

Statistical test

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Description of the project

- 1 Generate

$$X_{1,1}, X_{1,2}, X_{1,3}, \dots, X_{1,n}$$

$$\vdots$$

$$X_{r,1}, X_{r,2}, X_{r,3}, \dots, X_{r,n}$$

for a normally distributed random variable X and some r, n .

- 2 Calculate sample variances s_1^2, \dots, s_r^2 .
- 3 Test homoscedacity for significance level α , for some α .
- 4 Use the proposed statistical test:

$$F = \frac{\sum_{i=1}^r s_{(i)}^2 \frac{2i-1}{r}}{\sum_{i=1}^r s_{(i)}^2}$$

Assumptions

- $X \sim N(0, 1)$
- $n = \{2, 3, 4, \dots, 9, 10, 12, 14, \dots, 18, 20, 25, 30, 40, 60\}$
- $r = \{2, 3, 4, \dots, 9, 10, 15, 20\}$
- $\alpha = \{1\%, 5\%, 10\%\}$

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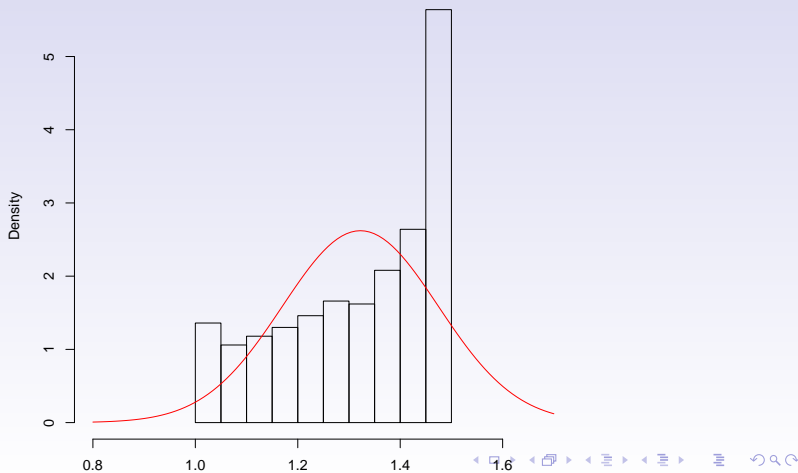
- (a) How many times should we generate the random variables?
- (b) How long will this take?

Loops

$n = 2, r = 2$

$1e+3$ loops

Histogram of F

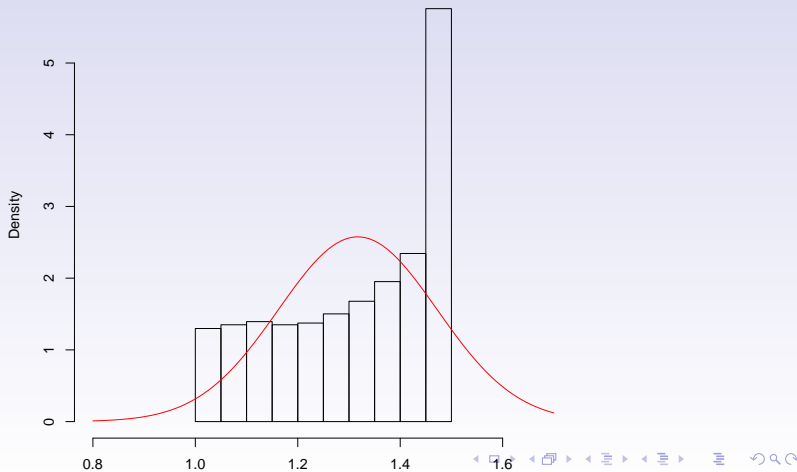


Loops

$$n = 2, r = 2$$

1e+4 loops

Histogram of F

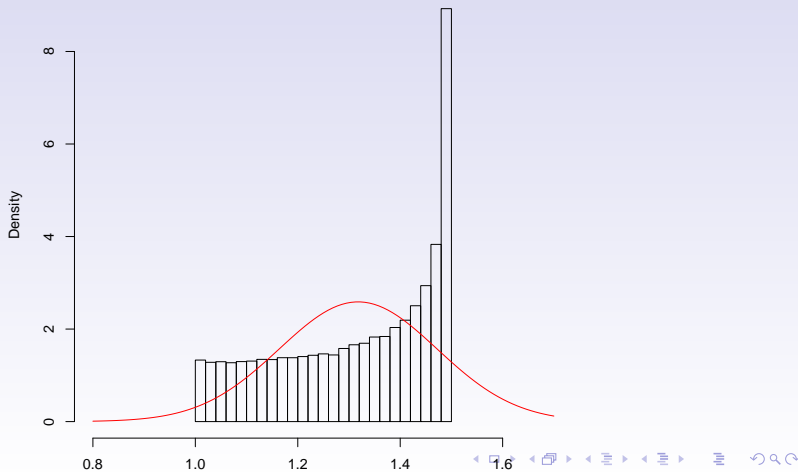


Loops

$n = 2, r = 2$

$1e+5$ loops

Histogram of F

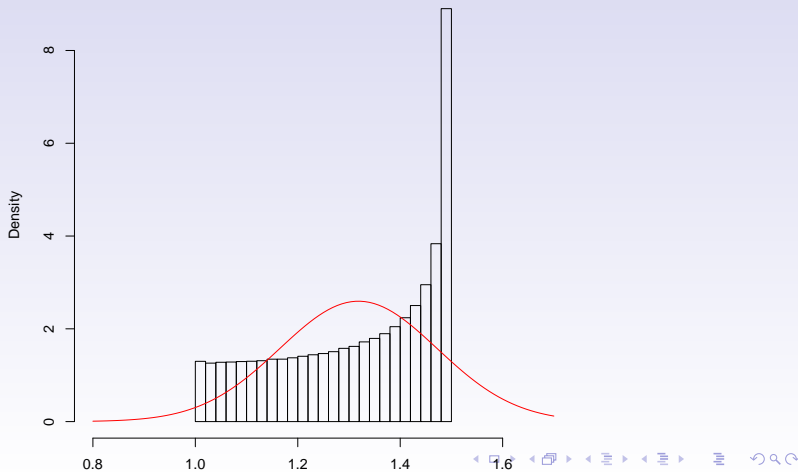


Loops

$n = 2, r = 2$

1e+6 loops

Histogram of F

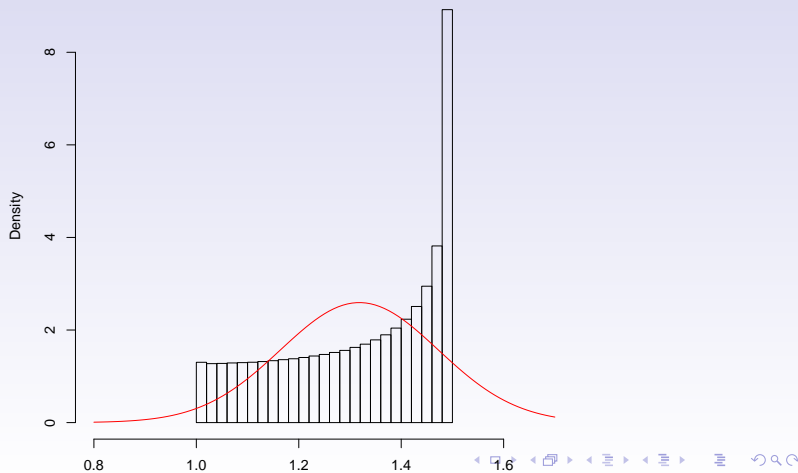


Loops

$n = 2, r = 2$

$1e+7$ loops

Histogram of F



- $n = 2, r = 2$: 15,06s
- $n = 2, r = 20$: 19,22s
- $n = 10, r = 20$: 69,25s
- $n = \{2, \dots, 10\}, r = \{1, \dots, 10\}$: 2123,33s – 35min
- $n = 60, r = 20$: 21,21min

One table can be generated in $\sim 3h$.

Main goal: Generate three tables

Work done so far: Generated all the tables

Plans:

- Compare the test to well known tests:
 - Bartlett's test
 - Levene's test
 - Brown–Forsythe test

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- Compare the test to well known tests:
 - Bartlett's test:

$$T = \frac{(nr - k) \ln s_p^2 - \sum_{i=1}^r (n - 1) \ln s_i^2}{1 + \frac{1}{3(r-1)} \left(\frac{r}{n-1} - \frac{1}{nr-r} \right)},$$

where s_p^2 is the pooled variance $s_p^2 = \sum_{i=1}^r \frac{(n-1)s_i^2}{nr-r}$.

- Levene's test :

$$W = \frac{(nr - r) \sum_{i=1}^r n(\bar{Z}_{i.} - \bar{Z}_{..})^2}{(r - 1) \sum_{i=1}^r \sum_{j=1}^n (z_{ij} - \bar{Z}_{i.})^2},$$

where $Z_{ij} = |X_{ij} - \bar{X}_j|$ (\bar{X}_j is the mean of group j).

- Brown-Forsythe test:

$$F = \frac{(nr - r) \sum_{i=1}^r n(\tilde{z}_{i.} - \tilde{z}_{..})^2}{(r - 1) \sum_{i=1}^r \sum_{j=1}^n (z_{ij} - \tilde{z}_{.j})^2},$$

where $z_{ij} = |X_{ij} - \tilde{X}_j|$ (\tilde{X}_j is the median of group j).

Plans:

- Compare the test to well known tests:
 - Bartlett's test
 - Levene's test
 - Brown–Forsythe test
- Improve the test (if time permits)