Question*:*

Suppose X is a binomial random variable, use Minitab to find the following probabilities:

a) $P(x = 3)$ for $n = 10$, $p = 0.3$

b) $P(x \geq 6)$ for $n = 15$, $p = 0.4$

c) $P(2 \leq x \leq 8)$ for $n = 15$, $p = 0.4$

d) $P(x > 5)$ for $n = 16$, $p = 0.3$

e) $P(x < 4)$ for $n = 20$, $p = 0.7$

Steps:

1. Go to Menu "Calc" > "Probability distribution" > "Binomial"

2. Select: Probability, No. of trials, Probability of success and "Input constant"

3. Click "OK"

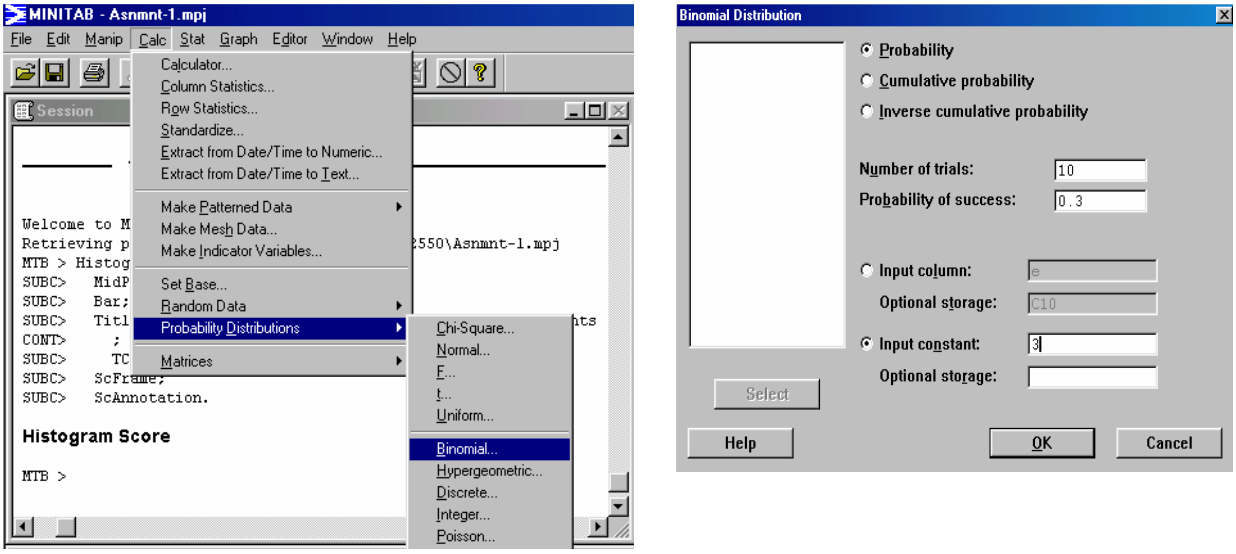


Figure: Calculation of (a)

a) P(X = 3) = 0.2668

b) P(X >= 6) = P(X = 6) + ... + P(X = 15) = 1- P(X = 0) + P(X = 1) + ... + P(X = 5)
= 1- (0.0005 + 0.0047+ 0.0219 + 0.0634 + 0.1268 + 0.1859)
= 1- 0.40322
= 0.5967

c) P(2<=X<= 8) = P(X=2) + ... + P(X=8)
= 0.0219+0.0633+0.1267+0.1859+0.2065+0.1770+0.1180
= 0.8997

d) P(X>5) = 1- P(X<=5) = 1- P(X=0)-...- P(X=5)
= 1- 0.6597
= 0.3403

e) P(X <4) = P(X=0) + P(X=1)+ P(X=2)+P(X=3)
= 0.0000005

Alternative way : Using Cumulative Probability

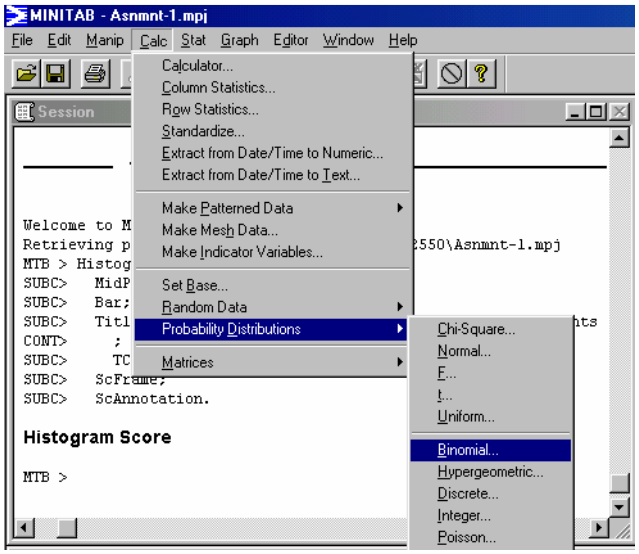
Steps:

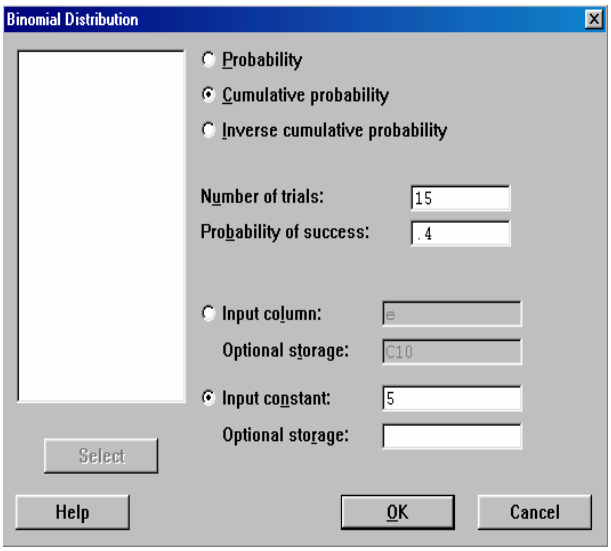
1. **Go to Menu "Calc" > "Probability distribution" > "Binomial"**
2. **Select: Cumulative Probability, No. of trials, Probability of success and "Input constant"**
3. **Click "OK"**

b) P(x>=6) = 1- P(x <= 5)

For this problem,

1. **Go to Menu "Calc" > Prob. dist > Binomial**
2. **Select Cumulative Probability, type 15 in 'No. of trials' and 0.4 in 'prob. of success'**
3. **Type 5 in 'Input Constant' and click OK.**





Output

Cumulative Distribution Function

```
Binomial with n = 15 and p = 0.400000

         x     P( X <= x )
      5.00          0.4032
```

Thus, P(x >= 6) = 1-0.4032 = 0.5967

Finding Probabilities for Normal Distribution

Steps:

1. Go to 'Calc' → 'Probability Dist' → 'Normal'
2. Select 'Cumulative probability', 'Mean' 'St. Deviation'
3. Select input constant
4. If you type 0.3 in 'Input Constant', you will have the probability that X lies between $(-\infty, 0.3)$

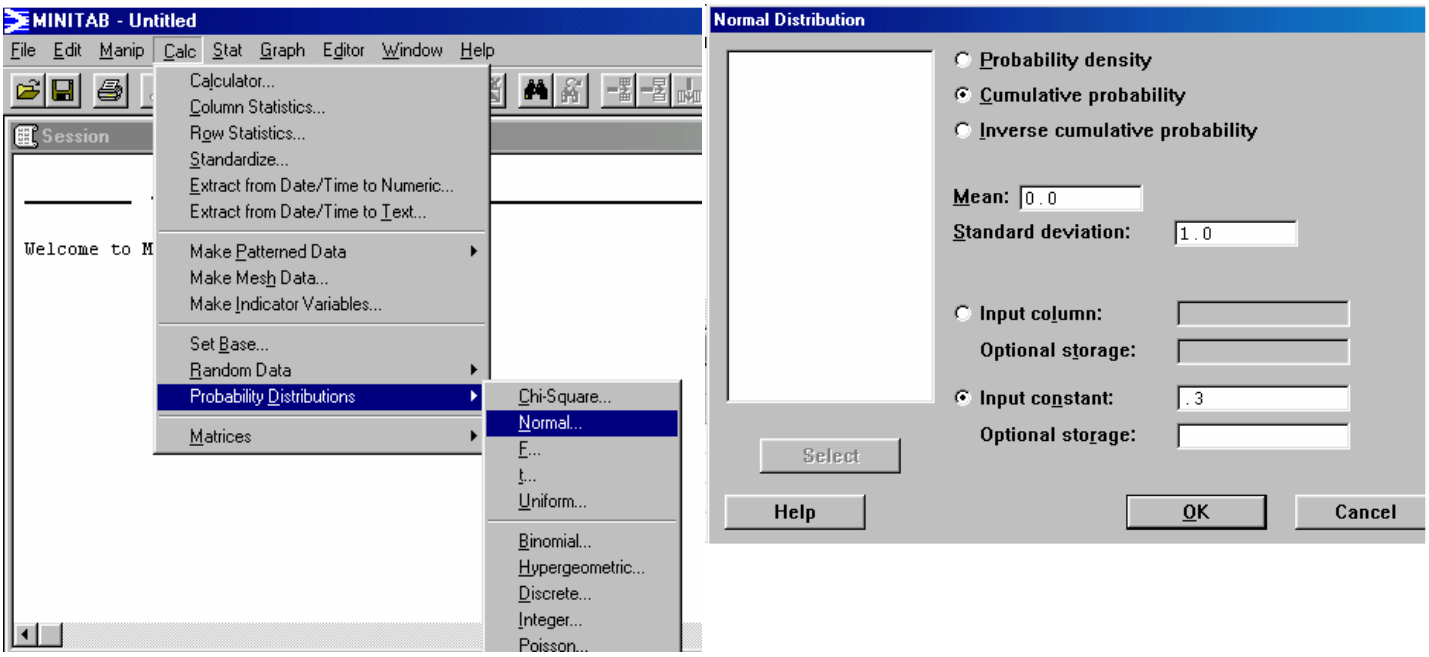


Figure: Calculation of $P(x \leq 0.3)$, when Mean = 0 and Variance = 1

Output

Cumulative Distribution Function

```
Normal with mean = 0 and standard deviation = 1.00000

         x     P( X <= x )
    0.3000          0.6179
```

Problem 1: *The random variable X has a normal distribution with μ=70 and σ=10. Find the following probabilities:*

a) $P(X<75)$ b) $P(X \geq 90)$ c) $P(60 \leq X \leq 75)$

Problem 2: *Assume that X is a binomial random variable with n=100 and p=0.5. Calculate the exact binomial probability and the approximation obtained by using the normal distribution for*

a) $P(X \leq 48)$ b) $P(50 \leq X \leq 65)$ c) $P(X \geq 70)$

Hints: For normal approximation:

a) $P(X \leq 48) = P(X \leq 48.5)$(approx)

b) $P(50 \leq X \leq 65) = P(X \leq 65) - P(X \leq 49) = P(X \leq 65.5) - P(X \leq 49.5)$ (approx)

c) $P(X \geq 70) = 1 - P(X < 70) = 1 - P(X \leq 69) = 1 - P(X \leq 69.5)$ (approx)

Then obtain those probabilities from normal distribution using $\mu = np$, $\sigma = \sqrt{npq}$.

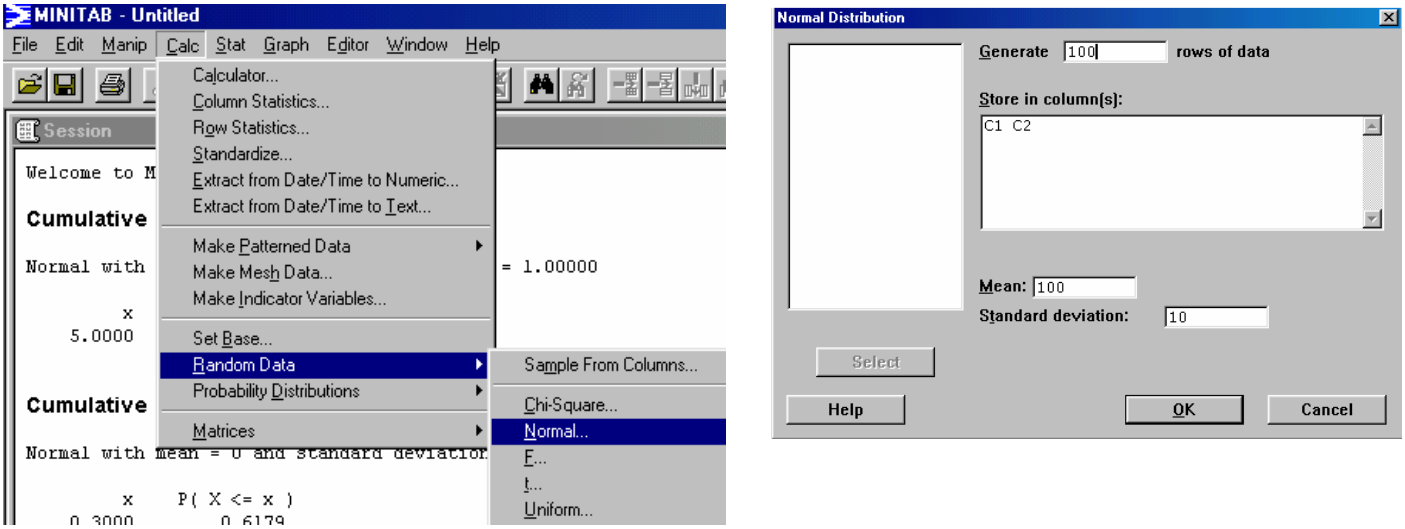
Generating Random Samples from Normal Population

Steps:

f) Go to 'Calc' → 'Random Data' → 'Normal'

g) Select Number of random sample, where to store the data (size of random sample, eg. c1-c5 means size 5), Mean and Standard Deviation

h) Click OK



The above figure describes drawing 100 random samples (written in Generate – rows of data) of size 2 (C1 and C2) from a Normal distribution with Mean 100, Standard Deviation 10.