Pre-class work

Create a Google document and record your work and all exercises. **Make sure the Google document is shared** so that it can be assessed, and **be ready to paste a link to your document into a class poll**.

Do the following exercises from Shonkwiler & Mendivil, Chapter 2.

- **Exercise 14, page 96: Sampling bias for bus waiting times**

  14. (4) (Sampling bias for bus waiting times) Suppose the interarrival time for a city bus has an exponential distribution with parameter $1/\lambda$. A passenger arrives at a uniformly random time and records the time until the next bus arrives. What is the expected waiting time? Use a simulation to get an answer. Is the answer surprising? Now suppose instead that the interarrival time is $U(0, 2\lambda)$. How does this change the situation? (Notice that the expected interarrival time is λ in both cases.)

  Note that there are 2 common, equivalent parameterizations of the exponential distribution.

  - $\text{Exponential}(x \mid \lambda) = \lambda\, e^{-\lambda x}$. This is used in Shonkwiler & Mendivil.
  - $\text{Exponential}(x \mid \beta) = \beta^{-1}\, e^{-x/\beta}$. This is used in Scipy. So if you import scipy and generate exponentially distributed random values using `scipy.random.exponential(beta)`, you should use $\beta = \lambda^{-1}$.

  This is an example of a difficult to compute value (the expected waiting time under two different distributions) with a counterintuitive result that be can simulated fairly easily.

- **Exercise 24, page 98: Retirement benefit projection**

  24. (5) (Retirement benefit projection) At age 50 Fannie Mae has \$150,000 invested and will be investing another \$10,000 per year until age 70. Each year the investment grows according to an interest rate that is normally distributed with mean 8% and standard deviation 9%. At age 70, Fannie Mae then retires and withdraws \$65,000 per year until death. Below is given a conditional death probability table. Thus if Fannie Mae lives until age 70, then the probability of dying before age 71 is 0.04979. Simulate this process 1000 times and histogram the amount of money Fannie Mae has at death.

Mortality table, probability of dying during the year by age*

50	0.00832	64	0.02904	78	0.09306	92	0.26593
51	0.00911	65	0.03175	79	0.10119	93	0.28930
52	0.00996	66	0.03474	80	0.10998	94	0.31666
53	0.01089	67	0.03804	81	0.11935	95	0.35124
54	0.01190	68	0.04168	82	0.12917	96	0.40056
55	0.01300	69	0.04561	83	0.13938	97	0.48842
56	0.01421	70	0.04979	84	0.15001	98	0.66815
57	0.01554	71	0.05415	85	0.16114	99	0.72000
58	0.01700	72	0.05865	86	0.17282	100	0.76000
59	0.01859	73	0.06326	87	0.18513	101	0.80000
60	0.02034	74	0.06812	88	0.19825	102	0.85000
61	0.02224	75	0.07337	89	0.21246	103	0.90000
62	0.02431	76	0.07918	90	0.22814	104	0.96000
63	0.02657	77	0.08570	91	0.24577	105	1.0000

* Source: Society of Actuaries, Life Contingencies.

You can get the data for this problem [here](#) so you don't have to retype the whole table.

```
data = {
    50: 0.00832, 51: 0.00911, 52: 0.00996, 53: 0.01089, 54: 0.01190,
    55: 0.01300, 56: 0.01421, 57: 0.01554, 58: 0.01700, 59: 0.01859,
    60: 0.02034, 61: 0.02224, 62: 0.02431, 63: 0.02657, 64: 0.02904,
    65: 0.03175, 66: 0.03474, 67: 0.03804, 68: 0.04168, 69: 0.04561,
    70: 0.04979, 71: 0.05415, 72: 0.05865, 73: 0.06326, 74: 0.06812,
    75: 0.07337, 76: 0.07918, 77: 0.08570, 78: 0.09306, 79: 0.10119,
    80: 0.10998, 81: 0.11935, 82: 0.12917, 83: 0.13938, 84: 0.15001,
    85: 0.16114, 86: 0.17282, 87: 0.18513, 88: 0.19825, 89: 0.21246,
    90: 0.22814, 91: 0.24577, 92: 0.26593, 93: 0.28930, 94: 0.31666,
    95: 0.35124, 96: 0.40056, 97: 0.48842, 98: 0.66815, 99: 0.72000,
    100: 0.76000, 101: 0.80000, 102: 0.85000, 103: 0.90000,
    104: 0.96000, 105: 1.00000}
```