Homework 2, due in Lab Thurs Sept 15th ---- **Solutions**

(assignment for these solutions can be found on the last page)

1. SW Exercise 3.6 p. 87.

Probability of a woman is .55.

```
                     .55 second woman  (.55)(.55)=.3025
  / .55 first woman /
 /                  \.45 second man    (.55)(.45)=.2475
/
\
 \                   .55 second woman  (.45)(.55)=.2475
  \ .45 first man   /
                    \.45 second man    (.45)(.55)=.2025
```

a) probability both women is .3025
b) probability at least one woman = prob both women + prob one woman
 = .3025 + (.2475 + .2475) = .7975
 = 1 – prob both men = 1 – .2025 = .7975

2. SW Exercises 3.9 and 3.10, p. 88.

3.9)
a) 100 of 1000 women are pregnant, or 10% which is .1.

```
                  .98 positive (.10)(.98)=.098
  / .1  preg     /
 /               \.02 negative (.10)(.02)=.002
/
\
 \                .01 positive (.90)(.01)=.009
  \ .9  not preg /
                 \.99 negative (.90)(.99)=.891
```

probability of being positive is .098 + .009 = .107

b) 50 of 1000 women are pregnant, or 5% which is .05.

```
                  .98 positive (.05)(.98)=.049
  / .05 preg     /
 /               \.02 negative (.05)(.02)=.001
/
\
 \                .01 positive (.95)(.01)=.0095
  \ .95 not preg /
                 \.99 negative (.95)(.99)=.9405
```

probability of being positive is .049 + .0095 = .0585.

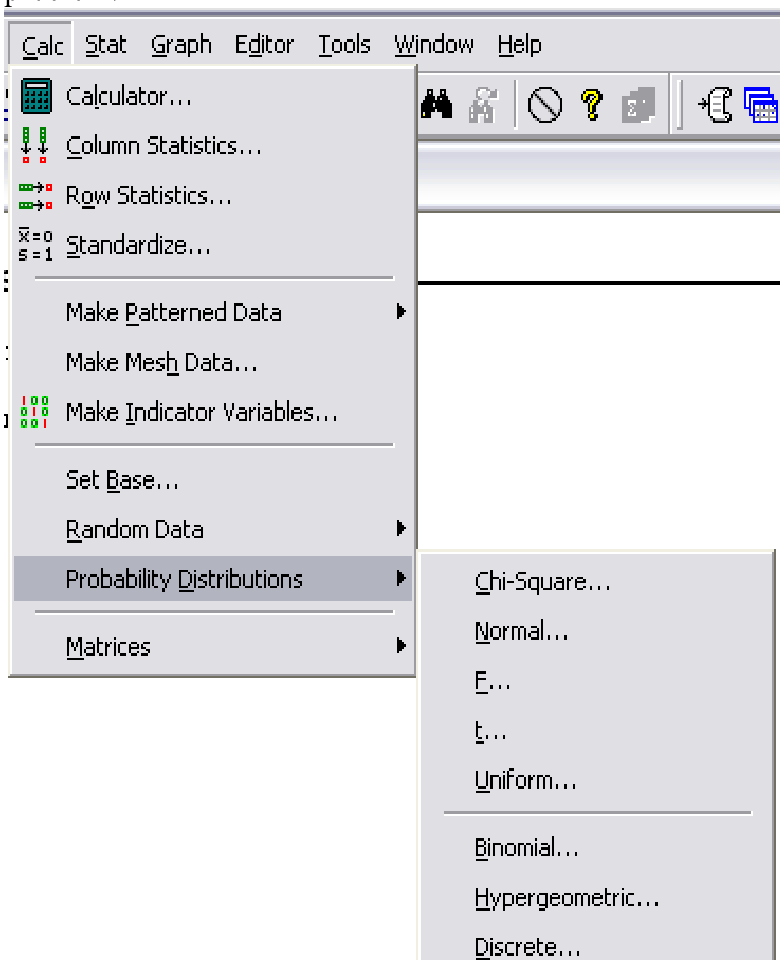
3.10)
a) Using part (a) above, those women who are pregnant from the group who test positive are .098/.107 = .9159.
b) Using part (b) above, those women who are pregnant from the group who test positive are .049/.0585 = .8376.

3. SW Exercise 3.16 p. 96
Simply add up the areas in the density curve that correspond to the question.

a) Pr(20<length<30) = .41+.21 = .62
b) Pr(length>20) = .41+.21+.03 = .65
c) Pr(length<20) = .01+.34 = .35   OR = 1 – Pr(length>20) = 1 – .65 = .35

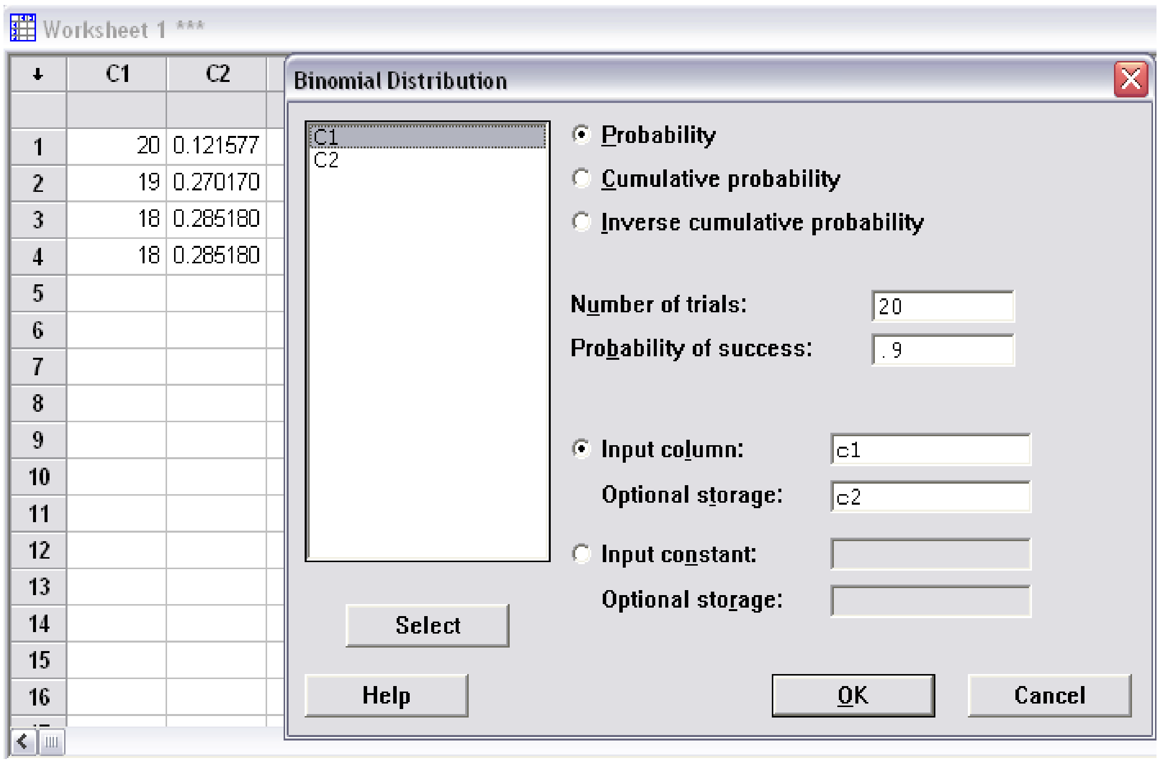
You should be able to use Minitab to do the calculations on the following problems:
4-6 are Binomial distribution and 7-9 are Normal distribution problems.

You can use Minitab to calculate probabilities based on certain probability distributions. You can first enter data in one of the columns then perform the correct calculation, or enter everything into the calc window. Both methods are illustrated below. Under the Calc menu, choose probability distributions, then Binomial or Normal depend on the problem.



4. SW Exercise 3.28 p. 111

We are considering binomial data where each child has a p=.9 probability of being cured, and there are n=20 children. In the table below, in column C1 I enter in the number of successes (children being cured) for parts (a) through (d) of the problem, that is 20, 19, 18, 18. Then, I choose the Calc menu, probability distributions, then Binomial. I want the Probability, so I select that bullet. I enter the number of trials, n=20, and the probability of success, p=.9, then select C1 as the input column, and C2 as the column I want the answers in (if you don't select optional storage, the output is put in the session window, included below screen capture).

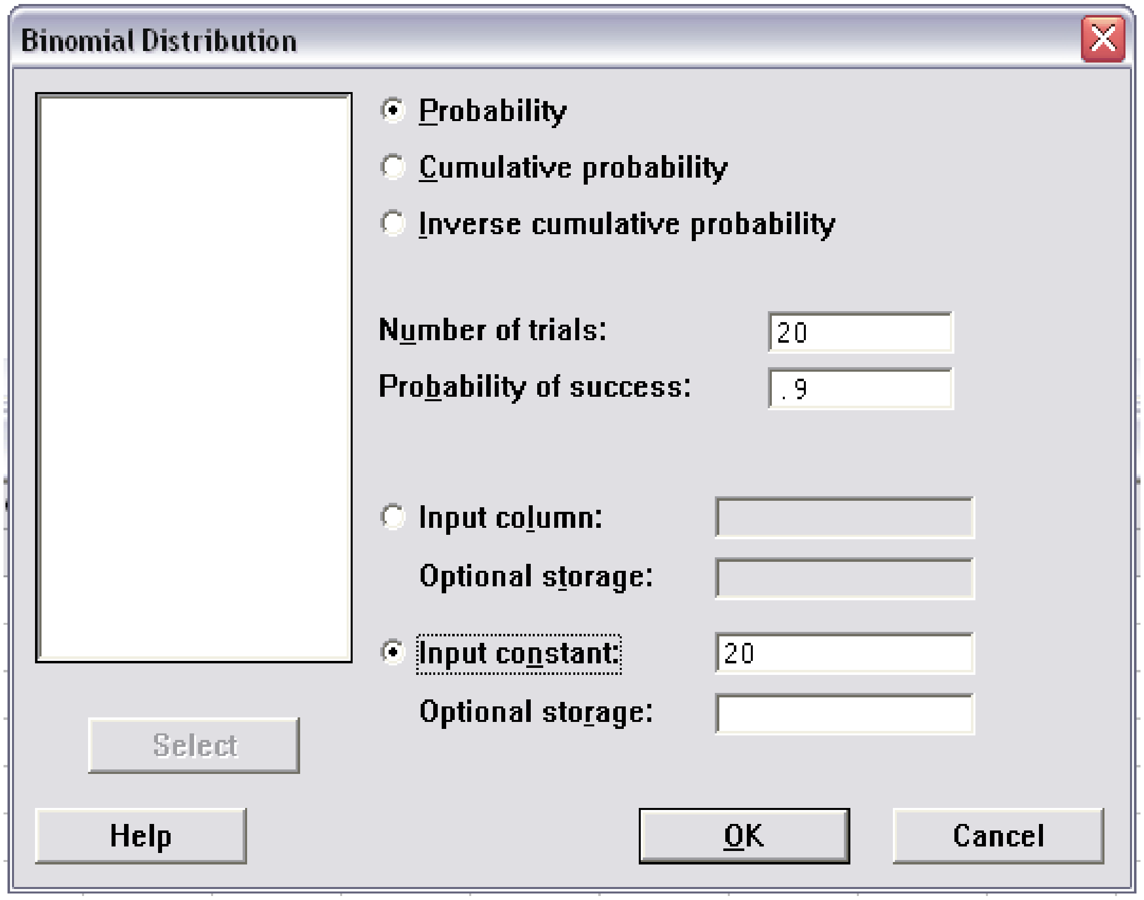


Probability Density Function

```
Binomial with n = 20 and p = 0.9

 x   P( X = x )
20     0.121577
19     0.270170
18     0.285180
18     0.285180
```

Alternatively, you can get solutions one at a time by inputing a value in the Input constant field like this:



Probability Density Function

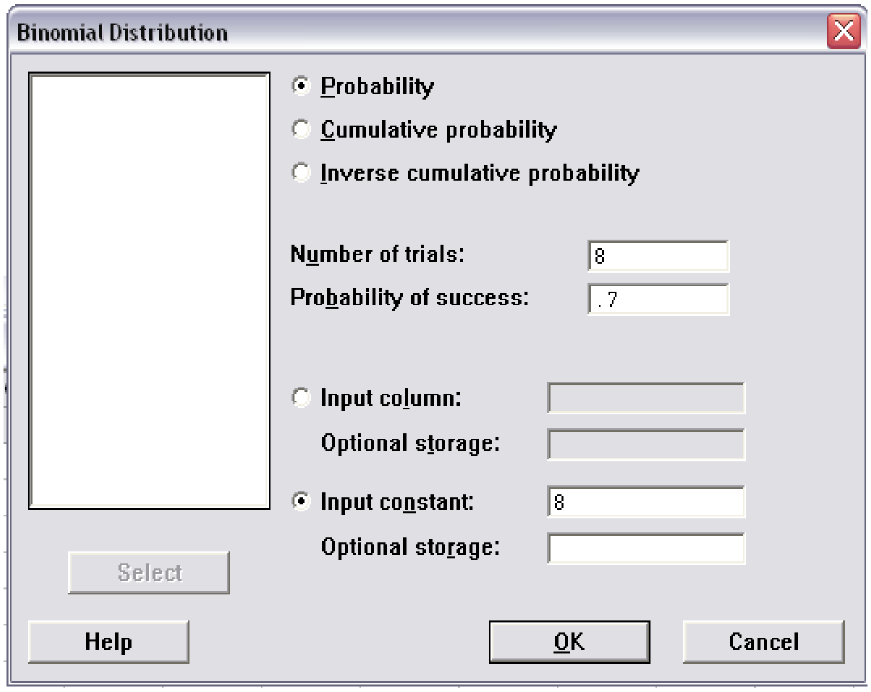
```
Binomial with n = 20 and p = 0.9

 x   P( X = x )
20     0.121577
```

5. SW Exercise 3.32 p. 111

Ignore the 300000, it is not important to answer this problem.
We are interested in the binomial distribution with n=8 children, with p=.7 probability of detecting the disease.

a) Pr(all 8 detected) = (.7)^8 = 0.0576480 This calculation is shown below using Minitab.



Probability Density Function

```
Binomial with n = 8 and p = 0.7

x  P( X = x )
8   0.0576480
```

b) Pr(7 of 8 detected) = 0.197650

Probability Density Function

```
Binomial with n = 8 and p = 0.7

x  P( X = x )
7    0.197650
```

c) Pr(2 or more missed) = 1 – [Pr(all detected) + Pr(7 of 8 detected)]
= 1 – [.057648 + .19765] = 1 – .255298 = .744702

6. SW Exercise 3.34 p. 111
We are interested in the binomial distribution with n=16 children, with p=1/8=.125 probability of having high blood lead level. Below I simply show the minitab output for parts (a) – (c), then answer (d) based on (a) – (c).

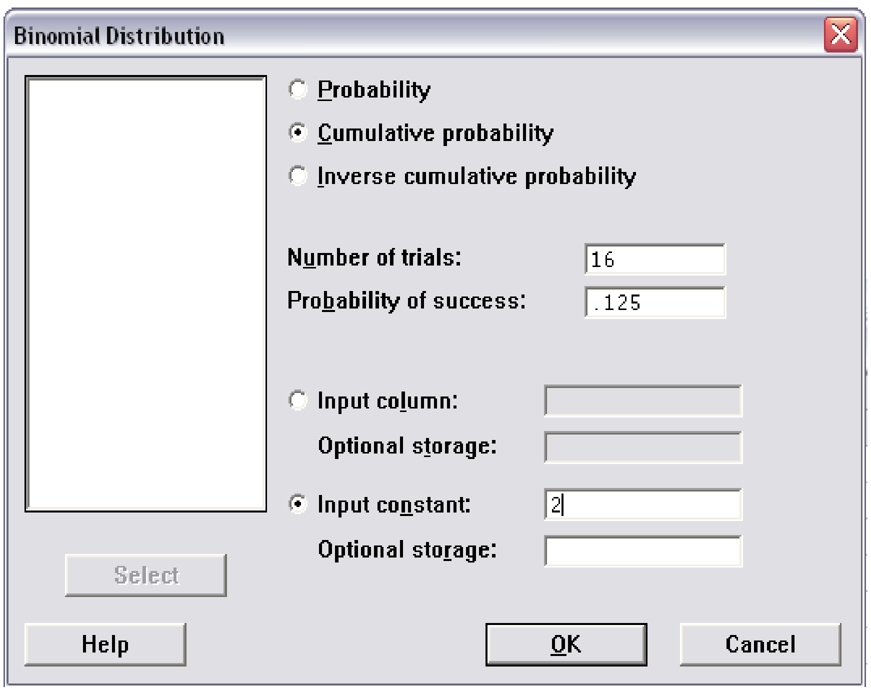
(a) – (c)
Probability Density Function

```
Binomial with n = 16 and p = 0.125

x  P( X = x )
0    0.118067
1    0.269868
2    0.289144
```

d) Pr(3 or more) = 1 – [Pr(0) + Pr(1) + Pr(2)]
= 1 – [.118067 + .269868 + .289144] = 1 - .677079 = .322921

We can use the Cumulative probability to get the sum of the first three probabilities from 0 to 2 below. Notice the result matches the .677079 above.



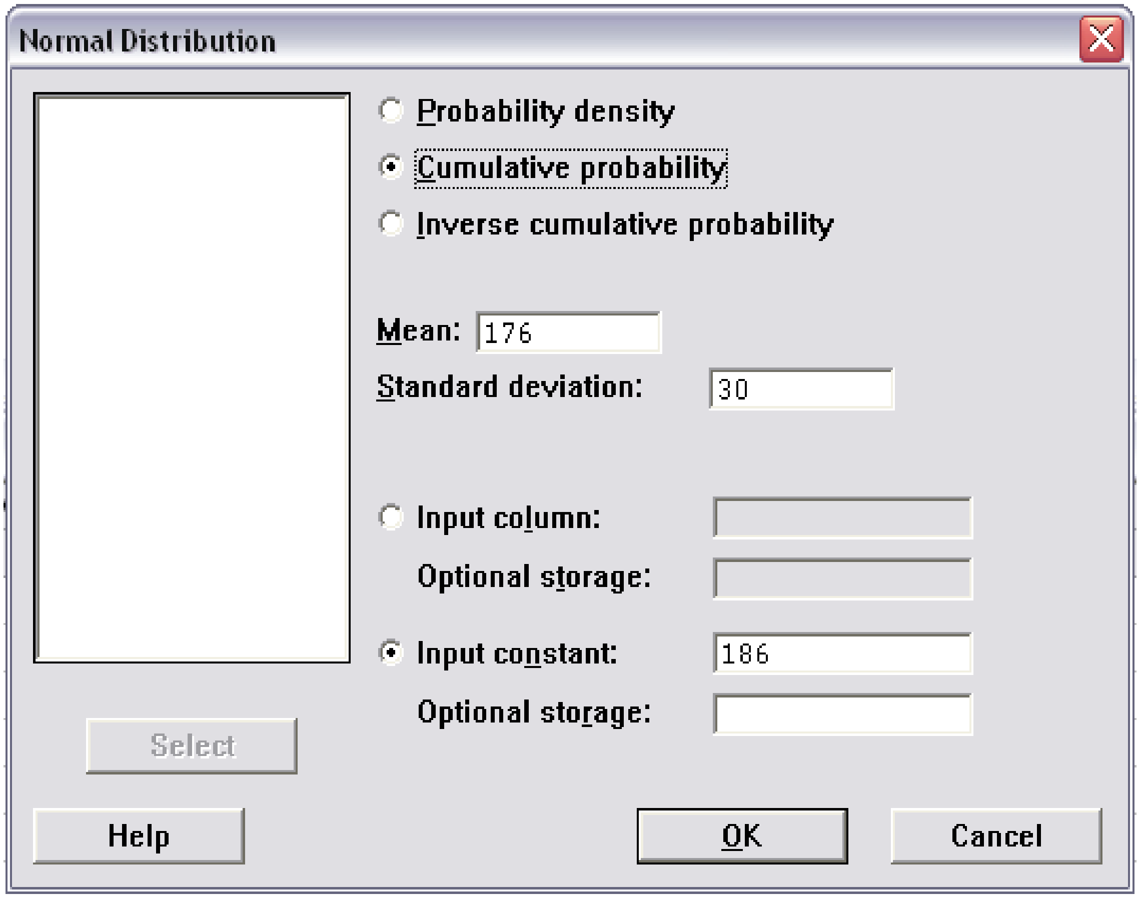
Cumulative Distribution Function

```
Binomial with n = 16 and p = 0.125

x  P( X <= x )
2     0.677079
```

7. SW Exercise 4.9 p. 132
We are interested in the normal distribution with mean 176 and standard deviation 30. To find probabilities in intervals (ranges of values), we use the cumulative probability to find the area to the left of a value (subtracting it from 1 to get the area to the right).

a) Pr(Y >= 186)
First find the area to the left:



Cumulative Distribution Function

```
Normal with mean = 176 and standard deviation = 30

  x  P( X <= x )
186     0.630559
```

Next, subtract this area from 1 to get the area to the right
Pr(Y >= 186) = 1 - .630559 = 0.369441

The areas to the left (cumulative probabilities) for each of the four values in (a) – (d) are

Cumulative Distribution Function

```
Normal with mean = 176 and standard deviation = 30

  x  P( X <= x )
```

```
186      0.630559
156      0.252493
216      0.908789
121      0.033377
```

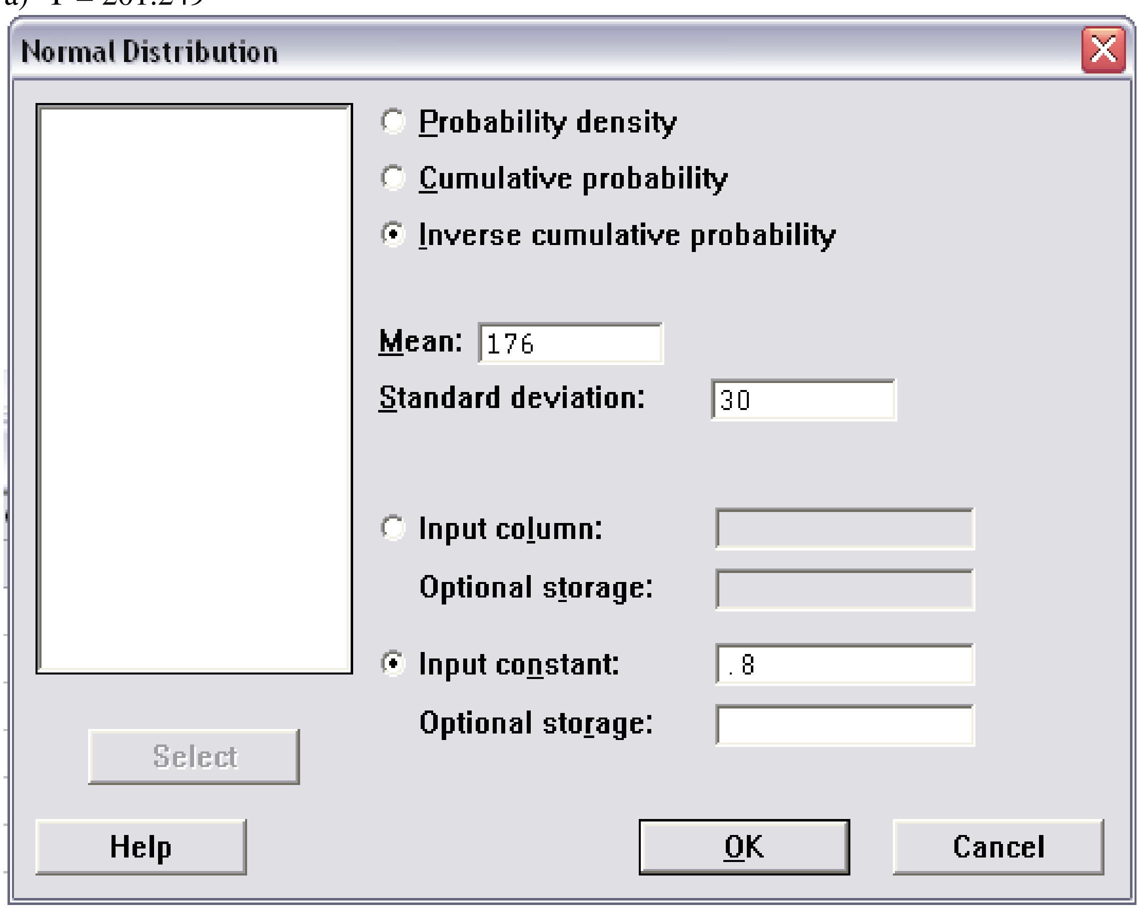
We will use these values to answer the remaining parts.

b) Pr(Y <= 156) = .252493
c) Pr(Y <= 216) = .908789
d) Pr(Y >= 121) = 1 - .033377 = .966623
e) Pr(186 < Y < 216) = Pr(Y < 216) – Pr(Y <= 186) = .908789 – .630559 = .27823
f) Pr(121 < Y < 156) = Pr(Y < 156) – Pr(Y <= 121) = .252493 – .033377 = .219116
g) Pr(156 < Y < 186) = Pr(Y < 186) – Pr(Y <= 156) = .630559 – .252493 = .378066

8. SW Exercise 4.11 p. 132

To find the percentiles, we are interested in the value of Y (serum cholesterol value) that gives a certain percent of the distribution below that value. For part (a) we want 80% or .8 of the distribution to the left of some value Y. To find that value, we select Inverse cumulative probability and enter .8 as the input constant. The result is below.

a) Y = 201.249



Inverse Cumulative Distribution Function

```
Normal with mean = 176 and standard deviation = 30

P( X <= x )        x
        0.8  201.249
```

b) Input .2 as the input constant to get Y = 150.751

Inverse Cumulative Distribution Function

```
Normal with mean = 176 and standard deviation = 30

P( X <= x )        x
        0.2  150.751
```

9. SW Exercise 4.16 p. 133

We are interested in the normal distribution with mean 230 minutes and standard deviation 36 minutes.
a) Pr(Y>200) = 1 – Pr(Y<=200) = 1 – .202328 = .797672

Cumulative Distribution Function

```
Normal with mean = 230 and standard deviation = 36

  x  P( X <= x )
200     0.202328
```

b) The 60^{th} percentile is 239.12, that means that 60 of the runner times are below 239 minutes.

Inverse Cumulative Distribution Function

```
Normal with mean = 230 and standard deviation = 36

P( X <= x )        x
        0.6  239.120
```

c) One explanation is that the 240 minute mark separates the professional runners from the amateur runners. Most all of the professional runners will finish early with less variation (spread). The amateur runners are likely to have more variation (spread) in their finishing times, some will finish early, some very late, and some not at all.

Stat 538 - Biostatistics 1

Homework 2, due in lab Thurs. Sept 15 - POSTPONED UNTIL 9/22

Do the first three problems by hand. You can turn in handwritten notes for these three problems.

1. SW Exercise 3.6 p. 87.
2. SW Exercises 3.9 and 3.10, p. 88.
3. SW Exercise 3.16 p. 96

You should be able to use Minitab to do the calculations on the following problems:

4. SW Exercise 3.28 p. 111
5. SW Exercise 3.32 p. 111
6. SW Exercise 3.34 p. 111
7. SW Exercise 4.9 p. 132
8. SW Exercise 4.11 p. 132
9. SW Exercise 4.16 p. 132