Stat 1040, Fall 2007 **Name:** _____

Final Test, December 13, 11:30pm–1:20pm

Show your work. The test is out of 100 points and you have 110 minutes to finish.

1. In the December 10 issue of NEWSWEEK medical writer Jerry Adler says:

> It's not too soon to start thinking about New Year's resolutions, and here's mine, as a medical writer: I will not report on any amazing new treatments for anything, unless they were tested in large, randomized, placebo-controlled, double-blind clinical trials published in high-quality peer-reviewed medical journals. If that means not telling NEWSWEEK's readers about, say, a new magnetized-water cure for osteoporosis, cancer and autism – well, there are infomercials to fill that gap.

(a) (2 points) Explain what it means for a study to be double-blind.

(b) (3 points) Give 3 different reasons *why* a medical study should be double-blind.

(c) (2 points) What is a placebo? Why is it used?

2. (5 points) Psychologist Daniel Kahneman was teaching flight instructors that praise is more effective than punishment for promoting learning, when one of the most seasoned instructors in his audience raised his hand and said, "On many occasions I have praised flight cadets for clean execution of some aerobatic maneuver, and in general when they try it again, they do worse. On the other hand, I have often screamed at cadets for bad execution, and in general they do better the next time. So please don't tell us that reinforcement works and punishment does not, because the opposite is the case."

   What does statistics say about this instructor's experience?

3. (5 points) For a sample of 570 California women age 25 to 29 in 2005 the relationship between education (years of schooling completed) and income can be summarized as follows:

   Average education $\approx$ 13.0 years, SD $\approx$ 3.4 years
   Average income $\approx$ \$18,000, SD $\approx$ \$20,000 r $\approx$ 0.37

   Predict the income for one of these women with 15 years of education.

4. (5 points) A 1999 study claimed that

   > Infants who sleep at night in a bedroom with a light on may be at higher risk for myopia (nearsightedness) later in childhood.

   The researchers surveyed parents of 479 children aged 2 to 16 seen in the ophthalmology outpatient department of a children's hospital. A questionnaire asked about the child's nighttime light exposure at the time of the survey and before age two. They noticed a positive association between myopia and nighttime light exposure.

   Explain why this is *not* strong evidence that sleeping with a light on *causes* myopia by suggesting a possible confounding factor and explaining how this confounding factor could account for the association they observed.

5. For a road trip, a student places the following ten CDs into the glove compartment of his car

   - 6 *modern rock* CDs (Fallout Boy, Hawthorne Heights, The Used, Finger Eleven, Taking Back Sunday, She Wants Revenge),
   - 3 *pop* CDs (P!nk, Fergie, Gwen Stefani),
   - 1 *American Idol* CD (Jordin Sparks).

   On his trip, the student blindly grabs a CD from the glove compartment, listens to it, and places it on the back seat when finished. Then he blindly grabs a second CD from the glove compartment. You should NOT comment on the musical taste of this student, but answer each of the following questions separately.

   (a) (2 points) What is the chance that the SECOND CD will be a *pop* CD or the *American Idol* CD?

   (b) (2 points) What is the chance that he will listen to Jordin Sparks as one of his two selections?

   (c) (2 points) What is the chance that he will listen to **none** of the *pop* CDs?

   (d) (2 points) What is the chance that he will listen to **at least one** of the *modern rock* CDs?

6. (8 points) In October 29 to November 1 2007, a local survey organization questioned 603 residents in Utah. They found that 23% of those surveyed "definitely favor" building a nuclear power plant in Utah. Assuming this is a simple random sample of Utahns, find a 90% confidence interval for the percentage of all Utahns who would say that they "definitely favor" building a nuclear power plant in Utah.

7. A grocery store carries a variety of "on the vine" tomatoes with an average weight of 5.0 ounces and an SD of 0.9 ounces. The weights of these tomatoes follow the normal curve.

(a) (6 points) What percentage of them would weigh more than 6.0 ounces?

(b) (6 points) Estimate the 25th percentile of their weights.

(c) (6 points) Find the chance that the total weight of 100 randomly selected tomatoes will be more than 506 ounces.

(d) (10 points) I'm a little skeptical of the claim that the average weight of the tomatoes is 5.0 ounces - I think it might be somewhat greater than 5.0 ounces. I select 9 tomatoes at random and find the following weights:

6.1 4.4 6.3 5.7 4.5 6.9 5.1 5.8 5.7

Is there evidence that the average weight of this type of tomato is greater than 5.0 ounces? Clearly state the null and alternative hypotheses, calculate the appropriate test statistic, find the P-value, and state your conclusion.

(e) (5 points) Which, if any, of your answers to the first 4 parts of this question would still be reliable if you were told that the weights of the tomatoes did NOT follow the normal curve? Explain.

8. A recent "live vote" survey on MSNBC.com asked participants whether men or women talked most. Anyone visiting the site was allowed to vote as many times as they wanted. The results are summarized in the following table.

	Gender of the participant		
Response	Female	Male	*Total*
Women talk more	1352	2994	4346
Men talk more	1545	451	1996
Evenly split	965	656	1621
Total	3862	4101	7963

For parts (a) through (g), treat this as a simple random sample from a population of interest, and suppose we are interested in knowing whether a person's gender is independent of their response for this population.

(a) (1 point) Clearly state the null hypothesis.

(b) (1 point) Clearly state the alternative hypothesis.

(c) (3 points) Find the appropriate test statistic. (Note: if you cannot calculate the answer to this part, use test statistic = 10. This is not the correct answer, but you can them proceed with the rest of the problem).

(d) (1 point) Find the degrees of freedom.

(e) (1 point) What can you say about the size of the P-value?

(f) (1 points) Do you reject the null hypothesis? **Why or why not?**

(g) (1 points) For this population, what are your conclusions about a person's gender and their response?

(h) (2 points) On the web page, MSNBC.com states that this is "not a scientific survey" and points to a page titled "How 1,000 people can be more representative than 200,000". Give 2 *different* reasons why this survey would not be representative of the population of people who visit that particular website.

9. (8 points) National data show that the number of years of schooling of people age 18 and over has an average of 13 years. A simple random sample of 700 people age 18 and over from a certain county has an average of 14 years of schooling, with an SD of 5 years. Can the difference between the average for the nation and the average for the sample be due to chance error or is there evidence that this county is different from the nation? Clearly state the null and alternative hypotheses, calculate the appropriate test statistic, find the P-value, and state your conclusion.

10. (10 points) In a randomized, controlled, double-blind study published in The *Journal of the American Medical Association* in October 2007, researchers followed 371 heavy drinkers for 14 weeks to try to determine whether the migraine drug Topamax could help them to quit drinking. By the end of the study, 27 of the 183 people in the Topamax group had quit drinking completely, while only 6 of the 188 people in the placebo group had quit drinking completely. Is this evidence that Topamax helps, or could the result just be due to chance error? Clearly state the null and alternative hypotheses, calculate the appropriate test statistic, find the P-value, and state your conclusion.

Memory Aids

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

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

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

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

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

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

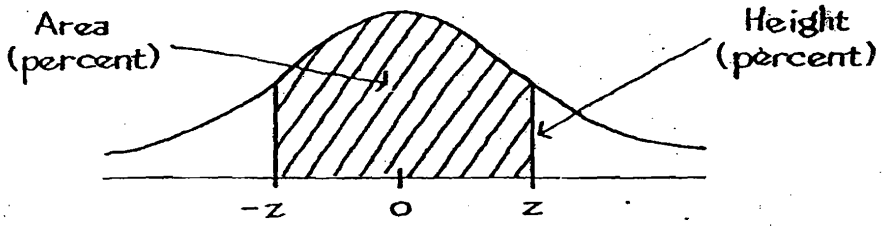
$$EV_{\text{sum}} = \text{number of draws} \times \text{ave}_{\text{box}}$$
$$SE_{\text{sum}} = \sqrt{\text{number of draws}} \times SD_{\text{box}}$$

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

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

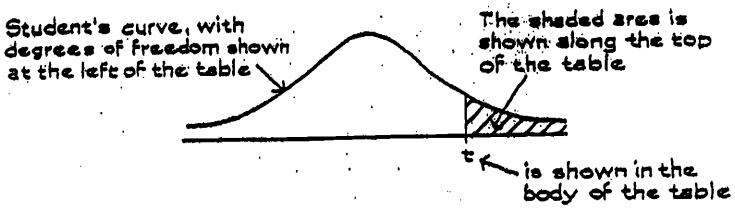
$SE_{\text{diff}} = \sqrt{a^2 + b^2}$ where a is the SE for the first quantity,
b is the SE for the second quantity, and the two quantities are independent

A NORMAL TABLE



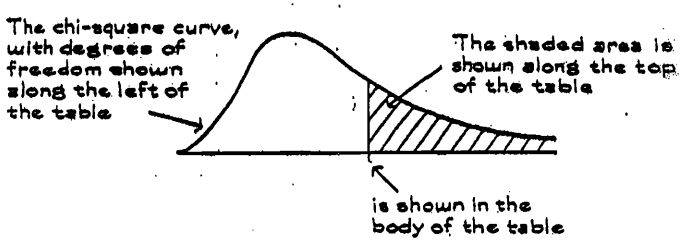
z	*Area*	*z*	*Area*	*z*	*Area*
0.00	0	1.50	86.64	3.00	99.730
0.05	3.99	1.55	87.89	3.05	99.771
0.10	7.97	1.60	89.04	3.10	99.806
0.15	11.92	1.65	90.11	3.15	99.837
0.20	15.85	1.70	91.09	3.20	99.863
0.25	19.74	1.75	91.99	3.25	99.885
0.30	23.58	1.80	92.81	3.30	99.903
0.35	27.37	1.85	93.57	3.35	99.919
0.40	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

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).