Name: ____

Probability Using Two-way Frequency Tables

A two-way frequency table is a way of representing data that fits into multiple categories. Any probability problem that has more than one overlapping category can be re-written as a two-way frequency table.

Example:

"If there are 8 junior baseball players, 4 junior soccer players, 7 senior baseball players, 5 senior track & field athletes, and 6 senior soccer players..."

To set up my table, I start with my two categories (which are called "variables"): their grade level and their sport, (including a row and a column to write in the totals). Then, I fill in the information that I know.

		Gra	de		_		Grade						
Sport		Junior	Senior	TOTAL		¢ Sport		Junior	Senior	TOTAL			
	Baseball						Baseball	JUNIOR BASEBALL	SENIOR BASEBALL				
	Soccer				\rightarrow		Soccer	JUNIOR SOCCER	SENIOR SOCCER				
	Track & Field						Track & Field	JUNIOR TRACK & FIELD	SENIOR TRACK & FIELD				
	TOTAL						TOTAL						

		Grade			
		Junior	Senior	TOTAL	
Sport	Baseball	8	7	15 Baseball	
	Soccer	4	6	10 Soccer	
	Track & Field	0	5	5 Track & Field	
	τοτλι	12	18	30	
	IUIAL	Junior	Senior	TOTAL	

So, according to the table, the probability of randomly selecting a **junior baseball player** would be:

$$P(junior \ baseball \ player) = \frac{8 \ Jr \ BB}{30 \ Total} = \boxed{\frac{4}{15}}$$

If I wanted the probability that he was a junior OR a baseball player, I would use count up those categories. Grade

	Junior	Senior	TOTAL
Baseball	8	7	15 Baseball
Soccer	4	6	10 Soccer
Track & Field	0	5	5 Track & Field
TOTAL	12 Junior	18 Senior	30 TOTAL
	Baseball Soccer Track & Field TOTAL	JuniorBaseball8Soccer4Track & Field0TOTAL12 Junior	JuniorSeniorBaseball87Soccer46Track & Field05TOTAL12 Junior18 Senior

Acceptable outcomes:

8 Jr. baseball, 7 Sr. baseball 4 Jr. Soccer <u>& 0 Jr. Track & Field</u> = 19 Total	$P(junior \ OR \ baseball \ player) = \frac{19}{30}$
= 19 Total	

I could also have done 15 baseball + 12 junior - 8 both = 27 - 8 = 19

I could also find the probability of randomly selecting a baseball player given that he is a junior ("given that" means he has to be a junior). For this probability, I would ignore all options that are not juniors:

$$P(Baseball \mid Junior) = \frac{8 BB}{12 Jr} = \frac{2}{3}$$

EXAM	IPLE		EXAMPLE								
		Со	lor		Grade						
50		Black	Blue	TOTAL	u		9 th	10 th	11 th	12 th	TOTAL
uing m	Shirts	12	8	20	tio	. .		10	**		101112
oth Ite	Jackets	3	2	5	ipa	Is in a	105	125	147	101	478
CI	Pants	9	6	15	rtic	Club					
	TOTAL	24	16	40	Pai	IS NOT IN	78	92	75	122	367
a. Nar	ne the two v	ariables disp Color & Clo	blayed in the thing	e table.	Club	TOTAL	183	217	222	223	845
b. If an item is selected at random, what is the						ne the two Gr	variable ade & C	e s displ ub Part	ayed ir icipatio	the ta	ble.
•	P(blue iac)	$(ket) = \frac{total j}{m}$	$\frac{1}{1}$ ackets = $\frac{5}{1}$	$=\frac{1}{2}$	b. If a	student is a stude	selected	at ran	dom, w	hat is t	he
c Wh	at is the pro	overa bability that	<i>ll total</i> 40 ta randomly	8 selected	prob	ibility that	ne or sn	total in	clubs	478	
item i	is black or a	shirt?	. a Tanuonny	selecteu		P(in a d	(lub) =	overali	total :	$= \frac{1}{845}$	
	The items t	that meet the	requirements	are:	c. Wł	at is the pr	obabilit	y that a	a rando	mly se	lected
	12 black shir	rts, 3 black ja	ckets, 9 blac	k pants,	stude	nt is in a cl	ub or in	, 11 th gr	ade?	^b	
	and 8 blue	shirts = 12	+3+9+8	= 32		<u>The studen</u>	ts that m	eet the	require	ments a	ire:
	D(11		32 4		105	9 th in clubs	s , 125 10	th in clu	14 5, 147	7 11 th ii	n clubs,
	P(Dl	ack or snirt)	$=\frac{1}{40}=\frac{1}{5}$			101 12 th i	n clubs	and 75	11 th no	t in club	DS
d. Wł	nat is the pro	bability that	t a randomly	v selected		= 105 +	- 125 + 2	147 + 1	01 + 75	b = 553	
item i	is a pair of p	ants given th	at the item	is blue?		Р(in clubs	or 11th	$i) = \frac{55}{2}$	3	
P(r	ants hlue) =	pants in blu	ie category	$-\frac{6}{-3}$	1 847	,			84	-5	1
ΓÇ	funcs (brue) -	blue	total	16 8	d. What is the probability that a randomly selected						
					student is in a club given that he of she is in 10 th ?						
						P(in club	10th) =		5 in 10t	$\frac{n}{2} = \frac{12}{24}$	5
4					0	,	,	10 <i>t</i> /	h total	21	.7
1.		Employ	yment		Ζ.			Colo	or		
		Has a job	Does not have a jo	TOTAL	ltem		Yellow	Pir	ık S	Silver	TOTAL
ıder	Male	27	36	63		Post-it	58	17	7	0	75
Gen	Female	28	24	52		Paper Clip	7	2	5	78	110
	TOTAL	55	60	115		TOTAL	65	42	2	78	185
a. Nan	ne the two va	riables displa	yed in the ta	ble.	a. Nar	ne the two v	ariables	display	red in th	ie table.	
b. If a person is selected at random, what is the probability that he or she has a job?						n item is sele : is a paper c	ected at lip?	random	ı, what i	s the pr	obability
c. What is the probability that a randomly selected person is male or has a job?						at is the pro k or a post-i	bability t?	that a r	andoml	y select	ed item
d. Wh perso	at is the prob n is female gi	pability that a ven that the p	d. Wł is silv	at is the pro er given tha	bability t it's a pa	that a r iper clij	andom) o?	ly selec	ted item		

2													
Grade									Spor	ts Partic	ipatio	n	
		9 th	10^{th}	11^{th}	12^{th}	TOTAL	ion		Tennis	Socce	r N S	Not in Sports	TOTAL
ıder	Male	204	179	165	202	750	cicipat	Is in a club	145	106		138	389
Gen	Female	170	246	143	131	690	b Part	Is not in a club	123	164		108	395
	TOTAL	374	425	308	333	1440	Clu	TOTAL	268	270		246	784
a. Nan	ne the two v	ariables	display	ed in th	e table.		a. Nan	ne the two	variables o	displaye	d in th	e table.	
b. If a student is selected at random, what is the probability that he or she will be in 9 th grade?						b. If a proba	b. If a person is selected at random, what is the probability that he or she plays tennis?						
c. Wh stude	at is the pro nt is in 10 th g	bability grade or	that a ra female?	andoml	y select	ed	c. Wh stude	c. What is the probability that a randomly selected student plays soccer or is not in a club?				ed	
d. What is the probability that a randomly selected student is in 11^{th} grade given that the student is female?					d. Wh stude sports	d. What is the probability that a randomly selected student is not in a club given that he or she does not play sports?							
5.		г	Employ	mont			6.			Crada			
		1	·	Does	not	TOTAL			Oth	Grade	114	1.044	TOTAL
		Has a	i jod	have	a job	IUIAL	ence		90	10	11.	120	IUIAL
	13-15	38	3	12	26	164	refer	Android	250	341	266	286	1143
Age	16-17	10	9	8	0	189	one P	iPhone	294	277	332	276	1179
	18-20	21	1	4	8	259	Ph	TOTAL	544	618	598	562	2322
	TOTAL	35	8	25	54	612	a. Nan	a. Name the two variables displayed in the table.					
a. Nan	ne the two v	ariables	display	ed in th	e table.		b. If a student is selected at random, what is the probability that he or she prefers the iPhone?						
b. If a person is selected at random, what is the probability that he or she has a job?						c. What is the probability that a randomly selected							
c. What is the probability that a randomly selected person is 16-17 years old or has a job?						d. What is the methodility that a way down be added				ed			
d. Wh perso	nat is the pro n has a job g	bability iven tha	that a r t he or s	andoml she is 18	y select 3-20 yea	ed ars old.	stude grade	nt prefers A	ndroid gi	ven that	he or	she is ir	n 12 th

Probability Using Two-way Frequency Tables' Answers										
1a. Employment & Gender	2a. Color & Item	3a. Grade & Gender								
11 91 28	22 20	187 869 143								
$1b. \frac{1}{23}$ $1c. \frac{1}{115}$ $1d. \frac{1}{55}$	$2b. \frac{37}{37} 2c. \frac{37}{37} 2d. 1$	$3b. \frac{3c}{720} \frac{3c}{1440} \frac{3d}{690}$								
4a. Sports & Club Participation	5a. Employment & Age	6a. Phone Preference & Grade								
67 501 16	¹⁷⁹ ⁷³ ²¹¹	, 131 , 1419 11 , 143								
$40.\overline{196}$ $40.\overline{784}$ $4a.\overline{41}$	$\frac{50.306}{306}$ $\frac{50.102}{102}$ $\frac{50.259}{259}$	$6b.\overline{258}$ $6c.\overline{2322} = \overline{18}$ $6d.\overline{281}$								

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