Name:_____

Stat 1040, Fall 2003
Final Test, Monday December 8, 7:30 – 9:20 am

Show your work. The test is worth 100 points and you have 110 minutes.

1. A tire manufacturer claims that the average life of a certain grade of tire is 25,000 (or more) miles under normal driving conditions. A random sample of 15 tires is tested. The mean and standard deviation are 22,500 and 5,000 miles, respectively. Assume that the lives of the tires are approximately normally distributed. Can we conclude from these data that the manufacture's product is as good as claimed?

a. (9 points) State the null and alternative hypothesis, perform the appropriate statistical test, and clearly state your conclusions.

b. (3 points) Suppose that tire life is not normally distributed, but has a long left tail. Can we rely on the results from part (a) above? Justify your answer.

c. (3 points) If you rejected the null hypothesis in part (a) above, have you shown that manufacture's claims cannot possibly be true?

2. (10 points) A firm that makes carpet is seeking a material that can withstand temperatures of up to 250° F. Two materials, one a natural material, and the other a synthetic (and cheaper) material, are equally satisfactory in all respects except, possibly, heat tolerance. A simple random sample of 300 specimens of the natural material is drawn, of which 45 fail at temperatures below 250° F. A simple random of sample of 350 specimens of the synthetic material is drawn of which 70 fail at temperatures below 250° F. Can we conclude from these data that the synthetic material is less heat tolerant? State the null and alternative hypothesis, perform the appropriate statistical test, and clearly state your conclusions.

3. "HEIGHT MATTERS for career success", said Timothy Judge, a University of Florida management professor whose research will appear in the spring issue of the Journal of Applied Psychology. Judge and Daniel Cable, a business professor at the University of North Carolina at Chapel-Hill, analyzed results from four large-scale studies in the U.S. and Britain that followed thousands of participants from childhood to adulthood, examining details of their work and personal lives. The study controlled for gender, weight and age, and found that each inch in height added about $789 a year in pay.

a.(3 points) Was the described study an **observational study** or a **controlled experiment?** Circle one and explain briefly.

b. (3 points) Was the described study **cross-sectional** or **longitudinal?** Circle one and explain briefly.

c. (3 points) What does it mean "The study controlled for gender, weight and age."? Explain why this is important.

4. A telephone answering service, at the end of each call, completes a report in which the length of the call is recorded. A simple random sample of 150 reports yields a mean length per call of 1.2 minutes with a standard deviation of 0.4 minutes.

a. (4 points) Construct a 95% confidence interval for the average length of all the calls handled by the answering service.

b. (3 points) Because some calls are quite lengthy, call length does not follow the normal curve; it has a long right tail. Does this mean that your confidence interval calculated above is incorrect? Briefly explain.

c. (2 points) True or False (please circle your choice):
95% of the calls received by the answering service have a length that falls between the lower limit and upper limit of the confidence interval you calculated in part (a.) above.

d.(4 points) The manager of the answering service collects the billing rate for *all* 472 clients during a month and finds the average bill to be $582.45 with a standard deviation of $231.59. If appropriate, calculate a 95% confidence interval for the average monthly bill for the answering service. If this is not appropriate, clearly state why not.

5. (4 points) To estimate the percentage of people who approve of Presidents Bush's visit to Baghdad on Thanksgiving, a major newspaper plans randomly sampled 500 people from Salt Lake City and 500 people from Logan. All other things being equal:

a. The accuracy in Logan will be about the same as the accuracy in Salt Lake City.
b. The accuracy in Logan will be quite a bit less than the accuracy in Salt Lake City
c. The accuracy in Logan will be quite a bit greater than the accuracy in Salt Lake City.
(Choose one options and explain briefly).

6. Psychologists have long studied anxiety…you know, that feeling you get just before taking a statistics final. Their research has led them to distinguish between just-before-the-final anxiety from a more general state in which some people are just more anxious than others. The former is called *state* anxiety – produced by a particular environment condition such as a statistics test. The latter is called *trait* anxiety, a condition that generalizes across situations. The following data was collected from a random sample of college sophomores:

(X) - average State Anxiety: 7.3, SD = 2.37
(Y) - average Trait Anxiety: 6.6, SD = 2.07
r = 0.80

a. (5 points) Find the equation of the regression line for predicting Trait Anxiety from State Anxiety.

b. (4 points) Predict the Trait Anxiety of a sophomore with a State Anxiety score of 9.4.

c. (3 points) About how far off do you expect your prediction to be?

d. (3 points) Would you be surprised to learn that a sophomore, with a *state* anxiety score of 9.4, had a *trait* anxiety score of 4.6? Explain your reasoning, using the rms error score.

7. (6 points) A certain brand of wheat bread can be classified as "fresh" for 72 hours with a SD of 8 hours. (We will assume that "freshness" follows the normal curve). The bakery wants 95% of the bread to be "fresh" if it is on the display shelf. How many hours after baking should the bread be taken off of the shelf? (Hint: what *percentile* are we looking for?)

8. The data shown in the table below were collected in a survey of the relationship between average number of hours spent studying per day and performance in advanced chemistry courses at a particular university. Determine whether there is a relationship between study time and course performance.

a. (State the null and alternative hypothesis, perform the appropriate statistical test, and clearly state your conclusions. (8 points)

Hours of Study per day	Performance Pass	Fail	**Total**
2 or less	60	32	92
3	65	13	78
4	25	5	30
Total	**150**	**50**	**200**

b. (2 points) Would you classify your results as (a) non-significant, (b) statistically significant, or (c) highly statistically significant? (circle your choice).

9. (4 points) In a certain county in Pennsylvania, it is known that exactly 75% of the adult residents have seen the movie "The Two Towers".

1. In a simple random sample of 1000 adult residents between 74% and 76% have seen the movie.
2. In a simple random sample of 100 adult residents between 74% and 76% have seen the movie.

Which of the following is more likely: (no explanation is necessary)

a. 1 is more likely than 2.
b. 2 is more likely than 1.
c. Both are equally likely.

10. Suppose that we are drawing **four** times **without replacement** from a candy dish containing the following M & M candies: (each part worth 2 points)

10 brown
8 green
12 red

a. What is the probability that all four draws will be green M & M's?

b. What is the probability that not all the candies you draw are green?

c. True or false (circle your choice) The events in part (b) above are independent.

Now suppose that we draw once from the original candy dish described above (before we made any draws) and once from a candy dish containing the following:

6 green jelly beans
7 yellow jelly beans
7 pink jelly beans

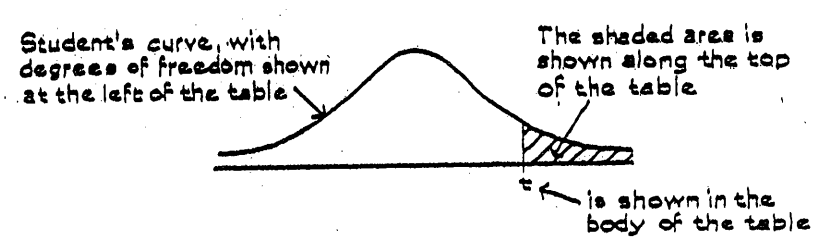
d. What is the probability of getting a red M&M and a pink jelly bean?

e. True or false (circle your choice) The events in part (d) above are independent.

f. Suppose we draw two cards from a well-shuffled standard deck of cards. What is the probability of getting the King of Hearts on the first draw or the King of Hearts on the second draw. (There are 52 cards in a standard deck – one King of Hearts).

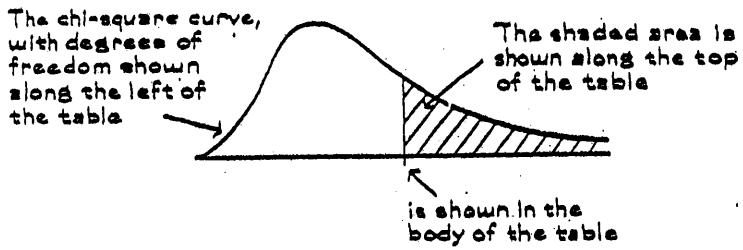
g. True or False (circle your choice) The events in part (f) above are mutually exclusive.

A *t*-TABLE



Degrees of freedom	*25%*	*10%*	*5%*	*2.5%*	*1%*	*0.5%*
1	1.00	3.08	6.31	12.71	31.82	63.66
2	0.82	1.89	2.92	4.30	6.96	9.92
3	0.76	1.64	2.35	3.18	4.54	5.84
4	0.74	1.53	2.13	2.78	3.75	4.60
5	0.73	1.48	2.02	2.57	3.36	4.03
6	0.72	1.44	1.94	2.45	3.14	3.71
7	0.71	1.41	1.89	2.36	3.00	3.50
8	0.71	1.40	1.86	2.31	2.90	3.36
9	0.70	1.38	1.83	2.26	2.82	3.25
10	0.70	1.37	1.81	2.23	2.76	3.17
11	0.70	1.36	1.80	2.20	2.72	3.11
12	0.70	1.36	1.78	2.18	2.68	3.05
13	0.69	1.35	1.77	2.16	2.65	3.01
14	0.69	1.35	1.76	2.14	2.62	2.98
15	0.69	1.34	1.75	2.13	2.60	2.95
16	0.69	1.34	1.75	2.12	2.58	2.92
17	0.69	1.33	1.74	2.11	2.57	2.90
18	0.69	1.33	1.73	2.10	2.55	2.88
19	0.69	1.33	1.73	2.09	2.54	2.86
20	0.69	1.33	1.72	2.09	2.53	2.85
21	0.69	1.32	1.72	2.08	2.52	2.83
22	0.69	1.32	1.72	2.07	2.51	2.82
23	0.69	1.32	1.71	2.07	2.50	2.81
24	0.68	1.32	1.71	2.06	2.49	2.80
25	0.68	1.32	1.71	2.06	2.49	2.79

A CHI-SQUARE TABLE



Degrees of freedom	*99%*	*95%*	*90%*	*70%*	*50%*	*30%*	*10%*	*5%*	*1%*
1	0.00016	0.0039	0.016	0.15	0.46	1.07	2.71	3.84	6.64
2	0.020	0.10	0.21	0.71	1.39	2.41	4.60	5.99	9.21
3	0.12	0.35	0.58	1.42	2.37	3.67	6.25	7.82	11.34
4	0.30	0.71	1.06	2.20	3.36	4.88	7.78	9.49	13.28
5	0.55	1.14	1.61	3.00	4.35	6.06	9.24	11.07	15.09
6	0.87	1.64	2.20	3.83	5.35	7.23	10.65	12.59	16.81
7	1.24	2.17	2.83	4.67	6.35	8.38	12.02	14.07	18.48
8	1.65	2.73	3.49	5.53	7.34	9.52	13.36	15.51	20.09
9	2.09	3.33	4.17	6.39	8.34	10.66	14.68	16.92	21.67
10	2.56	3.94	4.86	7.27	9.34	11.78	15.99	18.31	23.21
11	3.05	4.58	5.58	8.15	10.34	12.90	17.28	19.68	24.73
12	3.57	5.23	6.30	9.03	11.34	14.01	18.55	21.03	26.22
13	4.11	5.89	7.04	9.93	12.34	15.12	19.81	22.36	27.69
14	4.66	6.57	7.79	10.82	13.34	16.22	21.06	23.69	29.14
15	5.23	7.26	8.55	11.72	14.34	17.32	22.31	25.00	30.58
16	5.81	7.96	9.31	12.62	15.34	18.42	23.54	26.30	32.00
17	6.41	8.67	10.09	13.53	16.34	19.51	24.77	27.59	33.41
18	7.00	9.39	10.87	14.44	17.34	20.60	25.99	28.87	34.81
19	7.63	10.12	11.65	15.35	18.34	21.69	27.20	30.14	36.19
20	8.26	10.85	12.44	16.27	19.34	22.78	28.41	31.41	37.57

Source: Adapted from p. 112 of Sir R. A. Fisher, *Statistical Methods for Research Workers* (Edinburgh: Oliver & Boyd, 1958).

Memory Aids

Please note that these are provided for your convenience, but it is your responsibility to know how and when to use them.

$$\text{rms error} = \sqrt{1 - r^2} \times SD_Y$$

$$\text{slope} = r \times \frac{SD_Y}{SD_X}$$

$$\text{intercept} = \text{ave}_Y - \text{slope} \times \text{ave}_X$$

$$SD^+ = \sqrt{\frac{\text{number of draws}}{\text{number of draws} - 1}} \times SD$$

$$SD_{\text{box}} = \sqrt{\text{fraction of 0's} \times \text{fraction of 1's}}$$

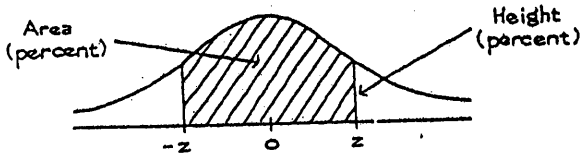
$$EV_{\text{sum}} = \text{number of draws} \times \text{ave}_{\text{box}}$$
$$SE_{\text{sum}} = \sqrt{\text{number of draws}} \times SD_{\text{box}}$$

$$EV_{\text{ave}} = \text{ave}_{\text{box}}$$
$$SE_{\text{ave}} = \frac{SE_{\text{sum}}}{\text{number of draws}}$$

$$EV_{\%} = \%\text{ of 1's in the box}$$
$$SE_{\%} = \left(\frac{SE_{\text{sum}}}{\text{number of draws}}\right) \times 100\%$$

$SE_{\text{diff}} = \sqrt{a^2 + b^2}$ where a is the SE for the first quantity, b is the SE for the second quantity, and the two quantities are independent

A NORMAL TABLE



z	Area	z	Area	z	Area
0.00	0	1.50	86.64	3.00	99.730
0.05	3.99	1.55	87.89	3.05	99.771
0.10	7.97	1.60	89.04	3.10	99.806
0.15	11.92	1.65	90.11	3.15	99.837
0.20	15.85	1.70	91.09	3.20	99.863
0.25	19.74	1.75	91.99	3.25	99.885
0.30	23.58	1.80	92.81	3.30	99.903
0.35	27.37	1.85	93.57	3.35	99.919
0.40	31.08	1.90	94.26	3.40	99.933
0.45	34.73	1.95	94.88	3.45	99.944
0.50	38.29	2.00	95.45	3.50	99.953
0.55	41.77	2.05	95.96	3.55	99.961
0.60	45.15	2.10	96.43	3.60	99.968
0.65	48.43	2.15	96.84	3.65	99.974
0.70	51.61	2.20	97.22	3.70	99.978
0.75	54.67	2.25	97.56	3.75	99.982
0.80	57.63	2.30	97.86	3.80	99.986
0.85	60.47	2.35	98.12	3.85	99.988
0.90	63.19	2.40	98.36	3.90	99.990
0.95	65.79	2.45	98.57	3.95	99.992
1.00	68.27	2.50	98.76	4.00	99.9937
1.05	70.63	2.55	98.92	4.05	99.9949
1.10	72.87	2.60	99.07	4.10	99.9959
1.15	74.99	2.65	99.20	4.15	99.9967
1.20	76.99	2.70	99.31	4.20	99.9973
1.25	78.87	2.75	99.40	4.25	99.9979
1.30	80.64	2.80	99.49	4.30	99.9983
1.35	82.30	2.85	99.56	4.35	99.9986
1.40	83.85	2.90	99.63	4.40	99.9989
1.45	85.29	2.95	99.68	4.45	99.9991