

**Statistics 300:  
Elementary Statistics**

**Section 11-3**

---

---

---

---

---

---

---

**Chapter 11 concerns  
the analysis of statistics  
that are “counts” in  
“categories”**

---

---

---

---

---

---

---

**Section 11-3 concerns  
“counts” in “categories”  
where each data value  
falls in two categories at  
the same time, such as  
“gender” and “age”.**

---

---

---

---

---

---

---

## Chapter 11-3

- Cross-classified counts are also called “Contingency Tables”
- Counts are (or can be) arranged in rows and columns

Tickets in Last 2 Years				
Cars	0	1	2+	Row
1	178	19	8	205
2	167	20	10	197
3	116	30	104	250
4+	136	45	22	203
Column	597	114	144	855

---

---

---

---

---

---

---

---

## Two types of Hypotheses

- Independence
  - The Row and Column factors affect counts independently
- Homogeneous proportions
  - All the Rows or all the Columns have the same set of proportions
- Calculations are the same for both types of hypotheses

---

---

---

---

---

---

---

---

## Contingency Table Tests

- Expected counts are calculated using this formula

$$E = \frac{(\text{row total})(\text{col. total})}{\text{grand total}}$$

---

---

---

---

---

---

---

---

## Contingency Table Tests

- Compare observed counts and expected counts in each category
- Test statistic with “r” rows and “c” columns

$$\sum_{i=1}^r \sum_{j=1}^c \left[ \frac{(Observed_{i,j} - Expected_{i,j})^2}{Expected_{i,j}} \right]$$

---

---

---

---

---

---

---

---

## Contingency Table Test Statistic

$$\sum_{i=1}^r \sum_{j=1}^c \left[ \frac{(Observed_{i,j} - Expected_{i,j})^2}{Expected_{i,j}} \right]$$
$$= \sum \left[ \frac{(O - E)^2}{E} \right]$$

$O$  = observed count in row "i" and col "j"

$E$  = expected count in row "i" and col "j"

---

---

---

---

---

---

---

---

## Contingency Table Test

- Observed counts come from the data
- Expected counts come from the hypothesis
- If  $H_0$  is correct, the test statistic should follow a chi-square distribution with  $(r-1)(c-1)$  degrees of freedom

$$\sum_{i=1}^r \sum_{j=1}^c \left[ \frac{(O - E)^2}{E} \right]$$

---

---

---

---

---

---

---

---

## Contingency Table Tests

- All tests are “right tailed” tests
- Why?
- Because when the test statistic is close to zero, the data are in agreement with the null hypothesis
- The null hypothesis is only rejected when the test statistic value is large, i.e., in the right tail critical region

---

---

---

---

---

---

---