GSB420

LAB3 Instructions and Assignment:

Probability Distribution and Hypothesis Tests using Minitab

1. Binomial Distribution Example

Ichiro Suzuki's hit. In 2004, Ichiro Suzuki of the Seattle Mariners hit 262 hits, a new record breaking an 84-year-old mark held by George Sisler of the St. Louise Browns who had 257 hits. Historically Suzuki hit 0.328, and he went to bet 704 times in 2004. Let's assume we have binary distribution with n=704 and p=0.328.

1) What is the probability of 200 or less hits?
   CALC -> Probability Distributions -> Binomial
   Here is the dialogue box to input:
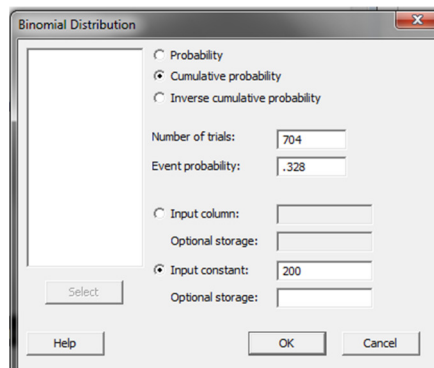
Note you select the cumulative probability to get the probability from 0 to 200.

Cumulative Distribution Function

Binomial with n = 704 and p = 0.328

```
  x   P( X <= x )
200     0.0068217
```

2) What is the probability he hits 250 or more?
   Instead of the menu, Here is the output from the Minitab command.

```
MTB > CDF 250;
SUBC>   Binomial 704 .328.
```

Cumulative Distribution Function

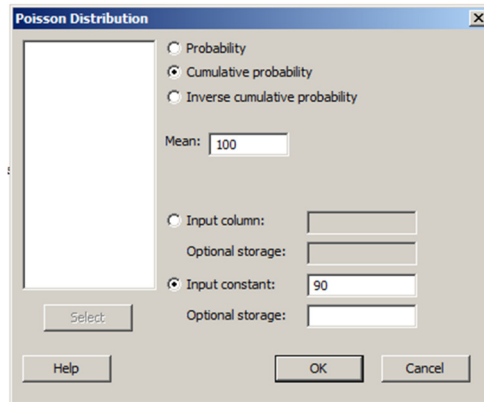Binomial with n = 704 and p = 0.328

```
  x   P( X <= x )
250      0.941340
```
To calculate the probability
P(X > 250) = 1−p(X <= 250) = 1−0.941340 = 0.05866

2. Poisson Distribution Example

1) Assume that the average number of inquiries to a toll-free telephone number for a computer company is 100 per business hour. What is the probability of getting exactly 90 or less calls per business hour today?


```
MTB > CDF 90;
SUBC>   Poisson 100.
```

Cumulative Distribution Function

```
        Poisson with mean = 100

          x   P( X <= x )
         90     0.171385
```

2) Assume that as a quality control manager of a firm that produces chocolate-chip cookies, you believe that the number of chocolate chips on a cookie is distributed as a Poisson distribution. Assume further that your machine is designed to put 20 chocolate chips per cookie.
   a. What is the probability that you will find a cookie with exactly 18 chocolate chips?

   b. What is the probability that you will find a cookie with exactly 25 or more chocolate chips?

3. Normal Distribution Example

1) Use the SP Annual Return (C22), and make a histogram and find the descriptive statistics.

2) Assuming the stock return has a normal distribution with the sample mean and the sample standard deviation. What is the probability that the stock return is 0 or less?

```
MTB > CDF 0;
SUBC>   Normal 0.0103 0.2298.
```

Cumulative Distribution Function

```
Normal with mean = 0.0103 and standard deviation = 0.2298

x  P( X <= x )
0     0.482125
```

3) From 2) what is the probability that the stock return is 10% or higher?

4. Minitab Example for Hypothesis Tests

Suppose that you know from previous experience that the average speed of a car on the highway is 60 m.p.h. last year. For this year, the population standard deviation is 8 m.p.h.

1) Find out whether the average speed of a car on the same highway has remained the same or not, you conducted a survey and found that the average speed of 25 cars surveyed was 64 m.p.h.
   $H_0: \mu = 60$ vs. $H_1: \mu \neq 60$
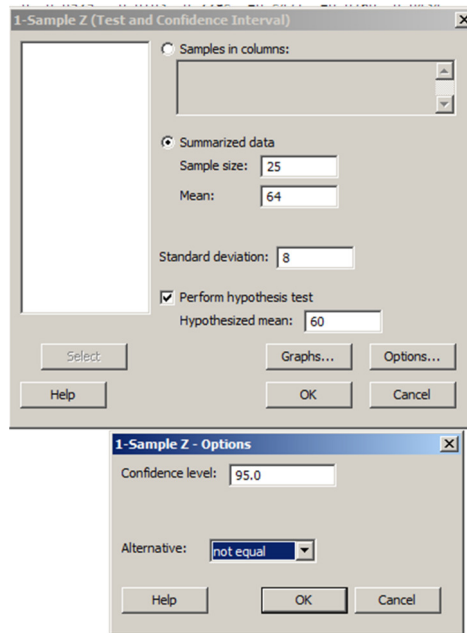

```
MTB > OneZ 25 64;
SUBC>   Sigma 8;
SUBC>   Test 60.
```

One-Sample Z

```
Test of mu = 60 vs not = 60
The assumed standard deviation = 8


 N    Mean   SE Mean       95% CI          Z      P
25   64.00      1.60   (60.86, 67.14)   2.50   0.012
```

2) Find out whether the average speed of a car on the same highway has remained the same or not, you conducted a survey and found that the average speed of 16 cars surveyed was 63.90375 m.p.h. and the sample standard deviation was 6 m.p.h.

H_0: μ = 60   vs. H_1: $\mu \neq$ 60

```
MTB > Onet 16 63.90375 6;
SUBC>   Test 60.
```

One-Sample T

```
Test of mu = 60 vs not = 60


 N    Mean   StDev  SE Mean      95% CI        T      P
16   63.90    6.00     1.50  (60.71, 67.10)  2.60   0.020
```

3) You know from previous experience that the average speed of a car on the highway is 60 m.p.h. In order to find out whether the average speed of a car on the same highway has increased or not, you conducted a survey and found that the average speed of 16 cars surveyed was 63.90375 m.p.h. and the sample variance was 36 m.p.h.

Verify at a 5% significance level if the average car speed had increased

H_0: $\mu \leq$ 60   vs. H_1: $\mu >$ 60

```
MTB > Onet 16 63.90375 6;
SUBC>   Test 60;
SUBC>   Alternative 1.
```

One-Sample T

```
Test of mu = 60 vs > 60


                         95% Lower
 N    Mean   StDev  SE Mean    Bound     T      P
16   63.90    6.00     1.50    61.27   2.60   0.010
```

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4) You know from previous experience that the average speed of a car on the highway is 60 m.p.h. The population variance is 64 m.p.h. In order to find out whether the average speed of a car on the same highway has decreased or not, you conducted a survey and found that the average speed of 25 cars surveyed was 56 m.p.h.

Verify at a 5% significance level if the average car speed had decreased
$H_0: \mu \geq 60$ vs. $H_1: \mu < 60$

5) You know from previous experience that the average speed of a car on the highway is 60 m.p.h. In order to find out whether the average speed of a car on the same highway has decreased or not, you conducted a survey and found that the average speed of 16 cars surveyed was 56.09625 m.p.h. and the sample standard deviation was 6 m.p.h.

Verify at a 5% significance level if the average car speed had decreased
$H_0: \mu \geq 60$ vs. $H_1: \mu < 60$

5. Two sample hypothesis tests

1) Find the mean and standard deviation for Phoenix and Los Angeles, and test if their average house price change are same.

Descriptive Statistics: AZ-Phoenix, CA-Los Angeles

```
Variable            N   N*      Mean   SE Mean      StDev   Minimum        Q1
AZ-Phoenix         12   0    -0.0270    0.0181     0.0628   -0.0955   -0.0857
CA-Los Angeles     12   0   -0.04356   0.00250    0.00865  -0.05402  -0.05192
```

STAT -> Basic Statistics -> 2-Sample t
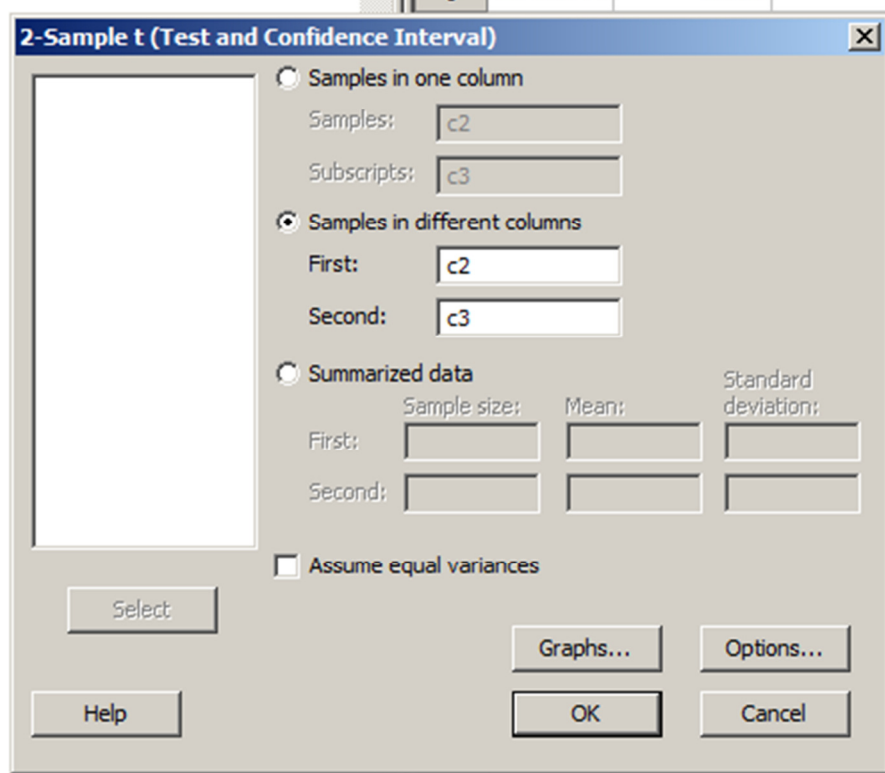

```
MTB > TwoSample c2 c3.
```

Two-Sample T-Test and CI: AZ-Phoenix, CA-Los Angeles

```
Two-sample T for AZ-Phoenix vs CA-Los Angeles

                 N      Mean     StDev   SE Mean
AZ-Phoenix      12   -0.0270    0.0628     0.018
CA-Los Angeles  12  -0.04356   0.00865    0.0025


Difference = mu (AZ-Phoenix) - mu (CA-Los Angeles)
Estimate for difference:  0.0165
95% CI for difference:  (-0.0237, 0.0568)
T-Test of difference = 0 (vs not =): T-Value = 0.90   P-Value = 0.386   DF = 11
```
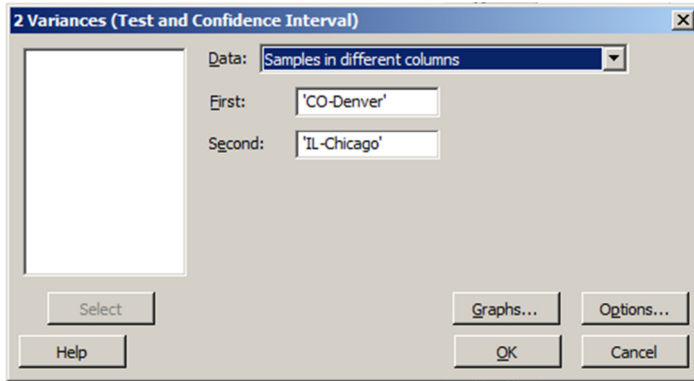
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2) Find the mean and standard deviation for Chicago (C11) and Detroit (C13), and test if their average house price changes are same.

3) Find if the average house price changes is higher in Denver than in Chicago

6. Two Sample Variance Test
1) Find if Chicago and Denver has the same variance of house price changes.

STAT -> Basic Statistics -> 2-Varience


```
MTB > TwoVariances 'CO-Denver' 'IL-Chicago';
SUBC>   Confidence 95.0;
SUBC>   STest 1;
SUBC>   Alternative 0;
SUBC>   TMethod;
SUBC>   TStatistics;
SUBC>   TConfidence;
SUBC>   TTest.
```

Test and CI for Two Variances: CO-Denver, IL-Chicago

```
Method
```

```
Null hypothesis         Sigma(CO-Denver) / Sigma(IL-Chicago) = 1
Alternative hypothesis  Sigma(CO-Denver) / Sigma(IL-Chicago) not = 1
Significance level      Alpha = 0.05
```

```
Statistics
```

Variable	N	StDev	Variance
CO-Denver	12	0.019	0.000
IL-Chicago	12	0.010	0.000

```
Ratio of standard deviations = 1.935
Ratio of variances = 3.745
```

```
95% Confidence Intervals
```

Distribution of Data	CI for StDev Ratio	CI for Variance Ratio
Normal	(1.038, 3.607)	(1.078, 13.008)
Continuous	(0.921, 3.970)	(0.848, 15.762)

```
Tests
```

Method	DF1	DF2	Test Statistic	P-Value
F Test (normal)	11	11	3.74	0.038
Levene's Test (any continuous)	1	22	3.52	0.074

2) Find if the variances of Boston and Seattle are same.

3) Find if the variance of Miami is higher than Chicago.