NAMES:

- 1. What is the unit of observation in the dataset shown in the screengrab?
- 2. Sketch a plot of the distribution of the vote counts for Ahmadinejad. Label your axes and title your plot with a claim about the shape and modality of the data. Depict a shape which reflects **your** expectation of the phenomenon.

3. Sketch a plot of the distribution of the *first digit* of the vote counts for Ahmadinejad. Label your axes and title your plot with a claim about the shape and modality of the data. Depict a shape which reflects **your** expectation of the phenomenon.

Let X be a random variable which represents the first digit of vote tallies.

- 4. If you had no inclination as to what the probability distribution of first digits of vote counts would look like, what distribution might you assign *X*?
- State a distribution (and the values which it can take).
- Write down the probability mass function of this distribution.
- 5. Sketch a probability histogram which describes the probability distribution of X. Label your axes.
- 6. Then calculate $\mathbb{E}(X)$ and Var(X) for a random variable X having the distribution you assigned it in the previous question.

One common theory on how to determine whether an election is fair is as follows:

In a normally occurring, fair election, the *first digit* of the vote counts for each voting precinct should follow **Benford's Law**. If they do not, that might suggest that vote counts have been manually altered.

Benford's Law is not any universal, binding statute but actually a probability distribution on the set $\{1, 2, 3, 4, 5, 6, 7, 8, 9\}$. Let Y be a random variable following the Benford's Law probability distribution. Then:

$$f(y) = \log_{10} \left(1 + \frac{1}{y} \right)$$

- 7. Sketch an (approximate) probability histogram which describes the probability distribution of *Y*. Label your axes.
- 8. Use the formula to calculate $\mathbb{E}(Y)$.
- 9. Use the formula to calculate Var(Y).