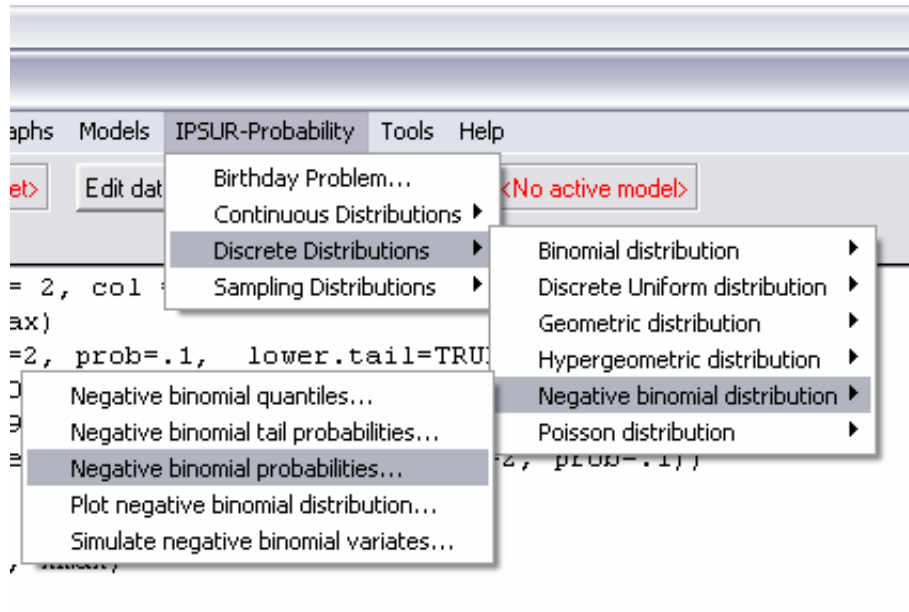


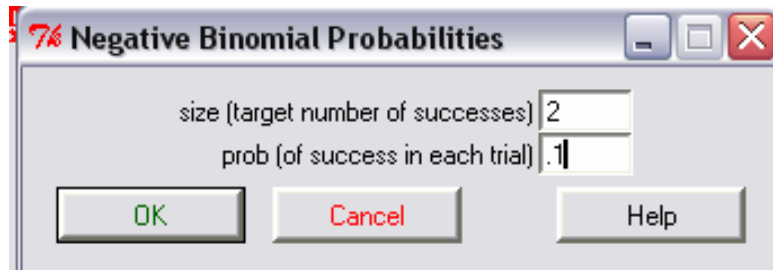
Negative Binomial Distribution

Example: It is reported that 10% of the apples from the Apple Farm are bad. If apples are randomly selected from this farm one after another, what is the probability that the 10th apple selected will be the 2nd bad apple selected?

- 1.) In R Commander, select **IPSUR-Probability, Discrete Distributions, Negative binomial distribution, and Negative binomial probabilities.**



- 2.) Enter information into the Negative binomial probabilities dialogue box. The number of successes equals 2 and the probability of success equals .1.



- 3.) R displays a list of values similar to the one shown below. Find the number of successes (10 in this case) and read the probability. ****Note that the Negative Binomial random variable takes on number failures before the r^{th} success**** So, the answer to this problem is around 0.0387 that is probability next to number 8 in the R output. It is the probability of observing 8 failures before the 2nd success.

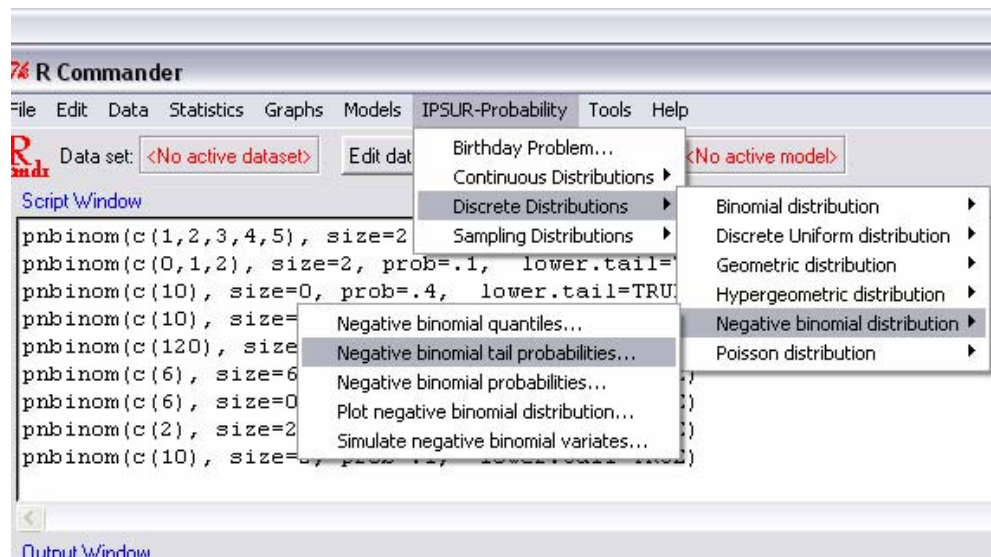
```

Output Window
> xmax <- qnbinom(.99995, size=2, prob=.1)
> .Table <- data.frame(Pr=dnbinom(xmin:xmax, size=2, prob=.1))
> rownames(.Table) <- xmin:xmax
> .Table
      Pr
0  1.000000e-02
1  1.800000e-02
2  2.430000e-02
3  2.916000e-02
4  3.280500e-02
5  3.542940e-02
6  3.720087e-02
7  3.826375e-02
8  3.874205e-02
9  3.874205e-02
10 3.835463e-02
11 3.765727e-02

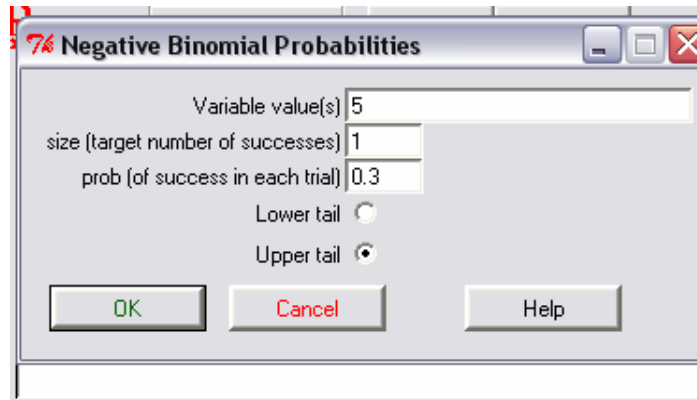
```

Tail Probability Example: If 30% of the cars passing your house are red what is the probability that more than 5 cars will pass before you observe the first red one? (Geometric Distribution: a special case of Negative Binomial Distribution.)

- 1.) In R Commander, select **IPSUR-Probability, Discrete Distributions, Negative binomial distribution, Negative binomial tail probabilities**



- 2.) Enter information into the Negative binomial probabilities dialogue box. The number of successes equals 1 and the probability of success equals .3. Since more than 5 cars is requested, the variable value is 5 and Upper tail probability option should be checked. (If Lower tail is selected, then the probability would be $P(X \leq 5)$.)



- 3.) Results should indicate approximately an 11% chance that more than 5 car will pass before seeing the first red one.

R output:

```
> pnbinom(c(5), size=1, prob=0.3, lower.tail=FALSE)
[1] 0.117649
```