

# Statistics 2000, Section 001, Midterm 1 (185 Points)

Friday, February 11, 2011

## Part I: Text Answers

Your Name: \_\_\_\_\_

### Question 1: z-Scores and Normal Distributions (50 Points)

The temperature at any random location in a kiln used for manufacturing bricks is normally distributed with a mean of  $1000^{\circ}\text{F}$  and a standard deviation of  $50^{\circ}\text{F}$ .

Show your work!

1. (10 Points) What is the z-score that relates to  $1075^{\circ}\text{F}$ ?
2. (10 Points) A z-score of  $-2.75$  relates to a temperature of \_\_\_\_\_ $^{\circ}\text{F}$ ?
3. (10 Points) If bricks are fired at a temperature above  $1125^{\circ}\text{F}$ , they will crack and must be discarded. If the bricks are placed randomly throughout the kiln, what is the percentage of bricks that crack during the firing process?
4. (10 Points) When glazed bricks are put in the oven, if the temperature is below  $900^{\circ}\text{F}$ , they will discolor. If the bricks are placed randomly throughout the kiln, what percentage of glazed bricks will discolor?
5. (10 Points) Suppose the kiln can hold 10,000 bricks at a time. When completely filled, bricks at the 1,000 hottest locations will be exposed to temperatures of \_\_\_\_\_ $^{\circ}\text{F}$  (and higher).

**Question 2: Boxplots (45 Points)**

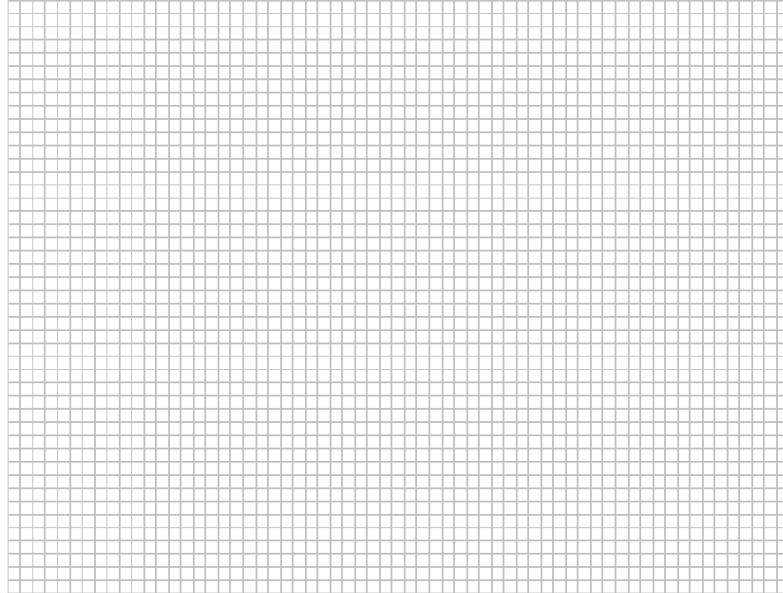
**Longleaf pine trees:** The Wade Tract in Thomas County, Georgia, is an old-growth forest of longleaf pine trees (*Pinus palustris*) that has survived in a relatively undisturbed state since before the settlement of the area by Europeans. A study collected data about 584 of these trees. One of the variables measured was the diameter at breast height (DBH). This is the diameter of the tree at 4.5 feet and the units are centimeters (cm). Only trees greater than 1.5 cm were sampled. Here are the diameters of a random sample of  $n = 11$  of these trees. The data have been sorted from smallest to largest:

$i$	$x_{(i)}$
1	2.3
2	2.7
3	11.4
4	13.3
5	18.3
6	26.0
7	32.6
8	43.6
9	47.2
10	52.2
11	69.3

**Show your work!**

- (20 Points)** Calculate the values for the five number summary for DBH and clearly name each of these values (e.g., if variance is one of these numbers than indicate “variance = ...”).
  - 1.)
  - 2.)
  - 3.)
  - 4.)
  - 5.)
- (5 Points)** First indicate the formula, and then calculate the IQR.

3. **(15 Points)** Draw a boxplot for the 11 observations above from the DBH data set. Make sure to label your graph! Be careful with outliers (in case there are any).



4. **(5 Points)** Based on your boxplot, is the distribution of DBH (i) roughly symmetric, (ii) skewed to the right, or (iii) skewed to the left? **Just circle your answer.**



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**Part II: Multiple Choice Questions**

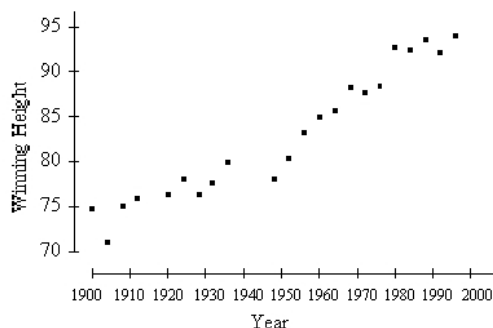
**Your Name:** \_\_\_\_\_

**Question 4: Multiple Choice Questions (60 Points)**

**Mark your answer for each multiple choice question in the table below. There is only one correct answer for each question.** Each correct answer is worth 4 points.

Question	(a)	(b)	(c)	(d)	Question	(a)	(b)	(c)	(d)
1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	11	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	12	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	13	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	14	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	15	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
7	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
8	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
9	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					
10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					

1. Below is a plot of the Olympic gold medal winning performance in the high jump (in inches) for the years 1900 to 1996.



- From this plot, the correlation between the winning height and year of the jump is
- (a) about 0.95.
  - (b) about 0.10.
  - (c) about  $-0.50$ .
  - (d) Can't be calculated for these types of data.
2. All but one of the following statements contain a blunder. Which one does not contain a blunder?
- (a) "The correlation between students' scores in an English exam and a Statistics exam was found to be  $r = 1.03$ ."
  - (b) "There is a correlation of  $r = 0.54$  between the position a football player plays and his or her weight."
  - (c) "The correlation between amount of fertilizer and yield of tomatoes was found to be  $r = 0.33$ ."
  - (d) "The correlation between the gas mileage of a car and its weight is  $r = 0.71$  gallon-pounds."
3. If females of a certain species of lizard always mate with males that are 0.50 years younger than they are, what would the correlation between the ages of these male and female lizards be?
- (a) 1.00.
  - (b) 0.50.
  - (c)  $-1.00$ .
  - (d)  $-0.50$ .

4. Which of the following is true of the slope of the least-squares regression line?
- (a) It has the same sign as the correlation.
  - (b) The square of the slope equals the fraction of the variation in the response variable that is explained by the explanatory variable.
  - (c) It is unitless.
  - (d) It can only take values between  $-1.00$  and  $1.00$ .
5. For a physics course containing 11 students, the maximum point total for the semester was 200. The point totals for the 11 students are given in the stem-and-leaf plot below.

11	6	8	
12	1	4	8
13	3	3	7
14	2	6	
15			
16			
17	9		

- Which of the following statements is correct?
- (a) Since there are 7 stems, the median must be contained in the fourth smallest stem and be between 140 and 150.
  - (b) We can compute the mean number of points for the 11 students from the information in the stem-and-leaf plot.
  - (c) Because of the small sample size, it would be impossible to split the stems in this stem-and-leaf plot.
  - (d) The median is 130.5 points.
6. A teacher gave a 25 question multiple-choice test. After scoring the tests, she computed a mean and standard deviation of the scores. The standard deviation was 0. Based on this information, what would be the best explanation?
- (a) All the students had the same score.
  - (b) She must have made a mistake.
  - (c) About half the scores were above the mean.
  - (d) The scores were symmetric around the mean, e.g., in case the mean equals 20, for a student with 21 points, there must be a student with 19 points; for a student with 15 points, there must be a student with 25 points, etc.

7. A sample was taken of the salaries of 20 employees from a large company. The following are the salaries (in thousands of dollars) for this year (the data are ordered).

28 31 34 35 37 41 42 42 42 47  
49 51 52 52 60 61 67 72 75 77

Suppose each employee in the company receives a \$3,000 raise for next year (each employee's salary is increased by \$3,000). The interquartile range of the salaries will

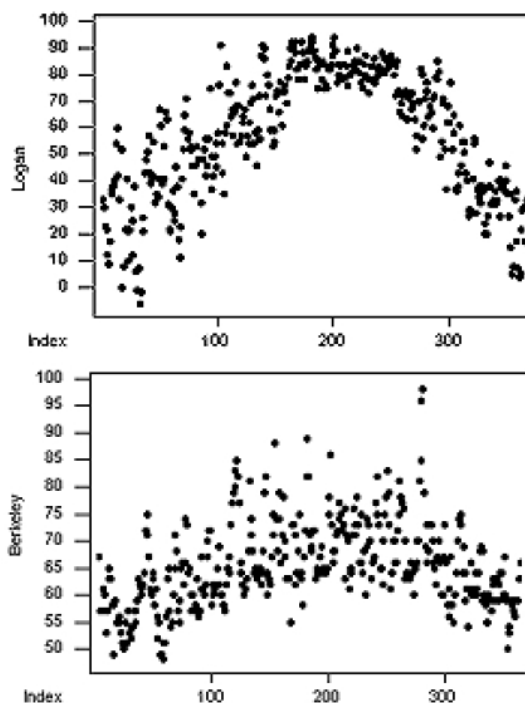
- (a) be unchanged.
  - (b) increase by \$3,000.
  - (c) be multiplied by 3000.
  - (d) become 50 (i.e., \$50,000).
8. A study is done to compare the extent of heart disease (on a scale from 0 to 100) in people who drink a few alcoholic drinks per day to the extent of heart disease in non-drinkers. The researcher is able to study 200 individuals of each type. The drinking status is recorded as the average number of drinks consumed per day for each individual participant.

Other factors that might affect the extent of heart disease are smoking habits (expressed as average number of cigarettes smoked per day) and exercise habits (expressed as average time spent exercising each day). The smoking habits of the two groups of people are similar, but those who drank generally exercised less than the non-drinkers.

In this study, the explanatory variable is

- (a) exercise habits.
- (b) heart disease.
- (c) smoking habits.
- (d) drinking status.

9. Below are scatterplots for (bottom) Berkeley, California, and (top) Logan, Utah, in 1996. For both,  $x = \text{day of the year}$  and  $y = \text{high temperature for that day}$ .



Consider the spread in high temperatures for the two locations over the year. Which statement is correct?

- (a) Logan has the greater spread.
  - (b) Berkeley has the greater spread.
  - (c) Both have the same spread.
  - (d) There is not enough information to answer the question.
10. Heights for 100 individuals range from 55 inches to 75 inches. Half the individuals have heights around 65 inches, a quarter have heights near 55 inches, and the rest have heights near 75 inches.

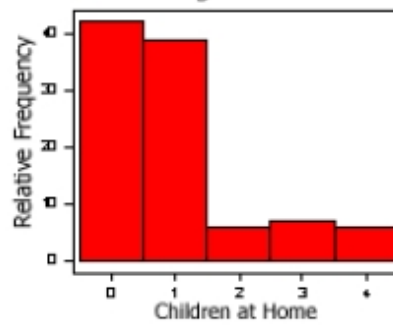
The SD of heights is about:

- (a) 10 inches or less.
- (b) 20 inches.
- (c) 40 inches.
- (d) 400 inches or more.

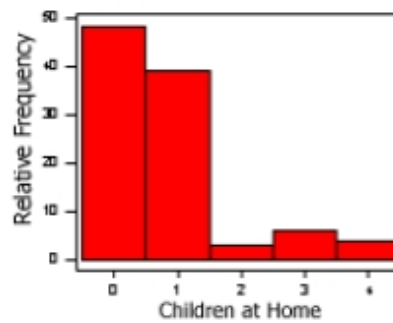
11. The following table is based on the numbers of children living at home, for 100 statistics students:

# Children	Number of Students
0	48
1	39
2	3
3	6
4	4

Histogram A



Histogram B



Which histogram corresponds to the data shown in the table?

- (a) Histogram A.
- (b) Histogram B.
- (c) Both — they are identical.
- (d) None of them.

12. Suppose that the correlation coefficient between two variables is zero. This implies that
- (a) there is no relationship between the two variables.
  - (b) there is no linear relationship between the two variables.
  - (c) there is no curved relationship between the two variables, but there may be a linear relationship.
  - (d) there are probably outliers.

**Use the following to answer questions 13, 14, and 15:**

In statistics, we usually refer to  $x_1$  as the first observation,  $x_2$  as the second observation, etc., and  $x_n$  as the final observation when we write down our observations in the order they were obtained (where  $n$  represents the total number of observations).

Often, we prefer to work with data that are sorted from smallest to largest, e.g., when calculating the median, we need the data to be sorted. Obviously, we can simply reorder any given list of numbers. However, we often use the notation  $x_{(1)}$  to refer to the smallest observation,  $x_{(2)}$  to refer to the 2nd smallest observation, etc., and  $x_{(n)}$  to refer to the largest observation.

13. For  $x_1 = 3, x_2 = -7, x_3 = -5, x_4 = -2, x_5 = 5, x_6 = 7$ , and  $n = 6$ , the sum

$$\sum_{i=2}^{n-1} x_i =$$

equals

- (a)  $-30$ .
  - (b)  $-12$ .
  - (c)  $-9$ .
  - (d)  $1$ .
14. For  $x_1 = 3, x_2 = -7, x_3 = -5, x_4 = -2, x_5 = 5, x_6 = 7$ , and  $n = 6$ , the sum

$$\sum_{i=2}^{n-1} x_{(i)} =$$

equals

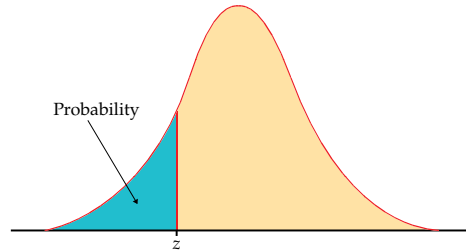
- (a)  $-30$ .
  - (b)  $-12$ .
  - (c)  $-9$ .
  - (d)  $1$ .
15. For  $x_1 = 3, x_2 = -7, x_3 = -5, x_4 = -2, x_5 = 5, x_6 = 7$ , and  $n = 6$ , the sum

$$\sum_{i=1}^n x_{(3)} =$$

equals

- (a)  $-30$ .
- (b)  $-12$ .
- (c)  $-9$ .
- (d)  $1$ .

Table entry for  $z$  is the area under the standard normal curve to the left of  $z$ .



$z$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
-3.4	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0002
-3.3	.0005	.0005	.0005	.0004	.0004	.0004	.0004	.0004	.0004	.0003
-3.2	.0007	.0007	.0006	.0006	.0006	.0006	.0006	.0005	.0005	.0005
-3.1	.0010	.0009	.0009	.0009	.0008	.0008	.0008	.0008	.0007	.0007
-3.0	.0013	.0013	.0013	.0012	.0012	.0011	.0011	.0011	.0010	.0010
-2.9	.0019	.0018	.0018	.0017	.0016	.0016	.0015	.0015	.0014	.0014
-2.8	.0026	.0025	.0024	.0023	.0023	.0022	.0021	.0021	.0020	.0019
-2.7	.0035	.0034	.0033	.0032	.0031	.0030	.0029	.0028	.0027	.0026
-2.6	.0047	.0045	.0044	.0043	.0041	.0040	.0039	.0038	.0037	.0036
-2.5	.0062	.0060	.0059	.0057	.0055	.0054	.0052	.0051	.0049	.0048
-2.4	.0082	.0080	.0078	.0075	.0073	.0071	.0069	.0068	.0066	.0064
-2.3	.0107	.0104	.0102	.0099	.0096	.0094	.0091	.0089	.0087	.0084
-2.2	.0139	.0136	.0132	.0129	.0125	.0122	.0119	.0116	.0113	.0110
-2.1	.0179	.0174	.0170	.0166	.0162	.0158	.0154	.0150	.0146	.0143
-2.0	.0228	.0222	.0217	.0212	.0207	.0202	.0197	.0192	.0188	.0183
-1.9	.0287	.0281	.0274	.0268	.0262	.0256	.0250	.0244	.0239	.0233
-1.8	.0359	.0351	.0344	.0336	.0329	.0322	.0314	.0307	.0301	.0294
-1.7	.0446	.0436	.0427	.0418	.0409	.0401	.0392	.0384	.0375	.0367
-1.6	.0548	.0537	.0526	.0516	.0505	.0495	.0485	.0475	.0465	.0455
-1.5	.0668	.0655	.0643	.0630	.0618	.0606	.0594	.0582	.0571	.0559
-1.4	.0808	.0793	.0778	.0764	.0749	.0735	.0721	.0708	.0694	.0681
-1.3	.0968	.0951	.0934	.0918	.0901	.0885	.0869	.0853	.0838	.0823
-1.2	.1151	.1131	.1112	.1093	.1075	.1056	.1038	.1020	.1003	.0985
-1.1	.1357	.1335	.1314	.1292	.1271	.1251	.1230	.1210	.1190	.1170
-1.0	.1587	.1562	.1539	.1515	.1492	.1469	.1446	.1423	.1401	.1379
-0.9	.1841	.1814	.1788	.1762	.1736	.1711	.1685	.1660	.1635	.1611
-0.8	.2119	.2090	.2061	.2033	.2005	.1977	.1949	.1922	.1894	.1867
-0.7	.2420	.2389	.2358	.2327	.2296	.2266	.2236	.2206	.2177	.2148
-0.6	.2743	.2709	.2676	.2643	.2611	.2578	.2546	.2514	.2483	.2451
-0.5	.3085	.3050	.3015	.2981	.2946	.2912	.2877	.2843	.2810	.2776
-0.4	.3446	.3409	.3372	.3336	.3300	.3264	.3228	.3192	.3156	.3121
-0.3	.3821	.3783	.3745	.3707	.3669	.3632	.3594	.3557	.3520	.3483
-0.2	.4207	.4168	.4129	.4090	.4052	.4013	.3974	.3936	.3897	.3859
-0.1	.4602	.4562	.4522	.4483	.4443	.4404	.4364	.4325	.4286	.4247
0.0	.5000	.4960	.4920	.4880	.4840	.4801	.4761	.4721	.4681	.4641

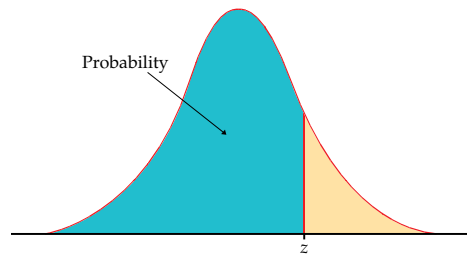


Table entry for  $z$  is the area under the standard normal curve to the left of  $z$ .

TABLE A										
Standard normal probabilities (continued)										
$z$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.5000	.5040	.5080	.5120	.5160	.5199	.5239	.5279	.5319	.5359
0.1	.5398	.5438	.5478	.5517	.5557	.5596	.5636	.5675	.5714	.5753
0.2	.5793	.5832	.5871	.5910	.5948	.5987	.6026	.6064	.6103	.6141
0.3	.6179	.6217	.6255	.6293	.6331	.6368	.6406	.6443	.6480	.6517
0.4	.6554	.6591	.6628	.6664	.6700	.6736	.6772	.6808	.6844	.6879
0.5	.6915	.6950	.6985	.7019	.7054	.7088	.7123	.7157	.7190	.7224
0.6	.7257	.7291	.7324	.7357	.7389	.7422	.7454	.7486	.7517	.7549
0.7	.7580	.7611	.7642	.7673	.7704	.7734	.7764	.7794	.7823	.7852
0.8	.7881	.7910	.7939	.7967	.7995	.8023	.8051	.8078	.8106	.8133
0.9	.8159	.8186	.8212	.8238	.8264	.8289	.8315	.8340	.8365	.8389
1.0	.8413	.8438	.8461	.8485	.8508	.8531	.8554	.8577	.8599	.8621
1.1	.8643	.8665	.8686	.8708	.8729	.8749	.8770	.8790	.8810	.8830
1.2	.8849	.8869	.8888	.8907	.8925	.8944	.8962	.8980	.8997	.9015
1.3	.9032	.9049	.9066	.9082	.9099	.9115	.9131	.9147	.9162	.9177
1.4	.9192	.9207	.9222	.9236	.9251	.9265	.9279	.9292	.9306	.9319
1.5	.9332	.9345	.9357	.9370	.9382	.9394	.9406	.9418	.9429	.9441
1.6	.9452	.9463	.9474	.9484	.9495	.9505	.9515	.9525	.9535	.9545
1.7	.9554	.9564	.9573	.9582	.9591	.9599	.9608	.9616	.9625	.9633
1.8	.9641	.9649	.9656	.9664	.9671	.9678	.9686	.9693	.9699	.9706
1.9	.9713	.9719	.9726	.9732	.9738	.9744	.9750	.9756	.9761	.9767
2.0	.9772	.9778	.9783	.9788	.9793	.9798	.9803	.9808	.9812	.9817
2.1	.9821	.9826	.9830	.9834	.9838	.9842	.9846	.9850	.9854	.9857
2.2	.9861	.9864	.9868	.9871	.9875	.9878	.9881	.9884	.9887	.9890
2.3	.9893	.9896	.9898	.9901	.9904	.9906	.9909	.9911	.9913	.9916
2.4	.9918	.9920	.9922	.9925	.9927	.9929	.9931	.9932	.9934	.9936
2.5	.9938	.9940	.9941	.9943	.9945	.9946	.9948	.9949	.9951	.9952
2.6	.9953	.9955	.9956	.9957	.9959	.9960	.9961	.9962	.9963	.9964
2.7	.9965	.9966	.9967	.9968	.9969	.9970	.9971	.9972	.9973	.9974
2.8	.9974	.9975	.9976	.9977	.9977	.9978	.9979	.9979	.9980	.9981
2.9	.9981	.9982	.9982	.9983	.9984	.9984	.9985	.9985	.9986	.9986
3.0	.9987	.9987	.9987	.9988	.9988	.9989	.9989	.9989	.9990	.9990
3.1	.9990	.9991	.9991	.9991	.9992	.9992	.9992	.9992	.9993	.9993
3.2	.9993	.9993	.9994	.9994	.9994	.9994	.9994	.9995	.9995	.9995
3.3	.9995	.9995	.9995	.9996	.9996	.9996	.9996	.9996	.9996	.9997
3.4	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9998