Nice fact about Binomial random variables.

Suppose Y_1 is Binomial with parameters n_1, p
Y_2 is Binomial with parameters n_2, p
$\vdots$
Y_k is Binomial with parameters n_k, p

need these p's to be the same!

Now define $U = Y_1 + Y_2 + \dots + Y_k$. If the Y_j's are independent

then U is a Binomial random variable too.

U has the same "p" for the probability of success

and U has $N = n_1 + n_2 + \dots + n_k$ for the number of trials.

So U is a Binomial(N, p) random variable.

Example: Say Y_1 is Binomial$(5, \frac{1}{3})$
Y_2 is Binomial$(7, \frac{1}{3})$
Y_3 is Binomial$(2, \frac{1}{3})$
Y_4 is Binomial$(10, \frac{1}{3})$

Define $U = Y_1 + Y_2 + Y_3 + Y_4$. If Y_1, Y_2, Y_3, Y_4 are independent then U is a Binomial$(24, \frac{1}{3})$ random variable.

$\uparrow$ $5+7+2+10$.

Why? Think:
$5+7+2+10 = 24$ trials, all are independent,
each has probability of success $1/3$,
U is the total number of successes among the 24 trials.