Hypothesis Testing

INST 808: Jordan Boyd-Graber

University of Maryland

Fall 2020

χ^2 Example

Random sample of 500 U.S. adults: political affiliation and opinion on a tax reform. Dependent at a 5% level of significance?

Observed

	Favor	Indifferent	Oppose
Dem	138	83	64
Rep	64	67	84

Expected

	Favor	Indifferent	Oppose
Dem			
Rep			

χ^2 Example

Random sample of 500 U.S. adults: political affiliation and opinion on a tax reform. Dependent at a 5% level of significance?

Observed

	Favor	Indifferent	Oppose
Dem	138	83	64
Rep	64	67	84

Expected

	Favor	Indifferent	Oppose
Dem	115.14		
Rep			

χ^2 Example

Random sample of 500 U.S. adults: political affiliation and opinion on a tax reform. Dependent at a 5% level of significance?

Observed

	Favor	Indifferent	Oppose
Dem	138	83	64
Rep	64	67	84

Expected

	Favor	Indifferent	Oppose
Dem	115.14	85.50	
Rep			

χ^2 Example

Random sample of 500 U.S. adults: political affiliation and opinion on a tax reform. Dependent at a 5% level of significance?

Observed

	Favor	Indifferent	Oppose
Dem	138	83	64
Rep	64	67	84

Expected

	Favor	Indifferent	Oppose
Dem	115.14	85.50	84.36
Rep			

χ^2 Example

Random sample of 500 U.S. adults: political affiliation and opinion on a tax reform. Dependent at a 5% level of significance?

Observed

	Favor	Indifferent	Oppose
Dem	138	83	64
Rep	64	67	84

Expected

	Favor	Indifferent	Oppose
Dem	115.14	85.50	84.36
Rep	86.86		

χ^2 Example

Random sample of 500 U.S. adults: political affiliation and opinion on a tax reform. Dependent at a 5% level of significance?

Observed

	Favor	Indifferent	Oppose
Dem	138	83	64
Rep	64	67	84

Expected

	Favor	Indifferent	Oppose
Dem	115.14	85.50	84.36
Rep	86.86	64.50	

χ^2 Example

Random sample of 500 U.S. adults: political affiliation and opinion on a tax reform. Dependent at a 5% level of significance?

Observed

	Favor	Indifferent	Oppose
Dem	138	83	64
Rep	64	67	84

Expected

	Favor	Indifferent	Oppose
Dem	115.14	85.50	84.36
Rep	86.86	64.50	63.64

χ^2 Example

Random sample of 500 U.S. adults: political affiliation and opinion on a tax reform. Dependent at a 5% level of significance?

Observed

	Favor	Indifferent	Oppose
Dem	138	83	64
Rep	64	67	84

Expected

	Favor	Indifferent	Oppose
Dem	115.14	85.50	84.36
Rep	86.86	64.50	63.64

$$4.539 + 0.073 + 4.914 + 6.016 + 0.097 + 6.514 = 22.152 \qquad (1)$$

Running test: df, *p*-Value

- Degrees of Freedom?

Running test: df, *p*-Value

- Degrees of Freedom? $(r-1)(c-1) = 1 \cdot 2 = 2$
- *p*-value

Running test: df, *p*-Value

- Degrees of Freedom? $(r-1)(c-1) = 1 \cdot 2 = 2$
- *p*-value

```
>>> from scipy.stats.distributions import chi2
>>> 1 - chi2.cdf(22.15, 2)
1.5494894118783797e-05
>>> from scipy.stats import chisquare
>>> chisquare([138, 83, 64, 64, 67, 84],
...           [115.14, 85.5, 84.36, 86.86, 64.5, 63.64],
...           3)
Power_divergenceResult(statistic=22.152468645918482,
                                                pvalue=1.5475780213
```

US vs. Japanese Mileage

Read in Data

```
>>> import pandas as pd
>>> mpg = pd.read_csv("jp-us-mpg.dat", delim_whitespace=Tr
>>> mpg.head()
   US  Japan
0  18   24.0
1  15   27.0
2  18   27.0
3  16   25.0
4  17   31.0
```

First things first

- Compute means

First things first

- Compute means

```
>>> from numpy import mean
>>> mean(mpg["Japan"].dropna())
30.481012658227847
>>> mean(mpg["US"].dropna())
20.14457831325301
```

- Compute sample variances

First things first

- Compute means

```
>>> from numpy import mean
>>> mean(mpg["Japan"].dropna())
30.481012658227847
>>> mean(mpg["US"].dropna())
20.14457831325301
```

- Compute sample variances

```
>>> from numpy import var
>>> us = mpg["US"].dropna()
>>> jp = mpg["Japan"].dropna()
>>> jp_std = std(jp) * len(jp) / float(len(jp) - 1)
>>> us_std = std(us) * len(us) / float(len(us) - 1)
```

Are Japanese Cars' MPG > 25?

- Degrees of freedom:
- Test statistic:
- p-value

Are Japanese Cars' MPG > 25?

- Degrees of freedom: $79 - 1 = 78$
- Test statistic:
- p-value

Are Japanese Cars' MPG > 25?

- Degrees of freedom: $79 - 1 = 78$
- Test statistic: $\frac{30.48 - 25}{\frac{6.14}{\sqrt{79}}}$
- p-value

Are Japanese Cars' MPG > 25?

- Degrees of freedom: $79 - 1 = 78$
- Test statistic: $\frac{30.48 - 25}{\frac{6.14}{\sqrt{79}}}$
- *p*-value

```
>>> t_test
7.93278589688753
>>> from scipy import stats
>>> 1.0 - stats.t.cdf(abs(t_test), 78)
6.3491434332263 45e-12
```