Discrete Probability Distributions.

1 Discrete (only certain clearly separated values)

(a) Gaps between numbers

(b) counting

Example: 1, 2, 3. or 1, 2, 3 . . . or 1.1, 1.2 . . .

2 Continuous (Infinite possibilities)

(a) Can assume any numberical value in an interval

(b) Depends on how small you want to go. Depends on measurement instrument.

Example: 1 . . . 2
Lots of possible numbers

3 Random Variable

A random variable is a numerical description of the outcome of an experiment.

or

A quantity resulting from an experiment that, by chance, can assume different values.

(a) Discrete Random variable "GAPS"

Counting!

Example 1, 2, 3 or 1, 2, 3 . . . or 1.1, 1.2 . . .

(b) Continuous Random variable "No Gaps"

measuring!

when timing, it depends on measurment instrument.

1 or 1.1 or 1.01 or 1.0001

(4) Discrete Random Variable "Gaps"

Book → May assume either a finite number of values (1, 2, 3) or an infinite sequence of values (1, 2, 3...).

or

A variable that can only assume certain clearly separated values.

Examples:

- Roll die	1, 2, 3, 4, 5, 6
- Scores for Dancer	0, .1, .2, ..., 9.8, 9.9, 10
- Product Defective	0 = False 1 = True
- Inspect to see if 100 Booms fly	0, 1, 2, ..., 99, 100

(5) Continuous Random Variable "No Gaps"

Book → May assume any numberical value in an interval or collection of intervals

Examples:

- Time to take timed Test (any time between 0 & 10 min)
- weight of cereal box
- air pressure in air compressor
- money (even though it seems discrete)

⑥ Probability Distribution

All outcomes & Prob.

A listing of all the experimental outcomes of an experiment and the probabilities associated with each outcome.

or

Just Random variable & Prob.

A description of how the probabilities are distributed over the values of the random variable

Description / Listing could be:

① Table
② chart
③ equation

See Next page →

⑦ Discrete Probability Function

A function, $f(x)$, that provides the probability that X assumes a particular value for a discrete random variable. Examples coming...

⑧ Required Conditions for a Discrete Probability Function & Distribution

$$P(x) = f(x) \geq 0$$ any probability ≥ 0

$$\sum P(x) = \sum f(x) = 1$$ All of Probability sum to 1

* outcomes are mutually exclusive & collectively exhaustive.

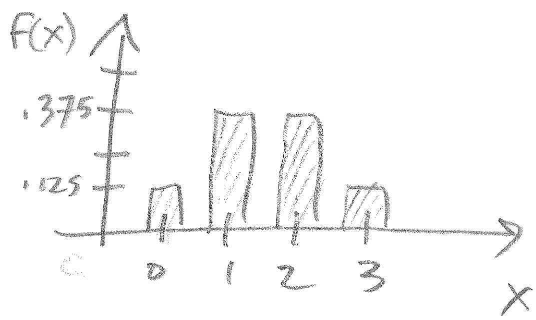
Probability Distribution

① table

Experiment: Toss coin 3 times

X # of Heads	P(x)
0	.125
1	.375
2	.375
3	.125
total	1

② chart



③ equation (later)

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

What is conveniant about Probability Distributions is that you can then figure out any probability you want:

$$P(x \geq 2) = P(2) + P(3) = .375 + .125$$
$$= .5$$

How to Make a Discrete Probability Distr.

consider random experiment: A coin tossed 3 times

X = random discrete variable = # of Heads

H = Heads

T = Tails

sample space (list of all possible outcomes) = SS

$\left\{\begin{array}{c}\text{\# of}\\ \text{Trials}\end{array}\right\}$ = Toss = 3 times = 3

outcomes = 2

$2 * 2 * 2 = 8$ = count of all outcomes = SS

count outcomes	coin toss 1st	coin toss 2nd	coin toss 3rd	# of Heads
1	H	H	H	3
2	H	H	T	2
3	H	T	H	2
4	T	H	H	2
5	H	T	T	1
6	T	H	T	1
7	T	T	H	1
8	T	T	T	0

possible values of x ⇒ 0, 1, 2, 3

Discrete Probability Distribution

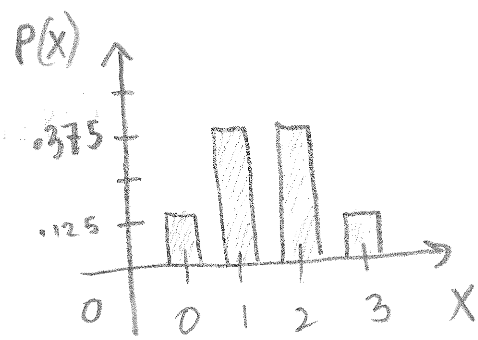
# of Heads	P(x)
0	1/8 = .125
1	3/8 = .375
2	3/8 = .375
3	1/8 = .125
	Σ = 1.00

P(0 Heads in 3 toss) = .125

P(1 Head in 3 toss) = .375

P(2 Heads in 3 toss) = .375

P(3 Heads in 3 toss) = .125



2nd method

# of Heads	P(x)
0	.5 * .5 * .5 * 1 = .125
1	.5 * .5 * .5 * 3 = .375
2	.5 * .5 * .5 * 3 = .375
3	.5 * .5 * .5 * 1 = .125

Steps for creating Probability Distributions

1. Define Random Variable
2. Build Frequency Distribution
3. Calculate Relative Frequency $P(x) = f(x)$
4. Check Requirement 1 $f(x) \geq 0$
5. Check Requirement 2 $\sum f(x) = 1$
6. Create column chart to visually portray Distribution (Discrete = Columns Do Not Touch)
7. Make Predictions

(10) Frequency Tables & Relative Frequency (Chapter 2) give us Probabilities based on the Relative Frequency Method

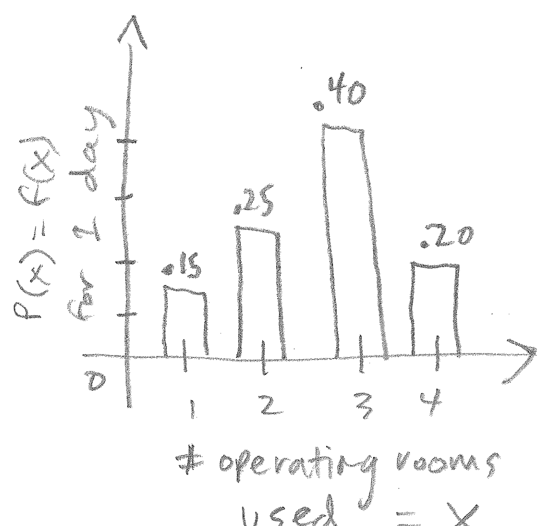
Example: over last 20 days the number of operating rooms used at TG Hospital were:

on 3 days only 1 was used
on 5 days 2 were used
on 8 days 3 were used
on 4 days all (4) were used

Let: Discrete Random variable = X
= # of operating rooms used for 1 day

Rooms used X	# Days Frequency	$P(x)$	each $f(x) > 0$?	
1	3	$3/20 = .15$	$.15 > 0$ T	✓
2	5	$5/20 = .25$	$.25 > 0$ T	✓
3	8	$8/20 = .40$	$.4 > 0$ T	✓
4	4	$4/20 = .20$	$.2 > 0$ T	✓
	$\Sigma = 20$	$\Sigma = 1$		

$\Sigma f(x) = 1$
T ✓



Columns Not touch w/ Discrete!!

$P(\text{3 rooms used in 1 day}) = f(3) = .4$

$P(X \geq 2) = f(2) + f(3) + f(4) = .85$

$P(X = 1) = f(1) = .15$

$P(X = 0) = 0$

11 Discrete Uniform Probability Function

equation

$$f(x) = \frac{1}{n}$$

n = # of values the random variable can assume

Example:

Roll Die

$$S = \{1, 2, 3, 4, 5, 6\}$$

$$\text{Probability} = f(x) = 1/6$$

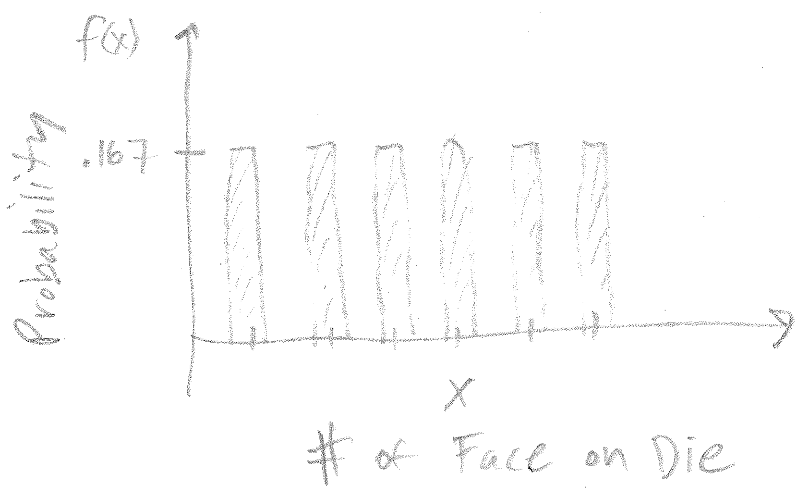
$$x = 1, 2, 3, 4, 5, 6 = \text{top face}$$

table

outcome x	$f(x)$
1	$\frac{1}{6} = .167$
2	$\frac{1}{6} = .167$
3	$\frac{1}{6} = .167$
4	$\frac{1}{6} = .167$
5	$\frac{1}{6} = .167$
6	$\frac{1}{6} = .167$

$\Sigma = 1$

chart



12) Mean & Standard deviation for Discrete Random Variable or Discrete Probability Distribution

Greek Letters are used

mean

$$E(X) = \mu = \sum X f(x)$$

1. Expected Value
2. long-run average of Random Var.
3. weighted Average (value * Prob.)
4. Does not have to be a value that the random variable can assume (why it's called long run Ave.)

standard Deviation

$$\sigma = \sqrt{\sum (x-\mu)^2 f(x)}$$

1. Amount of Spread in Data
2. Amount of Variability or Dispersion
3. Does mean fairly represent Data?
4. Each Deviation squared is multiplied by Prob. (weight), then all are added, then take square root.

μ = mean
σ = standard Deviation
X = random variable
$P(x) = f(x)$ = probability of taking on a particular value of X
Σ = add   * used often in Finance.

Example:

Discrete Prob. Distr.

Rooms used X	f(x) = P(x)
1	.15
2	.25
3	.40
4	.20

$P(2) = .25$

$P(x > 2) = .6$

But what is a typical number of rooms used?
what is variation?

$E(X) = \mu = \text{Mean} = 1*.15 + 2*.25 + 3*.4 + 4*.2$
$= 2.65$

on any typical day 2.65 rooms will be used. we won't get that exactly, but the numbe can be used for planning.

X	$X - \mu$	$(X-\mu)^2$	$(X-\mu)^2 * f(x)$
1	$1 - 2.65 = -1.65$	2.7225	.408375
2	$2 - 2.65 = -.65$	.4225	.105625
3	$3 - 2.65 = .35$	.1225	.049
4	$4 - 2.65 = 1.35$	1.8225	.3645
	$\Sigma = -.6$		$\Sigma = .9275$

Not equal to zero because we did not use all Raw Data!

$\sigma = (.9275)^{1/2} = .96306801$

used to compare our typical value 2.65 to other hospitals with 2.65 or close to 2.65 to tell which mean more fairly represents its data points.

Back to chapter 4:

Probability Rules for Adding & Multiplying

Example:

An insurance agent has appointments with 4 prospective clients tomorrow. From the past she knows that the probability of making a sale on any one appointment is 1 in 5 ($\frac{1}{5} = .2$). What is likelihood that she will sell 3 policies in 4 tries?

Event = sell 3 policies in 4 tries
# of outcomes in 1 sales attempt = 2
sale = S
No sale = NS
(Assume 4 attempts are independent)
Probability of success = $P_S = \pi_S$ ("pi") = .2 (same each time)
Probability of Not success = $P_{NS} = \pi_{NS} = 1 - .2 = .8$
# of Trials (steps) = n = 4
X = Discrete Random variable = # sales = # successes = 3

1st: use multiplication Rule (events are independent)

$$P(NS, S_1, S_2, S_3) = P(NS) * P(S_1) * P(S_2) * P(S_3) \leftarrow \text{(Example)}$$

# Sample Point Each is Mutually Exclusive	Sample points	Probability of Sample Point
SP_1	NS, S, S, S	.8 * .2 * .2 * .2 = .0064
SP_2	S, NS, S, S	.2 * .8 * .2 * .2 = .0064
SP_3	S, S, NS, S	.2 * .2 * .8 * .2 = .0064
SP_4	S, S, S, NS	.2 * .2 * .2 * .8 = .0064

P(Event = 3 sales in 4 Attempts) = .0256

2nd use Adding Rule
↓
Prob. of Event
Sum of all Sample Points
↓
mutually Exclusive
↓
$= P(NS \text{ or } S_1 \text{ or } S_2 \text{ or } S_3)$
$= P(NS) + P(S_1) + P(S_2) + P(S_3)$

Let's create whole Distribution ⇓

Build probability Distribution (Discrete)

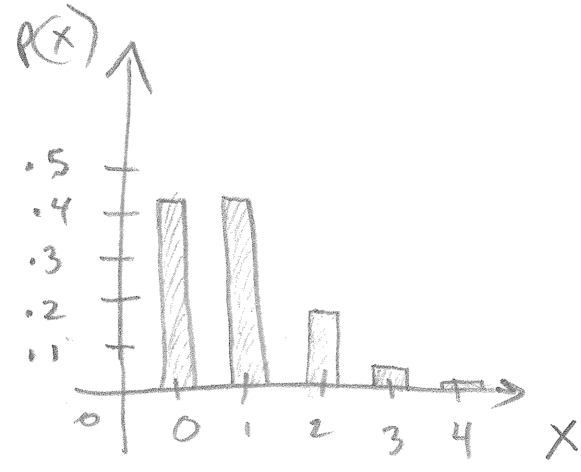
ss = 2*2*2*2 = 16

Possible outcomes sample points	Attempt sale 1st	2nd	3rd	4th	# of sales	Probability of occurrence
1	S	S	S	S	4	.2*.2*.2*.2 = .0016
2	S	S	S	NS	3	.2*.2*.2*.8 = .0064
3	S	S	NS	S	3	.2*.2*.8*.2 = .0064
4	S	NS	S	S	3	.2*.8*.2*.2 = .0064
5	NS	S	S	S	3	.8*.2*.2*.2 = .0064
6	S	S	NS	NS	2	.2*.2*.8*.8 = .0256
7	S	NS	NS	S	2	.2*.8*.8*.2 = .0256
8	NS	NS	S	S	2	.8*.8*.2*.2 = .0256
9	S	NS	S	NS	2	.2*.8*.2*.8 = .0256
10	NS	S	S	NS	2	.8*.2*.2*.8 = .0256
11	NS	S	NS	S	2	.8*.2*.8*.2 = .0256
12	S	NS	NS	NS	1	.2*.8*.8*.8 = .1024
13	NS	S	NS	NS	1	.8*.2*.8*.8 = .1024
14	NS	NS	S	NS	1	.8*.8*.2*.8 = .1024
15	NS	NS	NS	S	1	.8*.8*.8*.2 = .1024
16	NS	NS	NS	NS	0	.8*.8*.8*.8 = .4096

$\Sigma = 1$

x # of Sales Random variable	P(x)	P(x)
0	P(0) =	.4096*1 = .4096
1	P(1) =	.1024*4 = .4096
2	P(2) =	.0256*6 = .1536
3	P(3) =	.0064*4 = .0256
4	P(4) =	.0016*1 = .0016

$\Sigma = 1$



Discrete Probability Distributions with n = 4 pi = .2

But there must be an easier way!!

(13) Binomial Probability Distribution (Discrete P.D.)

List of all outcomes for a Binomial Experiment (common multi-step experiment that has many useful applications) and the probabilities associated with each experimental outcome (sample point). (P.13)

(14) Requirements for Binomial Experiment

(1) The experiment consists of a sequence of n identical Trials. (Random variable counts the # of successes in a Fixed # of Trials. Fixed # of Trials $= n$)

These 3 met = Bernoulli process

(2) 2 outcomes are possible on each Trial. one is defined as a "success" and the other is "Not success" or "failure". S or F.

(3) Probability of success, denoted as "p" or the greek letter π ("pi"), remains the same on each Trial. $1-p$ does Not change. (Stationary Assumption)

(4) The Trials are independent (one does Not affect Next)

Think of sales person loosing enthusiasm ... P.221

Examples:

(1) Make 4 sales calls. (1) $n=4$, (2) S = sale, (3) $P=.2$ (4) yes

(2) Test with 15 T/F questions. (1) $n=15$, (2) S = get correct, (3) $P=.5$ (4) yes

(3) Flip Coin 3 times. (1) $n=3$, (2) S = H, (3) $P=.5$ (4) yes

(4) Drive across Bridge 7 times During Rush Hour Traffic (1) $n=7$ (2) S = stuck in Traffic (3) $P=.15$ (4) yes

(5) Air Flight from Oak. to Seattle. 6 Flights per day. (1) $n=6$ (2) S = late (3) $P=.1$ (4) yes

For our sales agent problem we has 16 total possible sample points but we needed only 4 of them:

2	S, S, S, NS
3	S, S, NS, S
4	S, NS, S, S
5	NS, S, S, S

4 total ⇓

How can we calculate this 4?

"sample points"

15 Number of Experimental outcomes that provide exactly X successes in n Trials

$$\left\{\begin{array}{c}\text{\# experimental outcomes}\\ \text{that have } x \text{ successes}\\ \text{in } n \text{ Trials}\end{array}\right\} = \frac{n!}{X!(n-X)!}$$

X = # successes of Random Discrete variable

* we use X instead of n, because X = successes in n trials

n = # Fixed Trials

* we use n instead of N because n = # of Fixed Trials

$n = 4$
$X = 3$

$$\left\{\begin{array}{c}\text{\# of experimental}\\ \text{outcomes that}\\ \text{have } x \text{ successes}\\ \text{in } n \text{ trials}\end{array}\right\} = \frac{4!}{3!(4-3)!} = \frac{\cancel{1*2*3}*4}{\cancel{1*2*3}(1)!} = \frac{4}{1} = 4$$

* earlier formula $= \frac{N!}{n!(N-n)!}$

N = count of all objects = pop size

n = size of subset = sample size

16 Binomial Probability Function

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

$P(x) = f(x)$ = Probability of x successes in n Trials
n = # of Fixed Trials
p = Probability of success on any 1 Trial
$1-p$ = Probability of failure on any 1 Trial

17 Excel Binomial Probability Function

=BINOMDIST(number_s, trials, probability_s, cumulative)

number_s = X = Discrete Random variable count # successes
Trials = n = # of Fixed Trials
Probability_s = p = Probability of success.
cumulative = 0 for exactly x $\boxed{P(x=2)}$
1 for less than or equal to $\boxed{P(x \le 2)}$

Example:

For our sales Agent Problem, what is probability of making exactly 3 sales in 4 Attempts, p = .2 ?

n = 4
x = 3
p = .2

$$f(3) = P(3) = \frac{4!}{3!(4-3)!} * .2^3 * .8^{(4-3)} =$$

$$= 4 * .008 * .8 = .0256 ✓$$

or

= BINOMDIST(3, 4, .2, 0) = .0256

Binomial?
1) Fixed # Trials? yes.
2) 2 outcomes on each Trial? yes.
3) Probability same each Trial? yes.
4) Events independent? yes.

Example:

If $p = .2$

$n = 4$

$X = 0$ or $X = 1$ or $X = 2$

$\boxed{\text{Find } P(X \le 2) = f(X \le 2)}$

ⓐ $P(0 \text{ or } 1 \text{ or } 2) = f(0 \text{ or } 1 \text{ or } 2) = f(0) + f(1) + f(2) =$

$$= \frac{4!}{0!(4-0)!} * .2^0 * .8^{(4-0)} + \frac{4!}{1!(4-1)!} * .2^1 * .8^{(4-1)} + \frac{4!}{2!(4-2)!} * .2^2 * .8^{(4-2)}$$

$$= .4096 + .4096 + .1536$$

$$= .9728 = P(x \le 2) = f(x \le 2)$$

ⓑ = BINOMDIST(2, 4, .2, 1) = .9728

Example:

$p = .2$

$n = 4$

$X = 3$ or $X = 4$

Find $f(X \ge 3) = P(X \ge 3)$

ⓐ $P(X = 3 \text{ or } X = 4) = P(3) + P(4) =$

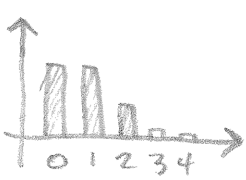
$$= \frac{4!}{3!(4-3)!} * .2^3 * .8^{(4-3)} + \frac{4!}{4!(4-4)!} * .2^4 * .8^{(4-4)}$$

$$= .0256 + .0016$$

$$= .0272 = P(X \ge 3) = f(X \ge 3$$

ⓑ = 1 − BINOMDIST(3−1, 4, .2, 1) = .0272

To go 1 below 50 3 is included.



* Excel function always does cumulative from Low End up ⟶ And All area = 1

18

Expected Value & Standard Deviation for the Binomial Distribution

$E(X) = \mu = \text{Mean} = n * p$

$\sigma = \text{Standard Deviation} = \sqrt{n*p*(1-p)}$

n = # of Fixed Trials
p = probability of success

Example:

For our sales Agent problem, what is the mean number of sales she will make in 4 attempts, and what is the standard Deviation?

$n = 4$
$p = .2$

$E(X) = \text{mean} = 4 * .2 = .8$

"For every 4 calls she can expect to sell .8 policies. If she has 40 calls planned, she can expect to sell

$\frac{40}{4} * .8 = 8$ policies

Standard Deviation $= \sqrt{.8 * (1-.2)} = .8$

measures dispersion & could be used to compare to other sales people.

Binomial Experiment Eamples:

① A flight from Oakland to Seattle occurs 6 times per day. The probability that any one flight is late is 0.1. What is the probability that exactly 2 planes are late? What is the probability that less than 2 planes are late? Is this a binomial experiment? Mean? SD?

Binomial Experiment?

① Fixed # of trials (each count S/F)?
yes ✓ $n = 5$

② Each Trial Independent? yes ✓ (more or less)

③ S/F each time? yes late or Not late

④ Probability of success same each trial?
yes $\pi = .1$

$* \pi = p$

Variables

$\pi = .1$ = success = late $x = 2$

$1-\pi = 1-.1 = .9$ = Not late $x < 2$

$n = 6$ = Fixed # of trials

$P(2) = \frac{6!}{(6-2)!\,2!} * (.1)^2 * (1-.1)^{(6-2)}$

$P(2) = \frac{6 \cdot 5}{2} * (.01) * (.9)^4$

$P(2) = 15 * .01 * .6561$

$P(2) = .098415$

Probability of exactly 2 flights late is .098415

Excel:
=BINOMDIST(x,n,π,0)

$P(x<2) = P(1) + P(0)$

$P(x<2) = .3543 + .5314$

$P(x<2) = .8857$

The probability that less than 2 flight will be late is .8857

Excel:
=BINOMDIST(x,n,π,1)

$\mu = n\pi$

$\mu = 6 * .1$

$\mu = .6$

The mean amount late per day is .6 flights

$\sigma = \sqrt{n\pi * (1-\pi)}$

$\sigma = \sqrt{6 * .1 * (1-.1)}$

$\sigma = \sqrt{.6 * .9}$

$\sigma = \sqrt{.54} = .7348$

The Standard Deviation is .7348

Binomial Experiment Example 2:

The probability of sitting in traffic on the West Seattle Bridge during rush hour is .15. During your next 7 rush hour bridge crossings, what is the probability that you will sit in traffic 3 times? 5 or more times? mean? SD?

Binomial?

Fixed # of trials? yes $n = 7$

$* \pi = p$

Independent? yes

S/F? stuck in traffic/Not stuck in traffic

π same each time? yes $\pi = .15$

$(1-\pi) = .85$

$$P(3) = \frac{7!}{(7-3)!\,3!} * .15^3 (1-.15)^{(7-3)} = \frac{7 \cdot 6 \cdot 5}{3 \cdot 2} * .003375 * .85^4 =$$

$$= 35 * .063375 * .5220625 = .061662$$

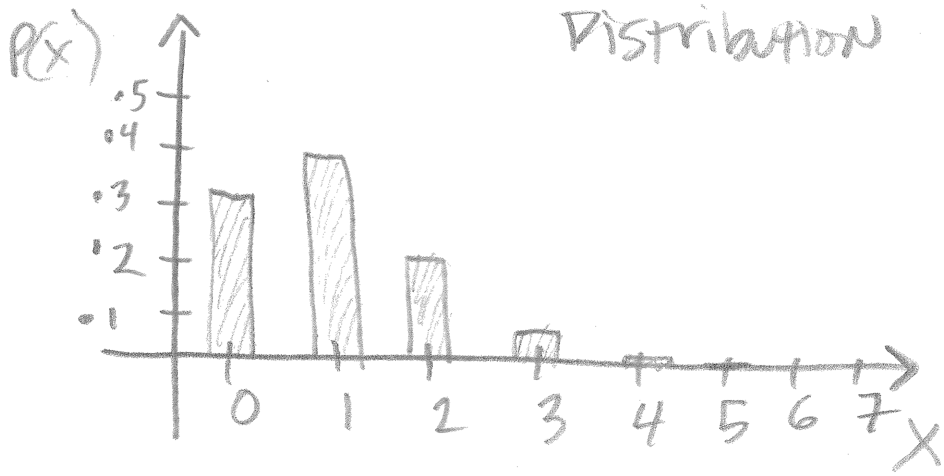
$$P(x \geq 5) = P(7) + P(6) + P(5) = .0011522 + .0000678 + .0000017 = .0012217$$

$$\mu = .15 * 7 = 1.05$$

$$\sigma = \sqrt{.15 * 7 * (1-.15)} = .94472181$$

Binomial Probability Distribution

f(x)



$n = 7$

$\pi = .15$

# of successes

of "stuck in traffic"

X # of times stuck in traffic	P(x)
0	.3206
1	.3960
2	.2097
3	.0617
4	.0109
5	.0012
6	.0001
7	.0000

P. 21, 22

For Binomial Distribution:

1. As p (π) approaches .5, the Distribution becomes symmetrical

2. As n gets larger, the Distribution becomes symmetrical.

Fixed # Trials ✓
independent ✓ π stays same ✓
S or F ✓

Problem 2

An insurance representative has appointments with four prospective clients tomorrow. From past experience she knows that the probability of making a sale on any appointment is 1 in 5 or 0.20. Use the rules of probability to determine the likelihood that she will sell a policy to 3 of the 4 prospective clients.

$\pi = .2$ Let NS = No sale $\pi_{NS} = 1 - .2 = .8$

# of Trials = $n = 4$ S = Sale $\pi_S = .2$

$X = 3$

Multiplying and then Adding Rules

Location of NS	order of occurrence	Probability of occurance
1	NS, S, S, S	(.8)(.2)(.2)(.2) = .0064
2	S, NS, S, S	(.2)(.8)(.2)(.2) = .0064
3	S, S, NS, S	(.2)(.2)(.8)(.2) = .0064
4	S, S, S, NS	(.2)(.2)(.2)(.8) = .0064

$\Sigma = .0256$

P(of exactly 3 sales in 4 trys) = .0256

Problem 3

Now let's use formula [6-3] for the binomial distribution to compute the probability that the sales representative in Problem 2 will sell a policy to exactly 3 out of the 4 prospective clients.

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

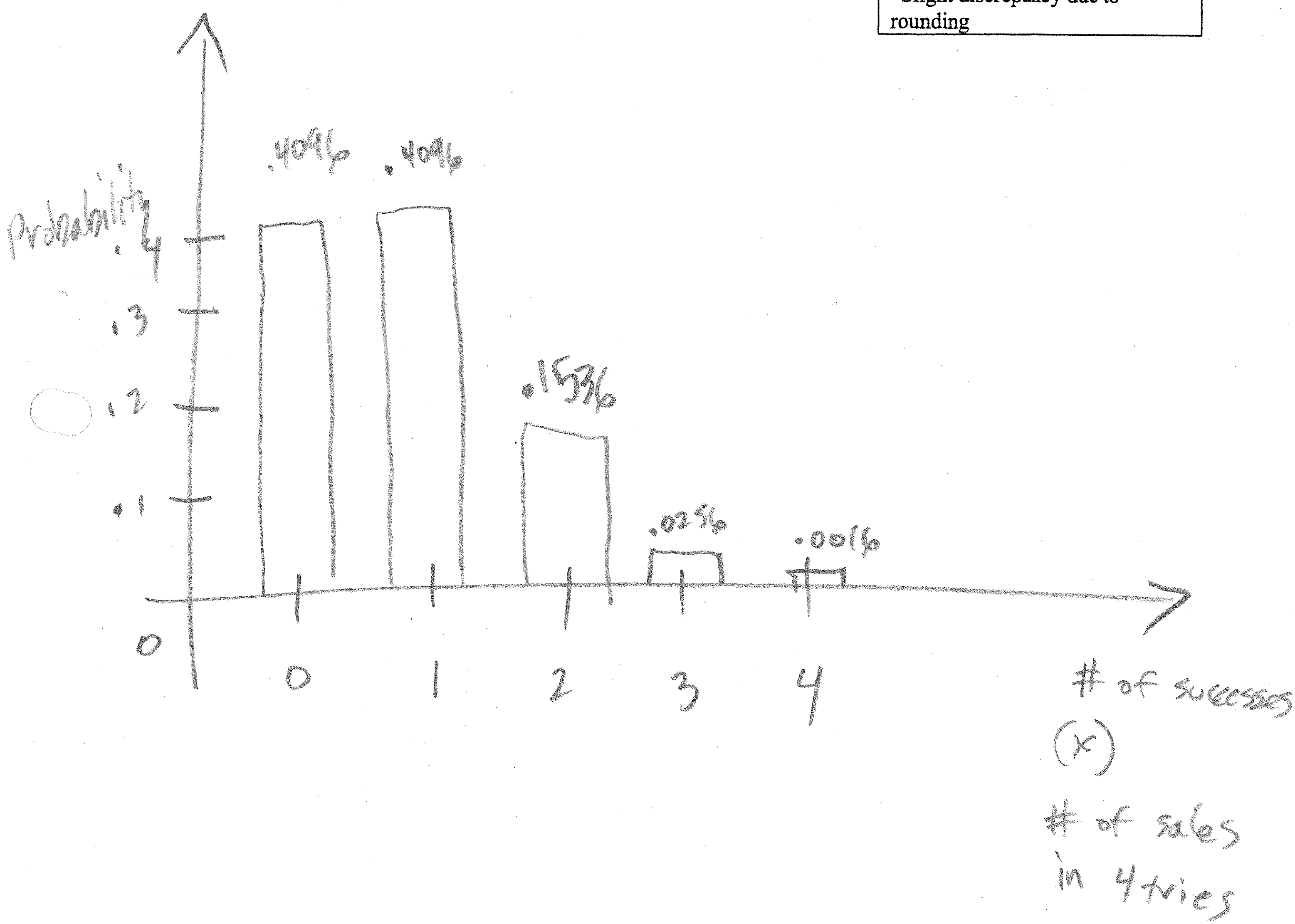
$$P(3) = \frac{4!}{3!(4-3)!} (.2)^3 (1-.2)^{4-3} = 4(.008)(.8) = .0256$$

Table $P(3) = .0256$

Problem 4

In Problems 2 and 3 the probability of 3 sales resulting from 4 appointments was computed using both the rules of addition and multiplication and the binomial formula. A more convenient way of arriving at the probabilities for 0, 1, 2, 3, or 4 sales out of 4 appointments is to refer to a binomial table. We use the binomial table to determine the probabilities for all possible outcomes.

Binomial Probability Distribution	
$n = 4$	$\pi = 0.20$
Number of Successes (x)	**Probability**
0	0.410
1	0.410
2	0.154
3	0.026
4	0.002
	*1.002
*Slight discrepancy due to rounding	



Problem 5

Use the information regarding the insurance representative, where $n = 4$ and $\pi = 0.20$, to compute the probability that the representative sells more than two policies. Also determine the mean and variance of the number of policyholders.

$P(x > 2) = .0272$

$\mu = n * \pi = .8$

$\sigma = \sqrt{n * \pi (1 - \pi)} = \sqrt{(.8)(.8)} = .8$

Exercise 6.3

Check your answers against those in the ANSWER section.

Labor negotiators estimate that 30 percent of all major contract negotiations result in a strike. During the next year, 12 major contracts must be negotiated. Determine the following probabilities using Appendix A:
a. no major strikes **b.** at least 5 **c.** between 2 and 4 (that is 2, 3, or 4).

π of strike $= .3$

$1 - \pi = .7$

$n = 12$

Trials fixed ✓ $n = 12$
Independent ✓
S/F ✓ $\pi = .3$
π stay same ✓

$P(0) = .0138$

$P(x >= 5) = .2763$

$P(2 \le x \le 4) = .6386$

Exercise 6.2

Check your answers against those in the ANSWER section.

It is known that 60 percent of all registered voters in the 42nd Congressional District are Republicans. Three registered voters are selected at random from the district. Compute the probability that exactly 2 of the 3 selected are Republicans, using:

a. The rules of probability **b**. The binomial formula. c. table

Binomial?

Fixed trials? yes $n = 3$

Independent? yes

S or F? R or Not yes

π same each time? yes $\pi = .6$

$n = 3$
$\pi = .6$
$X = 2$
$1 - \pi = .4$

a)

location NR	order of occurance	Probability of occurance	" "
3	R, R, NR	$(.6)(.6)(.4) =$	.144
1	NR, R, R	$(.4)(.6)(.6) =$	.144
2	R, NR, R	$(.6)(.4)(.6) =$	.144

$\Sigma = .432$

P(exactly 2 of 3 selected are Republicans) = .432

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

$P(2) = \frac{3!}{2!(3-2)!} (.6)^2 (1-.6)^{3-2} = 3(.36)(.4) = .432$

c)

$P(2) = .432$