Department of Statistics,
University of California - Los Angeles
STAT 10 **Statistical Reasoning**
Fall Quarter 2001

Name: .....
Student ID#: .....
Section/TA: .....
Score: ...../100

Mid-Term Exam, Friday, Nov. 02, 2001, 11:00-11:50 AM

FRANZ 1260
Instructor: Prof. Ivo D. Dinov
http://www.stat.ucla.edu/~dinov/

Instructions: Please write clearly and diligently. You may use the reverse pages if you need extra space, provided you make a comment on the front page. If this is still not enough please raise your hand and request more paper. You should **NOT** use your own scratch paper. This test booklet contains 4 pages and a total of 7 problems.

1. Consider the following three studies:

Study 1: An animal researcher was interested in cats' abilities to survive surprisingly high falls if they had time to twist round and prepare for the impact. Vets in New York City recorded incidents of cats falling out of apartment windows. The data was divided into three groups: cats that fell from one or two storeys above the ground; cats that fell from three to five storeys above the ground and cats that fell from six or more storeys above the ground. The proportion of cats that survived in each group was then compared.

Study 2: A random sample of 100 students is asked to keep a diary in which they record their clothing expenditures for the next three months. The expenditures of males and females are then compared.

Study 3: A sample of 50 shoppers at an appliance store is split into two groups. One group is shown a television commercial for a new range of appliances that has been filmed in the same style as previous television commercials for the store. The second group is shown a television commercial for the same new range of appliances that has been filmed in a totally new style. An hour after viewing the commercial, each of the shoppers was asked what they could recall about the new range of appliances and a score based on their recollection was recorded. The recall scores were then compared for the two groups.

- For each study, describe what are the **units** and what **treatment** is being compared.
  - Study 1:
  - Study 2:

- Study 3:

- Which of the three studies would be described as **experiments** and which would be described as **observational** studies?
  - Study 1:
  - Study 2:
  - Study 3:

- For the studies that are **observational**, briefly explain why an experiment could not be carried out instead.

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2. At one stage in the process of producing silicon chips, a very thin layer of silicon oxide is deposited on a *wafer*. The wafer is then broken up into chips. Using the following data from *Technometrics* (1994), draw a stem-and-leaf plot of the thickness of silicon oxide in 30 such chips. The thickness has been measured in a special unit for very small distances called Angstrom units, ***Å***.

840	900	930	940	950	960	970	980	990	990	1000	1000	1000	1010	1010
1030	1030	1030	1040	1040	1050	1050	1050	1050	1050	1070	1070	1100	1100	1120

- Complete the stem-and-leaf plot for these 30 thicknesses.

Units: **9 | 5 = 950Å**

8 |
8 |
9 |
9 |
10 |
10 |
11 |

- For this data set, the **median** is:
  - 950Å
  - 1030Å
  - 1010Å
  - 1012Å
  - 1020Å

- The **lower quartile** for the above data is (why?):
  - 840Å
  - 940Å
  - 985Å
  - 975Å
  - 980Å
- Which of the following statements is/are **not a feature** of the data?
  - The interquartile range is 70Å.
  - The range is 270Å.
  - The mode is 1050Å.
  - The median is 1020Å.
  - Those observations with values 1100Å or more represent about 10% of the distribution of thicknesses.

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3. Draw a graph representing the basic **types of variables** we have discussed. Describe the differences between them and give 2 examples of each type.

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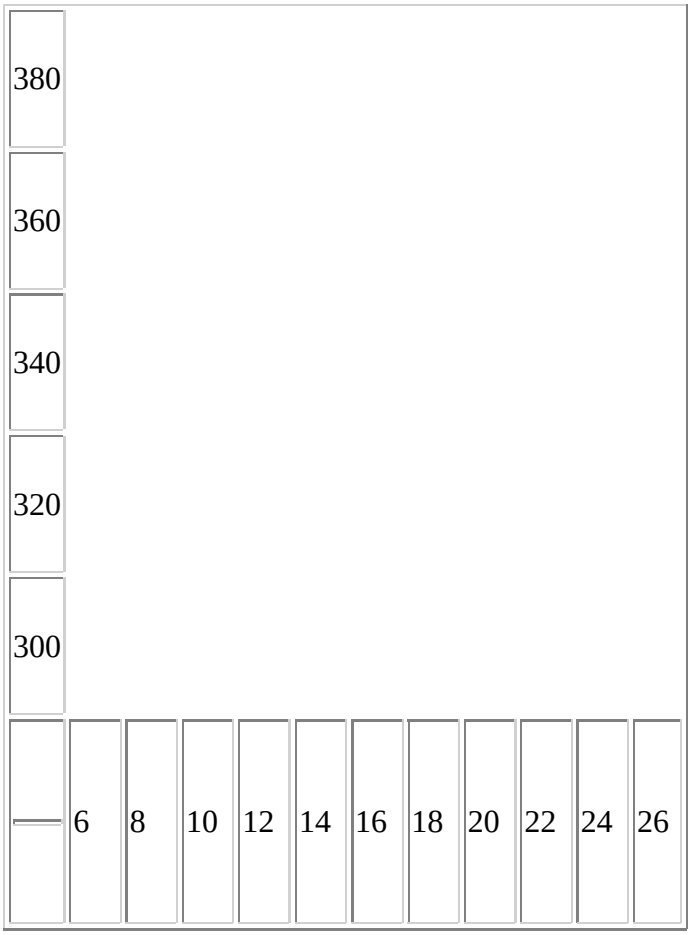
4. A 2 year record of **quarterly sales revenues** and the corresponding **advertising costs** from a large

retail outlet is given below. Draw a **scatter plot** of the data, fit a **trend curve** by eye and describe anything interesting you see in the plot.

Quarter	1	2	3	4	5	6	7	8
Advertising Costs ($1,000s)	10	12	8	20	11	15	10	25
Sales Revenue ($1,000s)	342	347	318	350	351	346	345	367



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5. The probability distribution function of a continuous random variable is represented by a density curve.

- How are **probabilities** represented?
- What is the **total area** under the density curve?
- What parameter is at the point where the density curve **balances**?
- When we calculate probabilities for a continuous random variable, does it matter whether interval **endpoints** are included or excluded?
- Write down some **features** of the Normal distribution p.d.f. curve.
- What are the parameters of the **Normal distribution**?

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6. The natural gestation period for human births, ***X***, has a *mean* of about **266** days and a *standard deviation* of about **16** days. Assume that ***X*** is Normally distributed with a mean of 266 days and a standard deviation of 16 days. 3. Using the table at the end of the test book, draw the area of interest and calculate the proportion of women who carry their babies for:

- Less than 245 days (i.e., deliver at least 3 weeks early).
- Between 255 and 280 days.
- Longer than 287 days (i.e., the baby is more than 3 weeks overdue).

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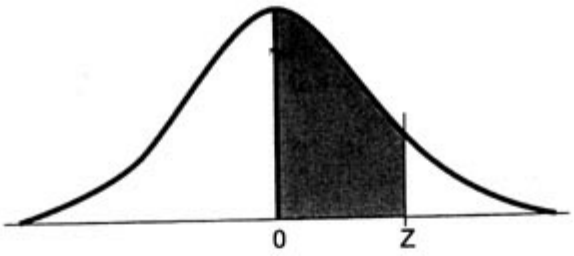
7. If ***X*** is a random variable from a distribution with mean $m_{\boldsymbol{X}}=25$ and standard deviation $s_{\boldsymbol{X}}=3$, and $\boldsymbol{Y}=-1.2\boldsymbol{X}+5$, compute the mean and standard deviation of the variable Y, $m_{\boldsymbol{Y}}$, $s_{\boldsymbol{Y}}$. Standardize ***Y*** and compute the 80^{th} percentile for the distribution of ***Y***.



This table presents the area between the mean and the Z score . When Z=1.96, the shaded area is 0.4750.

Areas Under the Standard Normal Curve

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990
3.1	.4990	.4991	.4991	.4991	.4992	.4992	.4992	.4992	.4993	.4993
3.2	.4993	.4993	.4994	.4994	.4994	.4994	.4994	.4995	.4995	.4995
3.3	.4995	.4995	.4995	.4996	.4996	.4996	.4996	.4996	.4996	.4997
3.4	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4997	.4998
3.6	.4998	.4998	.4999	.4999	.4999	.4999	.4999	.4999	.4999	.4999
3.9	.5000									

Source: Adapted by permission from *Statistical Methods* by George W. Snedecor and William G. Cochran, sixth edition