

Class 8

Daniel B. Rowe, Ph.D.

Department of Mathematical and Statistical Sciences



Agenda:

**Review Chapters 1 – 5
(Exam 1 Chapters)**

Just the highlights!

1. Summation Notation

$$\sum_{i=1}^n f(x_i) = f(x_1) + f(x_2) + \dots + f(x_n)$$

2. Factorials

$$n! = n \times (n-1) \times (n-2) \times \dots \times 2 \times 1$$

3. Computations

$$x=20, y=14, s=16, w=-2, m=15, n=10$$

$$\text{Compute } x + y \cdot \frac{\sqrt{s}}{n} = 25.6$$

4. Simple Linear Equations

$$2 - 2x = 3x + 3 \quad x = -1/5$$

1: Statistics

1.1 Americans Here's Looking at you

Statistics is all around us!

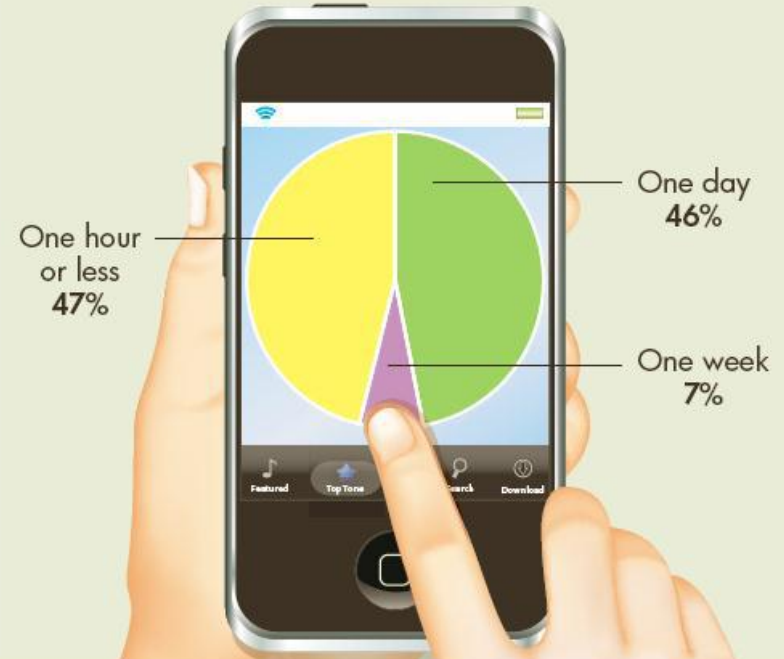
How much time between Internet usage?

Figure from Johnson & Kuby, 2012.

Fretting Over Messages

Are you fretting about messages?

How Wi-Fi users responded when asked how long they go before they get "antsy" about checking e-mail, instant messaging and social networking sites:



Source: Impulse Research for Qwest Communications online survey of 1,063 adult Wi-Fi users in April 2009.

1: Statistics

1.1 What is Statistics?

Population: A collection, or set, of individuals, objects, or events whose properties are to be analyzed.

Sample: Subset of the population.

Variable: A characteristic of interest about each individual element of a population or sample.

Data value: The value of the variable associated with one element of a population or sample.

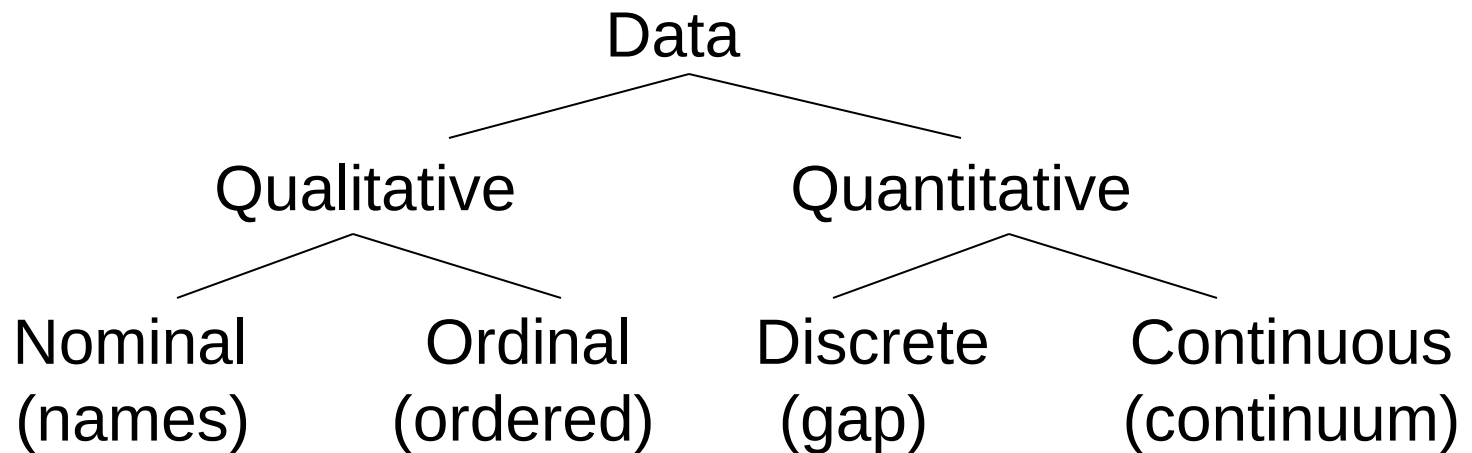
Parameter: A numerical value summarizing all the data of an entire population.

Statistic: A numerical value summarizing the sample data.

1: Statistics

1.1 What is Statistics?

Data: The set of values collected from the variable from each of the elements that belong to the sample.



1: Statistics

1.1 What is Statistics?

Qualitative variable: A variable that describes or categorizes an element of a population.

Nominal variable: A qualitative variable that characterizes an element of a population. No ordering. No arithmetic.

Ordinal variable: A qualitative variable that incorporates an ordered position, or ranking.

Quantitative variable: A variable that quantifies an element of a population.

Discrete variable: A quantitative variable that can assume a countable number of values. Gap between successive values.

Continuous variable: A quantitative variable that can assume an uncountable number of values. Continuum of values.

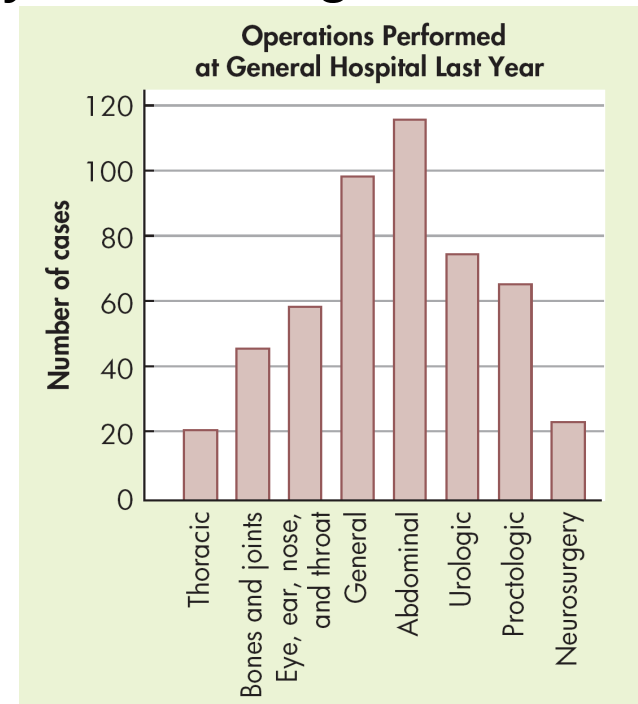
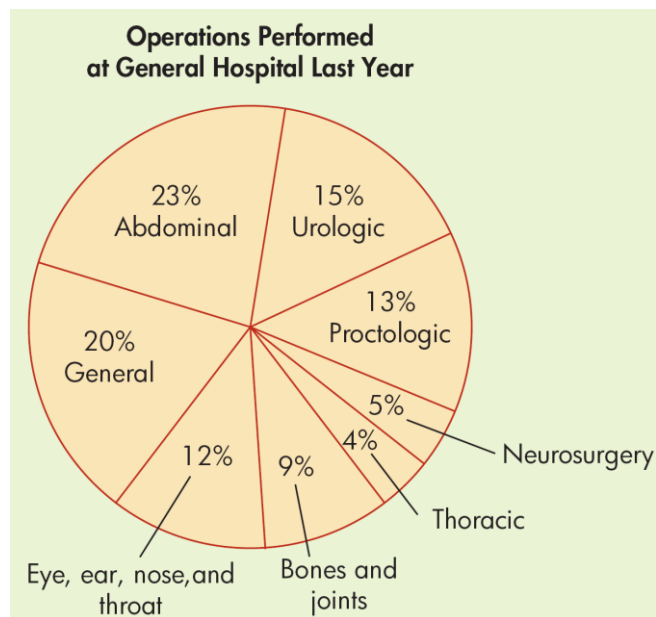
2: Descriptive Analysis and Single Variable Data

2.1 Graphs - Qualitative Data

Circle (pie) graphs and bar graphs:

Circle is parts to whole as angle.

Bar graph is amount in each category as rectangular areas.



Figures from Johnson & Kuby, 2012.

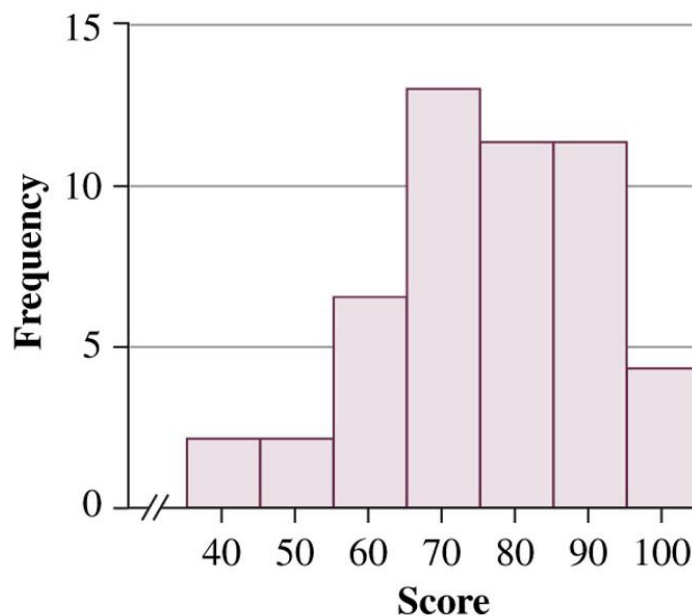
2: Descriptive Analysis and Single Variable Data

2.2 Frequency Distributions and Histograms

Statistics Exam Scores [TA02-06]

60	47	82	95	88	72	67	66	68	98	90	77	86
58	64	95	74	72	88	74	77	39	90	63	68	97
70	64	70	70	58	78	89	44	55	85	82	83	
72	77	72	86	50	94	92	80	91	75	76	78	

Boundaries	Frequency
$35 \leq x < 45$	2
$45 \leq x < 55$	2
$55 \leq x < 65$	7
$65 \leq x < 75$	13
$75 \leq x < 85$	11
$85 \leq x < 95$	11
$95 \leq x \leq 105$	4
	50



Figures from Johnson & Kuby, 2012.

2: Descriptive Analysis and Single Variable Data

2.3 Measures of Central Tendency

- Sample Mean:** Usual average, p. 63 $\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$
- Sample Median:** Middle value, p. 64 n odd, $\tilde{x} = \frac{n+1}{2}$ value
 n even, avg $\frac{n}{2}$ & $\frac{n}{2} + 1$ values
- Sample Mode:** Most often, p. 66 $\hat{x} = \text{most often}$

Measures of central tendency characterize center of distribution.

Measures of dispersion characterize the variability in the data.

2: Descriptive Analysis and Single Variable Data

2.4 Measures of Dispersion

Range: $H - L$, p. 74

Deviation from mean: value minus sample mean, p. 74

$$i^{th} \text{ deviation from mean} = x_i - \bar{x}$$

Sample Variance: avg squared dev using $n-1$ in den, p. 76

$$s^2 = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2 \qquad s^2 = \frac{1}{n-1} \left\{ \sum_{i=1}^n x_i^2 - \left[\left(\sum_{i=1}^n x_i \right)^2 / n \right] \right\}$$

Sample Standard Deviation: $s = \sqrt{s^2}$

2: Descriptive Analysis and Single Variable Data

2.3, 2.4 Measures of Central Tendency and Dispersion

Example: Data values: 1,2,2,3,4

$$\bar{x} = 2.4 \quad \hat{x} = 2 \quad \tilde{x} = 2$$

$$s^2 = 1.3 \quad s = 1.1$$

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i \quad \hat{x} = \text{most often value} \quad \tilde{x} = \text{middle value}$$

$$s^2 = \frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2 \quad s = \sqrt{s^2}$$

2: Descriptive Analysis and Single Variable Data

2.5 Measures of Position

Measures of Position: Quartiles - ranked data into quarters

L = lowest value

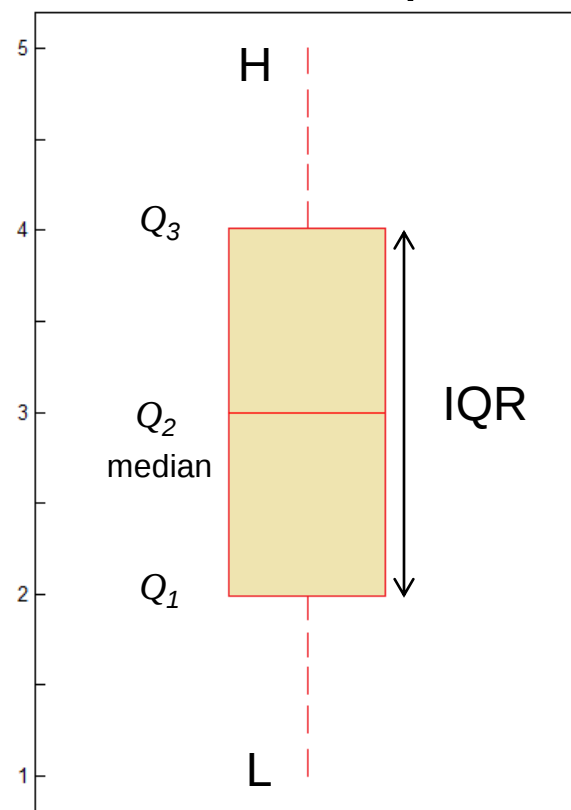
H = highest value

Q_2 = median

Q_1 = 25% smaller

Q_3 = 75% smaller

$IQR = Q_3 - Q_1$



2: Descriptive Analysis and Single Variable Data

2.5 Measures of Position

Measures of Position: percentiles - rank data into 100^{ths}

L = lowest value

H = highest value

P_k = value where $k\%$ are smaller

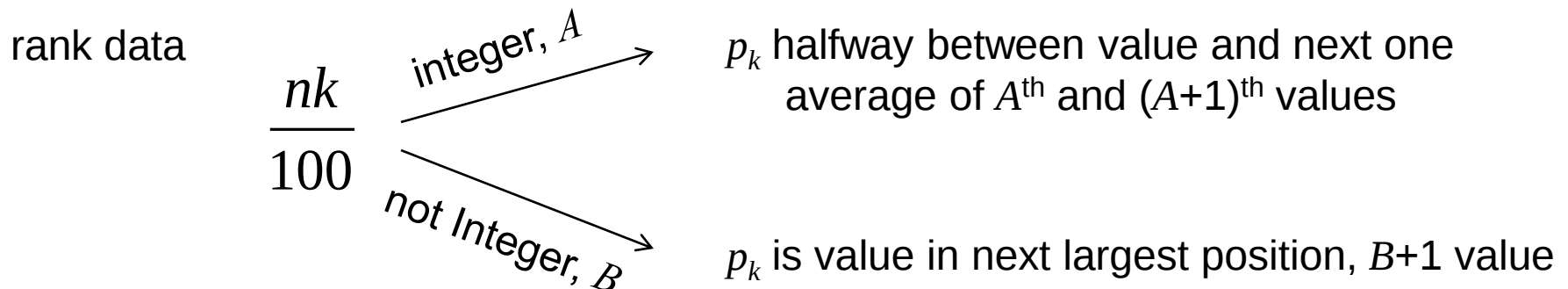
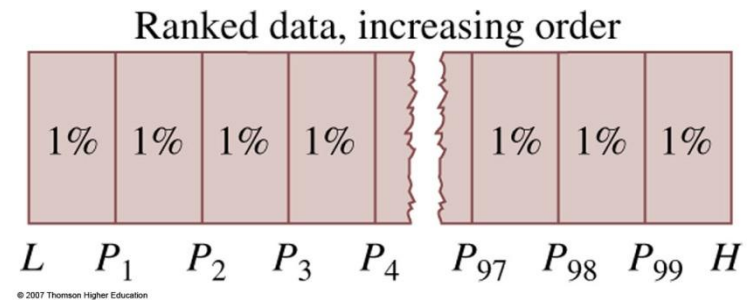


Figure from Johnson & Kuby, 2012.

2: Descriptive Analysis and Single Variable Data

2.5 Measures of Position

Standard score, or z-score: The position a particular value of x has relative to the mean, measured in standard deviations.

$$z_i = \frac{i^{\text{th}} \text{ value} - \text{mean}}{\text{std. dev.}} = \frac{x_i - \bar{x}}{s}$$

There can be n of these because we have $x_1, x_2, \dots, x_n$.

3: Descriptive Analysis and Bivariate Data

3.1 Bivariate Data: two qualitative

Cross-tabulation tables or contingency tables

Example:

Construct a 2×3 table.

Know different %ages.

Name	Gender	Major	Name	Gender	Major	Name	Gender	Major
Adams	M	LA	Feeney	M	T	McGowan	M	BA
Argento	F	BA	Flanigan	M	LA	Mowers	F	BA
Baker	M	LA	Hodge	F	LA	Ornt	M	T
Bennett	F	LA	Holmes	M	T	Palmer	F	LA
Brand	M	T	Jopson	F	T	Pullen	M	T
Brock	M	BA	Kee	M	BA	Rattan	M	BA
Chun	F	LA	Kleeberg	M	LA	Sherman	F	LA
Crain	M	T	Light	M	BA	Small	F	T
Cross	F	BA	Linton	F	LA	Tate	M	BA
Ellis	F	BA	Lopez	M	T	Yamamoto	M	LA

Gender	Major			Row Total
	LA	BA	T	
M	5	6	7	18
F	6	4	2	12
Col. Total	11	10	9	30

M = male

F = female

LA = liberal arts

BA = business admin

T = technology

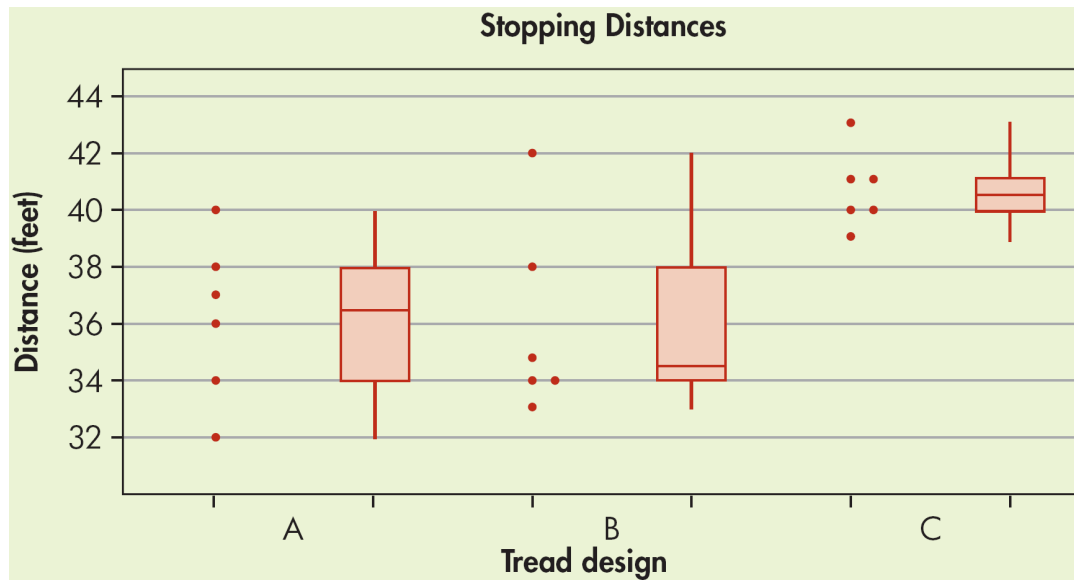
Figures from Johnson & Kuby, 2012.

3: Descriptive Analysis and Bivariate Data

3.1 Bivariate Data: one qualitative and one quantitative

Example:

Design A ($n = 6$)			Design B ($n = 6$)			Design C ($n = 6$)		
37	36	38	33	35	38	40	39	40
34	40	32	34	42	34	41	41	43



Vertical box-and-whiskers

Figures from Johnson & Kubly, 2012.

3: Descriptive Analysis and Bivariate Data

3.1 Bivariate Data: two quantitative, Scatter Diagram

Example: Push-ups

Student	1	2	3	4	5	6	7	8	9	10
Push-ups, x	27	22	15	35	30	52	35	55	40	40
Sit-ups, y	30	26	25	42	38	40	32	54	50	43

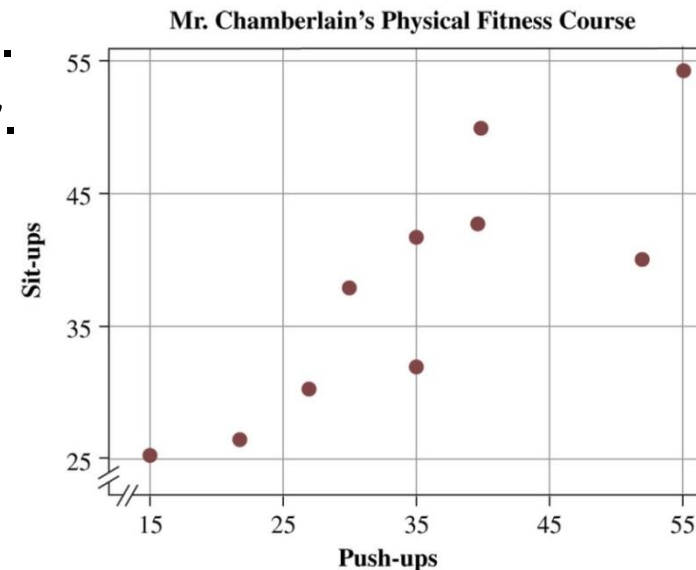
Input variable: independent variable, x .

Output variable: dependent variable, y .

Scatter Diagram: A plot of all the ordered pairs of bivariate data on a coordinate axis system.

(x,y) ordered pairs.

Figures from Johnson & Kuby, 2012.



3: Descriptive Analysis and Bivariate Data

3.2 Linear Correlation

Linear Correlation, r , is a measure of the strength of a linear relationship between two variables x and y .

$$-1 \leq r \leq 1$$

Will discuss its computation in a minute.



No correlation

$$r \approx 0$$



Positive

$$r \approx 0.5$$



High positive

$$r \approx 0.8$$



Negative

$$r \approx -0.5$$



High negative

$$r \approx -0.8$$

Figure from Johnson & Kuby, 2012.

3: Descriptive Analysis and Bivariate Data

3.2 Linear Correlation

Example:

Push-ups, x	27	22	15	35	30	52	35	55	40	40
Sit-ups, y	30	26	25	42	38	40	32	54	50	43

Student	Push-ups, x	x^2	Sit-ups, y	y^2	xy
1	27	729	30	900	810
2	22	484	26	676	572
3	15	225	25	625	375
4	35	1,225	42	1,764	1,470
5	30	900	38	1,444	1,140
6	52	2,704	40	1,600	2,080
7	35	1,225	32	1,024	1,120
8	55	3,025	54	2,916	2,970
9	40	1,600	50	2,500	2,000
10	40	1,600	43	1,849	1,720
$\Sigma x = 351$		$\Sigma x^2 = 13,717$	$\Sigma y = 380$	$\Sigma y^2 = 15,298$	$\Sigma xy = 14,257$
sum of x		sum of x^2	sum of y	sum of y^2	sum of xy

Figure from Johnson & Kuby, 2012.

3: Descriptive Analysis and Bivariate Data

3.2 Linear Correlation

Example:

Push-ups, x	27	22	15	35	30	52	35	55	40	40
Sit-ups, y	30	26	25	42	38	40	32	54	50	43

$$SS(x) = \sum_{i=1}^n x_i^2 - \frac{1}{n} \left(\sum_{i=1}^n x_i \right)^2 = 13717 - \frac{(351)^2}{10} = 1396.9$$

$$SS(y) = \sum_{i=1}^n y_i^2 - \frac{1}{n} \left(\sum_{i=1}^n y_i \right)^2 = 15298 - \frac{(380)^2}{10} = 858.0$$

$$SS(xy) = \sum_{i=1}^n x_i y_i - \frac{1}{n} \left(\sum_{i=1}^n x_i \right) \left(\sum_{i=1}^n y_i \right) = 14257 - \frac{(351)(380)}{10} = 919.0$$

$$r = \frac{SS(xy)}{\sqrt{SS(x)SS(y)}} = \frac{919.0}{\sqrt{(1396.9)(858.0)}} = 0.84$$

$$\sum_{i=1}^n x_i = 351$$

$$\sum_{i=1}^n x_i^2 = 13717$$

$$\sum_{i=1}^n y_i = 380$$

$$\sum_{i=1}^n y_i^2 = 15298$$

$$\sum_{i=1}^n x_i y_i = 14257$$

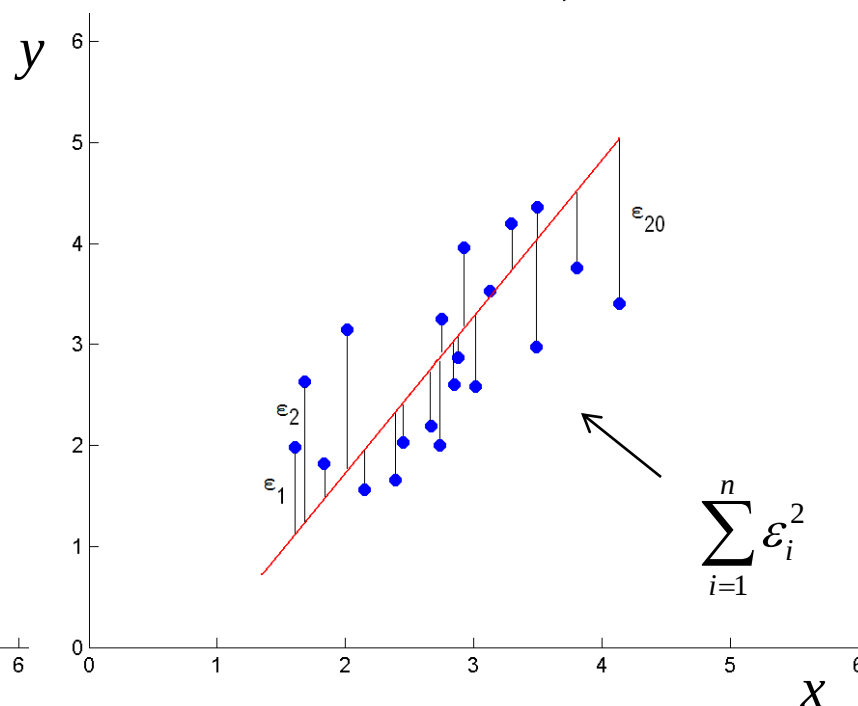
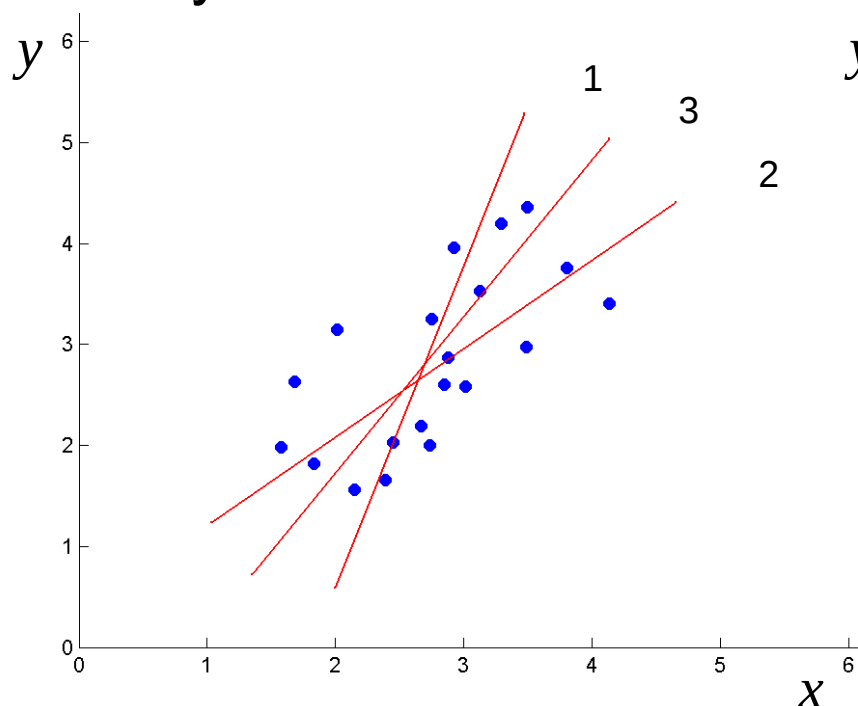
Figure from Johnson & Kuby, 2012.

3: Descriptive Analysis and Bivariate Data

3.3 Linear Regression

b_0 is estimated y-intercept
 b_1 is estimated slope.

We try different lines until we find the “best” one, $\hat{y} = b_0 + b_1x$



Move line until sum of the squared residuals is a minimum.

3: Descriptive Analysis and Bivariate Data

3.3 Linear Regression

(x,y) pairs: (1,1),(3,2),(2,3),(4,4)

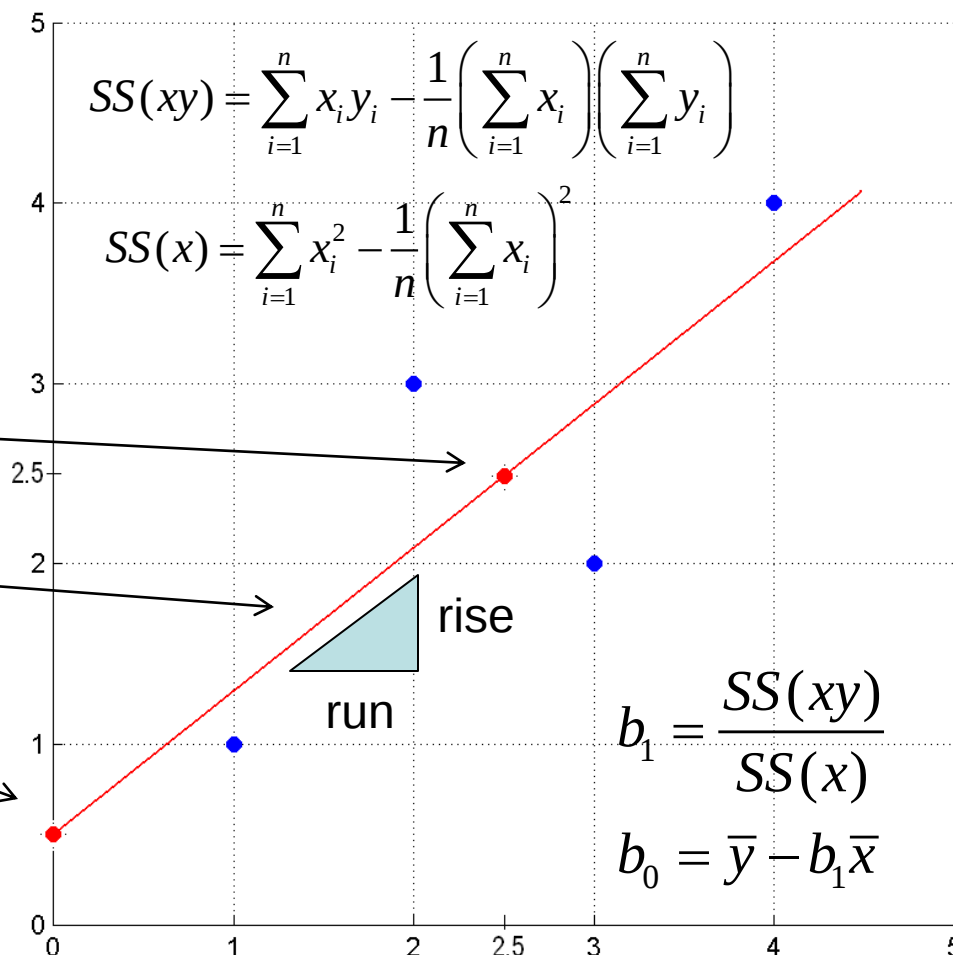
Plotted **points**.

The **line** goes through $(\bar{x}, \bar{y})$.

The **slope** is $b_1=0.8$.

The **y - intercept** $b_0=0.5$.

Two points **(2.5,2.5)** and **(0,.5)**.



3: Descriptive Analysis and Bivariate Data

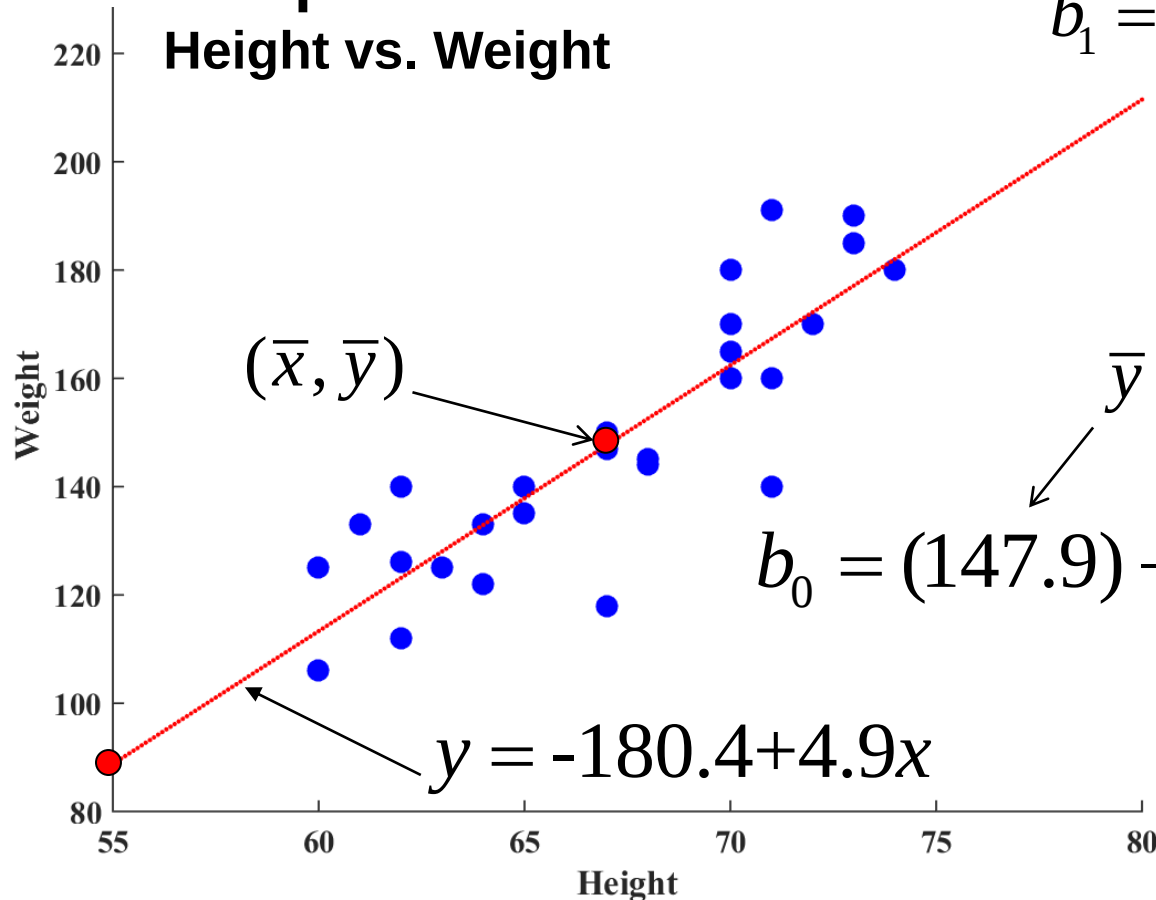
3.3 Linear Regression

Example: Previous class data!

Height vs. Weight

$$b_1 = \frac{SS(xy)}{SS(x)} = \frac{2370.1}{483.0} = 4.9$$

units of lbs/in



4: Probability

4.1 Probability of Events

An **experiment** is a process by which a measurement is taken or observations is made. i.e. flip coin or roll die

An **outcome** is the result of an experiment. i.e. Heads, or 3

Sample space is a listing of possible outcomes. i.e. $S=\{H,T\}$

An **event** is an outcome or a combination of outcomes.
i.e. even number when rolling a die

4: Probability

4.1 Probability of Events

A_i are events

Property 1: $0 \leq P(A_i) \leq 1$

Property 2: $\sum_{i=1}^n P(O_i) = 1$ $i = 1, \dots, n$

O_i are outcomes

Approaches to probability.

(1) Empirical (AKA experimental)

empirical probability of $A = \frac{\text{number of times } A \text{ occurred}}{\text{number of trials}}$

(2) Theoretical (AKA classical or equally likely)

theoretical probability of $A = \frac{\text{number of times } A \text{ occurs in sample space}}{\text{number of elements in the sample space}}$

4: Probability - Empirical

4.1 Probability of Events – Law of large numbers

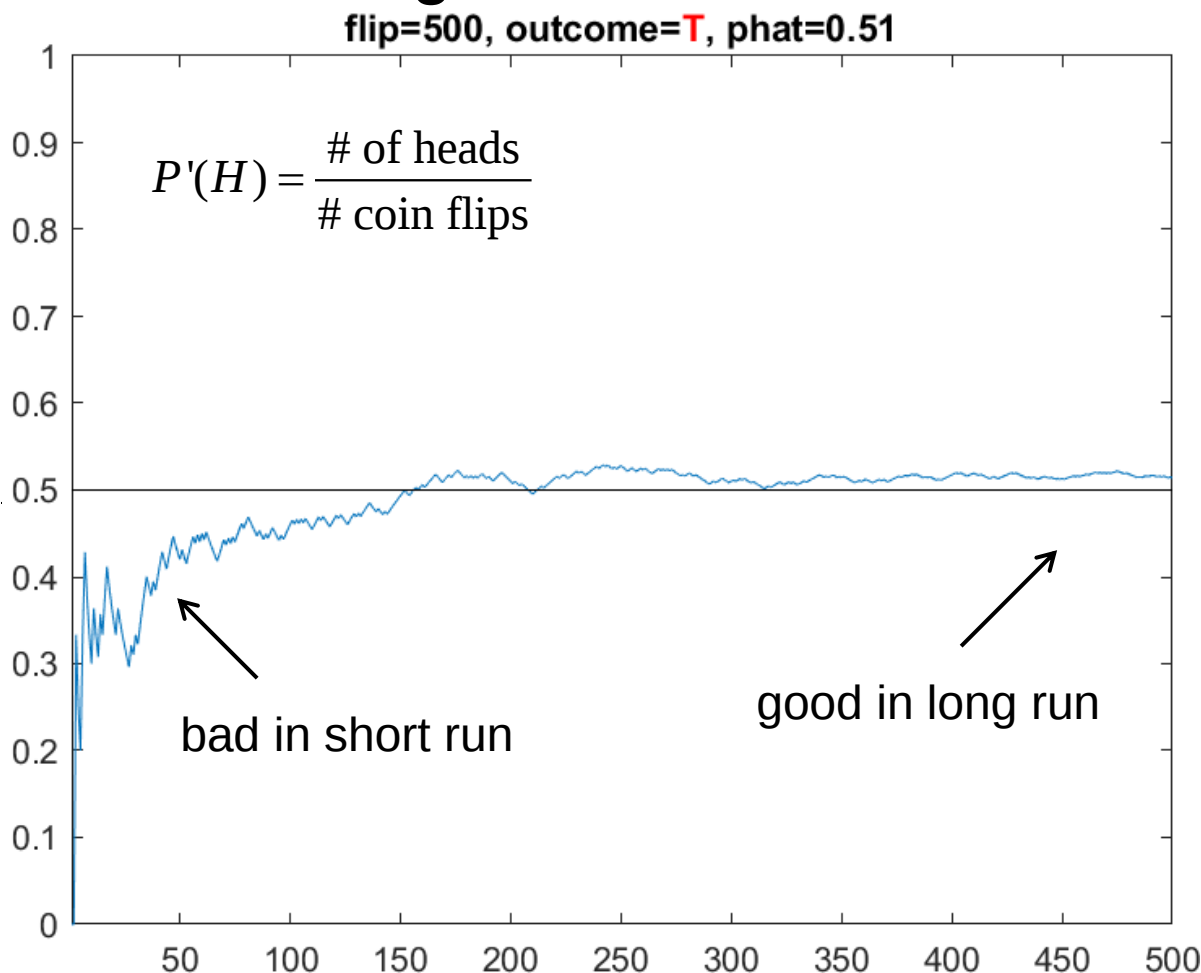
Had computer flip a single coin 1000 times.



Flip # on x axis

$P'(H)$ on y axis.

This shows convergence to true value of $1/2$.

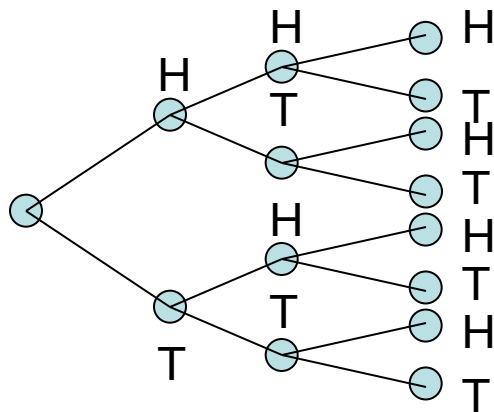


4: Probability

4.1 Probability of Events

So let's flip a coin three times.

Can flip three times.



Sample space:

listing of outcomes
for 3 flips

$$S = \{HHH, HHT, HTH, HTT, THH, THT, TTH, TTT\}$$

$$P(HHH) = \frac{\# \text{ times } HHH \text{ occurs in } S}{\# \text{ elements in } S}$$

4: Probability

4.2 Rules of Probability – “A or B”

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

Example: Pick Card, $A=\text{Heart}$, $B=\text{Ace}$

$P(\text{Heart or Ace})$

$$P(\text{Heart}) = 13 / 52$$

$$P(\text{Ace}) = 4 / 52$$

$$P(\text{Heart and Ace}) = 1 / 52$$

$$P(\text{Heart or Ace}) = P(\text{Heart}) + P(\text{Ace}) - P(\text{Heart and Ace})$$

$$P(\text{Heart or Ace}) = 13 / 52 + 4 / 52 - 1 / 52 = 16 / 52$$

double
counted

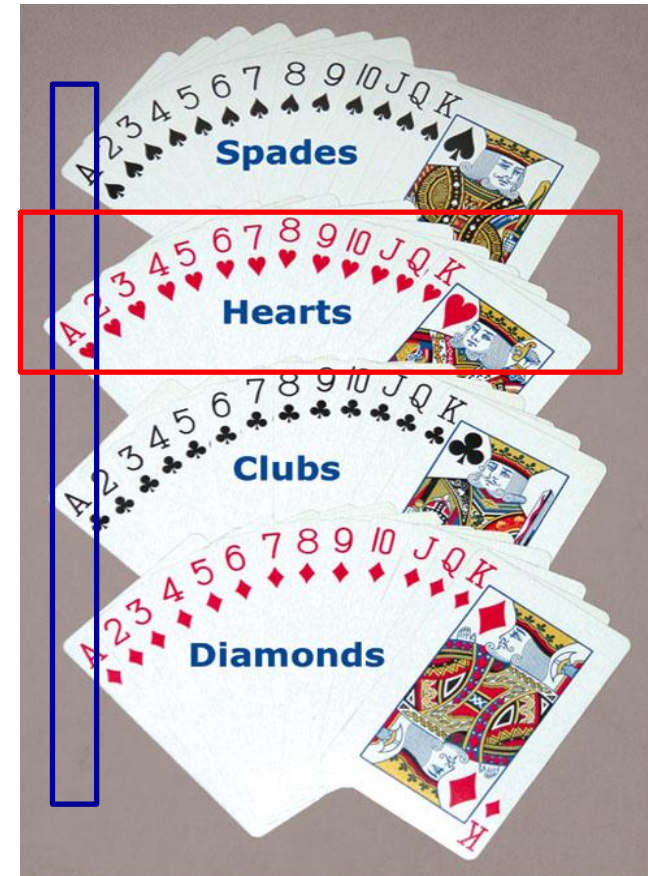


Figure from Johnson & Kuby, 2012.

4: Probability

4.3 Rules of Probability

Example: Pick Card, A =Heart, B =Ace

$$P(\bar{A}) = 1 - P(A)$$

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$$

$$P(A \text{ and } B) = P(A) \cdot P(B | A)$$

$$P(A | B) = \frac{P(A \text{ and } B)}{P(B)}$$

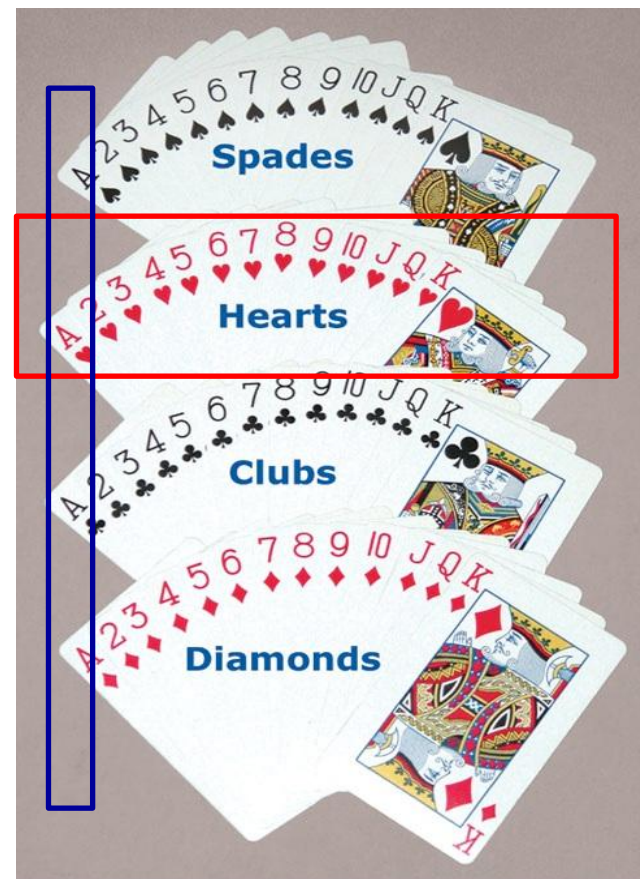


Figure from Johnson & Kuby, 2012.

4: Probability

4.5 Independent Events

Independent events: ... the occurrence or nonoccurrence of one gives no information about ... occurrence for the other.

$$P(A) = P(A \mid B) = P(A \mid \text{not } B)$$

Dependent events: ... occurrence of one event does have an effect on the probability of occurrence of the other event.

$$P(A) \neq P(A \mid B)$$

Special multiplication rule:

Let A and B ... independent events ... in a sample space S .

$$P(A \text{ and } B) = P(A) \cdot P(B)$$

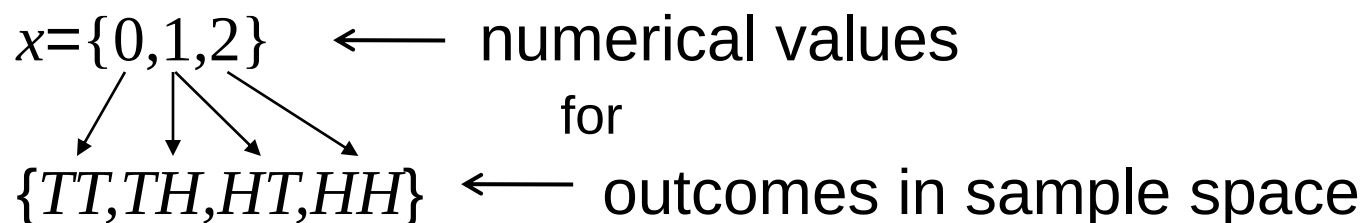
5: Probability Distributions (Discrete Variables)

5.1 Random Variables

Random Variables: A variable that assumes a unique numerical value for each of the outcomes in the sample space of a probability experiment.

Example:

Let x = the number of heads when we flip a coin twice.



5: Probability Distributions (Discrete Variables)

5.1 Random Variables

Discrete Random Variables: A quantitative random variable that can assume a countable number of values.

Continuous Random Variable: A quantitative random variable that can assume an uncountable number of values.



Continuum of values.

Examples:

Discrete: Number of heads when we flip a coin ten times.

Continuous: Distance from earth center to sun center.

5: Probability Distributions (Discrete Variables)

5.2 Probability Distributions of a Discrete Random Variable

Random Variables: ... assumes a unique ... value for each of the outcomes in the sample space

Probability Function: A rule $P(x)$ that assigns probabilities to the values of the random variable x .

Example:

Let $x = \#$ of heads when we flip a coin twice.

$$x = \{0, 1, 2\}$$

$$P(x) = \frac{2!}{x!(2-x)!} \left(\frac{1}{2}\right)^x \left(\frac{1}{2}\right)^{2-x} \longrightarrow$$

x	$P(x)$
0	$\frac{1}{4}$
1	$\frac{1}{2}$
2	$\frac{1}{4}$

5: Probability Distributions (Discrete Variables)

5.2 Mean and Variance of a Discrete Random Variable

$$\mu = \sum_{i=1}^n [x_i P(x_i)] = x_1 P(x_1) + x_2 P(x_2) + \dots + x_n P(x_n)$$

For the # of H when we flip a coin twice discrete distribution:

$$\mu = (x_1) \cdot P(x_1) + (x_2) \cdot P(x_2) + (x_3) \cdot P(x_3)$$

$$\mu = (0) \cdot P(0) + (1) \cdot P(1) + (2) \cdot P(2)$$

$$\mu = (0) \cdot (1/4) + (1) \cdot (1/2) + (2) \cdot (1/4)$$

$$\mu = 0 + 1/2 + 1/2$$

$$\mu = 1$$

	x	$P(x)$	
$\nearrow$	0	$\frac{1}{4}$	$\nwarrow$
x_1			$P(x_1)$
$\nearrow$	1	$\frac{1}{2}$	$\nwarrow$
x_2			$P(x_2)$
$\nearrow$	2	$\frac{1}{4}$	$\nwarrow$
x_3			$P(x_3)$

5: Probability Distributions (Discrete Variables)

5.2 Mean and Variance of a Discrete Random Variable

$$\sigma^2 = \sum_{i=1}^n [(x_i - \mu)^2 P(x_i)] = (x_1 - \mu)^2 P(x_1) + (x_2 - \mu)^2 P(x_2) + \dots + (x_n - \mu)^2 P(x_n)$$

For the # of H when we flip a coin twice discrete distribution:

$$\begin{aligned} \sigma^2 &= (x_1 - \mu)^2 \cdot P(x_1) + (x_2 - \mu)^2 \cdot P(x_2) + (x_3 - \mu)^2 \cdot P(x_3) \\ \sigma^2 &= (0-1)^2 \cdot P(0) + (1-1)^2 \cdot P(1) + (2-1)^2 \cdot P(2) \\ \sigma^2 &= (-1)^2 \cdot (1/4) + (0)^2 \cdot (1/2) + (1)^2 \cdot (1/4) \\ \sigma^2 &= 1/4 + 0 + 1/4 \\ \sigma^2 &= 1/2 \rightarrow \sigma \approx 0.7071 \end{aligned}$$

	$\mu = 1$	
	x	$P(x)$
	0	$\frac{1}{4}$
$\nearrow x_1$		$\nwarrow P(x_1)$
	1	$\frac{1}{2}$
$\nearrow x_2$		$\nwarrow P(x_2)$
	2	$\frac{1}{4}$
$\nearrow x_3$		$\nwarrow P(x_3)$

5: Probability Distributions (Discrete Variables)

5.2 Mean and Variance of a Discrete Random Variable

$$\sigma^2 = \sum_{i=1}^n [x_i^2 P(x_i)] - \mu^2 = [x_1^2 P(x_1) + x_2^2 P(x_2) + \dots + x_n^2 P(x_n)] - \mu^2$$

Alternate Formula

For the # of H when we flip a coin twice discrete distribution:

$$\sigma^2 = x_1^2 \cdot P(x_1) + x_2^2 \cdot P(x_2) + x_3^2 \cdot P(x_3) - \mu^2$$

$$\sigma^2 = [0^2 \cdot P(0) + 1^2 \cdot P(1) + 2^2 \cdot P(2)] - 1^2$$

$$\sigma^2 = [0 \cdot (1/4) + 1^2 \cdot (1/2) + 2^2 \cdot (1/4)] - 1$$

$$\sigma^2 = 0 + 1/2 + 4/4 - 1$$

$$\sigma^2 = 1/2 \rightarrow \sigma \approx 0.7071$$

$\mu = 1$	
x	$P(x)$
$\nearrow 0$	$\frac{1}{4}$
$x_1 \nearrow$	$\frac{1}{2}$
$x_2 \nearrow$	$\frac{1}{4}$
$x_3 \nearrow$	$\frac{1}{4}$

$\nwarrow P(x_1)$
 $\nwarrow P(x_2)$
 $\nwarrow P(x_3)$

5: Probability Distributions (Discrete Variables)

5.3 The Binomial Probability Distribution

Bi means two like bicycle

An experiment with only two outcomes is called a Binomial exp.
 Call one outcome *Success* and the other *Failure*.
 Each performance of expt. is called a trial and are independent.

$$P(x) = \frac{n!}{\underbrace{x!(n-x)!}_{\text{num}(x \text{ successes})} \underbrace{p^x(1-p)^{n-x}}_{P(x \text{ successes and } n-x \text{ failures})}} \quad x = 0, \dots, n$$

Prob of exactly x successes

(5.5)

n = number of trials or times we repeat the experiment.

x = the number of successes out of n trials.

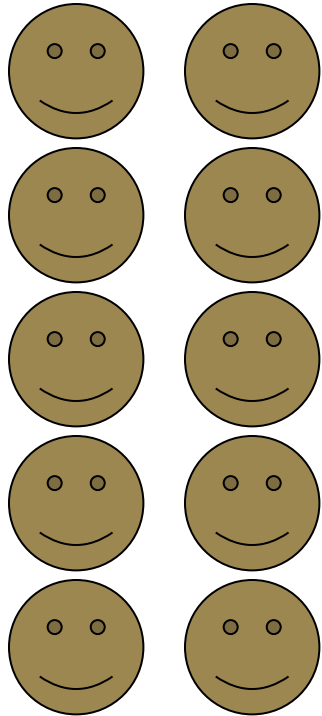
p = the probability of success on an individual trial.

$$\binom{n}{x} = \frac{n!}{x!(n-x)!}$$

5: Probability Distributions (Discrete Variables)

5.3 The Binomial Probability Distribution

Flip coin ten times.



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

n = number of trials

x = the number of successes

p = the probability of success

$$n=10, x=7, p=.5$$

$$P(7) = \frac{10!}{7!(10-7)!} \left(\frac{1}{2}\right)^7 \left(1 - \frac{1}{2}\right)^{10-7}$$

$$P(7) = \frac{10 \cdot 9 \cdot 8 \cdot \cancel{7!}}{\cancel{7!} 3!} \left(\frac{1}{2}\right)^7 \left(\frac{1}{2}\right)^{10-7}$$

$$P(7) = \frac{10 \cdot \cancel{3} \cdot \cancel{3} \cdot \cancel{2} \cdot 4}{\cancel{3} \cdot \cancel{2}} \left(\frac{1}{2}\right)^{10} \longrightarrow P(7) = \frac{120}{1024}$$

5: Probability Distributions (Discrete Variables)

5.3 The Binomial Probability Distribution

TABLE 2 page 713

Binomial Probabilities $\left[\binom{n}{x} \cdot p^x \cdot q^{n-x} \right]$ (continued)

$n=10, x=7, p=1/2$

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

Figure from Johnson & Kubly, 2012.

n	x	p													x
		0.01	0.05	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	0.95	0.99	
10	0	.904	.599	.349	.107	.028	.006	.001	0+	0+	0+	0+	0+	0+	0
	1	.091	.315	.387	.268	.121	.040	.010	.002	0+	0+	0+	0+	0+	1
	2	.004	.075	.194	.302	.233	.121	.044	.011	.001	0+	0+	0+	0+	2
	3	0+	.010	.057	.201	.267	.215	.117	.042	.009	.001	0+	0+	0+	3
	4	0+	.001	.011	.088	.200	.251	.205	.111	.037	.006	0+	0+	0+	4
	5	0+	0+	.001	.026	.103	.201	.246	.201	.103	.026	.001	0+	0+	5
	6	0+	0+	0+	.006	.037	.111	.205	.251	.200	.088	.011	.001	0+	6
	7	0+	0+	0+	.001	.009	.042	.117	.215	.267	.201	.057	.010	0+	7
	8	0+	0+	0+	0+	.001	.011	.044	.121	.233	.302	.194	.075	.004	8
	9	0+	0+	0+	0+	0+	.002	.010	.040	.121	.268	.387	.315	.091	9
	10	0+	0+	0+	0+	0+	0+	.001	.006	.028	.107	.349	.599	.904	10
x		0	1	2	3	4	5	6	7	8	9	10			
P(x)		$\frac{1}{1024}$	$\frac{10}{1024}$	$\frac{45}{1024}$	$\frac{120}{1024}$	$\frac{210}{1024}$	$\frac{252}{1024}$	$\frac{210}{1024}$	$\frac{120}{1024}$	$\frac{45}{1024}$	$\frac{10}{1024}$	$\frac{1}{1024}$			

Questions?

Exam 1 on Tuesday!

Bring pencil, calculator, scratch paper.
(And caffeinated beverage!)

Will be given exam, formula sheet,
binomial tables.