

## How to calculate Binomial Probabilities Using StatCrunch.

In class we discussed how to calculate binomial probabilities using the binomial tables. The tables only show the probabilities for some values of  $n$  and  $p$ . For example, the maximum value of  $n$  in the tables is 20 and the maximum value of  $p$  is 0.5. For other values, if we have  $np \geq 10$  and  $n(1-p) \geq 10$ , then we can use Normal approximation to the binomial distribution., but this will give only approximate values. These two methods are sufficient for our final exam. However, some questions on webwork requires probabilities for binomial distributions with  $n$  and  $p$  values not in the table that we have posted on course webpage and it wants the exact probability correct to 5 decimal places, instead of the approximate probabilities from the Normal approximation. One way to calculate exact probabilities for binomial distributions with  $n$  and  $p$  values not in the table, is to use StatCrunch. This document shows how to calculate exact probabilities for binomial distributions using StatCrunch.

I will use the following question which I copied from webwork to show the steps. Note that  $n = 23$  is not in the binomial table posted and so that cannot be used to calculate the required probabilities using that table.

Suppose the number of TV's in a household has a **binomial distribution** with parameters  $n = 23$ , and  $p = 40\%$ .

Find the probability of a household having **(Keep at least 5 digits)**

(a) 11 or 15 TV's

(b) 13 or fewer TV's

(c) 11 or more TV's

(d) fewer than 15 TV's

(e) more than 13 TV's

Here are the steps to answer part (b). I start with part (b), because it is a bit easier than part (a).

**Step 1:** Login to Statcrunch: You should come up with the screen shown below:

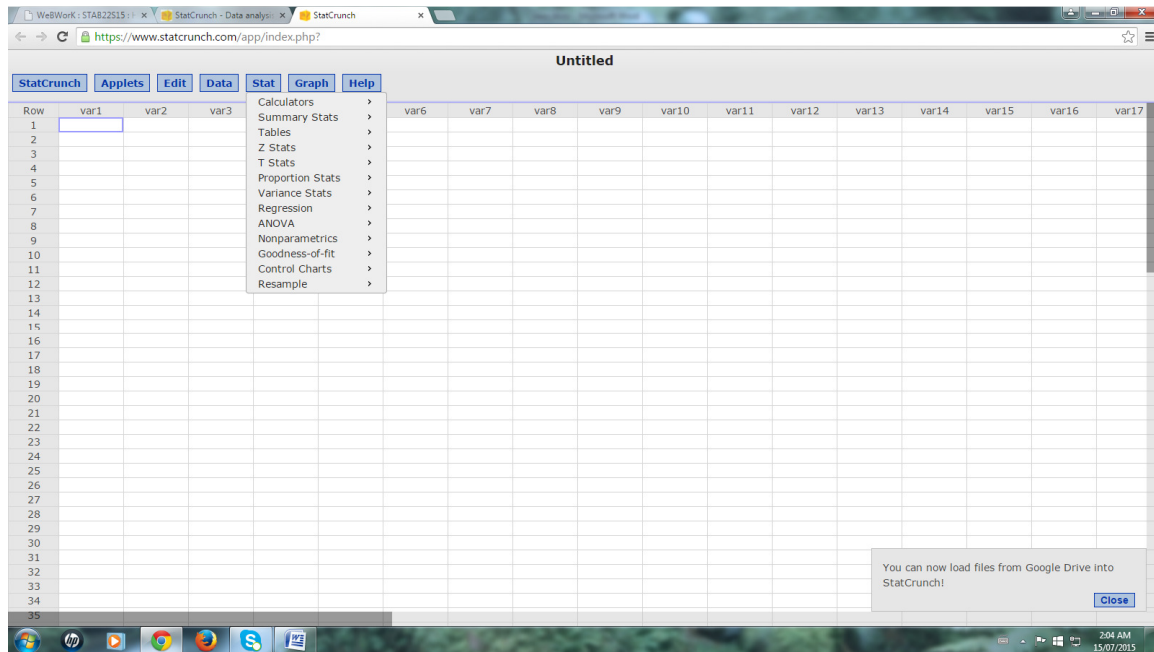
The screenshot shows the StatCrunch website interface. The user is logged in as 'mahindasam'. The page is titled 'My StatCrunch for mahindasam'. On the left, there is a 'My Account' section with fields for StatCrunch ID, Email, Name, Occupation, Organization, and Expires. The main content area is divided into several sections: 'My Preferences', 'My Data', 'My Results', 'My Reports', 'My Surveys', 'My Groups', 'My Favorites', 'My Comments', and 'My Public Profile'. On the right, there is a section titled 'Some data sets that might interest you' with several recommendations, including 'AMSTAT Census at School', 'Knee and Hip Replacement Re-admissions for PA Hospitals in 2013', 'Major League Players Elected to Hall of Fame as Players', and 'JF HEALTHCARE SATISFACTION SURVEY'.

**Step 2:** On this screen, Click the tab “Open StatCrunch”: Another window (shown below) will popup:

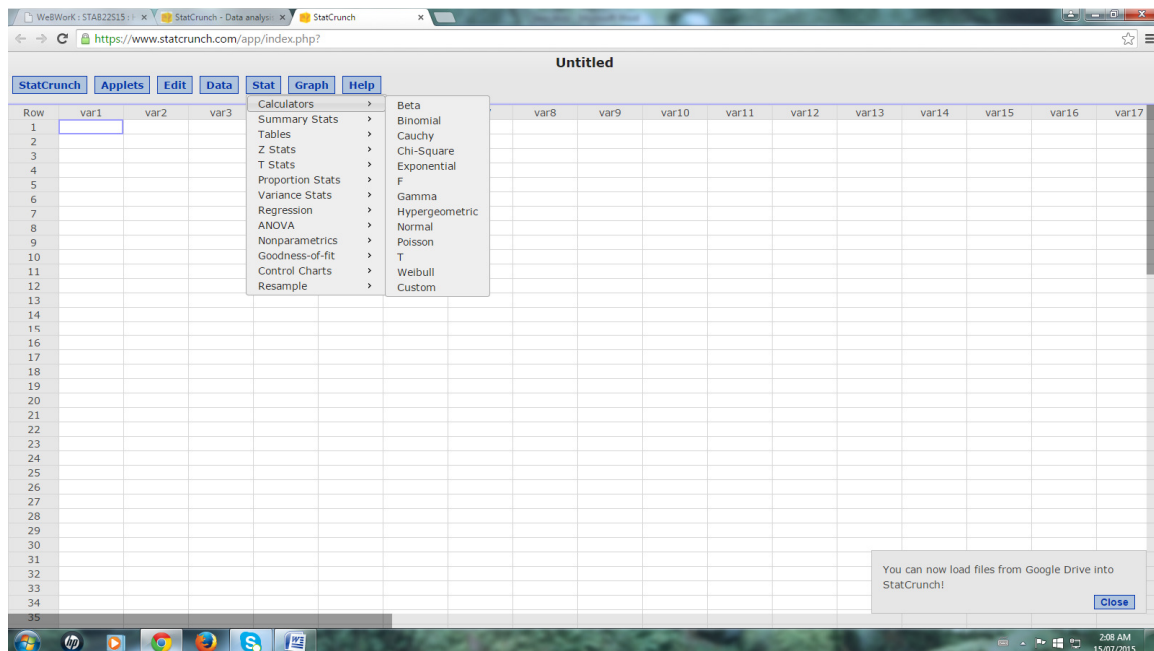
The screenshot shows the StatCrunch application window. The window is titled 'Untitled'. It has a menu bar with 'StatCrunch', 'Applets', 'Edit', 'Data', 'Stat', 'Graph', and 'Help'. Below the menu bar is a data table with 17 columns labeled 'var1' through 'var17' and 35 rows. The first row is highlighted. A message box in the bottom right corner says 'You can now load files from Google Drive into StatCrunch!' with a 'Close' button.

Row	var1	var2	var3	var4	var5	var6	var7	var8	var9	var10	var11	var12	var13	var14	var15	var16	var17
1																	
2																	
3																	
4																	
5																	
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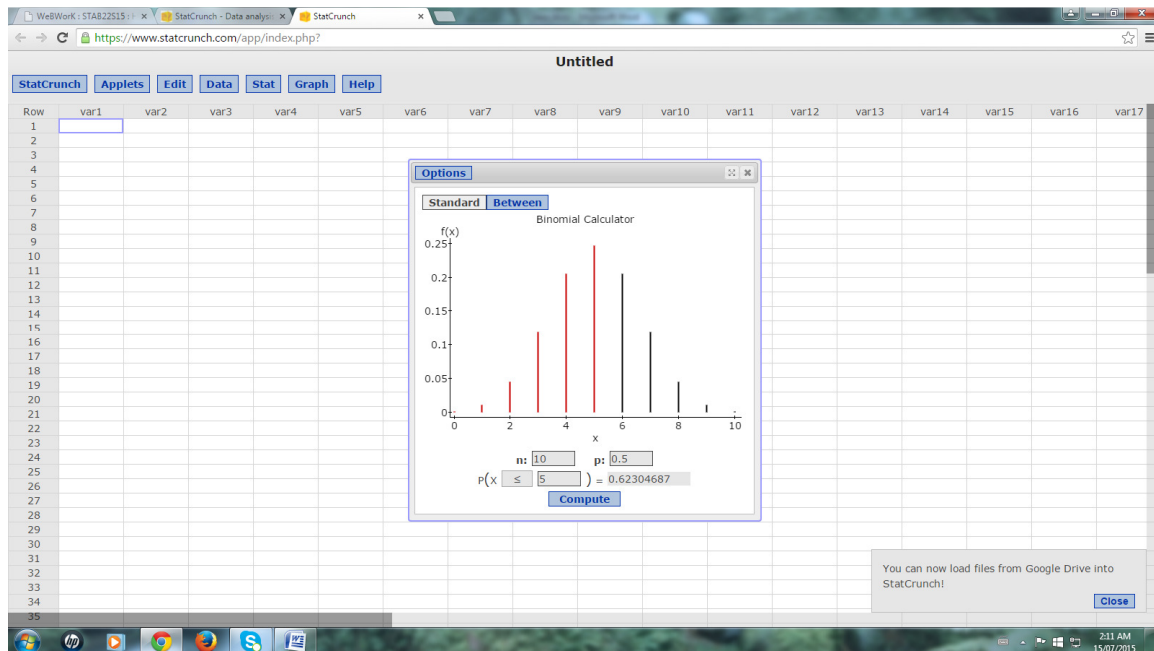
**Step 3:** On this window click the tab “Stat”: A list of items (shown below) will show up



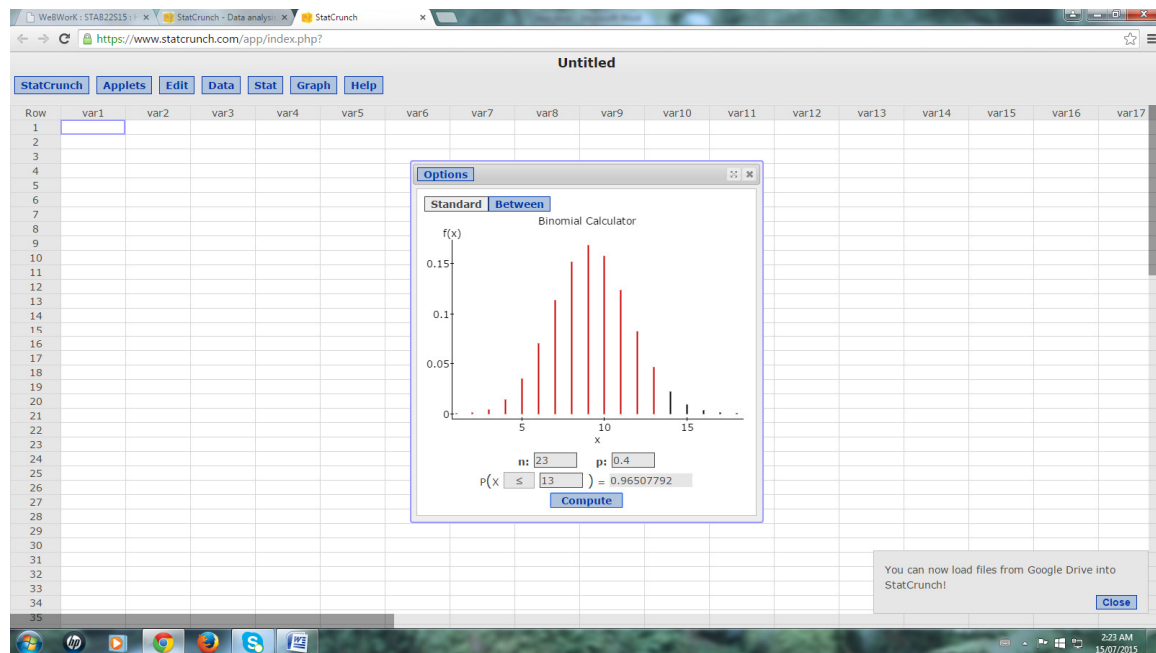
**Step 4:** On this list, click on (or just point at) the first item “Calculators”: You will get another list of items (Shown below)



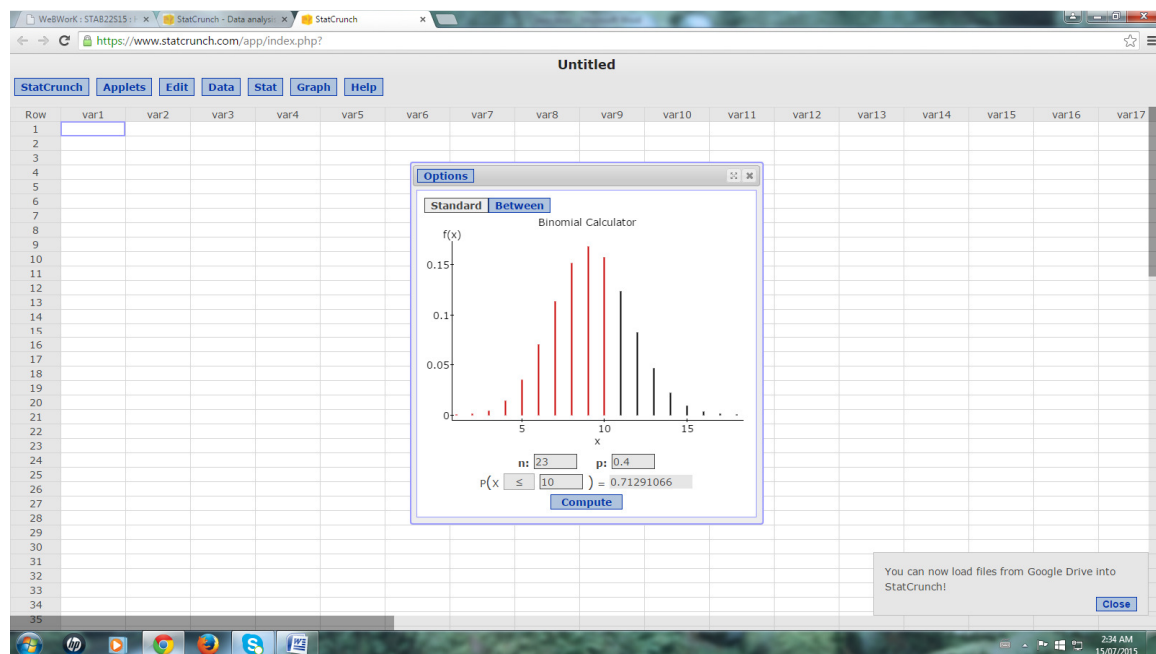
**Step 5:** On this list click the item “Binomial”: Another window (shown below) will pop up.



**Step 5:** On this window, you will see some values of  $n$  and  $p$  (e.g.  $n=10$  and  $p=0.5$ ) which are not the values we want to answer this question. It also shows how  $P(X \leq 5)$  is calculated, again this is not the probability we want to calculate). In our question (on page 1 of this document),  $n = 23$  and  $p = 0.40$  and we want to calculate  $P(X \leq 13)$ . You can type these values into those boxes. When you click the tab “Calculate”, the required probability will appear on the box, right next to  $P(X \leq 13)$ . The window I got is shown below and the answer to this part (i.e. part b) is 0.96508.



**Part (c) :** This part wants the the probability of a household having 11 or more TV's. i.e.  $P(X \geq 11)$ . In StatCrunch was can calculate the probability of the compliment of this event. i.e.  $P(X \leq 10)$ , just like the one before. This probability is 0.71291066. i.e.  $P(X \leq 10) = 0.71291066$  and so  $P(X \geq 11) = 1 - 0.71291066 = 0.28708934$  or 0.28709 (since webwork wants 5 digits).



**Part (d)** : This part wants the the probability of a household having fewer than 15 TV's. This means  $P(X \leq 14)$ . (since 15 is not smaller than 15) and this is now just like just like part (b) above.

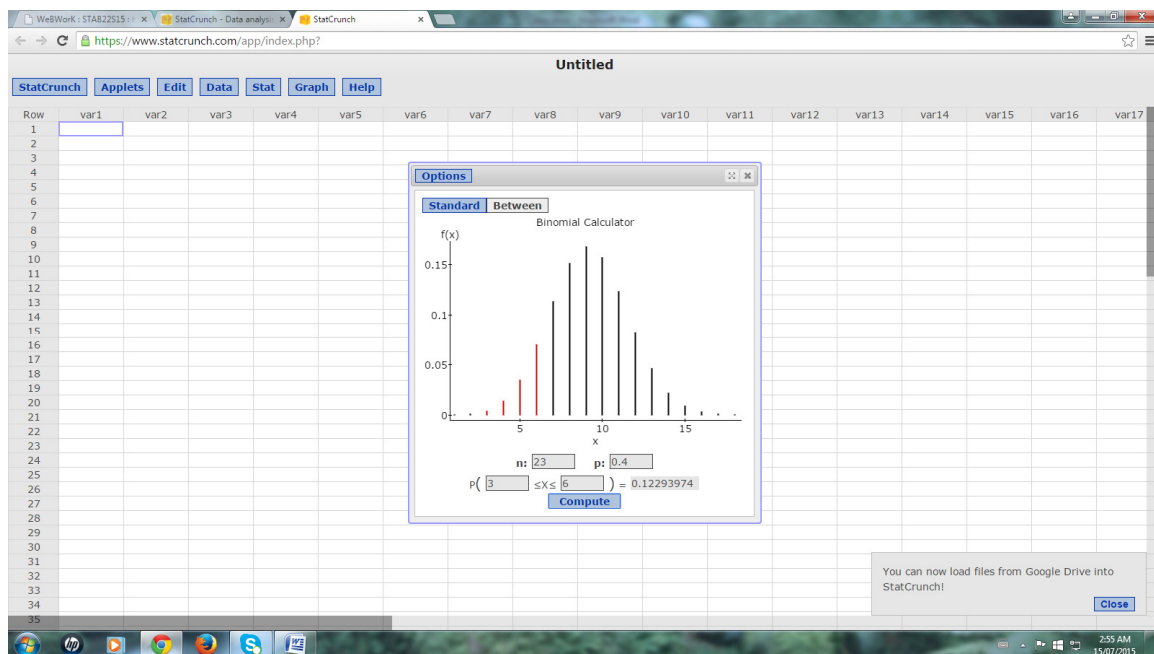
**Part (e)**. This part wants the the probability of a household having more than 13 TV's. This means  $P(X \geq 14)$ . (since 13 is not larger than 13) and this is now just like just like part (c) above.

Now let's look at part (a)

**Part (a)**: This part wants the the probability of a household having 11 or 15 TV's. This means  $P(X=11)+P(X=15)$ . We have to  $P(X=11)$  and  $P(X = 15)$  separately and add the two.

How to calculate  $P(X = 11)$ ?

At the top left hand corner of the StatCrunch window that we used to calculate all the probabilities of the parts above, there are two tabs called “Standard” and “Between”. Click the tab “Between”. The window shown below will popup.



This time there are two boxes above the tab “Compute”. These boxed will contain some numbers. In order to calculate  $P(X = 11)$ , type 11 in BOTH the boxes. Make sure that the values of n and p are correct, if not type in the correct values into those boxes. Now click the tab “Compute” to get the value of  $P(X = 11)$ . The window I got is copied below and

on that we see  $P(X = 11) = 0.1234459$ . To calculate  $P(X = 15)$ , just replace 11 by 15 (i.e. type in 15 on both the boxes) and click the tab “Compute”. You get  $P(X = 15) = 0.00884269$ .

The answer to the question is  $P(X = 11) + P(X = 15) = 0.1234459 + 0.00884269 = 0.13228859$  (i.e. 0.13229 with 5 digits)

