Math 221

Hypothetical Exam 2, Wi2008, (Chapter 8, 9, 10, 11, 12, 13 in Moore, 4th)
April 6, 1830
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Name:_____

These questions are intended to give students in Math 221 some idea of the types of questions which could be asked on an exam. They may not cover all of the topics which will be on your exam (and they may cover more topics than are on your exam). The length of your exam may be shorter than this practice exam. Working these problems is not a substitute for studying your notes and reading the book.

Show all your work to receive credit. All answers must be justified to get full credit.
There is a formula sheet at the end of the test. Don't forget to look there.

Multiple Choice

Circle the letter corresponding to the best answer for each of the problems below (4 pts each)

1. To investigate whether women are more likely than men to prefer Democratic candidates, a political scientist selects a large sample of registered voters, both men and women. She asks every voter whether they voted for the Republican or the Democratic candidate in the last election. This is

   A. an observational study.
   B. a multistage sample.
   C. a double blind experiment.
   D. a block design.

For the following description, answer questions 2 to 3.

The city council of a suburb of Columbus is interested in the level of public support for a new recreation center. A marketing research firm is selected which then selects a simple random sample of 75 adult residents and contacts each to determine whether the resident would be interested in joining this recreation center if it were built. Of these, 45 indicated they would be interested in joining the recreation center.

2. The sample is
   A. the 45 residents interested in joining the recreation center.
   B. the 75 residents selected.
   C. the 30 residents not interested in joining the recreation center.
   D. all residents interested in joining the recreation center.

3. The population of interest is
   A. the residents in the suburb that support the new recreation center.
   B. the 75 residents contacted.
   C. all adult residents in the suburb.
   D. all households in the suburb.

4. A public opinion poll in Florida wants to determine whether registered voters in the state approve of a measure to ban smoking in all public areas. The researchers select a simple random sample of 60 registered voters from each county in the state and ask whether they approve or disapprove of the measure. This is an example of

   A. a systematic county sample.
   B. a stratified sample.
   C. a multistage sample.
   D. a simple random sample.

5. The television program *Nightline* once asked viewers whether the United Nations should continue to have its headquarters in the United States. Two phone numbers were given. Viewers were asked to call one telephone number to respond "Yes" and the other to respond "No". More than 186,000 callers responded and 67% said "No". This is an example of
   A. a survey with little bias since someone who called would know his or her opinion.
   B. a survey with little bias because a large SRS was used.
   C. voluntary response sampling.
   D. all of the above.

For the following description, answer questions 6 to 7.
You need to select a simple random sample of size three from the following employees of a small company. To do so, use the following list of random digits.

44090 08023 20751 27498 12009 45287 71753 98236 66419 84533 11793 20495 11384

1. Berliner	4. Wolfe	7. Verducci
2. Blumenthal	5. Stasny	8. Lin
3. MacEachern	6. Santner	9. Critchlow

6. The simple random sample is

   A. 449.
   B. 498.
   C. 483.
   D. Wolfe twice and Critchlow.
   E. Wolfe, Critchlow, and Lin.
   F. Wolfe, Lin, and MacEachern.

7. Which of the following statements is true?

   A. If we used another list of random digits to select the sample, we would get the same result as obtained with the list actually used.
   B. If we used another list of random digits to select the sample, we would get a completely different sample than that obtained with the list actually used.
   C. If we used another list of random digits to select the sample, we would get at most one name in common with a name obtained with the list actually used.
   D. If we used another list of random digits to select the sample, the result obtained with the list actually used would be just as likely to be selected as any other set of three names.

8. A simple random sample of 3200 adult Americans is selected, and each person is asked the following question.

   "In light of the huge national deficit, should the government at this time spend additional money to establish a national system of health insurance?"

   Only 39% of those responding answered "yes." This survey

   A. is reasonably accurate since it used a large, simple random sample.
   B. probably overstates the percentage of people that favor a system of national health insurance.
   C. probably understates the percentage of people that favor a system of national health insurance.
   D. is very inaccurate, but neither understates nor overstates the percentage of people that favor a system of national health insurance. Since simple random sampling was used, it is unbiased.

For the following description, answer questions 9 to 10.
In a study of human development, investigators showed two movies that were different types to groups of children. Crackers were available in a bowl, and the investigators compared the number of crackers eaten by children watching both movies. One movie was shown at 8 AM (right after the children had breakfast) and the other at 11 AM (right before the children had lunch). It was found that during the movie shown at 11 AM, more crackers were eaten than during the movie shown at 8 AM. The investigators concluded that the different types of movies had different effects on appetite.

9. The results cannot be trusted because

   A. the study was not double blind. Neither the investigators nor the children should have been aware of which movie was being shown.
   B. the time each movie was shown is a confounding variable.
   C. the investigators were biased. They knew beforehand what the study would show.
   D. the investigators should have used several bowls, with crackers randomly placed in each.

10. The treatment in this experiment is

    A. the number of crackers eaten.
    B. the different kinds of movies.
    C. the time each movie was shown.
    D. the bowls.

For the following description, answer questions 11 to 13.
Here is the probability model for critics' ratings of one of the Lord of the Rings movies. Assume that only the ratings A, B, C, D, and F are possible.

Grade	A	B	C	D	F
Probability	.25	.37	.18	.07	?

11. This probability model is

    A. continuous B. discrete C. binomial D. normal

12. What is the probability that a randomly chosen rating is an F?

    A. 0.87 B. 0.13 C. 0.07 D. Can't be determined

13. What is the probability that a randomly chosen rating is an A or a B?

    A. 0.25 B. 0.37 C. 0.62 D. Can't be determined

For the following description, answer questions 14 to 16.
Here is the frequency of teams at the local district History Day competition. Each team can compete in one category.

School	Kahuku	Castle
Display Boards	11	9
Performance	3	1
Media	3	1
Research Paper	7	7

14. Choose a team at random. The probability that the team is from Kahuku is about

    A. 0.57 B. 0.43 C. 0.50 D. 0.59

15. Choose a team at random. The conditional probability that the team is from Kahuku, given that the team is a Performance team is

    A. 0.43 B. 0.50 C. 0.57 D. 0.75

16. Choose a team at random. The conditional probability that the team did a paper, given that the team is from Kahuku is

    A. 0.29 B. 0.33 C. 0.50 D. 0.53

17. On a particular farm, there are 47 banana trees, and 100 papaya trees. If one of the trees is chosen at random, what is the probability that it is a banana tree?

    A. 0.24 B. 0.32 C. 0.47 D. 0.68

18. x is a random variable and $\bar{x}$ is the random variable measuring the mean of x. The distribution of $\bar{x}$ is the sampling distribution, and the distribution of x is the population distribution. Which of the following is true?

    A. The shape of the sampling distribution is always exactly normal.

    B. The shape of the sampling distribution gets closer to the shape of the population distribution as n gets large.

    C. The shape of the sampling distribution gets approximately normal as n gets large.

    D. The shape of the sampling distribution is approximately normal only when the population distribution is normal.

19. Which of the following situation will guarantee that the mean of the sampling distribution $\bar{x}$ equals to the mean of the population distribution x.

    A. The sample size n is very large.

    B. The sample size n is very large and x is approximately Normal.

    C. The sample size n is very large and x is Normal.

    D. The two means always equal to each other.

20. The following density curve represents waiting times at a customer service counter at a national department store. The mean waiting time is 5 minutes with standard deviation 5 minutes. If we took all possible samples of size $n = 100$, how would you describe the sampling distribution of the $\bar{x}$'s?

    A. Shape is right skewed, mean = 5, standard deviation = 5

    B. Shape is less right skewed, mean = 5, standard deviation = 0.5

    C. Shape is approx. Normal, mean = 5, standard deviation = 5

    D. Shape is approx. Normal, mean = 5, standard deviation = 0.5

21. The level of nitrogen oxides (NOX) in the exhaust of cars of a particular model varies Normally with mean 0.2 grams per mile (g/m) and standard deviation 0.08 g/mi. Government regulations call for NOX emissions no higher than 0.3 g/mi. A company has 16 cars of this model in its fleet. What is the probability that the average NOX level $\bar{x}$ of these cars is above the 0.3 g/mi limit?

    A. less than 0.0002

    B. between 0.0002 and 0.003

    C. between 0.003 and 0.08

    D. more than 0.08

22. The number of hours a light bulb burns before failing varies from bulb to bulb. The distribution of burnout times is strongly skewed to the right. The central limit theorem says that

    A. as we look at more and more bulbs, their average burnout time gets ever closer to the mean μ for all bulbs of this type.

    B. the mean burnout time of a large number of bulbs has a distribution of the same shape (strongly skewed) as the distribution for individual bulbs.

    C. the average burnout time of a large number of bulbs has a distribution that is closed to Normal.

    D. we should save energy by burning less light bulbs.

23. For which of the following would a binomial probability model be reasonable?

    A. the number of sevens in a randomly selected set of five random digits from your table of random digits (Table B)

    B. the number of hearts in a hand of 5 cards dealt from a standard deck of 52 cards that has been thoroughly shuffled

    C. the number of phone calls received in a one-hour period

    D. all if the above

24. Use the formula for the binomial probability distribution to find the probabilities for $n = 4$, $p = .2$, and $y = 0, 1, 2, 3$, and 4. Which of the following specifies the correct distribution?

A.

x	0	1	2	3	4
$P(x)$	0.4096	0.4096	0.1536	0.0256	0.0016

B.

x	0	1	2	3	4
$P(x)$	0.4096	0.8192	0.9728	0.9984	1.0000

C.

x	0	1	2	3	4
$P(x)$	0.0016	0.0272	0.1808	0.5904	1.0000

D.

x	0	1	2	3	4
$P(x)$	0.0016	0.0256	0.1536	0.4096	0.4096

Show Your Work

Show all work clearly and neatly. No work shown means no credit will be given. Use correct notation to get full credit. Reserve scratch paper work for scratch paper, which means only include necessary work on the exam. Erase all mistakes neatly. Keep it neat!

25. In an investigation to examine the effects of using charts of past trends to produce future prices, 21 business students are selected. They are to trade a foreign currency at computer monitors with the goal of making as much money as possible. The 21 business students are then randomly selected to be in one of each of the following:

    - a computer and paper access, but no computer access, to a price history of the foreign currency,
    - a computer and computer access to a price history of the foreign currency,
    - a computer with software available that helps to highlight trends or foreign currency.

    Seven students are randomly assigned to each treatment, and the amount of profit they made over a 2 month period is measured.

    (a) What is the response variable?

    (b) What are the experimental units?

    (c) What kind of study is this an example of?

    (d) Make an outline (diagram) of the above experiment.

26. The width of a slot cut by a super milling robot is important to the proper functioning of hydraulic systems in the X-wing fighter.

Image of a x-wing fighter
http://www.themovieblog.com/archives/X-Wing.jpg

During each hour of production, the X-wing manufacturer checks the control of the milling process by measuring the mean of a random sample of 16 items for 15 consecutive hours. The target width for the slot is $\mu = 0.8600$ cm. The process has been operating in control with center close to the target and the standard deviation of the process is known to be $\sigma = 0.012$ cm. Here are the mean width $\bar{x}$ of the samples taken over the 15 hours:

Sample	1	2	3	4	5	6	7	8
Mean Width	0.8600	0.8610	0.8580	0.8580	0.8620	0.8590	0.8420	0.8430

Sample	9	10	11	12	13	14	15
Mean Width	0.8500	0.8600	0.8650	0.8480	0.8460	0.8540	0.8570

(a) Draw the $\bar{x}$ control chart with center line and control limits.

(b) What can you conclude from the $\bar{x}$ chart?

27. The National Science Foundation reports that 70% of the U.S. graduate students who earn Ph.D. degrees in engineering are foreign nationals (Science, Sept. 24, 1993). Let X = the number of international students in a random sample of 25 engineering students who recently earned their Ph.D.

    (a) Find $P(X = 10)$

    (b) Find $P(X \leqslant 3)$

    (c) Find the mean and standard deviation for X.

Table entry for z is the area under the standard Normal curve to the left of z

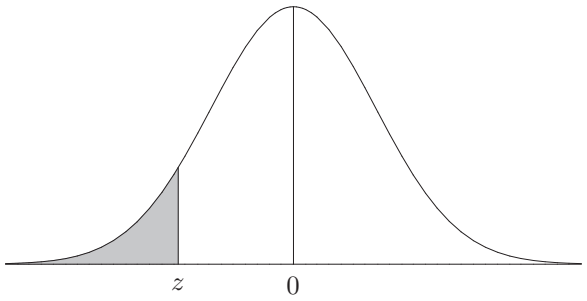

Table A: Standard Normal probabilities

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

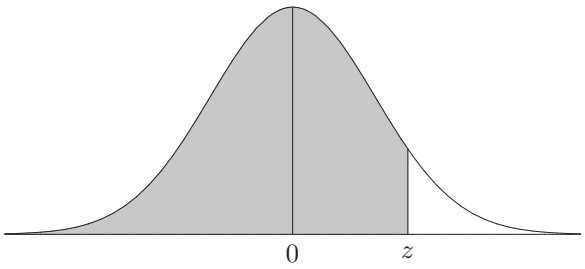

Table A: Standard Normal probabilities

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

Various Formulas

$$Z = \frac{X - \mu}{\sigma} \qquad Z = \frac{\overline{X} - \mu}{\frac{\sigma}{\sqrt{n}}} \qquad P(B|A) = \frac{P(A \text{ and } B)}{P(A)}$$

$$P(A \text{ and } B) = P(A)P(B|A) \qquad P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$\mu = np \qquad \mu_{\overline{x}} = \mu \qquad P(x) = \binom{n}{x} p^x (1-p)^{n-x}$$

$$\sigma = \sqrt{np(1-p)} \qquad \sigma_{\overline{x}} = \frac{\sigma}{\sqrt{n}} \qquad \binom{n}{x} = \frac{n!}{x!(n-x)!}$$