

Foundations of R Software

Lecture 17

Basics of Calculations

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Relational and Logical Operators

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Relational Operators and Comparisons

The following table shows the operations and functions for relational comparisons (True or False).

TRUE and **FALSE** are reserved words denoting logical constants.

Operator	Executions
>	Greater than
>=	Greater than or equal
<	Less than
<=	Less than or equal
==	Exactly equal to
!=	Not equal to
!	Negation (not)

Zero is considered as
FALSE
and
non-zero numbers are
taken as **TRUE**

Logical Operators and Comparisons

Operator	Executions	
!	Logical not	
&	Element-wise logical and	Performs operation element-wise
&&	Logical and	examines only the first element of the operands
 	Element-wise logical or	Performs operation element-wise
 	Logical or	examines only the first element of the operands

Logical Operators and Comparisons

Operator	Executions
xor(x, y)	Either x or y (x or y but not x and y)
isTRUE(x) isFALSE(x)	test if x is TRUE test if x is FALSE
TRUE FALSE	true false

Example of Standard logical operations

Truth table

Statement 1 :: (x)	Statement 2 :: (y)	Outcome :: x and y	Outcome :: x or y
True	True	True	True
True	False	False	True
False	True	False	True
False	False	False	False

Example of Standard logical operations

```
> x = TRUE
```

```
> y = FALSE
```

```
> x & y          # x AND y  
[1] FALSE
```

```
> x | y          # x OR y  
[1] TRUE
```

```
> !x             # negation of x  
[1] FALSE
```

 R Console

```
> x = TRUE  
> y = FALSE  
> x & y  
[1] FALSE  
> x | y  
[1] TRUE  
> !x  
[1] FALSE
```

Example

```
> x = 5
```

```
> Logical1 = (x > 2)
```

```
> Logical1
```

```
[1] TRUE
```

```
> is.logical(Logical1)
```

```
[1] TRUE
```

```
> Logical2 = (x < 10)
```

```
> Logical2
```

```
[1] TRUE
```

```
> is.logical(Logical2)
```

```
[1] TRUE
```

```
> Logical3 = (x != 5)
```

```
> Logical3
```

```
[1] FALSE
```

```
> is.logical(Logical3)
```

```
[1] TRUE
```

Example

```
R Console

> x = 5
> Logical1 = (x > 2)
> Logical1
[1] TRUE
> is.logical(Logical1)
[1] TRUE
>
> Logical2 = (x < 10)
> Logical2
[1] TRUE
> is.logical(Logical2)
[1] TRUE
>
> Logical3 = (x != 5)
> Logical3
[1] FALSE
> is.logical(Logical3)
[1] TRUE
> |
```

Example

```
> x = 5
```

```
> Logical4 = (2*x > 11)
```

```
> Logical4
```

```
[1] FALSE
```

```
> is.logical(Logical4)
```

```
[1] TRUE
```

```
> Logical5 = (3*x < 20)
```

```
> Logical5
```

```
[1] TRUE
```

```
> is.logical(Logical5)
```

```
[1] TRUE
```

R Console

```
> x = 5
> Logical4 = (2*x > 11)
> Logical4
[1] FALSE
> is.logical(Logical4)
[1] TRUE
>
> Logical5 = (3*x < 20)
> Logical5
[1] TRUE
> is.logical(Logical5)
[1] TRUE
> |
```

Examples:

```
> 8 > 7  
[1] TRUE
```

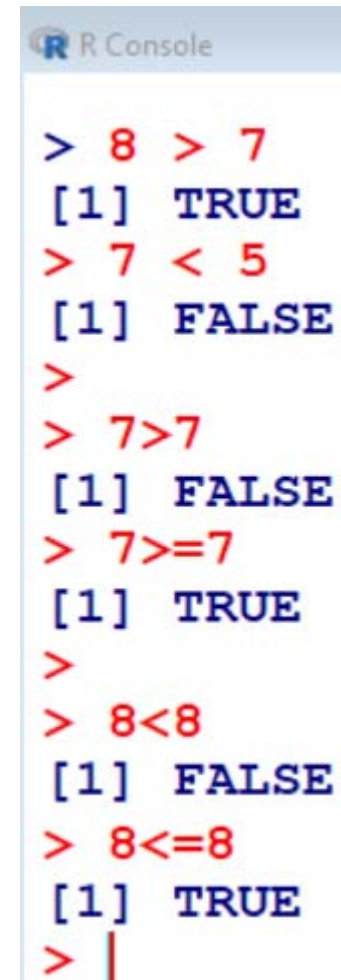
```
> 7 < 5  
[1] FALSE
```

```
> 7 > 7  
[1] FALSE
```

```
> 7 >= 7  
[1] TRUE
```

```
> 8 < 8  
[1] FALSE
```

```
> 8 <= 8  
[1] TRUE
```

A screenshot of an R console window. The title bar says "R Console". The console shows a series of R commands and their outputs. The commands are: 8 > 7, 7 < 5, 7 > 7, 7 >= 7, 8 < 8, and 8 <= 8. The outputs are: TRUE, FALSE, FALSE, TRUE, FALSE, and TRUE respectively. The prompt character is ">".

```
R Console  
> 8 > 7  
[1] TRUE  
> 7 < 5  
[1] FALSE  
>  
> 7 > 7  
[1] FALSE  
> 7 >= 7  
[1] TRUE  
>  
> 8 < 8  
[1] FALSE  
> 8 <= 8  
[1] TRUE  
> |
```

Examples:

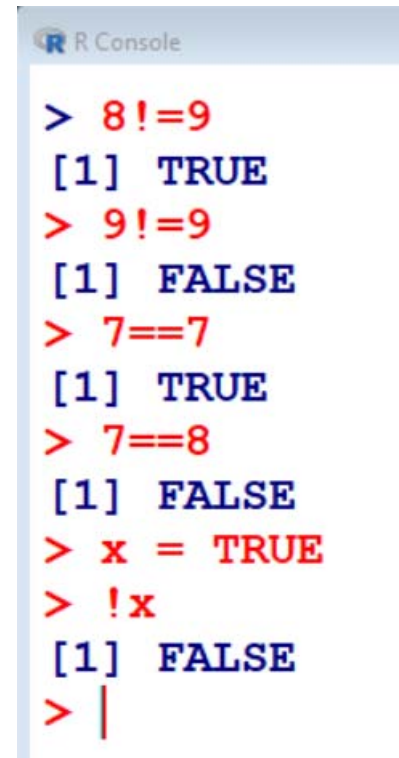
```
> 8 != 9  
[1] TRUE
```

```
> 9 != 9  
[1] FALSE
```

```
> 7 == 7  
[1] TRUE
```

```
> 7 == 8  
[1] FALSE
```

```
> x = TRUE  
> !x  
[1] FALSE
```

A screenshot of an R console window with a light blue header bar containing the R logo and the text "R Console". The console displays a series of R commands and their outputs. The commands are: > 8 != 9, > 9 != 9, > 7 == 7, > 7 == 8, > x = TRUE, > !x, and > |. The outputs are: [1] TRUE, [1] FALSE, [1] TRUE, [1] FALSE, [1] TRUE, [1] FALSE, and a blank line respectively. The commands are in red text, and the outputs are in dark blue text.

```
R Console  
  
> 8 != 9  
[1] TRUE  
> 9 != 9  
[1] FALSE  
> 7 == 7  
[1] TRUE  
> 7 == 8  
[1] FALSE  
> x = TRUE  
> !x  
[1] FALSE  
> |
```

Examples:

```
> x = c(1, 2, 3)
```

```
> y = c(4, 5, 6)
```

```
> x > y      # Compares 1 > 4, 2 > 5, 3 > 6  
[1] FALSE FALSE FALSE
```

```
> x < y      # Compares 1 < 4, 2 < 5, 3 < 6  
[1] TRUE TRUE TRUE
```

```
> x != y     # Compares 1 ≠ 4, 2 ≠ 5, 3 ≠ 6  
  
[1] TRUE TRUE TRUE
```

```
> x == y     # Compares 1 = 4, 2 = 5, 3 = 6  
[1] FALSE FALSE FALSE
```

```
R Console  
  
> x = c(1, 2, 3)  
> y = c(4, 5, 6)  
> x > y  
[1] FALSE FALSE FALSE  
>  
> x < y  
[1] TRUE TRUE TRUE  
>  
> x != y  
[1] TRUE TRUE TRUE  
>  
> x == y  
[1] FALSE FALSE FALSE  
> |
```

Examples:

Is 8 less than 6?

```
> isTRUE(8 < 6)
[1] FALSE
```

Is 8 greater than 6?

```
> isTRUE(8 > 6)
[1] TRUE
```

Is 5 less than 8?

```
> isFALSE(5 < 8)
[1] FALSE
```

Is 5 greater than 8?

```
> isFALSE(5 > 8)
[1] TRUE
```

R Console

```
> isTRUE(8<6)
[1] FALSE
>
> isTRUE(8>6)
[1] TRUE
>
> isFALSE(5<8)
[1] FALSE
>
> isFALSE(5>8)
[1] TRUE
> |
```