

## **Homework 2**    *Monte Carlo Money Jar*

Loose change seems to pile up. Here, we'll model how fast that happens and the distribution of coins in different scenarios. The basic assumptions are:

- 1) you make  $X$  purchases each day with petty cash, starting out with only bills in your pocket (i.e., no change).
- 2) Each purchase has a random chance of costing some dollar amount plus  $YY$  cents (where  $YY$  goes from 0-99). You always get change in the smallest number of coins possible. For instance, if you have a purchase of \$2.34, then you assume you acquire 66 cents in change (2 quarters, 1 dime, 1 nickel, 1 penny).
- 3) If you have enough change to cover the  $YY$  cents of the current transaction, you use it. Otherwise, you accumulate more change. For example, if you have \$1.02 in loose change, and you have a purchase of \$10.34, then you use 34 cents (or as close to it as possible) in coins, leaving you with 68 cents.
- 4) At the end of each day you dump all your coins collected for the day in a Money Jar.

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- a) What is the average total amount of change accumulated each year (assume  $X=5$ )? What is the 1-sigma scatter about this quantity?
- b) What coin (quarter, dime, nickel, penny) are you most likely to accumulate over time? Second most likely? Does it depend on  $X$ ?
- c) Let's say you need 8 quarters per week to do laundry. How many quarters do you have at the end of the year? (if you do not have enough quarters at the end of each week, use only what you have).

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## Hints

- write a class called CookieJar, which knows how many coins it has, how many transactions it has completed, how long it has been filled for, etc.
- write a function which takes a input a transaction amount and returns the number of coins in change as a dictionary. For example,  
`calc_change(3.45) → {"quarter": 2, "dime": 0, "nickel": 1, "penny": 0}`
- instantiate CookieJar (and run its method that performs all the transactions in one year) a number of times (~50) so you can get a good sense of the spread of results
- look at the doc: <http://lyra.berkeley.edu/~jbloom/change.html>