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Problem set 2

i.

```
> CT = table(nepal621$trt, nepal621$status)
>addmargins(CT)
```

	Alive	Died	Sum
Placebo	13099	290	13389
Vit A	13499	233	13732
Sum	26598	523	27121

```
> prop.table(ct, margin = 1)
```

	Alive	Died
Placebo	0.97834043	0.02165957
Vit A	0.98303233	0.01696767

Calculate the rate of child mortality in Nepal for children receiving placebo; Vitamin A. Summarize the difference in mortality in a sentence as if for a journal.

For placebo group,
Mortality rate = 290/13389 = 0.02166 = 21.66 per 1000 children

For vit A group,
Mortality rate =233/13732 = 0.01697 = 16.97 per 1000 children

Risk ratio = 21.66 / 16.97 = 1.2764

The mortality rate for children in the vitamin A group is 16.97 per 1000 compared to 21.66 per 1000 in the placebo group which gives a protective relative risk of 0.78 for a 22% reduction in mortality.

ii.

Pr(vit A) = 13732/27121 = 0.5063
Pr(died) = 523/27121 = 0.0193

Pr(died and vitA) = 233/27121 = 0.0086
Pr(died and placebo) = 290/27121 = 0.0107

Pr(placebo) = 13389/27121 = 0.4937

Pr(died|vitA) = Pr(died and vitA)/Pr(vit A) = 0.0086/0.5063 = 0.017
Pr(died|placebo) = Pr(died and placebo)/Pr(placebo) = 0.0107/0.4937 = 0.0217

Pr(VitA | Died) =

$$\frac{Pr(VitA\ and\ Died)}{Pr(died)} = \frac{Pr(died|vitA).(vitA)}{Pr(died)} = \frac{Pr(\text{died}|\text{vitA}).Pr(vitA)}{Pr(died|vitA).Pr(vitA) + Pr(died|placebo).Pr(placebo)}$$

$$= \frac{0.017x0.5063}{(0.017x0.5063)+(0.0217x0.4937)} = \frac{0.0861}{0.0193} = 0.45$$

iii.

Placebo cohort

>nepal.plac = filter(nepal621, trt=="Placebo")
>CT = table(nepal.plac$sex, nepal.plac$status)
>addmargins(CT)

	Alive	Died	Sum
Female	6376	166	6542
Male	6723	124	6847
Sum	13099	290	13389

>prop.table(CT, margin=1)

Probability table

	Alive	Died
Female	0.97462550	0.02537450
Male	0.98188988	0.01811012

For children in the placebo cohort grouped according to sex vs vital status
Pr(died | male) = Pr(died and male) / Pr(male) = (124/13389)/(6847/13389)
124/6847 = 0.01811

Pr(died | female) = 166/6542 = 0.02537

Vitamin A cohort

>nepal.vit = filter(nepal621, trt=="Vit A")
>CT = table(nepal.vit$sex, nepal.vit$status)
>addmargins(CT)

	Alive	Died	Sum
Female	6544	121	6665
Male	6955	112	7067
Sum	13499	233	13732

>prop.table(CT, margin=1)

Probability table

	Alive	Died
Female	0.98184546	0.01815454
Male	0.98415169	0.01584831

For children in the vit A cohort grouped according to sex vs vital status
Pr(died | male) = 112/7067 = 0.01584
Pr(died | female) = 121/6665 = 0.01815

The mortality rate for children in the vitamin A group is 16.97 per 1000 compared to 21.66 per 1000 in the placebo group which gives a protective relative risk of 0.78 for a 22% reduction in mortality.

Yes, treatment varies by sex.
There was a sex-based effect modification where there was slightly greater reduction in mortality in girls than in boys.
The difference in risk between females in placebo group vs females in vitamin A group was 7 excess cases per 1000 (0.025 – 0.018) while the difference for males was 2 per 1000 (0.018 – 0.016)

iv.

[hypothesis 1]
Vitamin A supplementation has no effect on mortality in Nepali pre-school children;

	Alive	*Died*
Placebo	0.97834043	0.02165957
Vit A	0.98303233	0.01696767

Reject the null hypothesis

[hypothesis 2]
The treatment effect is the same for both boys and girls (i.e., “not modified by sex”)

Sex	*Vitamin A group*		*Placebo group*		*RR(vit A vs Plac)*
	Alive	Died	Alive	Died	
Female	0.98184546	0.01815454	0.97462550	0.02537450	0.7154(29% reduction)
Male	0.98415169	0.01584831	0.98188988	0.01811012	0.8747(13% reduction)

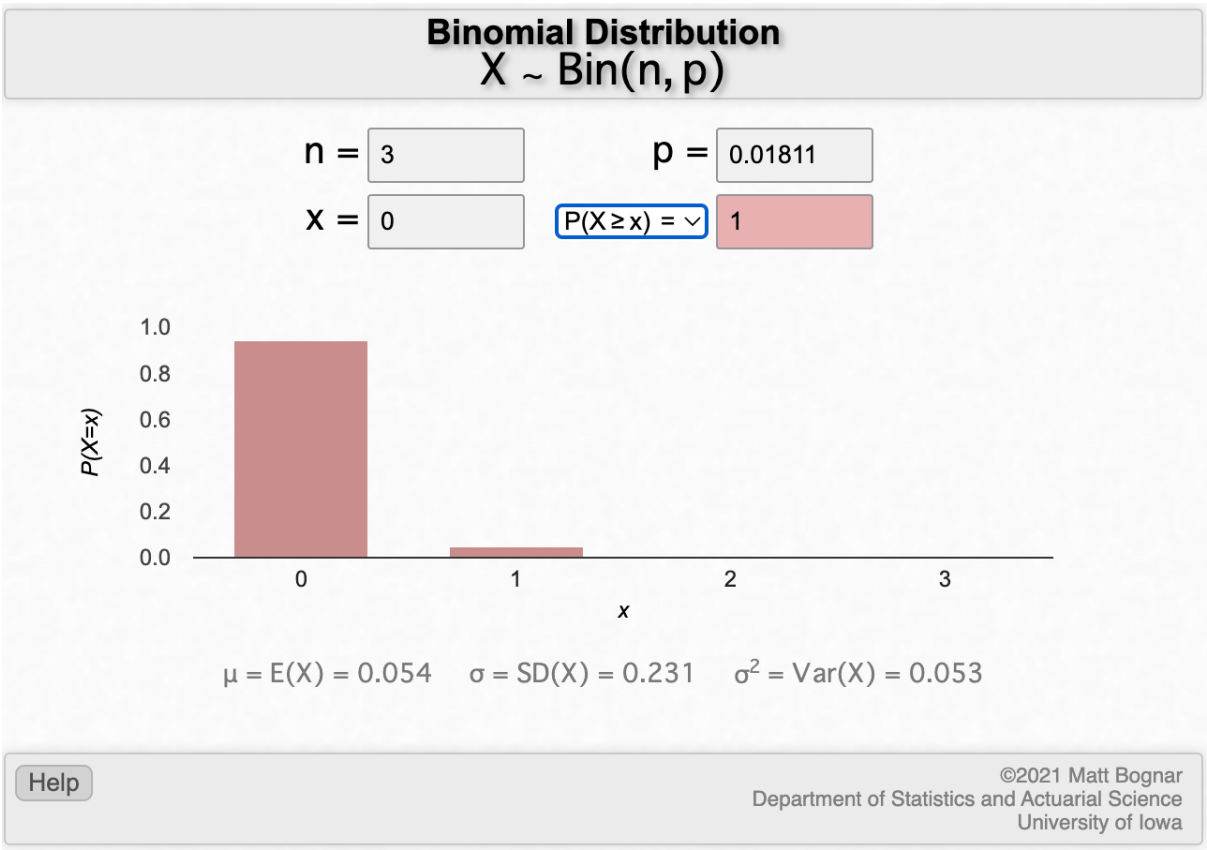
Reject the null hypothesis

V.

Consider a family with 3 boys and 2 girls who received placebo. Suppose that each child's survival is independent of all the other children in the family. Calculate the probability that 0, 1, 2 or 3 boys die during the study follow-up.

Let p = Pr(a male child who received placebo dies),
q = Pr(a child who received placebo does not die) = 1-p
from the study, p = 0.01811
q = 1-0.02 = 0.978

Pr(0,1,2,or 3 boys die) = Pr(boys who die >= 0)



vi.

Using poisson approximation

u = np

u = 3x0.01811 = 0.05433

Pr(>=0 boys die) =