

Midterm will be held  
here in class  
this Tuesday 11/07  
during regular class hours  
12pm-1:50pm

# Midterm Info

- **Closed book exam**; no books, notes, laptops, phones...
- **Calculators (not on smartphones) can be used**
- You can prepare **one 2-sided cheat sheet**
- The following **two printouts** will be provided

$z$	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.500000	0.503989	0.507978	0.511967	0.515953	0.519939	0.523922	0.527903	0.531881	0.535856
0.1	0.539828	0.543795	0.547758	0.551717	0.555670	0.559618	0.563559	0.567495	0.571424	0.575345
0.2	0.579260	0.583166	0.587064	0.590954	0.594835	0.598706	0.602568	0.606420	0.610261	0.614092
0.3	0.617911	0.621719	0.625516	0.629300	0.633072	0.636831	0.640576	0.644309	0.648027	0.651732
0.4	0.655422	0.659097	0.662757	0.666402	0.670031	0.673645	0.677242	0.680822	0.684386	0.687933
0.5	0.691462	0.694974	0.698468	0.701944	0.705401	0.708840	0.712260	0.715661	0.719043	0.722405
0.6	0.725747	0.729069	0.732371	0.735653	0.738914	0.742154	0.745373	0.748571	0.751748	0.754903
0.7	0.758036	0.761148	0.764238	0.767305	0.770350	0.773373	0.776373	0.779350	0.782305	0.785236
0.8	0.788145	0.791030	0.793892	0.796731	0.799546	0.802338	0.805106	0.807850	0.810570	0.813267
0.9	0.815940	0.818589	0.821214	0.823815	0.826391	0.828944	0.831472	0.833977	0.836457	0.838913
1.0	0.841345	0.843752	0.846136	0.848495	0.850830	0.853141	0.855428	0.857690	0.859929	0.862143
1.1	0.864334	0.866500	0.868643	0.870762	0.872857	0.874928	0.876976	0.878999	0.881000	0.882977
1.2	0.884930	0.886860	0.888767	0.890651	0.892512	0.894350	0.896165	0.897958	0.899727	0.901475
1.3	0.903199	0.904902	0.906582	0.908241	0.909877	0.911492	0.913085	0.914657	0.916207	0.917736
1.4	0.919243	0.920730	0.922196	0.923641	0.925066	0.926471	0.927855	0.929219	0.930563	0.931888
1.5	0.933193	0.934478	0.935744	0.936992	0.938220	0.939429	0.940620	0.941792	0.942947	0.944083
1.6	0.945201	0.946301	0.947384	0.948449	0.949497	0.950529	0.951543	0.952540	0.953521	0.954486
1.7	0.955435	0.956367	0.957284	0.958185	0.959071	0.959941	0.960796	0.961636	0.962462	0.963273
1.8	0.964070	0.964852	0.965621	0.966375	0.967116	0.967843	0.968557	0.969258	0.969946	0.970621
1.9	0.971283	0.971933	0.972571	0.973197	0.973810	0.974412	0.975002	0.975581	0.976148	0.976705
2.0	0.977250	0.977784	0.978308	0.978822	0.979325	0.979818	0.980301	0.980774	0.981237	0.981691
2.1	0.982136	0.982571	0.982997	0.983414	0.983823	0.984222	0.984614	0.984997	0.985371	0.985738
2.2	0.986097	0.986447	0.986791	0.987126	0.987455	0.987776	0.988089	0.988396	0.988696	0.988989
2.3	0.989276	0.989556	0.989830	0.990097	0.990358	0.990613	0.990863	0.991106	0.991344	0.991576
2.4	0.991802	0.992024	0.992240	0.992451	0.992656	0.992857	0.993053	0.993244	0.993431	0.993613
2.5	0.993790	0.993963	0.994132	0.994297	0.994457	0.994614	0.994766	0.994915	0.995060	0.995201
2.6	0.995339	0.995473	0.995604	0.995731	0.995855	0.995975	0.996093	0.996207	0.996319	0.996427
2.7	0.996533	0.996636	0.996736	0.996833	0.996928	0.997020	0.997110	0.997197	0.997282	0.997365
2.8	0.997445	0.997523	0.997599	0.997673	0.997744	0.997814	0.997882	0.997948	0.998012	0.998074
2.9	0.998134	0.998193	0.998250	0.998305	0.998359	0.998411	0.998462	0.998511	0.998559	0.998605
3.0	0.998650	0.998694	0.998736	0.998777	0.998817	0.998856	0.998893	0.998930	0.998965	0.998999
3.1	0.999032	0.999065	0.999096	0.999126	0.999155	0.999184	0.999211	0.999238	0.999264	0.999289
3.2	0.999313	0.999336	0.999359	0.999381	0.999402	0.999423	0.999443	0.999462	0.999481	0.999499
3.3	0.999517	0.999533	0.999550	0.999566	0.999581	0.999596	0.999610	0.999624	0.999638	0.999650
3.4	0.999663	0.999675	0.999687	0.999698	0.999709	0.999720	0.999730	0.999740	0.999749	0.999758
3.5	0.999767	0.999776	0.999784	0.999792	0.999800	0.999807	0.999815	0.999821	0.999828	0.999835
3.6	0.999841	0.999847	0.999853	0.999858	0.999864	0.999869	0.999874	0.999879	0.999883	0.999888
3.7	0.999892	0.999896	0.999900	0.999904	0.999908	0.999912	0.999915	0.999918	0.999922	0.999925
3.8	0.999928	0.999931	0.999933	0.999936	0.999938	0.999941	0.999943	0.999946	0.999948	0.999950
3.9	0.999952	0.999954	0.999956	0.999958	0.999959	0.999961	0.999963	0.999964	0.999966	0.999967

Name	Probability Distribution	Mean	Variance	Section in Book
<b>Discrete</b>				
Uniform	$\frac{1}{n}, a \leq b$	$\frac{(b+a)}{2}$	$\frac{(b-a+1)^2-1}{12}$	3-5
Binomial	$\binom{n}{x} p^x (1-p)^{n-x}$ $x = 0, 1, \dots, n, 0 \leq p \leq 1$	$np$	$np(1-p)$	3-6
Geometric	$(1-p)^{x-1} p$ , $x = 1, 2, \dots, 0 \leq p \leq 1$	$1/p$	$(1-p)/p^2$	3-7.1
Negative binomial	$\binom{x-1}{r-1} (1-p)^{x-r} p^r$ $x = r, r+1, r+2, \dots, 0 \leq p \leq 1$	$r/p$	$r(1-p)/p^2$	3-7.2
Hypergeometric	$\frac{\binom{K}{x} \binom{N-K}{n-x}}{\binom{N}{n}}$ $x = \max(0, n-N+K), 1, \dots$ $\min(K, n), K \leq N, n \leq N$	$np$ , where $p = \frac{K}{N}$	$np(1-p) \left( \frac{N-n}{N-1} \right)$	3-8
Poisson	$\frac{e^{-\lambda} \lambda^x}{x!}, x = 0, 1, 2, \dots, 0 < \lambda$	$\lambda$	$\lambda$	3-9
<b>Continuous</b>				
Uniform	$\frac{1}{b-a}, a \leq x \leq b$	$\frac{(b+a)}{2}$	$\frac{(b-a)^2}{12}$	4-5
Normal	$\frac{1}{\sigma\sqrt{2\pi}} e^{-1/2(\frac{x-\mu}{\sigma})^2}$ $-\infty < x < \infty, -\infty < \mu < \infty, 0 < \sigma$	$\mu$	$\sigma^2$	4-6
Exponential	$\lambda e^{-\lambda x}, 0 \leq x, 0 < \lambda$	$1/\lambda$	$1/\lambda^2$	4-8
Erlang	$\frac{\lambda^r x^{r-1} e^{-\lambda x}}{(r-1)!}, 0 < x, r = 1, 2, \dots$	$r/\lambda$	$r/\lambda^2$	4-9.1
Gamma	$\frac{\lambda^r x^{r-1} e^{-\lambda x}}{\Gamma(r)}, 0 < x, 0 < r, 0 < \lambda$	$r/\lambda$	$r/\lambda^2$	4-9.2

# What is included in the midterm?

- Probability of events (set operations), Multiplication rules. Combinatorics
- Bayes Theorem
- Discrete Random Variables
- Continuous Random Variables
- Other topics covered  
(see HW1-HW2 for inspiration)
- No joint probabilities, correlation and covariation
- No Matlab exercises (since no computers)

# Probability Multiplication Rules

## Combinatorics

Mr. Jones has 6 different books that he is going to put on his bookshelf. Of these, 3 are chemistry books, 2 are physics books, and 1 is a mathematics book. Jones wants to arrange his books so that two conditions are met:

(1) all the books dealing with the same subject are together on the shelf

**AND**

(2) all chemistry books are on the leftmost side.

How many such different arrangements are possible?

Mr. Jones has 6 different books that he is going to put on his bookshelf. Of these, 3 are chemistry books, 2 are physics books, and 1 is a mathematics book. Jones wants to arrange his books so that two conditions are met:

(1) all the books dealing with the same subject are together on the shelf

**AND**

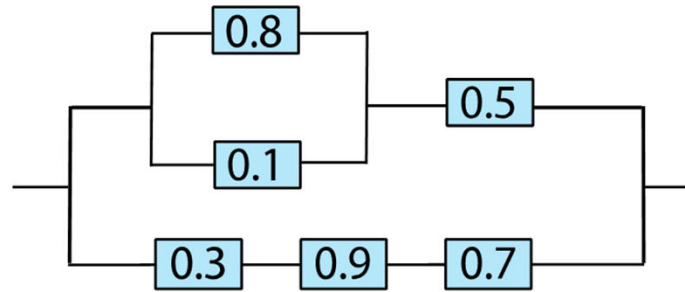
(2) all chemistry books are on the leftmost side.

How many such different arrangements are possible?

**Answer:  $(3! * 2! * 1!) * 2! = 24$**

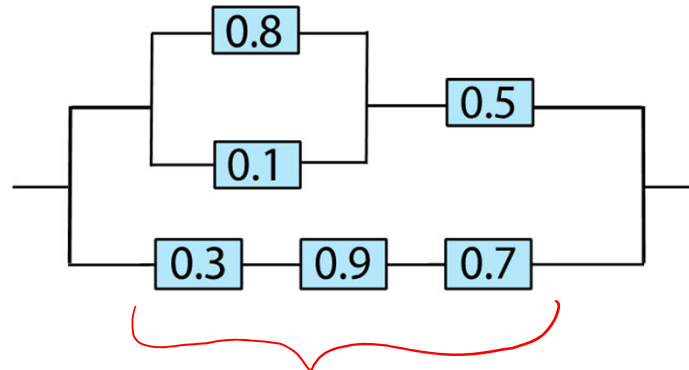


4. (4 points) The following circuit operates if and only if there is a path of functional devices from left to right. The probability that each device functions is as shown. Assume that the probability that a device is functional does not depend on whether or not other devices are functional. What is the probability that the circuit operates?



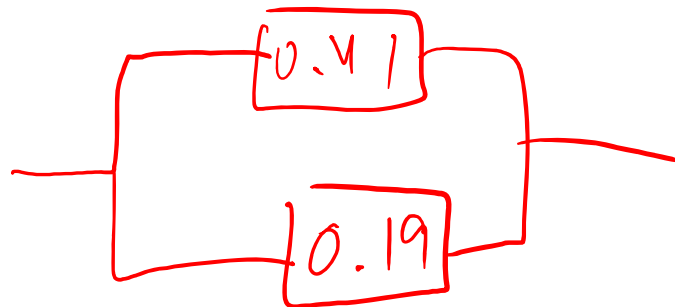
4. (4 points) The following circuit operates if and only if there is a path of functional devices from left to right. The probability that each device functions is as shown. Assume that the probability that a device is functional does not depend on whether or not other devices are functional. What is the probability that the circuit operates?

$$1 - (1 - 0.8) \cdot (1 - 0.1) = 0.82$$



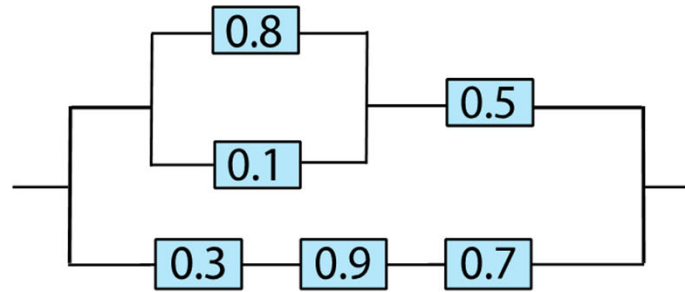
$$0.3 \cdot 0.9 \cdot 0.7 = 0.19$$

$$0.82 \times 0.5 = 0.41$$



$$1 - (1 - 0.41) \cdot (1 - 0.19) = 0.52$$

4. (4 points) The following circuit operates if and only if there is a path of functional devices from left to right. The probability that each device functions is as shown. Assume that the probability that a device is functional does not depend on whether or not other devices are functional. What is the probability that the circuit operates?



**Answer:  $P(\text{Operate}) = 1 - (1 - 0.3 * 0.9 * 0.7) * (1 - 0.5 * (1 - (1 - 0.8) * (1 - 0.1))) = \underline{0.52}$**

# Bayes theorem

In answering a question on a multiple-choice test, a student either knows the answer or he guesses. Let  $\frac{1}{3}$  be the probability that he knows the answer. If he does not know the answer, he randomly guesses one out of 4 multiple choice questions. What is the conditional probability that a student knew the answer to a question given that he answered it correctly?

A.  $\frac{1}{4}$

B.  $\frac{1}{3}$

C.  $\frac{2}{3}$

D.  $\frac{1}{5}$

E. I don't know

Get your i-clickers

In answering a question on a multiple-choice test, a student either knows the answer or he guesses. Let  $1/3$  be the probability that he knows the answer. If he does not know the answer, he randomly guesses one out of 4 multiple choice questions. What is the conditional probability that a student knew the answer to a question given that he answered it correctly?

**Answer:  $P(K)=1/3$ ,  $P(K')=2/3$ ,  $P(C|K)=1$ ,  $P(C|K')=1/4$ .**

**$P(K|C)=P(C|K)*P(K)/P(C)=1*(1/3)/(1*1/3+(1/4)*(2/3))=2/3=0.666\dots$**

**(10 points)** Suppose that a bag contains ten coins, three of which are fair, while the remaining seven are biased: they have probability of 0.6 of heads when flipped. A coin was taken at random from the bag and flipped five times. All five flips gave heads. What's the probability that this coin is fair?

**(10 points)** Suppose that a bag contains ten coins, three of which are fair, the remaining seven having probability 0.6 of giving heads when flipped. A coin is taken at random from the bag and flipped five times. All five flips give heads. What's the probability that a coin is fair given the five coin flips?

Answer: Let us denote  $H_1$  as the hypothesis that a coin is fair and  $H_2$  that a coin is biased. The data that all five flips were heads is denoted as  $D$ . Therefore,

$$P(H_1|D) = P(D|H_1)P(H_1)/P(D) = 0.5^5 * 0.3 / (0.5^5 * 0.3 + 0.6^5 * 0.7) = 0.147$$

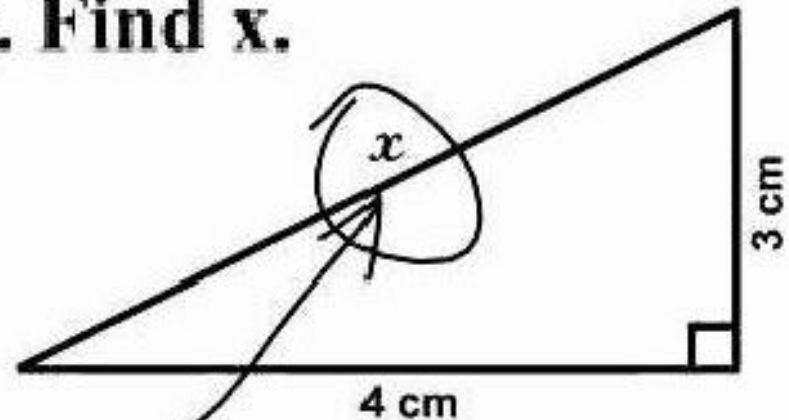


# Discrete Probability Distributions

# What is $X$ in this problem?

- What is the random variable: Look for keywords:
  - Find the probability that....
  - What is the mean (or variance) of...
- What are parameters? Look for keywords:
  - Given that...
  - Assuming that...

**3. Find  $x$ .**



*Here it is*



# Guide to probability distributions

- Binomial: # of samples,  $n$ , is fixed, # of successes,  $x$ , is variable

$$P(X=x) = \frac{n!}{x!(n-x)!} p^x (1-p)^{n-x}$$

- Geometric: # of samples,  $x$  is variable. # of successes  $1$  is fixed. Success comes in the end

$$P(X=x) = (1-p)^{x-1} \cdot p$$

- Negative binomial: # of samples,  $x$  is variable. # of successes,  $r$ , is fixed  $r$ th success in the end

$$P(X=x) = \frac{(x-1)!}{(r-1)!(x-r)!} p^r (1-p)^{x-r}$$

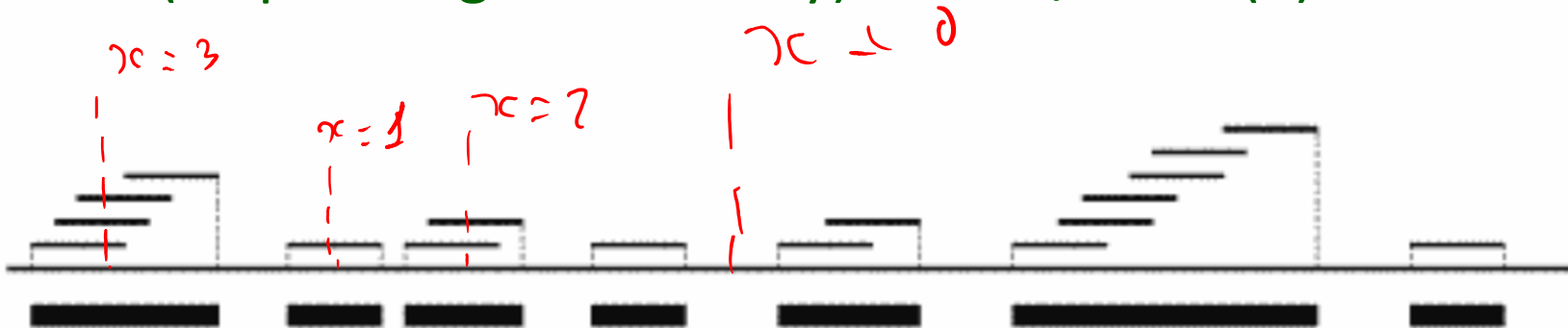
# Poisson distribution in genomics

- $G$  - genome length (in bp)
- $L$  - short read average length
- $N$  - number of short read sequenced
- $\lambda$  - sequencing redundancy =  $LN/G$
- $x$  - number of short reads covering a given site on the genome

$$P(x) = \frac{\lambda^x e^{-\lambda}}{x!}$$

Ewens, Grant, Chapter 5.1

Poisson as a limit of Binomial. For a given site on the genome for each short read Prob(site covered):  $p=L/G$  is very small. Number of attempts (short reads):  $N$  is very large. Their product (sequencing redundancy):  $\lambda = NL/G$  is  $O(1)$ .



Probability that a base pair in the genome is not covered by any short reads is 0.1

One randomly selects base pairs until exactly 5 uncovered base pairs are found.

Which discrete probability distribution describes the number of attempts?

- A. Poisson
- B. Binomial
- C. Geometric
- D. Negative Binomial
- E. I have no idea

Poisson	$\frac{e^{-\lambda}\lambda^x}{x!}, x = 0, 1, 2, \dots, 0 < \lambda$
Binomial	$\binom{n}{x} p^x (1-p)^{n-x}$ $x = 0, 1, \dots, n, 0 \leq p \leq 1$
Geometric	$(1-p)^{x-1} p$ $x = 1, 2, \dots, 0 \leq p \leq 1$
Negative binomial	$\binom{x-1}{r-1} (1-p)^{x-r} p^r$ $x = r, r+1, r+2, \dots, 0 \leq p \leq 1$

Get your i-clickers

Probability that a base pair in the genome is not covered by any short reads is 0.1

One randomly selects base pairs until exactly 5 uncovered base pairs are found.

Which discrete probability distribution describes the number of attempts?

- A. Poisson
- B. Binomial
- C. Geometric
- D. Negative Binomial**
- E. I have no idea

Poisson	$\frac{e^{-\lambda} \lambda^x}{x!}, x = 0, 1, 2, \dots, 0 < \lambda$
Binomial	$\binom{n}{x} p^x (1-p)^{n-x}$ $x = 0, 1, \dots, n, 0 \leq p \leq 1$
Geometric	$(1-p)^{x-1} p$ $x = 1, 2, \dots, 0 \leq p \leq 1$
Negative binomial	$\binom{x-1}{r-1} (1-p)^{x-r} p^r$ $x = r, r+1, r+2, \dots, 0 \leq p \leq 1$

Get your i-clickers





Probability that a base pair in the genome is not covered by any short reads is 0.1

One randomly selects base pairs until exactly 5 uncovered base pairs are found.

What are the values of  $p$ ,  $r$ ?

- A.  $p=0.5, r=5$
- B.  $p=0.1, r=0.5$
- C.  $p=0.1, r=5$
- D.  $p=0.5, r=0.1$
- E. I have no idea

Poisson	$\frac{e^{-\lambda} \lambda^x}{x!}, x = 0, 1, 2, \dots, 0 < \lambda$
Binomial	$\binom{n}{x} p^x (1-p)^{n-x}$ $x = 0, 1, \dots, n, 0 \leq p \leq 1$
Geometric	$(1-p)^{x-1} p$ $x = 1, 2, \dots, 0 \leq p \leq 1$
Negative binomial	$\binom{x-1}{r-1} (1-p)^{x-r} p^r$ $x = r, r+1, r+2, \dots, 0 \leq p \leq 1$

Get your i-clickers

Probability that a base pair in the genome is not covered by any short reads is 0.1

One randomly selects base pairs until exactly 5 uncovered base pairs are found.

What are the values of  $p$ ,  $r$ ?

- A.  $p=0.5, r=5$
- B.  $p=0.1, r=0.5$
- C.  $p=0.1, r=5$**
- D.  $p=0.5, r=0.1$
- E. I have no idea

Poisson	$\frac{e^{-\lambda} \lambda^x}{x!}, x = 0, 1, 2, \dots, 0 < \lambda$
Binomial	$\binom{n}{x} p^x (1-p)^{n-x}$ $x = 0, 1, \dots, n, 0 \leq p \leq 1$
Geometric	$(1-p)^{x-1} p$ $x = 1, 2, \dots, 0 \leq p \leq 1$
Negative binomial	$\binom{x-1}{r-1} (1-p)^{x-r} p^r$ $x = r, r+1, r+2, \dots, 0 \leq p \leq 1$

Get your i-clickers



Cancer happens when the gene p53 mutates.

Probability of p53 to mutate per year is 5%.

How many years before a patient gets disease?

Which discrete probability distribution would you use to answer?

- A. Poisson
- B. Binomial
- C. Geometric
- D. Negative Binomial
- E. I have no idea

Poisson	$\frac{e^{-\lambda} \lambda^x}{x!}, x = 0, 1, 2, \dots, 0 < \lambda$
Binomial	$\binom{n}{x} p^x (1-p)^{n-x}$ $x = 0, 1, \dots, n, 0 \leq p \leq 1$
Geometric	$(1-p)^{x-1} p$ $x = 1, 2, \dots, 0 \leq p \leq 1$
Negative binomial	$\binom{x-1}{r-1} (1-p)^{x-r} p^r$ $x = r, r+1, r+2, \dots, 0 \leq p \leq 1$

Get your i-clickers

Cancer happens when the gene p53 mutates.

Probability of p53 to mutate per year is 5%.

How many years before a patient gets disease?

Which discrete probability distribution would you use to answer?

- A. Poisson
- B. Binomial
- C. Geometric**
- D. Negative Binomial
- E. I have no idea

Poisson	$\frac{e^{-\lambda} \lambda^x}{x!}, x = 0, 1, 2, \dots, 0 < \lambda$
Binomial	$\binom{n}{x} p^x (1-p)^{n-x}$ $x = 0, 1, \dots, n, 0 \leq p \leq 1$
Geometric	$(1-p)^{x-1} p$ $x = 1, 2, \dots, 0 \leq p \leq 1$
Negative binomial	$\binom{x-1}{r-1} (1-p)^{x-r} p^r$ $x = r, r+1, r+2, \dots, 0 \leq p \leq 1$

Get your i-clickers

# Continuous Probability Distributions

**2. (8 points)** The length of stay at a specific emergency department in Phoenix, Arizona, in 2009 had a mean of 4.6 hours with a standard deviation of 2.9. Assume that the length of stay is normally distributed.

**(A) (4 points)** What is the probability of a length of stay greater than 10 hours?

**Answer:**  $(10-4.6)/2.9=1.86$  Using table one finds  $\text{Prob}=1-0.9687=0.0313$

**(B) (4 points)** How long does one have to stay in this emergency room to know that approximately 25% of all visits last even longer?

**Answer:** Using table one finds  $P(Z<0.67)=0.75$  meaning it is  $4.6+2.9*0.67=6.543$

1. **(8 points)** The expression level of a *TP53* tumor suppressor gene in a randomly selected cell is normally distributed with mean  $\mu = 20$ , and standard deviation  $\sigma = 8$ .

**(A)(4 points)** What is the probability that the expression level in a given cell will be between 24 and 16?

**(B)(4 points)** How many cells does one have to sample (on average) until there will be exactly 2 cells with such “close to average” *TP53* expression?



1. **(8 points)** The expression level of a *TP53* tumor suppressor gene in a randomly selected cell is normally distributed with mean  $\mu = 20$ , and standard deviation  $\sigma = 8$ .

**(A)(4 points)** What is the probability that the expression level in a given cell will be between 24 and 16?

**Answer:** Using table one finds  $\text{Prob}(Z < 0.5) = 0.6914$ . Thus the answer is  $0.6914 - (1 - 0.6914) = 0.3829$

**(B) (4 points)** On average, how many cells does one have to sample until there will be exactly 2 cells with such “close to average” *TP53* expression?

**Answer:** Using the negative binomial distribution one gets  $2 / 0.3829 = 5.22$

I can show you how to solve any  
HW1-HW2 problem.

Which one do you choose?

Credit: XKCD  
comics

WHY ARE THERE SLAVES IN THE BIBLE

WHY DO TWINS HAVE DIFFERENT FINGERPRINTS  
WHY ARE AMERICANS AFRAID OF DRAGONS

WHY IS HTTPS CROSSED OUT IN RED  
WHY IS THERE A LINE THROUGH HTTPS  
WHY IS THERE A RED LINE THROUGH HTTPS ON FACEBOOK  
WHY IS HTTPS IMPORTANT

# QUESTIONS

FOUND IN GOOGLE AUTOCOMPLETE



WHY ARE THERE WEEKS  
WHY DO I FEEL DIZZY

WHY AREN'T ECONOMISTS RICH

WHY ARE THERE SO MANY CROWS IN ROCHESTER, MN  
WHY IS THERE PHLEGM

WHY DO AMERICANS CALL IT SOCCER

WHY IS PSYCHIC WEAK TO BUG

WHY ARE MY EARS RINGING

WHY DO CHILDREN GET CANCER

WHY ARE THERE SO MANY AVENGERS

WHY IS POSEIDON ANGRY WITH ODYSSEUS

WHY ARE THE AVENGERS FIGHTING THE X MEN  
WHY IS WOLVERINE NOT IN THE AVENGERS

WHY IS THERE ICE IN SPACE

## WHY ARE THERE ANTS IN MY LAPTOP

WHY IS EARTH TILTED  
WHY IS SPACE BLACK  
WHY IS OUTER SPACE SO COLD  
WHY ARE THERE PYRAMIDS ON THE MOON  
WHY IS NASA SHUTTING DOWN



WHY IS THERE AN OWL IN MY BACKYARD  
WHY IS THERE AN OWL OUTSIDE MY WINDOW  
WHY IS THERE AN OWL ON THE DOLLAR BILL  
WHY DO OWLS ATTACK PEOPLE

WHY ARE AK 47s SO EXPENSIVE

WHY ARE THERE HELICOPTERS CIRCLING MY HOUSE

WHY ARE THERE GODS

WHY ARE THERE TWO SPOCKS

WHY IS MT VESUVIUS THERE

WHY DO THEY SAY T MINUS

WHY ARE THERE OBELISKS

WHY ARE WRESTLERS ALWAYS WET

WHY ARE OCEANS BECOMING MORE ACIDIC

WHY IS ARWEN DYING

WHY AREN'T MY QUAIL LAYING EGGS  
WHY AREN'T MY QUAIL EGGS HATCHING  
WHY AREN'T THERE ANY FOREIGN MILITARY BASES IN AMERICA

WHY ARE CIGARETTES LEGAL  
WHY ARE THERE DUCKS IN MY POOL  
WHY IS JESUS WHITE  
WHY IS THERE LIQUID IN MY EAR  
WHY DO Q TIPS FEEL GOOD  
WHY DO GOOD PEOPLE DIE



WHY ARE ULTRASOUNDS IMPORTANT  
WHY ARE ULTRASOUND MACHINES EXPENSIVE  
WHY IS STEALING WRONG

WHY ARE DOGS AFRAID OF FIREWORKS  
WHY IS THERE NO KING IN ENGLAND

WHY DO WHALES JUMP  
WHY ARE WITCHES GREEN  
WHY ARE THERE MIRRORS ABOVE BEDS

WHY DO I SAY UH  
WHY IS SEA SALT BETTER

WHY ARE THERE TREES IN THE MIDDLE OF FIELDS  
WHY IS THERE NOT A POKEMON MMO  
WHY IS THERE LAUGHING IN TV SHOWS  
WHY ARE THERE DOORS ON THE FREEWAY  
WHY ARE THERE SO MANY SVCHOST.EXE RUNNING  
WHY AREN'T THERE ANY COUNTRIES IN ANTARCTICA  
WHY ARE THERE SCARY SOUNDS IN MINECRAFT  
WHY IS THERE KICKING IN MY STOMACH  
WHY ARE THERE TWO SLASHES AFTER HTTP

WHY ARE THERE CELEBRITIES  
WHY DO SNAKES EXIST

WHY DO OYSTERS HAVE PEARLS  
WHY ARE DUCKS CALLED DUCKS  
WHY DO THEY CALL IT THE CLAP  
WHY ARE KYLE AND CARTMAN FRIENDS  
WHY IS THERE AN ARROW ON AANG'S HEAD  
WHY ARE TEXT MESSAGES BLUE

WHY ARE THERE MUSTACHES ON CLOTHES  
WHY ARE THERE MUSTACHES ON CARS  
WHY ARE THERE MUSTACHES EVERYWHERE  
WHY ARE THERE SO MANY BIRDS IN OHIO  
WHY IS THERE SO MUCH RAIN IN OHIO  
WHY IS OHIO WEATHER SO WEIRD

## WHY ARE THERE MALE AND FEMALE BIKES

WHY ARE THERE BRIDESMAIDS  
WHY DO DYING PEOPLE REACH UP  
WHY AREN'T THERE VARICOSE ARTERIES  
WHY ARE OLD KUNGONS DIFFERENT

WHY ARE THERE SQUIRRELS



WHY IS PROGRAMMING SO HARD  
WHY IS THERE A 0 OHM RESISTOR  
WHY DO AMERICANS HATE SOCCER  
WHY DO RHYMES SOUND GOOD  
WHY DO TREES DIE  
WHY IS THERE NO SOUND ON CNN  
WHY AREN'T POKEMON REAL  
WHY AREN'T BULLETS SHARP  
WHY DO DREAMS SEEM SO REAL

WHY ARE THERE TINY SPIDERS IN MY HOUSE  
WHY DO SPIDERS COME INSIDE  
WHY ARE THERE HUGE SPIDERS IN MY HOUSE  
WHY ARE THERE LOTS OF SPIDERS IN MY HOUSE  
WHY ARE THERE SPIDERS IN MY ROOM  
WHY ARE THERE SO MANY SPIDERS IN MY ROOM

WHY DO SPIDER BITES ITCH

WHY IS DYING SO SCARY

WHY IS THERE NO GPS IN LAPTOPS

WHY DO KNEES CLICK  
WHY AREN'T THERE E GRADES  
WHY IS ISOLATION BAD

WHY DO BOYS LIKE ME  
WHY DON'T BOYS LIKE ME

WHY IS THERE ALWAYS A JAVA UPDATE  
WHY ARE THERE RED DOTS ON MY THIGHS

WHY IS LYING GOOD

WHY IS SEX SO IMPORTANT



WHY AREN'T THERE DINOSAUR GHOSTS

WHY ARE THERE FEMALE MR NIMES

WHY ARE THERE SWARMS OF GNATS  
WHY IS THERE PHLEGM

WHY IS LIFE SO BORING