Chi-Square test

Chi square test is a statistical method to determine if two categorical variables have a significant correlation between them.

Both those variables should be from same population and they should be categorical like – Yes/No, Male/Female, Red/Green etc.

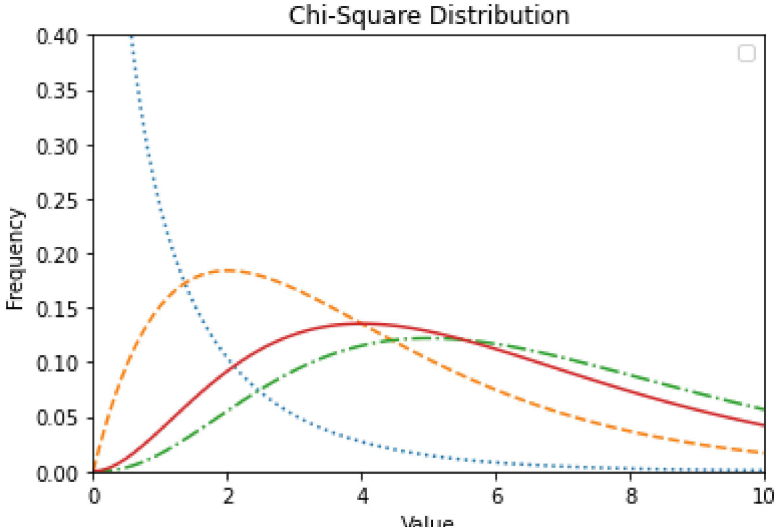
For example, we can build a data set with observations on people's ice-cream buying pattern and try to correlate the gender of a person with the flavour of the ice-cream they prefer.

If a correlation is found we can plan for appropriate stock of flavours by knowing the number of gender of people visiting.

We use various functions in **numpy and scipy library** to carry out the chi-square test.

```
from scipy import stats
import numpy as np
import matplotlib.pyplot as plt

x = np.linspace(0, 10, 100)
fig,ax = plt.subplots(1,1)

linestyles = [':', '--', '-.', '-']
deg_of_freedom = [1, 4, 7, 6]
for df, ls in zip(deg_of_freedom, linestyles):
  ax.plot(x, stats.chi2.pdf(x, df), linestyle=ls)

plt.xlim(0, 10)
plt.ylim(0, 0.4)

plt.xlabel('Value')
plt.ylabel('Frequency')
plt.title('Chi-Square Distribution')

plt.legend()
plt.show()
```

```
No handles with labels found to put in legend.
```




```
# chi-squared test with similar proportions
from scipy.stats import chi2_contingency
from scipy.stats import chi2
# contingency table
table = [ [10, 20, 30],
      [6,  9,  17]]
print(table)
stat, p, dof, expected = chi2_contingency(table)
print('dof=%d' % dof)
print(expected)
print('chi2_stat=%.2f'% stat)
# interpret test-statistic
prob = 0.95
critical = chi2.ppf(prob, dof)
print('probability=%.3f, critical=%.3f, stat=%.3f' % (prob, critical, stat))
if abs(stat) >= critical:
  print('Dependent (reject H0)')
else:
  print('Independent (fail to reject H0)')
# interpret p-value
alpha = 1.0 - prob
print('significance=%.3f, p=%.3f' % (alpha, p))
if p <= alpha:
```

```
  print('Dependent (reject H0)')
else:
  print('Independent (fail to reject H0)')
```

```
[[10, 20, 30], [6, 9, 17]]
dof=2
[[10.43478261 18.91304348 30.65217391]
 [ 5.56521739 10.08695652 16.34782609]]
chi2_stat=0.27
probability=0.950, critical=5.991, stat=0.272
Independent (fail to reject H0)
significance=0.050, p=0.873
Independent (fail to reject H0)
```

```
# Load libraries
from sklearn.datasets import load_iris
from sklearn.feature_selection import SelectKBest
from sklearn.feature_selection import chi2

# Load iris data
iris_dataset = load_iris()

# Create features and target
X = iris_dataset.data
y = iris_dataset.target

# Convert to categorical data by converting data to integers
X = X.astype(int)

# Two features with highest chi-squared statistics are selected
chi2_features = SelectKBest(chi2, k = 2)
X_kbest_features = chi2_features.fit_transform(X, y)

# Reduced features
print('Original feature number:', X.shape[1])
print('Reduced feature number:', X_kbest_features.shape[1])

```

```
Original feature number: 4
```

```
Reduced feature number: 2
```

```
from scipy.stats import chi2_contingency

# defining the table
data = [[207, 282, 241], [234, 242, 232]]
stat, p, dof, expected = chi2_contingency(data)

# interpret p-value
alpha = 0.05
print("p value is " + str(p))
if p <= alpha:
  print('Dependent (reject H0)')
else:
  print('Independent (H0 holds true)')

```

```
p value is 0.1031971404730939
Independent (H0 holds true)
```

```
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```

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