Chi-squared tests are used for **categorical data**: the outcome variable is nominal scale

Goodness of fit tests compare observed frequencies for *one nominal variable* to a hypothesis about the true probabilities

diagnostic test statistic	X^2	larger value = more evidence against null
distribution	chi-squared: χ^2	describes what you get when you square and sum normally distributed data, like X^2
degrees of freedom	k-1 where k is the number of categories	given by # of things - constraints

observed frequencies (table)

null hypothesis

```
> chisq.test(x=votingTable,p=ed)
. . . BLAH BLAH BLAH . . .
data:  votingTable
X-squared = 11.304, df = 3, p-value = 0.01019
```

Report:

1. Descriptives (use figure or table if you can)
2. Statistical test and null hypothesis
3. Stat reference
4. Interpretation for your research hypothesis

Stat reference version 1

$\chi^2 = 11.30, df = 3, p = .0102$

test statistic, degrees of freedom, p-value

Stat reference version 2

$\chi^2(3) = 11.30, p = .0102$

sampling distribution(degrees of freedom), test statistic, p-value

Chi-squared test of independence: are two nominal variables are related to one another?

diagnostic test statistic	X^2	larger value = more evidence against null. calculated slightly differently from GOF test
distribution	chi-squared: χ^2	describes what you get when you square and sum normally distributed data, like X^2
degrees of freedom	(r-1)(c-1) where r=# of categories of one variable, and c=# of categories of other	given by # of things - constraints

Two assumptions of chi-squared tests

1. "Large" expected frequencies

⇩

if violated:
Fisher's exact test

```
> fisher.test(x=bowTable)
```

2. Independence of the data

⇩

if pre-and-post test:
McNemar's test

```
> mcnemar.test(x=medTable)
```

contingency table

```
> ct <- chisq.test(x=boxesTable)
```

observed frequencies (contingency table)
can assign to a variable that contains lots of info

```
> ct$stdres
```

reports adjusted residuals: rule of thumb is +/- 1.96 suggests which items are "significant"

Effect size: Cramer's V for test of independence

based on X^2 (i.e., divergence from null) and sample size

```
> library(DescTools)
> CramerV(x=boxesTable)
```

← contingency table

Cramer's V for Goodness of Fit

based on X^2 (i.e., divergence from null) and sample size

```
> library(rcompanion)
> cramerVFit(x=votingTable,p=ed)
```