

HYPOTHESIS

TESTING - 4

χ^2 -Test

Hypothesis Testing Framework

- 1) Setup the Null and Alternate Hypothesis
- 2) Choose the right test statistic
- 3) Left tailed vs Right tailed vs Two-Tailed
- 4) Compute P-value
- 5) If P- value is less than α , then reject the null hypothesis.

ID	Test 1	Test 2	$T2 - T1$
x_1	●		
x_2	●	●	
x_3	●		
x_4			
x_5	●	●	
x_6			
x_7		●	
	μ_1	μ_2	μ_3

$$H_0: \mu_1 = \mu_2$$

$$H_a: \mu_1 < \mu_2$$

t_{test_rel}

$$H_0: \mu_2 - \mu_1 = 0$$

$$H_a: \mu_2 - \mu_1 > 0$$

$t_{test_1 Samp}$

DOF \rightarrow Degree of Freedom

$$\underline{\text{●}} \quad \underline{\text{●}} \quad \underline{\text{X}} = 36$$







If I have 'n' places and I know mean

$$\text{DOF} = n - 1$$

	H	W	
X1			
X2		●	
X3	●		
X4		●	
	μ_H	μ_W	
	n_1	n_2	
	4	4	

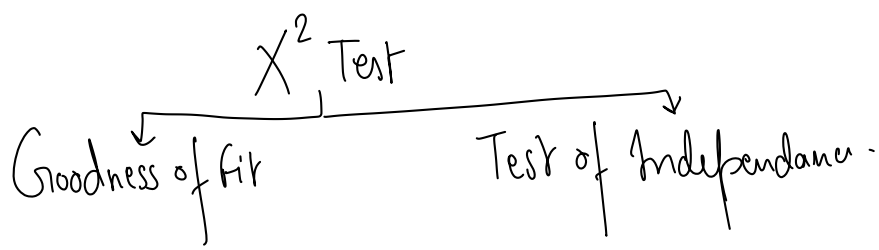
$$\text{DOF} = (n_1 - 1) + (n_2 - 1)$$

$$= n_1 + n_2 - 2$$

	A	B	C	D	
X_1					350
X_2					50
X_3					200
	150	140	160	150	600

Rows = m
 Columns = n

$$DOF = (n-1) \times (m-1)$$



① Cointoss

50

H_0 : Coin is fair

H_a : Coin is biased

	Heads	Tails
observation	28	22
expected	25	25

$$\chi^2_{\text{stat}} = \frac{(28-25)^2}{25} + \frac{(22-25)^2}{25} = \frac{(280-250)^2}{250} + \frac{(220-250)^2}{250}$$

$$\chi^2_{\text{stat}} = \sum \frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}$$

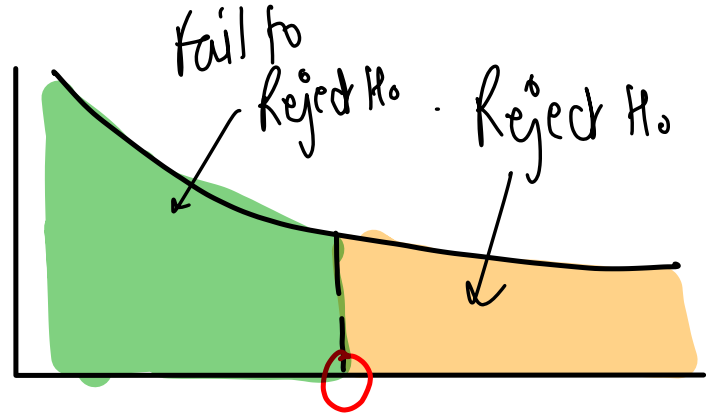
Under $H_0 \Rightarrow$

χ^2 High / low ✓

If H_a is true:

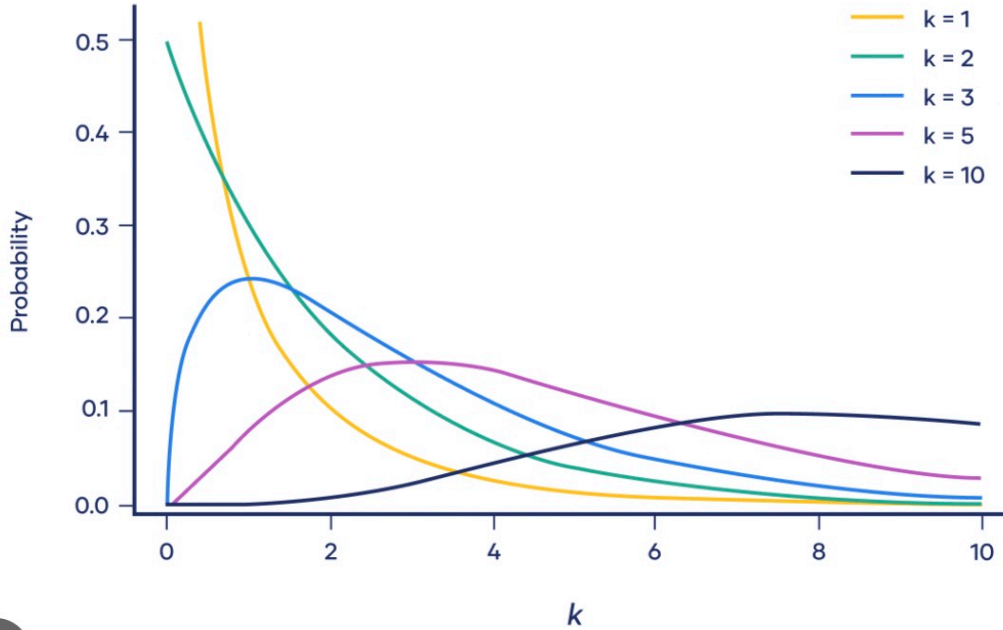
$\Rightarrow \chi^2$ High / low ✓

	Heads	Tails
observation	45	5
expected	25	25



χ^2 tests are always right tailed

χ^2 star



10000

8000

100

200

18000

20000 - 5000

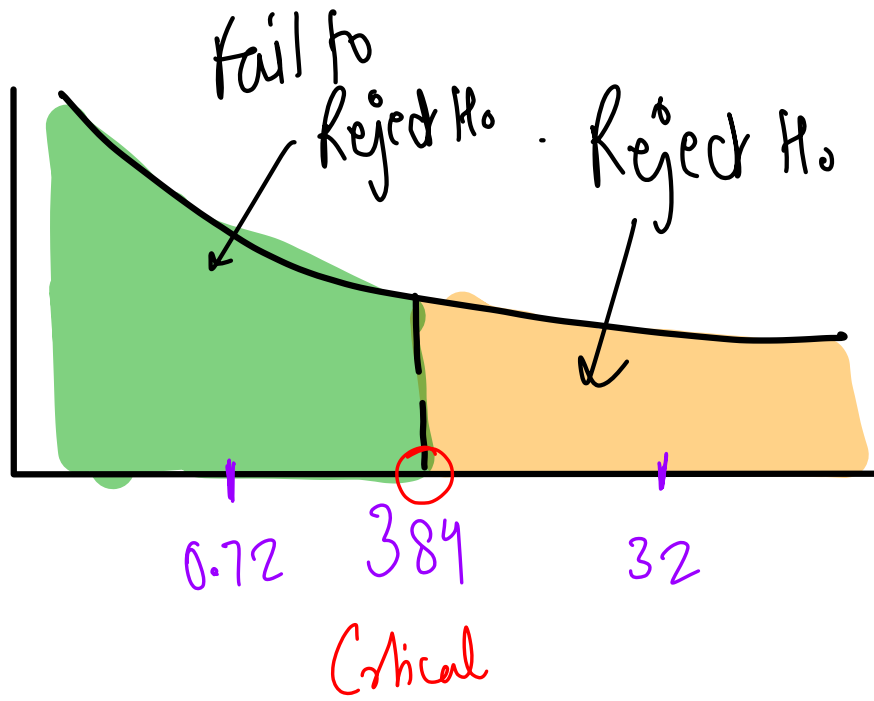
1000

15600

5000

but manufacturer

	B1	B2	B3	B4	B5	B6
Expected	.10	.20	.30	.10	.15	.15
observed	50 0.25	20 0.1	10 0.05	30 0.15	40 0.2	50 0.25



Rolling

	1	2	3	4	5	6
Observation	15	12	13	12	13	1
Expected	11	11	11	11	11	11

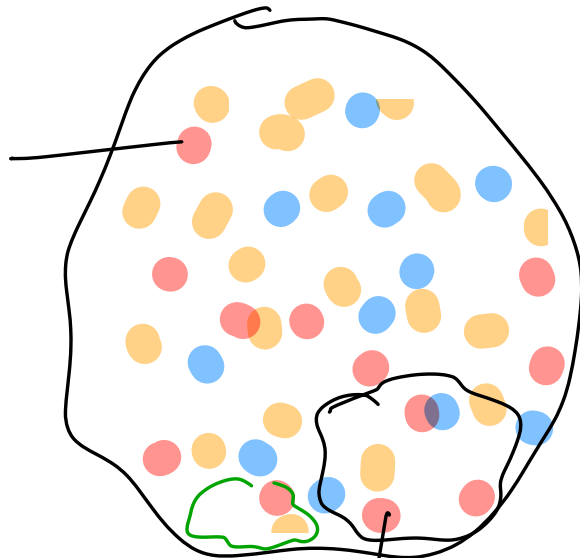
66 Rolls -

$$\sqrt{\frac{(x - \mu)^2}{n}}$$

$$\sqrt{\frac{(x - \mu)^2}{n+1}}$$

Diagram illustrating the calculation of the standard deviation for a sample of size $n+1$. The expression $\sqrt{\frac{(x - \mu)^2}{n+1}}$ is shown. A red circle highlights the denominator $n+1$. Red arrows point from this circle to five green circles containing the numbers 2, 3, 4, and 5, representing the sample size. A green arrow points from the expression to the first green circle (2).

$$\sigma_p$$



$$\sigma_s$$