

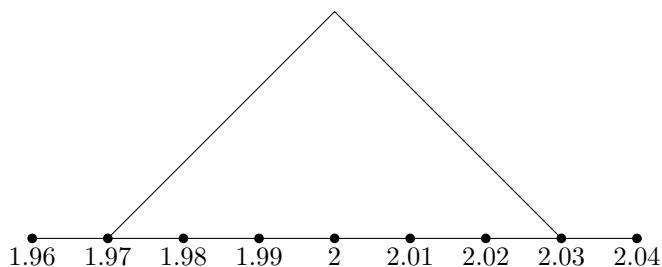
## Week 8

**Exercise 76** Suppose we've designed a new backpack for camping that is super light weight! On average the backpack weighs 12 grams and the standard deviation is 1.1 grams. (Assume that each backpack are independent and that all distributions are normally distributed)

- (1) What is the probability that a single backpack weighs between 11.8 and 12.2 grams?
- (2) What is the probability that the average of 100 backpacks is between 11.8 and 12.2 grams?

**Exercise 77** Team Canada is going to the Olympics and they're getting ready to buy poles for pole vaulting! They go to a pole manufacturer and want to make sure they're being environmentally friendly by not throwing away too many "disfigured" poles. By regulation, the poles must be 2 meters long and are allowed to vary by at most 0.02 meters. (In other words, poles must be between 1.98 and 2.02 meters or else they are "disfigured" and are thrown away) Suppose that the expected value is equal to 2 meters and that the standard deviation is given by 0.01. What proportion of poles are disfigured and must be thrown away? (Assume a normal distribution)

**Exercise 78** Team Canada has decided that they want to actually check a second manufacturing company to see if they're more environmentally friendly or not. They go to a new company and the same principles apply. The poles must be 2 meters and anything outside of the 0.02 meter variance are all discarded. Unlike the previous company, the distribution is not a normal distribution. When asking about their distribution, you're given the following distribution diagram:



What proportion of poles are disfigured and must be thrown away.

**Exercise 79** Over time, paintings start to lose their colour as their pigments begin to fade. Suppose you just bought a painting and it has roughly  $10^{20}$  pigments of colour. Each pigment fades in half roughly once every 10 years. (In other words,  $P(T > 10) = \frac{1}{2}$ ) How many years until your painting only has 1000 pigments remaining? (Assume exponential distribution)

**Exercise 80** You're given a light bulb that says the average life expectancy is 100 hours.

- (1) What is the probability the light bulb lasts 200 hours?
- (2) What is the standard deviation of the light bulb lasting?

(Assume exponential distribution)

**Exercise 81** Transistors that are produced by machine A have an average lifetime of 10 hours. Transistors that are produced by machine B have an average lifetime of 20 hours. Your company just received 12 transistors, 4 from machine A and 8 from machine B. Let  $X$  be the lifetime of a transistor picked at random from those received. What is the expected value and variance of  $X$  and what is the probability that the transistor lasts at least 20 hours? (Suppose that both machines have exponential distribution and are independent)

**Exercise 82** Suppose that we are building a new computer and we know that, on average, a new graphics card lasts 2 years (exponential distribution). We go to the store, buy 4 graphics cards and go home. The plan is to use one graphics card at a time, and when it goes bad, replace it with a new one. When we arrive home we find out that the bit coin miners have used up all the graphics cards and you can't buy any more for the next 10 years.

- (1) What is the expected number of years your graphics cards will last?
- (2) What is the standard deviation?
- (3) What is the probability that your graphics cards will last 10 or more years?