

10/23

Previously we saw:

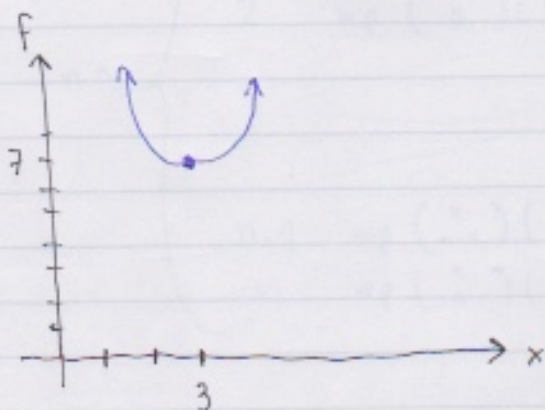
$$X_1, X_2, \dots, X_n \stackrel{\text{iid}}{\sim} \text{Bern}(p)$$

$$T = X_1 + \dots + X_n \sim \text{Bin}(n, p)$$

$$X_1, X_2, \dots \stackrel{\text{iid}}{\sim} \text{Bern}(p)$$

Def to wr
from subject :

$$f(x) = 7 + (x-3)^2$$



$$\begin{aligned} \min \{f(x)\} &= 7 \\ \max \{f(x)\} &= \text{d.n.e.} \\ \arg \min \{f(x)\} &= 3 \\ x \text{ s.t. } f(x) &= \min \{f(x)\} \\ \arg \max \{f(x)\} &= \text{d.n.e.} \end{aligned}$$

Back on track

$$T = \min \{t: X_t = 1\}$$

↑
discrete time

$$\begin{array}{cccccc} 0 & 0 & 0 & 0 & 0 & 1 \\ t=1 & t=2 & t=3 & t=4 & t=5 & t=6 \end{array}$$

$$P(T=1) = p$$

$$P(T=2) = (1-p)p$$

$$P(T=3) = (1-p)^2 p$$

⋮

$$P(T=x) = (1-p)^{x-1} p$$

$$T \sim \text{Geometric}(p) \equiv (1-p)^{x-1} p$$

$$\text{Supp}(X) = \mathbb{N} \quad (0 \text{ not included})$$

$$p \in (0, 1)$$

↑ not inclusive

$$\text{let } i = x-1 \Rightarrow x = i+1$$

$$\sum_{x \in \text{Supp}(X)} P(x) = 1$$

$$\sum_{x=1}^{\infty} (1-p)^{x-1} p = 1 \quad \Rightarrow \quad \sum_{x=1}^{\infty} (1-p)^{x-1} = \frac{1}{p} \quad \Rightarrow \quad \sum_{i=0}^{\infty} (1-p)^i = \frac{1}{p}$$

Want to find

$$q \in (0, 1)$$

$$\text{let } q = 1 - p$$

$$S = \sum_{i=0}^{\infty} q^i = 1 + q + q^2 + q^3 + \dots$$
$$= 1 + q(1 + q + q^2 + \dots)$$

$$S = 1 + qS$$

$$\Rightarrow S - qS = 1$$

$$\Rightarrow S(1 - q) = 1$$

$$\Rightarrow S = \frac{1}{1 - q}$$

$$\sum_{i=0}^{\infty} (1 - p)^i = \frac{1}{p} \quad \checkmark$$

$$\frac{1}{1 - (1 - p)}$$

||

$$\frac{1}{p}$$

$$F(x) = P(X \leq x) = \sum_{i=1}^x p(i)$$

$$= \sum_{i=1}^x (1-p)^{i-1} p$$

$$F(x) = 1 - P(X > x) = 1 - (1-p)^x$$

PMF Question

① Play poker until a royal flush

$$P(\text{royal flush}) = \frac{4}{\binom{52}{5}} = .00000153$$

a) Create a r.v. model for first time get the RF
 $X \sim \text{Geometric}(.00000153)$

b) What's the prob. you get it on the 1,000,000th hand?
 $P(X = 1,000,000) = (1 - .00000153)^{999,999} \cdot (.00000153)$

c) What's the prob. you get it before the 1,000,001st hand?
 $P(X \leq 1,000,001) = P(X \leq 1,000,000) = 1 - (1 - .00000153)^{1,000,000}$
 $\approx 77.7\%$

using
CDF

Data Datum

$$X \sim \text{Bern}(\frac{1}{2})$$

$$p(x) := P(X=x)$$

PMF

$$P(X=1) = \frac{1}{2}$$

$$P(X=0) = \frac{1}{2}$$

X, x
 $x \in \text{Supp}(X)$
 r.v. realization

datum: a realized r.v.

data: realized (r.v.)

• iid

intensity distributive without replacement

Experiment in class

$$X \sim \text{Hypergeometric}(\overset{n}{4}, \overset{k}{3}, \overset{N}{8})$$

$$\text{Supp}(x) = \{0, 1, 2, 3\}$$

$$x_1, \dots, x_8 \stackrel{\text{iid}}{\sim} \text{Hyper}(4, 3, 8)$$

independent

$$\left. \begin{array}{l} x_1 = 1 \\ x_2 = 1 \\ x_3 = 2 \\ x_4 = 2 \\ x_5 = 2 \\ x_6 = 1 \\ x_7 = 1 \\ x_8 = 1 \end{array} \right\}$$

$$\bar{x} = \frac{4}{3} = 1.375$$

(2nd Experiment)
Heads or Tails

$$X \sim \text{Binomial}(\overset{n}{8}, \overset{p}{\frac{1}{2}})$$

$$\text{Supp}(x) = \{0, 1, \dots, 8\}$$

$$\bar{x} = \frac{41}{9} = 4.55$$

$$\begin{array}{l} x_1 = 6 \\ x_2 = 4 \\ x_3 = 3 \\ x_4 = 2 \\ x_5 = 5 \\ x_6 = 7 \\ x_7 = 5 \\ x_8 = 6 \\ x_9 = 3 \end{array}$$

3^h

3rd Experiment

$$X \sim \text{Geometric} \left(\frac{3}{8} \right)$$

$$P(X=10) = \left(\frac{5}{8} \right)^9 \cdot \frac{3}{8} = 0.005$$

$$X_1 = 10$$

$$X_2 = 2$$

$$X_3 = 1$$

$$X_4 = 2$$

$$X_5 = 1$$

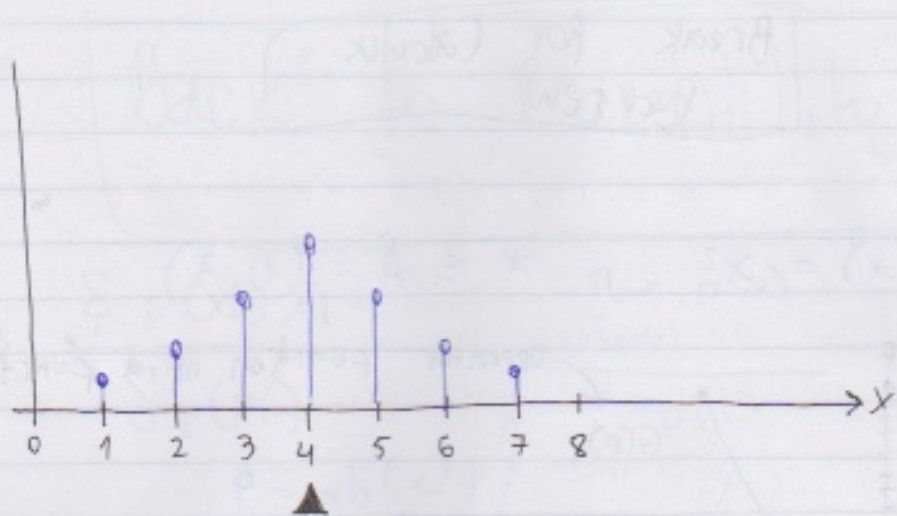
$$X_6 = 2$$

sum
r.v.

$$T_n = X_1 + \dots + X_n = \sum_{i=1}^n X_i$$

$$\text{average r.v. } \bar{X}_n = \frac{X_1 + \dots + X_n}{n} = \frac{1}{n} T_n = \frac{1}{n} \sum_{i=1}^n X_i$$

next
section..



10/10/2017
10/10/2017
10/10/2017

10/10/2017
10/10/2017
10/10/2017

When you use a credit card to pay for a purchase, you will be charged interest on the amount you owe. The interest rate is usually between 12% and 18% per year. This means that if you borrow \$100 at 12% interest, you will have to pay back \$112 after one year. If you borrow \$100 at 18% interest, you will have to pay back \$118 after one year. The interest rate is usually higher for people who have a bad credit record. This means that if you have a bad credit record, you will have to pay back more than \$118 after one year if you borrow \$100 at 18% interest.

When you use a credit card to pay for a purchase, you will be charged interest on the amount you owe. The interest rate is usually between 12% and 18% per year. This means that if you borrow \$100 at 12% interest, you will have to pay back \$112 after one year. If you borrow \$100 at 18% interest, you will have to pay back \$118 after one year. The interest rate is usually higher for people who have a bad credit record. This means that if you have a bad credit record, you will have to pay back more than \$118 after one year if you borrow \$100 at 18% interest.

When you use a credit card to pay for a purchase, you will be charged interest on the amount you owe. The interest rate is usually between 12% and 18% per year. This means that if you borrow \$100 at 12% interest, you will have to pay back \$112 after one year. If you borrow \$100 at 18% interest, you will have to pay back \$118 after one year. The interest rate is usually higher for people who have a bad credit record. This means that if you have a bad credit record, you will have to pay back more than \$118 after one year if you borrow \$100 at 18% interest.

When you use a credit card to pay for a purchase, you will be charged interest on the amount you owe. The interest rate is usually between 12% and 18% per year. This means that if you borrow \$100 at 12% interest, you will have to pay back \$112 after one year. If you borrow \$100 at 18% interest, you will have to pay back \$118 after one year. The interest rate is usually higher for people who have a bad credit record. This means that if you have a bad credit record, you will have to pay back more than \$118 after one year if you borrow \$100 at 18% interest.