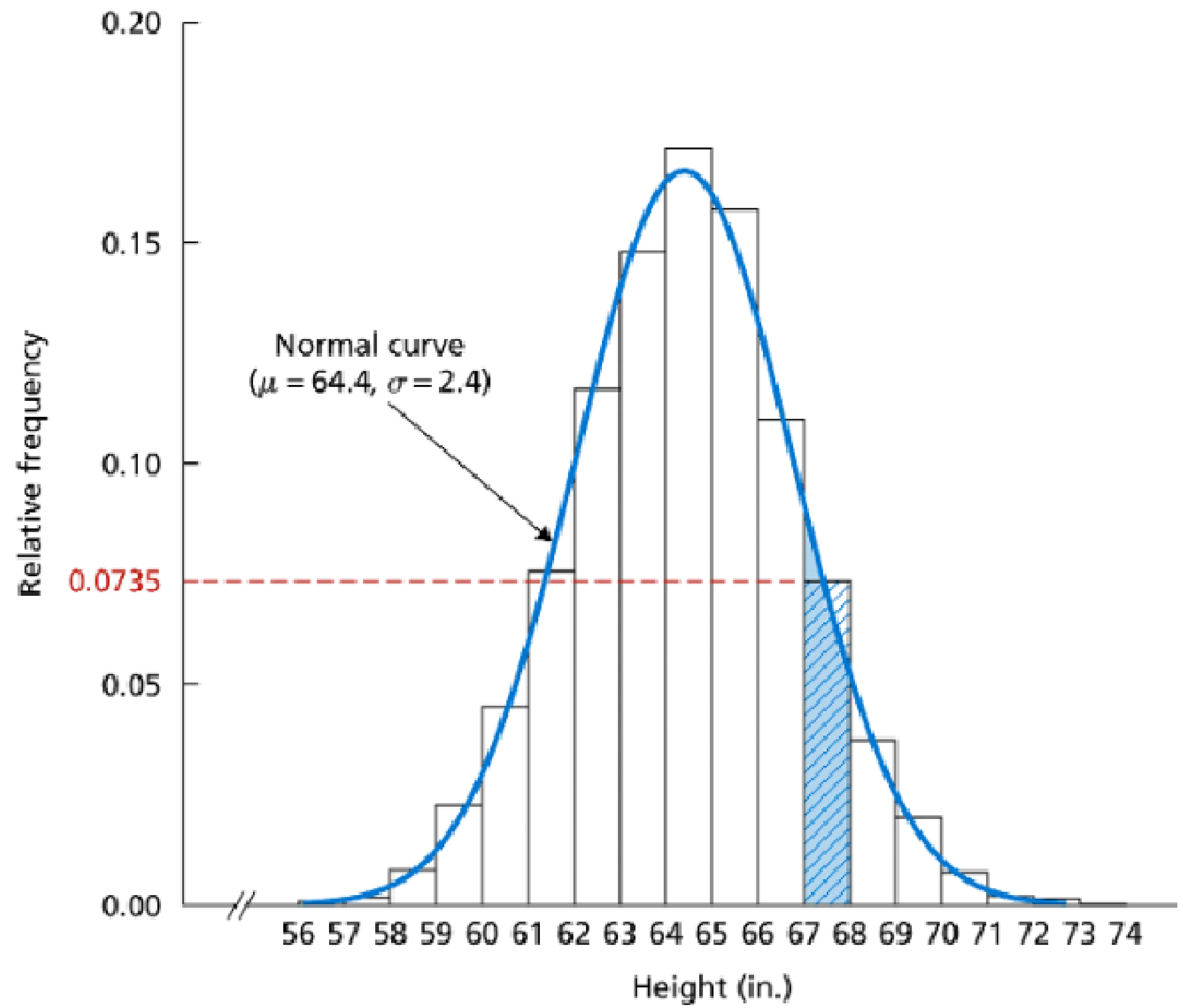
$0.5625 - 0.25 = 0.3125$

c) $1 - \frac{(0.25)^2}{4} = 1 - 0.0156$

$= .9844$

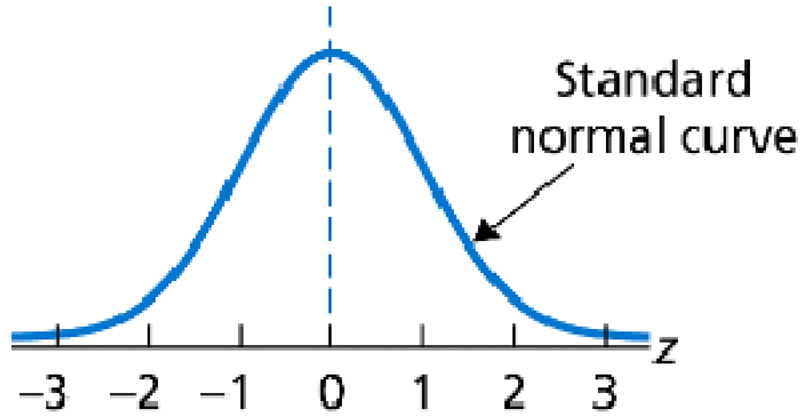
98.44%

Heights of Female College Students A midwestern college has an enrollment of 3264 female students. Records show that the mean height of these students is 64.4 inches and that the standard deviation is 2.4 inches. Here the variable is height, and the population consists of the 3264 female students attending the college. Frequency and relative-frequency distributions for these heights appear in Table 6.1. The table shows, for instance, that 7.35% (0.0735) of the students are between 67 and 68 inches tall.



56–under 57	3	0.0009
57–under 58	6	0.0018
58–under 59	26	0.0080
59–under 60	74	0.0227
60–under 61	147	0.0450
61–under 62	247	0.0757
62–under 63	382	0.1170
63–under 64	483	0.1480
64–under 65	559	0.1713
65–under 66	514	0.1575
66–under 67	359	0.1100
67–under 68	240	0.0735
68–under 69	122	0.0374
69–under 70	65	0.0199
70–under 71	24	0.0074
71–under 72	7	0.0021
72–under 73	5	0.0015
73–under 74	1	0.0003

Figure 6.14



Standard normal distribution and standard normal curve

Key Fact 6.5: Basic Properties of the Standard Normal Curve

Property 1: The total area under the standard normal curve is 1.

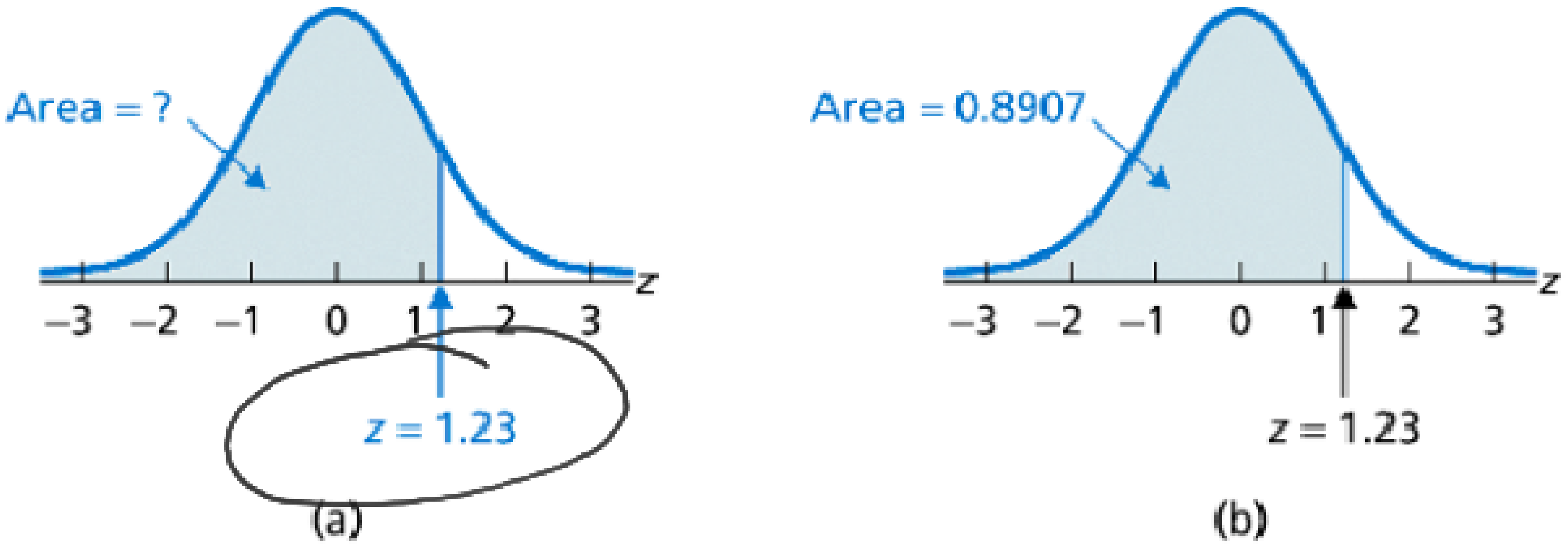
Property 2: The standard normal curve extends indefinitely in both directions, approaching, but never touching, the horizontal axis as it does so.

Property 3: The standard normal curve is symmetric about 0; that is, the part of the curve to the left of the dashed line in Fig. 6.14 is the mirror image of the part of the curve to the right of it.

Property 4: Almost all the area under the standard normal curve lies between −3 and 3.

Determine the area under the standard normal curve that lies to the left of 1.23, as shown in Fig. 6.15(a).

Figure 6.15

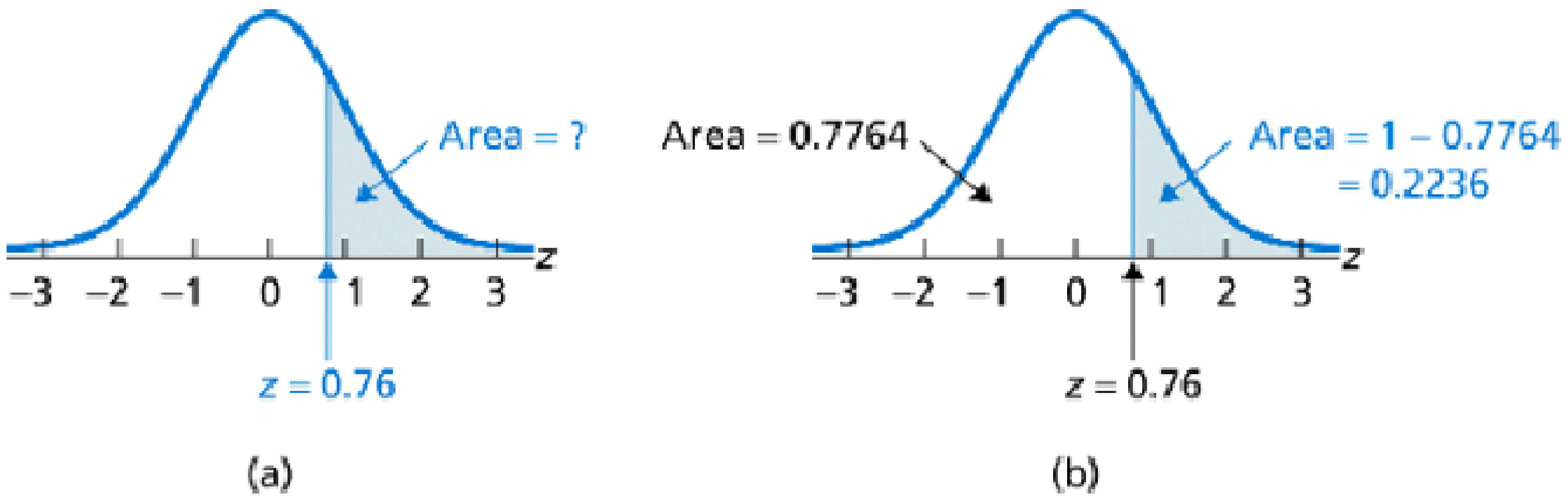


Finding the area under the standard normal curve to the left of 1.23

z → z-score is # of standard deviations from the mean

Determine the area under the standard normal curve that lies to the right of 0.76, as shown in Fig. 6.16(a).

Figure 6.16

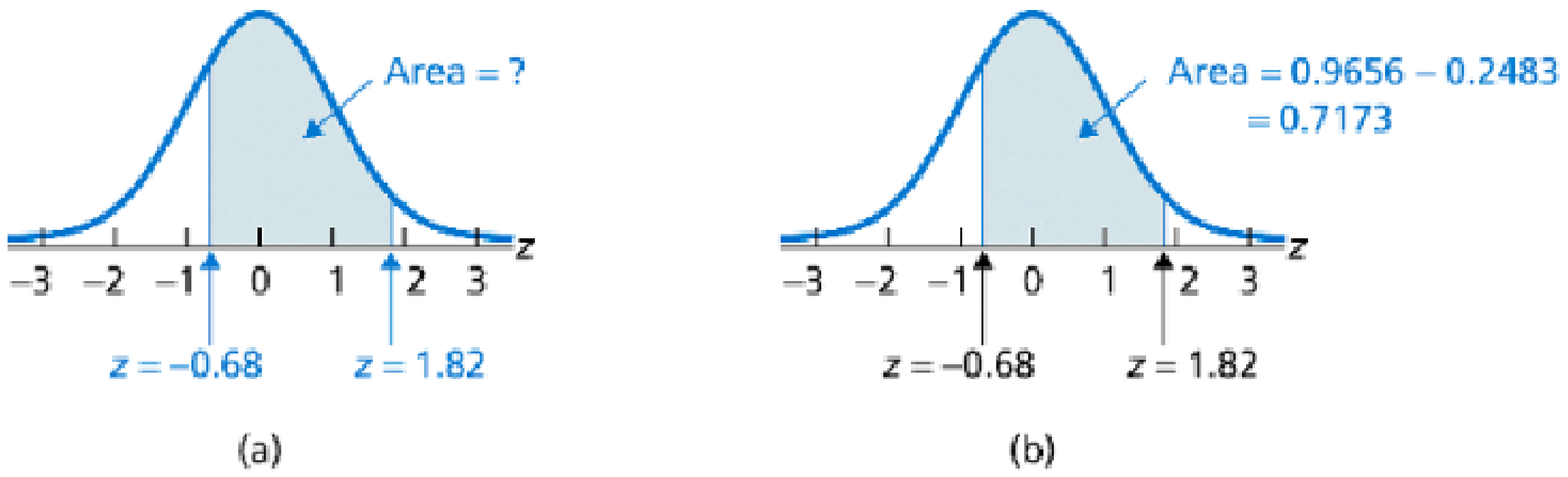


Finding the area under the standard normal curve to the right of 0.76

z = 0.76   Area 0.7764

Determine the area under the standard normal curve that lies between –0.68 and 1.82, as shown in Fig. 6.17(a).

Figure 6.17



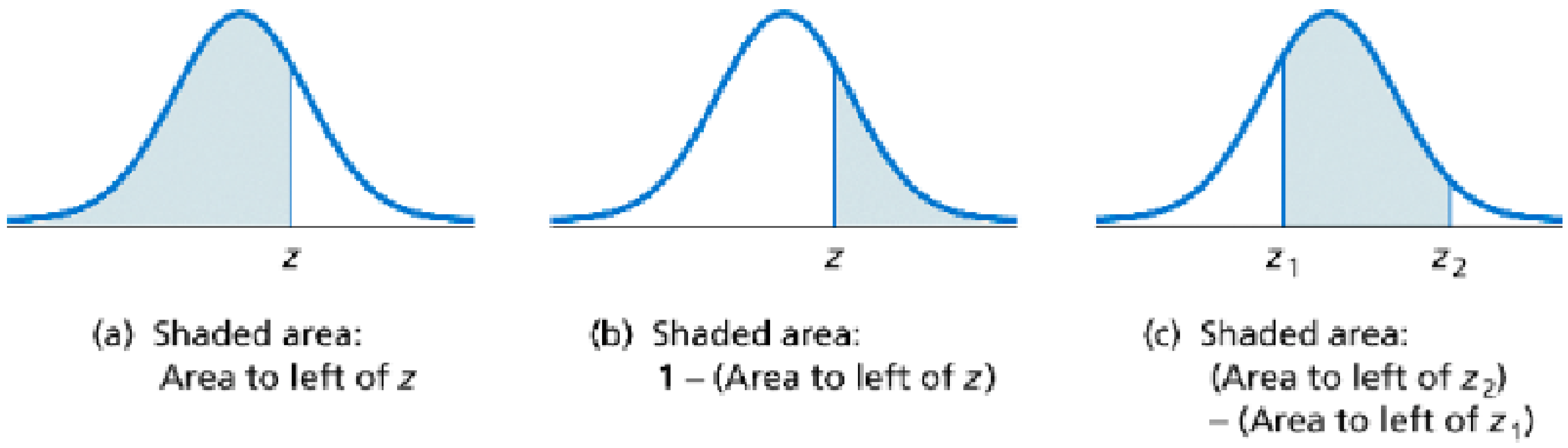
Finding the area under the standard normal curve that lies between −0.68 and 1.82

z-score −0.68 Area 0.2483

z-score 1.82 Area 0.9656

Z-score -1 to 1

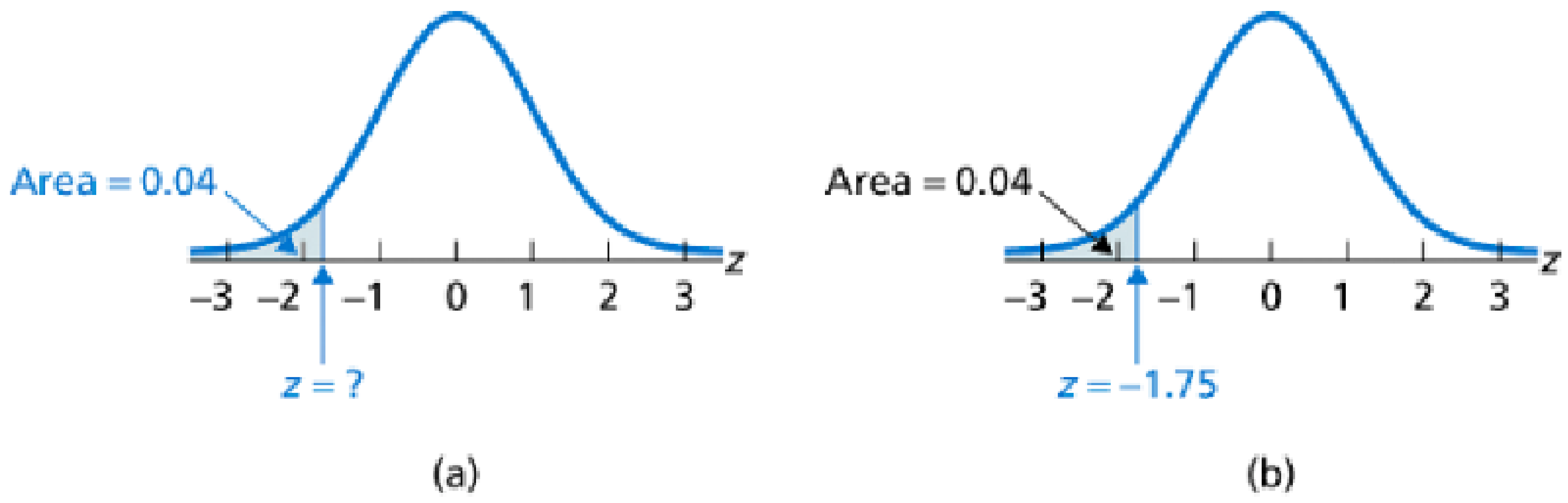
Figure 6.18



Using Table II to find the area under the standard normal curve that lies (a) to the left of a specified z-score, (b) to the right of a specified z-score, and (c) between two specified z-scores

Determine the z-score having an area of 0.04 to its left under the standard normal curve, as shown in Fig. 6.19(a).

Figure 6.19



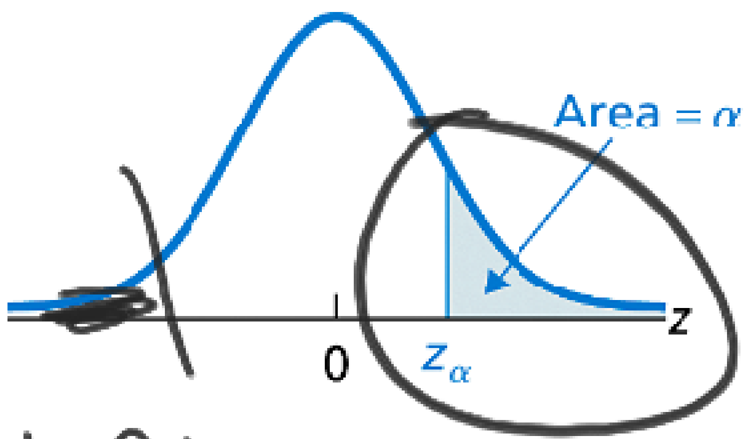
Finding the z-score having an area of 0.04 to its left

$z \to -1.75$

Definition 6.3: The z_α Notation

The symbol $\boldsymbol{z_\alpha}$ is used to denote the z-score that has an area of α (alpha) to its right under the standard normal curve, as illustrated in Fig. 6.20. Read "z_α" as "z sub α" or more simply as "z α."

Figure 6.20



−1.96

The z_α notation

Use Table II to find

a. $z_{0.025}$.

b. $z_{0.05}$.

$z_{0.025} = 1.96$

$1 - 0.025 = 1.96$

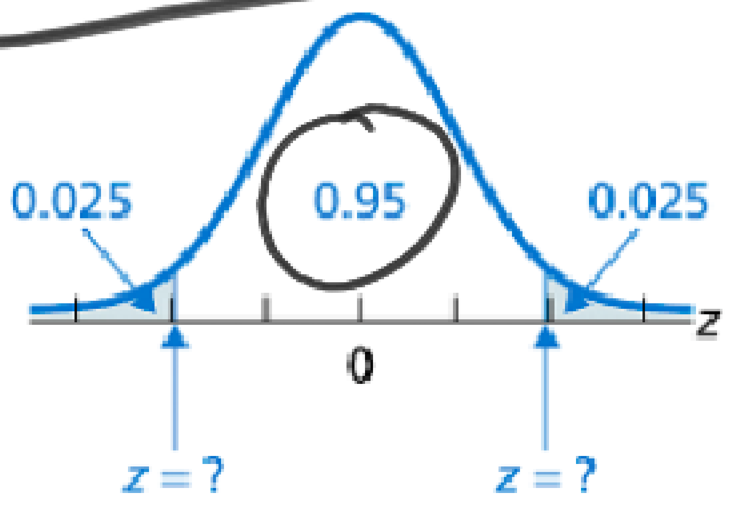
$.975$

$z_{0.975} = -1.96$

Example 6.10: Finding the z-Scores for a Specified Area

Find the two z-scores that divide the area under the standard normal curve into a middle 0.95 area and two outside 0.025 areas, as shown in Fig. 6.23(a).

Figure 6.23



−1.96 (a) 1.96

Finding the two z-scores that divide the area under the standard normal curve into a middle 0.95 area and two outside 0.025 areas

2 2

68% 95%, 99.7%

1 2 3

Key Fact 6.6: Empirical Rule for Variables

For any variable whose distribution is bell-shaped (in particular, for any normally distributed variable), the following three properties hold.

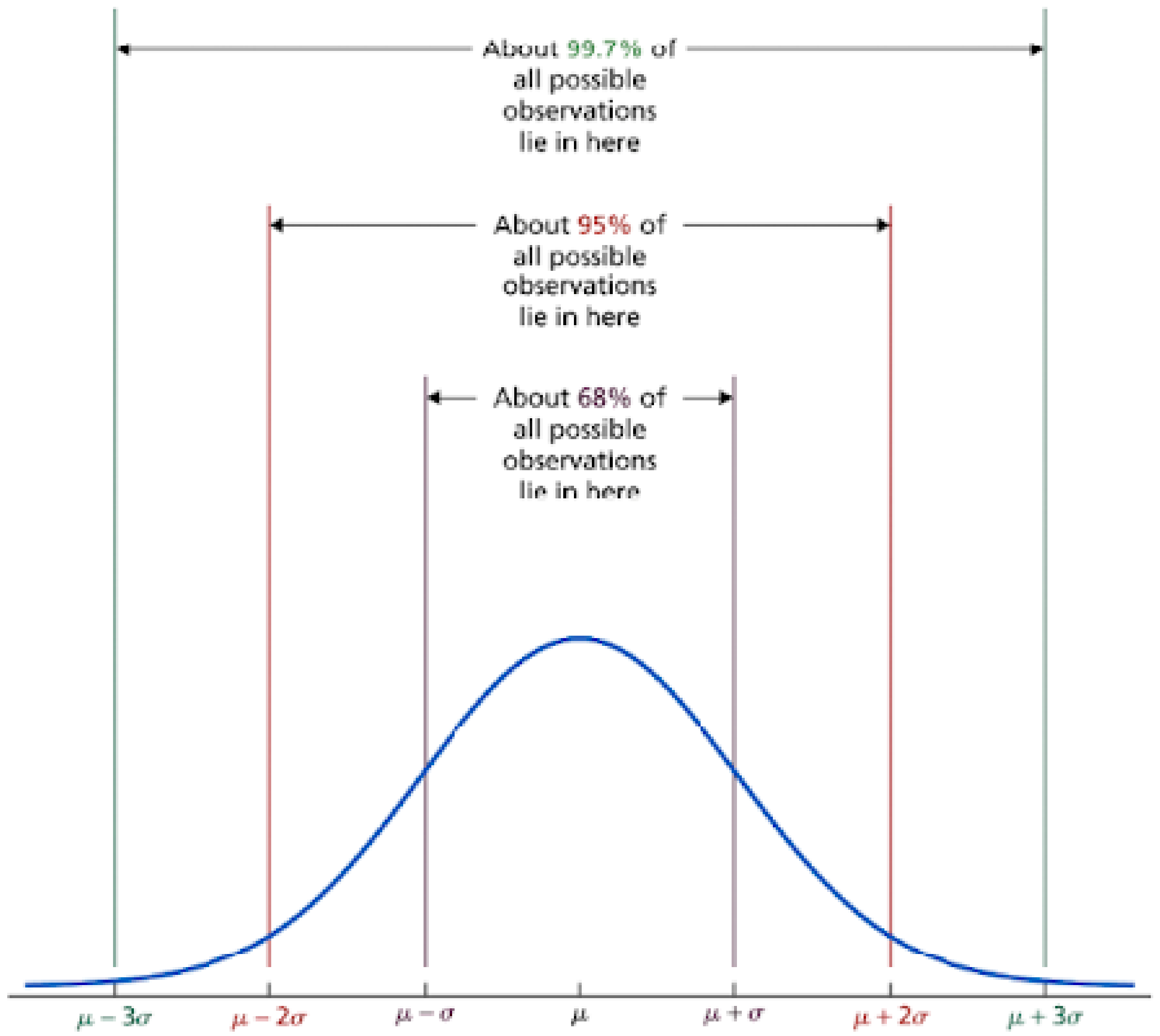
Property 1: Approximately 68% of all possible observations lie within one standard deviation to either side of the mean, that is, between $\mu - \sigma$ and $\mu + \sigma$.

Property 2: Approximately 95% of all possible observations lie within two standard deviations to either side of the mean, that is, between $\mu - 2\sigma$ and $\mu + 2\sigma$.

Property 3: Approximately 99.7% of all possible observations lie within three standard deviations to either side of the mean, that is, between $\mu - 3\sigma$ and $\mu + 3\sigma$.

These three properties are illustrated together in Fig. 6.26.

Figure 6.26



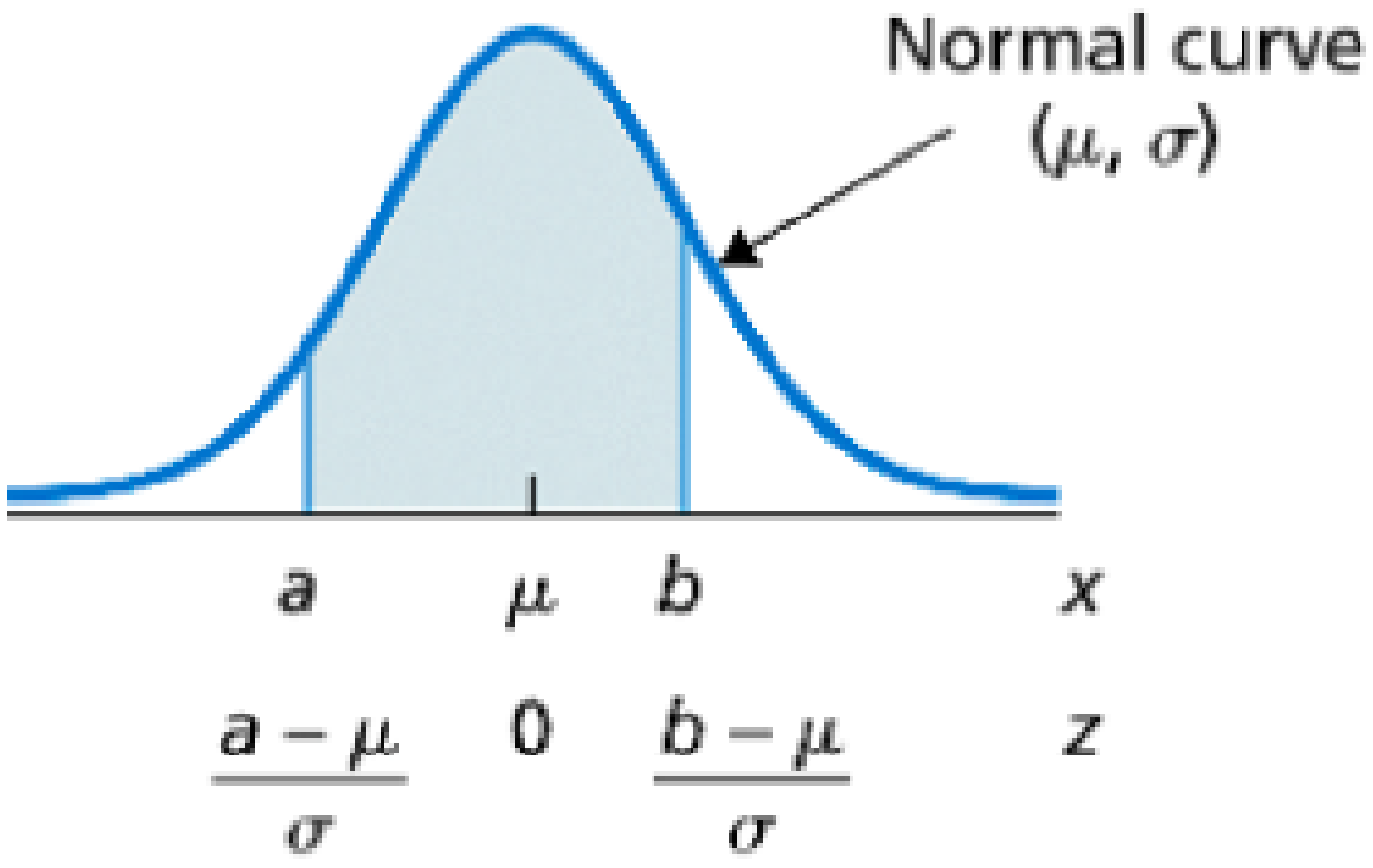
To Determine a Percentage or Probability for a Normally Distributed Variable

Step 1 Sketch the normal curve associated with the variable.

Step 2 Shade the region of interest and mark its delimiting x-value(s).

Step 3 Find the z-score(s) for the delimiting x-value(s) found in Step 2.

Step 4 Use Table II to find the area under the standard normal curve delimited by the z-score(s) found in Step 3.



Intelligence Quotients Intelligence quotients (IQs) measured on the Stanford Revision of the Binet–Simon Intelligence Scale are normally distributed with a mean of 100 and a standard deviation of 16. Determine the percentage of people who have IQs between 115 and 140.

$\mu = 100$ $\sigma = 16$ $a = 115$ $b = 140$

$z_1 = \frac{115 - 100}{16} = 0.94$ $z_2 = \frac{140 - 100}{16} = 2.50$

0.8264 0.9938

$0.9938 - 0.8264 = 0.1674$

16.74%

90^{th} percentile

$\mu = 100 \quad \sigma = 16$

$A \rightarrow .9000$

$z\text{-Score} = 1.28$

$IQ \rightarrow 120.5$

$$z = \frac{a - \mu}{\sigma}$$

$$\left(1.28 = \frac{\boxed{a} - 100}{16}\right) 16$$

$$20.48 = a - 100$$

$$+100 \qquad +100$$

$$\boxed{120.48 = a}$$

Mortality Mortality tables enable actuaries to obtain the probability that a person at any particular age will live a specified number of years. Insurance companies and others use such probabilities to determine life-insurance premiums, retirement pensions, and annuity payments.

According to tables provided by the National Center for Health Statistics in *Vital Statistics of the United States*, a person of age 20 years has about an 80% chance of being alive at age 65 years. In Example 5.12, we used the binomial probability formula to determine probabilities for the number of 20-year-olds out of three who will be alive at age 65.

For most real-world problems, the number of people under investigation is much larger than three. Although in principle we can use the binomial probability formula to determine probabilities regardless of number, in practice we do not. Suppose, for instance, that 500 people of age 20 years are selected at random. Find the probability that

a. exactly 390 of them will be alive at age 65.

b. between 375 and 425 of them, inclusive, will be alive at age 65.

$P(x=390)$

${}_{500}C_{390}(.80)^{390}(.20)^{110}$

a) $= 0.023$

b) $P(x=375) \to P(x=425)$

To Approximate Binomial Probabilities by Normal-Curve Areas

$n = 500 \quad p = .80$

Step 1 Find n, the number of trials, and p, the success probability.

Step 2 Continue only if both np and $n(1-p)$ are 5 or greater.

$\mu = 400$

Step 3 Find μ and σ, using the formulas $\mu = np$ and $\sigma = \sqrt{np(1-p)}$.

Step 4 Make the correction for continuity, and find the required area under the normal curve with parameters μ and σ.

$\mu = np = 500(.80) = 400$

$n(1-p) = 500(.20) = 100$

$\sigma = \sqrt{500(.8)(.2)}$

$\sigma = 8.94$

Mortality The probability is 0.80 that a person of age 20 years will be alive at age 65 years. Suppose that 500 people of age 20 are selected at random. Determine the probability that

a. exactly 390 of them will be alive at age 65.

b. between 375 and 425 of them, inclusive, will be alive at age 65.

$\mu = 400$

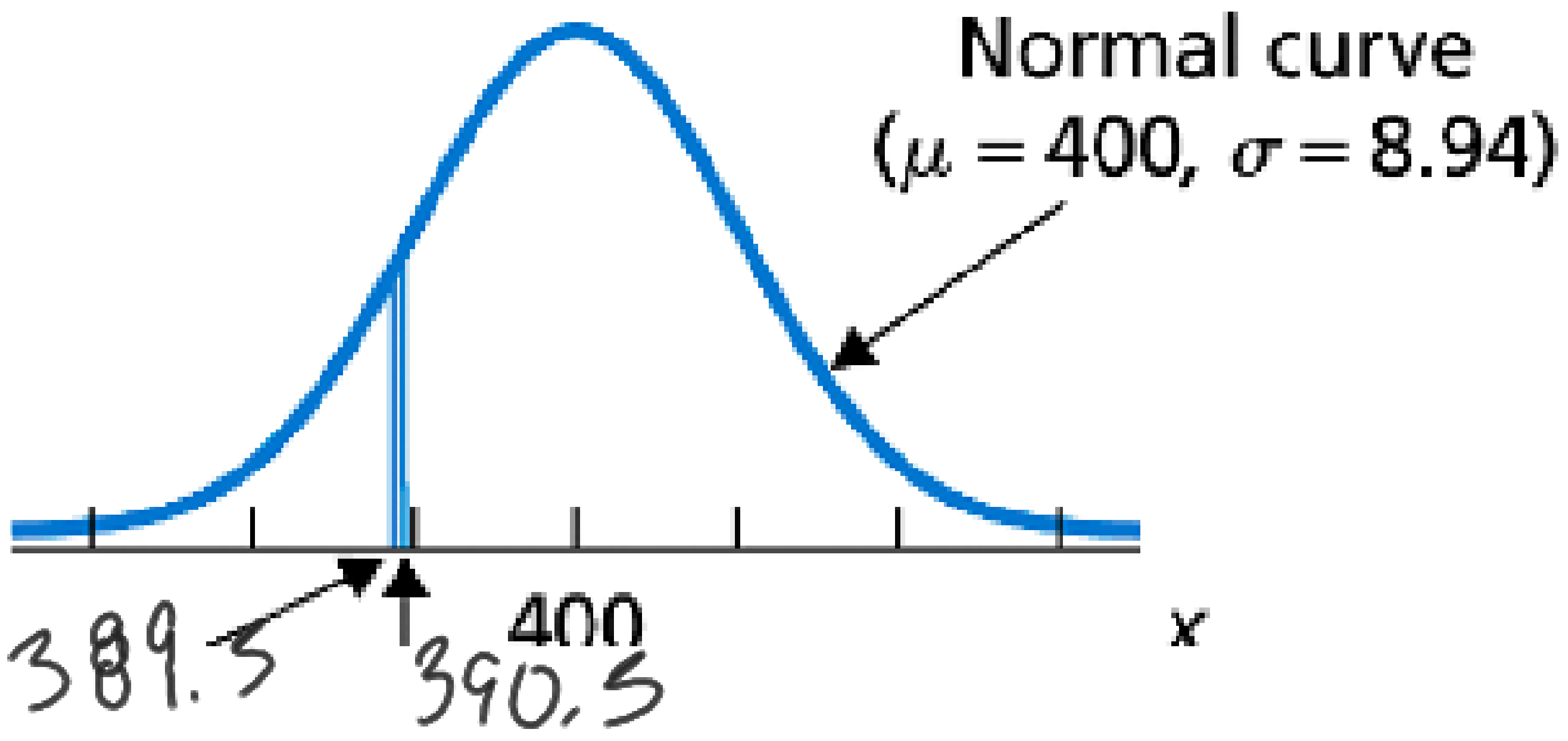
$\sigma = 8.94$

a) 0,0236

$z_1 = \dfrac{389,5 - 400}{8.94} = -1,17\ (0,1210)$

$z_2 = \dfrac{390.5 - 400}{8.94} = -1,06\ (0,1446)$

0,0236



Mortality The probability is 0.80 that a person of age 20 years will be alive at age 65 years. Suppose that 500 people of age 20 are selected at random. Determine the probability that

a. exactly 390 of them will be alive at age 65.

b. between 375 and 425 of them, inclusive, will be alive at age 65.

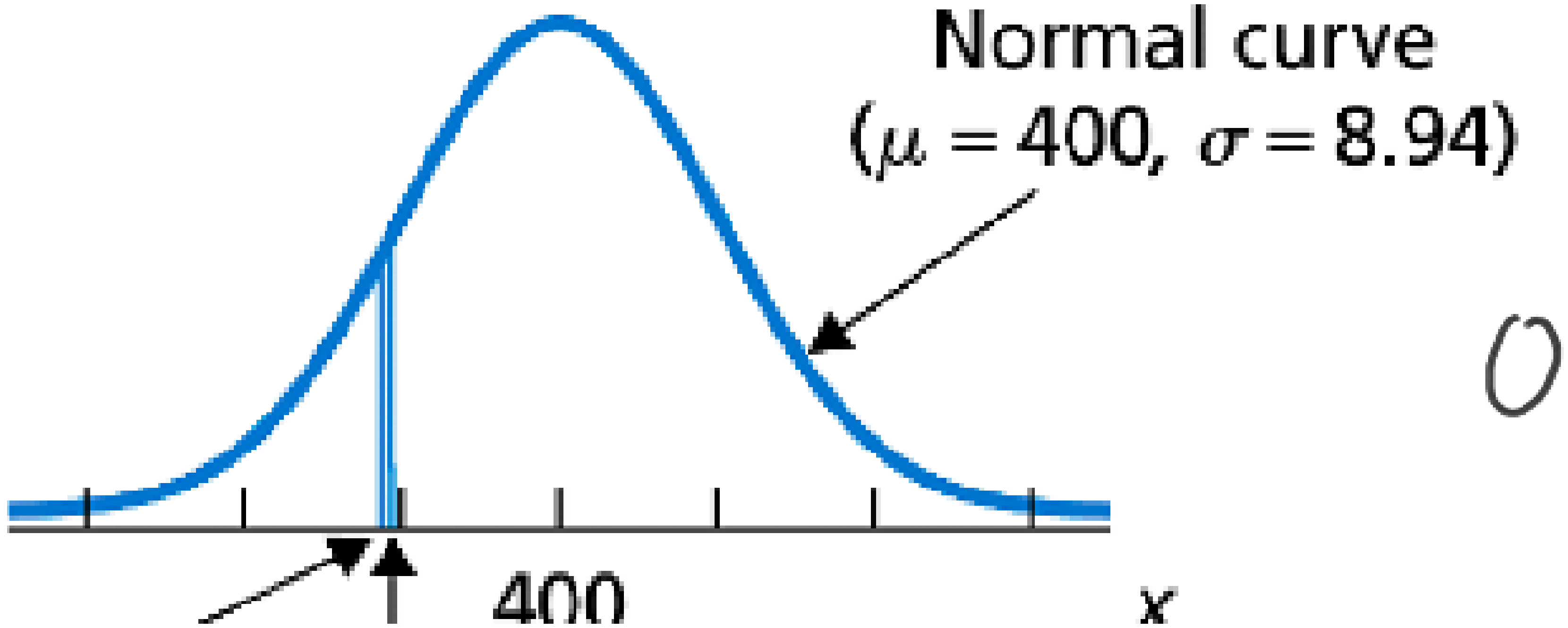
$\mu = 400$

$\sigma = 8.94$

b) 375 - 425

$z_1 = \frac{374.5 - 400}{8.94} = -2.85$

$z_2 = \frac{425.5 - 400}{8.94} = 2.85$



$0.9978 - 0.0022 =$

0.9956

12. Consider the normal curves that have the parameters $\mu = 1.5$ and $\sigma = 3$; $\mu = 1.5$ and $\sigma = 6.2$; $\mu = -2.7$ and $\sigma = 3$; $\mu = 0$ and $\sigma = 1$.

a. Which curve has the largest spread? 2

b. Which curves are centered at the same place? 1, 2

c. Which curves have the same spread? 1, 3

d. Which curve is centered farthest to the left? 3

e. Which curve is the standard normal curve? 4

1) $\mu = 1.5$ $\sigma = 3$

2) $\mu = 1.5$ $\sigma = 6.2$

3) $\mu = -2.7$ $\sigma = 3$

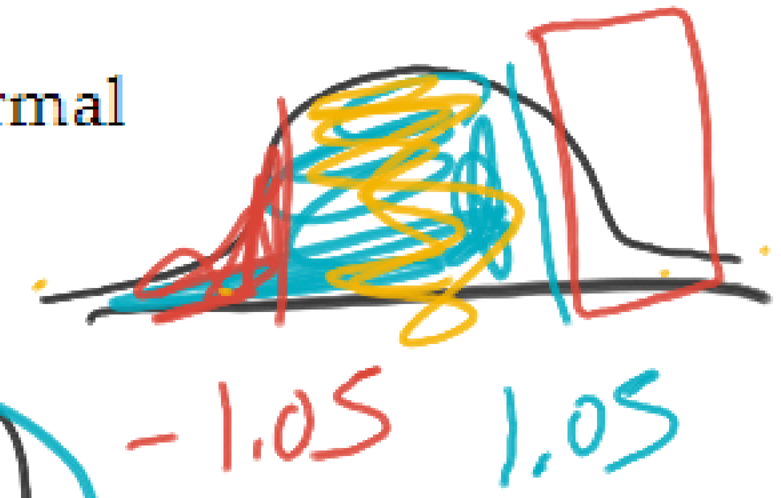
4) $\mu = 0$ $\sigma = 1$

21. According to Table II, the area under the standard normal curve that lies to the left of 1.05 is 0.8531. Without further reference to Table II, determine the area under the standard normal curve that lies

a. to the right of 1.05.

b. to the left of −1.05.

c. between −1.05 and 1.05.



Z-score 1.05

Area 0.8531

a) 1 − 0.8531 = 0.1469

b) 0.1469

c) 1 − 0.1469 − 0.1469 = 0.7062

22. Determine and sketch the area under the standard normal curve that lies

a. to the left of -3.02.

b. to the right of 0.61.

c. between 1.11 and 2.75.

d. between -2.06 and 5.02.

e. between -4.11 and -1.5.

f. either to the left of 1 or to the right of 3.

27. Lower Limb Surgery. The study "Intrathecal Sufentanil versus Fentanyl for Lower Limb Surgeries – A Randomized Controlled Trial" (*Journal of Anaesthesiology Clinical Pharmacology*, Vol. 27, Issue 1, pp. 67 73) by P. Motiani et al. compares two different agents, intrathecal sufentail and fentanyl, used in enhancing the anesthesiology of patients receiving major lower limb surgery. One variable compared between the two agents was the amount of blood loss during the surgery. Based on the study, we will assume that, using fentanyl, the amount of blood loss during major lower limb surgery is normally distributed with mean 283.3 ml and standard deviation 83.3 ml. Find the percentage of patients whose amount of blood loss during major lower limb surgery using fentanyl is

a. less than 304 ml.

b. between 221 and 429 ml.

c. more than 450 ml.

c) $\frac{450-283.3}{83.3} = 2$

$1 - 0.9772$

0.0228

a) $\frac{304-283.3}{83.3} = 0.25$ $\boxed{0.5987}$

b) $\frac{221-283.3}{83.3} = -0.75$ 0.2266

$\frac{429-283.3}{83.3} = 1.75$ 0.9599 $\boxed{0.7333}$

28. Verbal GRE Scores. The Graduate Record Examination (GRE) is a standardized test that students usually take before entering graduate school. According to the document *GRE Guide to the Use of Scores*, a publication of the Educational Testing Service, the scores on the verbal portion of the GRE have mean 150 points and standard deviation 8.75 points. Assuming that these scores are (approximately) normally distributed,

a. obtain and interpret the quartiles.

b. find and interpret the 99th percentile.

29. Verbal GRE Scores. Refer to Problem 28, and fill in the following blanks.

a. Approximately 68% of students who took the verbal portion of the GRE scored between _______ and _______.

b. Approximately 95% of students who took the verbal portion of the GRE scored between _______ and _______.

c. Approximately 99.7% of students who took the verbal portion of the GRE scored between _______ and _______.

32. Diarrhea Vaccine. Acute rotavirus diarrhea is the leading cause of death among children under age 5, killing an estimated 4.5 million annually in developing countries. Scientists from Finland and Belgium claim that a new oral vaccine is 80% effective against rotavirus diarrhea. Assuming that the claim is correct, use the normal approximation to the binomial distribution to find the probability that, out of 1500 cases, the vaccine will be effective in

a. exactly 1225 cases.

b. at least 1175 cases.

c. between 1150 and 1250 cases, inclusive.

Second decimal place in z										
0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	z
									0.0000	-3.9
0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	3.8
0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	3.7
0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	-3.6
0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	-3.5
0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	-3.4
0.0003	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0005	0.0005	0.0005	-3.3
0.0005	0.0005	0.0005	0.0006	0.0006	0.0006	0.0006	0.0006	0.0007	0.0007	-3.2
0.0007	0.0007	0.0008	0.0008	0.0008	0.0008	0.0009	0.0009	0.0009	0.0010	3.1
0.0010	0.0010	0.0011	0.0011	0.0011	0.0012	0.0012	0.0013	0.0013	0.0013	-3.0

Second decimal place in z										
0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	z
0.0014	0.0014	0.0015	0.0015	0.0016	0.0016	0.0017	0.0018	0.0018	0.0019	-2.9
0.0019	0.0020	0.0021	0.0021	0.0022	0.0023	0.0023	0.0024	0.0025	0.0026	-2.8
0.0026	0.0027	0.0028	0.0029	0.0030	0.0031	0.0032	0.0033	0.0034	0.0035	-2.7
0.0036	0.0037	0.0038	0.0039	0.0040	0.0041	0.0043	0.0044	0.0045	0.0047	-2.6
0.0048	0.0049	0.0051	0.0052	0.0054	0.0055	0.0057	0.0059	0.0060	0.0062	-2.5
0.0064	0.0066	0.0068	0.0069	0.0071	0.0073	0.0075	0.0078	0.0080	0.0082	2.4
0.0084	0.0087	0.0089	0.0091	0.0094	0.0096	0.0099	0.0102	0.0104	0.0107	2.3
0.0110	0.0113	0.0116	0.0119	0.0122	0.0125	0.0129	0.0132	0.0136	0.0139	2.2
0.0143	0.0146	0.0150	0.0154	0.0158	0.0162	0.0166	0.0170	0.0174	0.0179	-2.1
0.0183	0.0188	0.0192	0.0197	0.0202	0.0207	0.0212	0.0217	0.0222	0.0228	-2.0

Second decimal place in z										
0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	z
0.0233	0.0239	0.0244	0.0250	0.0256	0.0262	0.0268	0.0274	0.0281	0.0287	−1.9
0.0294	0.0301	0.0307	0.0314	0.0322	0.0329	0.0336	0.0344	0.0351	0.0359	−1.8
0.0367	0.0375	0.0384	0.0392	0.0401	0.0409	0.0418	0.0427	0.0436	0.0446	−1.7
0.0455	0.0465	0.0475	0.0485	0.0495	0.0505	0.0516	0.0526	0.0537	0.0548	1.6
0.0559	0.0571	0.0582	0.0594	0.0606	0.0618	0.0630	0.0643	0.0655	0.0668	−1.5
0.0681	0.0694	0.0708	0.0721	0.0735	0.0749	0.0764	0.0778	0.0793	0.0808	1.4
0.0823	0.0838	0.0853	0.0869	0.0885	0.0901	0.0918	0.0934	0.0951	0.0968	−1.3
0.0985	0.1003	0.1020	0.1038	0.1056	0.1075	0.1093	0.1112	0.1131	0.1151	−1.2
0.1170	0.1190	0.1210	0.1230	0.1251	0.1271	0.1292	0.1314	0.1335	0.1357	−1.1
0.1379	0.1401	0.1423	0.1446	0.1469	0.1492	0.1515	0.1539	0.1562	0.1587	−1.0

Second decimal place in z										
0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	z
0.1611	0.1635	0.1660	0.1685	0.1711	0.1736	0.1762	0.1788	0.1814	0.1841	0.9
0.1867	0.1894	0.1922	0.1949	0.1977	0.2005	0.2033	0.2061	0.2090	0.2119	-0.8
0.2148	0.2177	0.2206	0.2236	0.2266	0.2296	0.2327	0.2358	0.2389	0.2420	0.7
0.2451	0.2483	0.2514	0.2546	0.2578	0.2611	0.2643	0.2676	0.2709	0.2743	-0.6
0.2776	0.2810	0.2843	0.2877	0.2912	0.2946	0.2981	0.3015	0.3050	0.3085	0.5
0.3121	0.3156	0.3192	0.3228	0.3264	0.3300	0.3336	0.3372	0.3409	0.3446	-0.4
0.3483	0.3520	0.3557	0.3594	0.3632	0.3669	0.3707	0.3745	0.3783	0.3821	0.3
0.3859	0.3897	0.3936	0.3974	0.4013	0.4052	0.4090	0.4129	0.4168	0.4207	-0.2
0.4247	0.4286	0.4325	0.4364	0.4404	0.4443	0.4483	0.4522	0.4562	0.4602	-0.1
0.4641	0.4681	0.4721	0.4761	0.4801	0.4840	0.4880	0.4920	0.4960	0.5000	-0.0

	Second decimal place in *z*									
z	*0.00*	*0.01*	*0.02*	*0.03*	*0.04*	*0.05*	*0.06*	*0.07*	*0.08*	*0.09*
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389

	Second decimal place in *z*									
z	*0.00*	*0.01*	*0.02*	*0.03*	*0.04*	*0.05*	*0.06*	*0.07*	*0.08*	*0.09*
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767

	Second decimal place in *z*									
z	*0.00*	*0.01*	*0.02*	*0.03*	*0.04*	*0.05*	*0.06*	*0.07*	*0.08*	*0.09*
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986

	Second decimal place in *z*									
z	*0.00*	*0.01*	*0.02*	*0.03*	*0.04*	*0.05*	*0.06*	*0.07*	*0.08*	*0.09*
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.7	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.8	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.9	1.0000[†]									