Test 2 is May 1st and will cover the material in chapters 10,11,12 which broadly covered the idea of hypothesis or significance testing. Along the way, we learned the general setup of H_o and H_A, some specific tests for situations and some general theory about the most powerful tests and generic tests with good properties.

This review sheet is probably full of typos, misstated problems and is missing some things that will appear on the test. On the other hand, you didn't pay for it now did you? We can discuss this sheet on Monday in class.

Here are some samples:

1. Given a particular type of problem apply the appropriate test:

   large sample test of proportion For example test the hypothesis that windows has more than its historical 85% market share since the introduction of XP with the random sample of size 100 which found 92 used windows.

   Small sample test of proportion In a random survey of 10 people, 3 admitted to using macintosh. Test the hypothesis that mac users are more than 10% of the market.

   Large sample test for the mean A microsoft team manager wants to know how many applications a user has purchased. They perform a survey of 200 randomly chosen users and find that the average number of applications purchased was 3 with a s.d. of 1. Test the hypothesis that the mean number is different from 4. (What assumptions on the data are used? Are they valid?)

   small sample test of mean A virus infects a computer how many times per year? Infotech has sent out virus hunters again, and they want to know how many times per year they have to do this so they can budget. They survey 10 people at random and find the the average last year was 3 with a s.d. of 1. Test the hypothesis that the average is less than 4.

   tests for the median We had 2 tests for the median: the sign test which had no assumptions and the sign-rank test which had the assumption of a symmetric distribution.

   Microsoft has a wide range of employee wealth. Some are fabulously wealthy, others who have not had a stock runup are not. Suppose 10 are sampled at random and the value of their stock options is given by (in thousands)

   ```
   10  100  100 8800   25    5    6 3200   10   12
   ```

   Test the hypothesis that the median is 100 (thousand) dollars. (What test can you use on this data?)

   You next take a log (base 10) and find the following numbers

   ```
   1.00 2.00 2.00 3.94 1.40 0.70 0.78 3.51 1.00 1.08
   ```

A plot reveals that these are more or less symmetric. Now test the hypothesis that the median is 2 against the alternative that it is not 2.

test for variance An investigation into pirated or illegally copied software is set up to check if there is a difference between age groups. THe first group is comprised of 25 years and under individuals and this group had a mean of 26.1 and standard deviation of 7.2. The group of people made up of 26 or older, had a mean of 17.3 and a standard deviation of 6.1.

If the data is normal, is there a difference in the standard deviations?

two sample test of proportion Microsoft has Xboxes made in Taiwan and Mexico (say). They want to know if there is a difference in quality. The pick 100 at random from each site. They found 10 unsatisfactory units from Taiwan and 13 from Mexico. Do a significance test to see if there is a difference in the proportion of defectives.

two sample test for mean Each year msn.com has tested users to see how much time they spend online per sitting. Last year 12 people were monitored and it was found that the mean time was 27 minutes with a standard deviation of 12 minutes. This year 15 were monitored and the mean was recorded at 17 minutes with a standard deviation of 10 minutes.

Do a significance test for a difference in means. Assume the data is normally distributed.

paired comparisons Msn.com is trying out a new homepage layout, and they want to test ease of use. They find 10 users and give them specific tasks to do. They time the amount of time it takes. They do this for both the old and new homepage. The data is summarized below (time in minutes)

```
Old:  9 16 12 10 6 15 16 24 21 7
New:  6 14 10 10 4 13 13 20 17 4
```

Test the hypothesis that the new page is faster to use.

comparison of means when data is not normal

2. For all of these problems, you should be clear what assumptions are made about the underlying parent population. For some this is an assumption of normality (F-test), near normality (t-test), symmetry (signed-rank test), no assumption (large n for z-test, sign test). You should also appreciate the role of the sampling distribution and how it allows you make a statistical statement.

3. In addition to these types of problems, there are some theoretical ones to consider. In particular, in chapter 11 we had a discussion of the following issues

   (a) A dicussion of α, β and the power curve.

   (b) Most Powerful Neyman-Pearson tests.

   (c) Uniformly most powerful tests

(d) The likelihood ratio tests

For this test expect to see some problems where you need to simplify the test into something more familiar. These will generally involve finding the likelihood functions and algebraically manipulating, or applying calculus to maximize or minimize.

Here are some examples

power calculation If X_i are normal with mean μ and variance 1 and if $H_o : \mu = 0$ vs, $H_A : \mu = 1$. If you reject at the $\alpha = 0.05$ level, what is the power of the test when $n = 1, 10, 100$?

most powerful Suppose your data is uniform on $[0, \theta]$, and you have n samples. If $H_o : \theta = 1$, $H_A : \theta = 2$, Simplify the neyman-pearson test. test

likelihood ratio test Suppose your model is binomial(p,n) with $n = 100$ and the number of successes is 57. If $H_o : p = .5$ vs. $H_A : p \neq .5$. What is the likelihood ratio test's rejection rejion. Is the likelihood ratio asymptotically normal? Something else?