1. The incubation time for Rhode Island Red chicks is normally distributed with a mean of $\mu = 21$ days and a standard deviation of about $\sigma = 1$ day. If 1000 eggs are being incubated, how many chicks do we expect to hatch

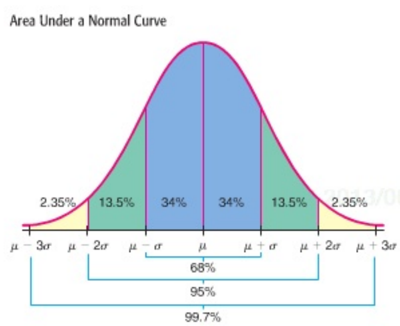
   (a) on day 21 or after?

   (b) between 20 and 21 days?

   (c) between 22 and 23 days?

   (d) between 19 and 22 days?

2. The Empirical Rule tells us the percentage of data values that lie within certain intervals about the mean when we have a normal distribution as follows.



   (a) According to Chebyshev's Theorem, what is the minimum percentage of data that must lie within the interval $\mu - 2\sigma$ to $\mu + 2\sigma$? How does this compare to the results for the Empirical Rule?

   (b) The diagram for the Empirical Rule only accounts for 99.7% of the data values. Where do the remaining 0.3% of the data fall?

(c) Keeping in mind that remaining 0.3% of the data, what percentage of the data values lie to the left of $\mu - \sigma$?

(d) Keeping in mind that remaining 0.3% of the data, what percentage of the data values lie to the left of $\mu + 2\sigma$?

3. In preparation for Sections 6.2 and 6.3 (of Brase and Brase), suppose the mean of a normal distribution is $\mu = 75$ with a standard deviation of $\sigma = 8$. For each of the following values of the random variable x, determine whether x is above or below the mean and then determine the number of standard deviations away from the mean that x lies. (Note that your second answer could be a fraction or decimal number.)

   (a) $x = 83$

   (b) $x = 51$

   (c) $x = 79$

   (d) $x = 65$

4. Hydraulic pressure in the main cylinder of the landing gear of a commercial jet is very important for a safe landing. In-flight landing tests show that the actual pressure in the main cylinders is variable (approximately normal) with a mean of 819 pounds per square inch and a standard deviation of 23 pounds per square inch, which are considered safe.

   Two different planes were tested with 10 test-landings.

landing number for plane A	1	2	3	4	5	6	7	8	9	10
pressure	870	855	830	815	847	836	825	810	792	820

landing number for plane B	1	2	3	4	5	6	7	8	9	10
pressure	865	850	841	820	815	789	801	765	730	725

(a) Is the pressure for Plane A "in control" or not? If not, describe the specific out-of-control signals present.

(b) Is the pressure for Plane B "in control" or not? If not, describe the specific out-of-control signals present.

5. Let x be a random variable with a normal distribution with mean $\mu = 15$ and standard deviation $\sigma = 4$. Find the indicated probability.

   (a) $P(x \leq 12)$

   (b) $P(x > 10)$

   (c) $P(15 \leq x \leq 20)$

   (d) $P(8 < x < 22)$

6. Find the z-value described.

   (a) Find z such that 5.2% of the standard normal curve lies to the left of z.

   (b) Find z such that 5% of the standard normal curve lies to the right of z.

(c) Find z such that 95% of the standard normal curve lies between $-z$ and $+z$.

7. Suppose that the scores for a Chemistry midterm had a normal distribution with mean $\mu = 71.4$ and a standard deviation of $\sigma = 8.3$.

   (a) Find the exam score for a student that scored in the 80th percentile.

   (b) Find the exam score for a student that scored in the 25^{th} percentile.

   (c) Find the exam score for a student who score lower than 60% of the class.

8. Suppose the distribution of heights of American men (20 years of age and older) is approximately normal with a mean of 69.4 inches and a standard deviation of 3 inches.

   (a) What is the z value for a height of 6 feet?

   (b) What percentage of American men (20 years of age and older) are shorter than 6 feet?

   (c) What is the z value for a height of 6 feet 4 inches?

   (d) What percentage of American men (20 years of age and older) are taller than 6 feet 4 inches?

9. Accrotime is a manufacturer of quartz crystal watches. Accrotime researchers have shown that the watches have an average life of 28 months before certain electronic components deteriorate, causing the watch to become unreliable. The standard deviation of watch lifetimes is 5 months, and the distribution of lifetimes is normal.

   (a) If Accrotime guarantees a full refund on any defective watch for 2 years, what percentage of total production will the company expect to replace?

   (b) If Accrotime does not want to make refunds on more than 12% of the watches it makes, how long should the guarantee period be (to the nearest month)?

This section of the problem set is an activity with the goal of simulating a sampling distribution of sample means. The first part of the activity is for each of you to generate a list of sample means. After the data is gathered, the second part directs you to use the results of the entire class to analyze the outcome.

10. Attached to this page is a copy of a random number table for the population of digits {0, 1, 2, 3, 4, 5, 6, 7, 8, 9}. Assuming that this random distribution is uniform:

    (a) What is the population mean of the digits?

    (b) What is the population standard deviation of the digits?

11. Repeat the following steps 10 times. In the end, you will have generated 10 different sample means. Please do NOT simply copy a classmate's values on this part, but please do your own work so that you really are generating your own list of sample means.

    (a) *Randomly* select a spot on the random number table.
    (b) Write down the next 10 digits listed from that spot horizontally (if you reach the end of a row, wrap around to the start of the next row to complete your list of 10).
    (c) Compute the mean of that sample of 10 random digits.

Sample	List of 10 digits	Sample mean
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

(a) Looking at the list of sample means, there should be a variety of values, but they are not uniformly distributed. What is the shape of the distribution for the sample means?

(b) What is the mean of the sample means?

(c) What is the standard deviation of the sample means?

(d) In Section 6.5, one of the most critical theorems in statistics is introduced; the Central Limit Theorem. Essentially it says that a sampling distribution for sample means (where the sample size for all samples is n) will have a distribution close to a normal distribution. Further, the mean of the sample means will equal the population mean μ and the standard deviation of the sample means will equal $\frac{\sigma}{\sqrt{(n)}}$. How did the simulation the class do match up to the theorem?

i. Was the shape of the distribution of sample means approximately normal?

ii. Was the mean of the sample means close the the population mean μ?

iii. What was the sample size for our sample means?

iv. Was the standard deviation of the sample means close to the value $\frac{\sigma}{\sqrt{(n)}}$?

61925	80296	81048	97191	65182	62823	10742	16859
94295	40339	04553	19656	77645	15044	72815	42638
20489	38455	95724	74646	74441	90397	48630	55843
50196	06330	77568	87054	82858	59692	62171	27887
28401	97510	63507	14396	39005	57078	71002	24425
70166	51421	84055	25146	81476	27963	52337	43004
36990	16507	18768	13186	83106	45919	07088	96302
85534	71355	36030	28950	72154	48467	44779	16152
50436	30876	80367	60422	23807	09524	47154	88821
15563	06020	00440	47708	91417	37725	33132	55409
01998	89558	47105	15197	45209	30907	06551	50400
62520	96703	79896	55312	03159	66495	69833	94662
91269	44061	72584	39158	76508	18334	39357	17935
05261	73655	31712	49990	62790	66238	95738	68712
46872	88291	88853	28213	09230	43522	04376	01097
57537	28708	52451	81740	54828	89445	15368	88252
93961	64027	34451	86870	03580	78046	58328	25606
69069	40891	00524	05644	90945	73206	03562	89309
86498	21297	70483	03222	89177	41766	12623	87141
62954	79629	23938	42506	49417	89076	15841	39822
95367	67265	82947	91696	76231	75523	34769	30496
80020	56428	89291	56413	87558	54781	59877	62363
09044	02511	50612	79715	02350	32726	00555	45628
97082	30301	56266	11652	41540	93693	08757	92349
12035	21941	67738	67779	65084	05455	19931	87557
91127	43364	33080	46088	74341	94220	47999	62175
25908	69511	47524	78623	74916	39083	65575	64050
78722	65845	14570	65316	00228	49114	86801	79881
70614	15407	87446	90296	76886	55712	99475	78640
87375	73649	90224	66087	97674	51490	33674	33062
49020	17419	46180	92223	00435	48319	05835	15259
17166	11381	63515	31285	79637	61059	54923	87088
76800	57187	93248	63792	16994	07972	75337	27559
64908	22971	70837	30040	55497	68496	31017	10329
96544	60453	21956	56385	53366	35717	43402	80397
20746	02656	82890	95256	70346	78118	53885	66594
09892	03858	79466	25230	51696	25191	51192	75978
81858	67653	85167	03555	99327	02354	20941	67509
84720	32523	17979	43334	16695	08921	97849	82652
72587	40135	61067	03486	14823	29200	92719	04474
56184	34983	76341	16558	54501	90579	36423	21885
27450	90680	58388	76586	11463	35729	08493	74794
22145	87103	27731	27265	58039	86787	39272	59717
40895	92160	80252	24620	32471	54763	45115	67202
68748	58228	61061	84631	74528	65734	44959	40212
19113	62398	17033	62039	64810	36149	72632	71294
82737	66688	76923	56416	76116	60870	91064	26867
29151	07681	87947	05515	15998	85174	09101	64331
66222	93965	41586	48417	41772	25784	05094	76419
10234	59020	70872	74099	45788	83137	63222	12522

12. Suppose a population has a distribution with $\mu = 72$ and $\sigma = 8$.

    (a) If we know nothing about the original population distribution and random samples of size $n = 16$ are selected, why can't we say anything about the $\bar{x}$ distribution of sample means?

    (b) If we know that the original population distribution is normal, then what can we say about the $\bar{x}$ distribution of random samples of $n = 16$. In this case, find $P(68 \leq \bar{x} \leq 73)$.

13. The heights of 18-year-old men are approximately normally distributed, with a mean of 68 inches and a standard deviation of 3 inches.

    (a) What is the probability that an 18-year-old man selected at random is between 67 and 69 inches tall?

    (b) If a random sample of nine 18-year-old men are selected at random, what is the probability that the mean height of the sample $\bar{x}$ is between 67 and 69 inches?

    (c) Explain why the probability in part (b) is so much higher than the probability in part (a) even though they both refer to the same interval of heights (67 to 69 inches).

14. Let x be a random variable that represents white blood cell count per cubic milliliter of whole blood. Assume that x has a distribution that is approximately normal with a mean of $\mu = 7500$ and estimated standard deviation of $\sigma = 1750$. A test result of $x < 3500$ is an indication of leukopenia. This indicates bone marrow repression that may be the result of a viral infection.

(a) What is the probability that, on a single test, x is less than 3500?

(b) Suppose a doctor uses the average $\bar{x}$ for two tests taken about a week apart. What can we say about the probability distribution of $\bar{x}$? What is the probability that $\bar{x} < 3500$?

(c) Repeat part (b) but with $n = 3$ tests.

(d) How did the probabilities change as n increased? What do such results imply about a patient that has $\bar{x} < 3500$ for 3 those tests?

15. Assume that IQ scores are normally distributed, with a standard deviation of 15 points and a mean of 100 points. If 10 people are chosen at random, what is the probability that the sample mean of their IQ scores will not differ from the population mean by more than 2 points?

16. A large tank of fish from a hatchery is being delivered to a lake. The hatchery claims that the mean length of fish in the tank is 15 inches, and the standard deviation is 2 inches. A random sample of 36 fish is taken from the tank. Let $\bar{x}$ be the mean length of the sample. What is the probability that $\bar{x}$ is within 0.5 inches of the claimed population mean?