Normal Distribution

December 8, 2025

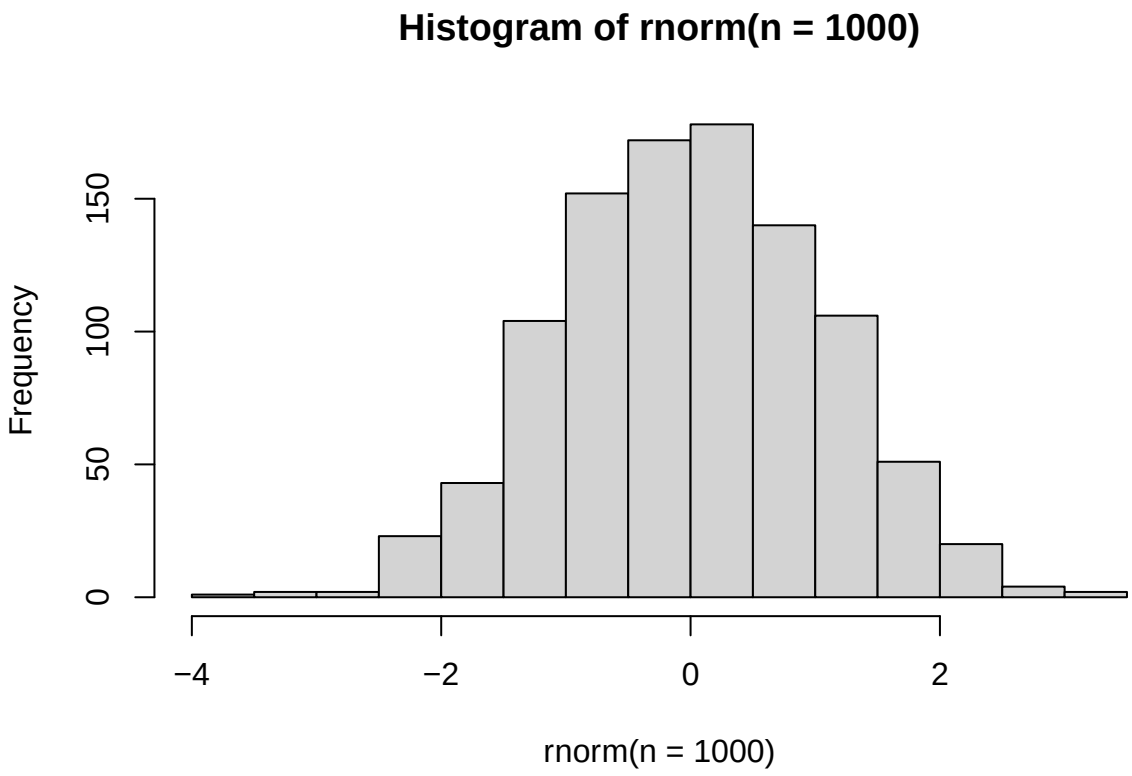
Contents

1 Random sampling from a normal distribution

```r
# Simulate this using `rnorm()`
# n: number of observations
# mean: 0 by default
# sd: standard deviation, 1 by default
rnorm(n = 10, mean = 5, sd = 2)
```

```
##  [1] 1.8714601 3.8625069 0.9231922 5.4840891 7.2656045 5.5658947 8.3520078
##  [8] 4.7245955 1.2392458 5.7506999
```

```r
# Plotting a normal distribution
hist(rnorm(n = 1000))
```



2 Density of a normal distribution

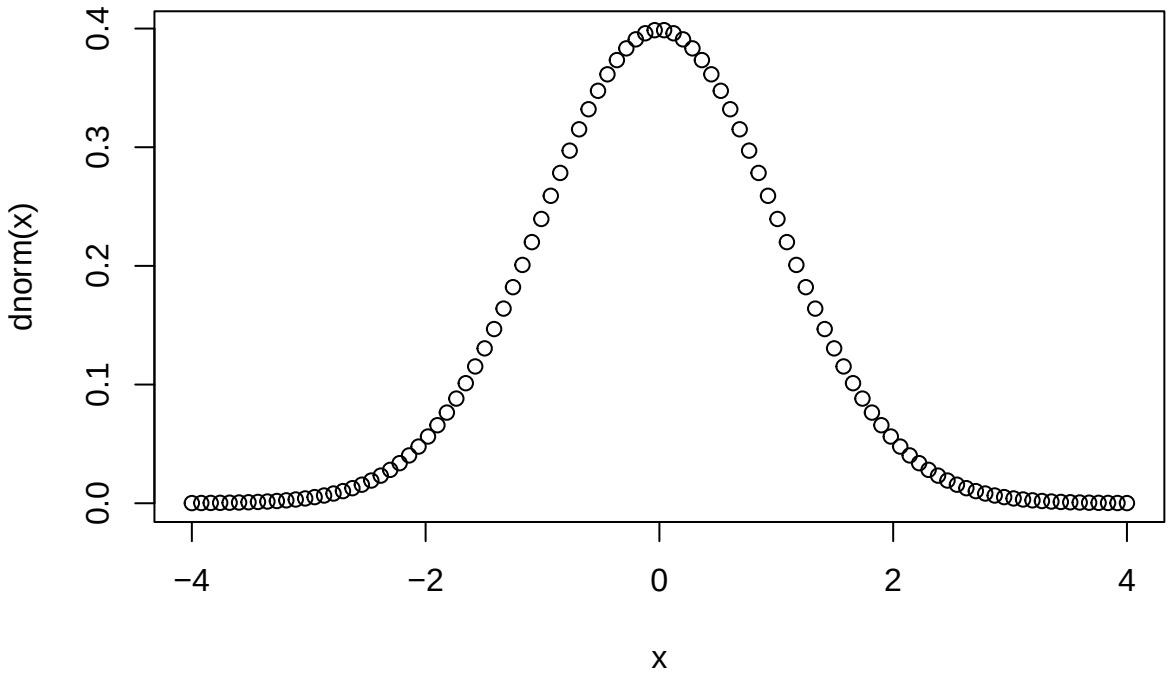
```
# Calculate P(X = r) in a normal distribution
# Using `dnorm()`
# Probability of getting a specific value/range in the normal distribution
# x: specific value or range of values
# mean & sd follow the same rules as before

# Example: Probability of drawing 3 (P(X = 3)) from N(0,1)
dnorm(x = 3)
```

```
## [1] 0.004431848
```

```
#Example: Probability of drawing -3 to 3 from N(0,1)
sum(dnorm(-3:3))
```

```
## [1] 0.9997294
```

```r
# Density Graph
x <- seq(from=-4,to=4,len=100)
plot(x,dnorm(x))
```



3 Cumulative Distribution

```r
# Calculate P(X <= r) in a normal distribution
# Using `pnorm()`
# q: specific value (r) or range of values
# mean & sd follow the same rules as before
# lower.tail: if TRUE (default) -> P(X <= r), if FALSE -> P(X > r)

# Example: Probability of drawing 3 or less (P X <= 3) from N(0,1)
pnorm(3)
```

```
## [1] 0.9986501
```

```r
# Example: Probability of drawing -3 or more (P X > -3) from N(0,1)
pnorm(-3, lower.tail = FALSE)
```

```
## [1] 0.9986501
```

4 Quantile Function

```r
# To get r given P(X <= r)
# Using `qnorm()`
# p: probability of P(X <= r)
# mean, sd & lower.tail follow the same rules as before

# Example: In N(0,1) there is a 5% chance of exceeding x. Find x?
# 0.05 chance of exceeding x, means 0.95 chance of getting x or less
qnorm(p = 0.95) # = 1.644854
```

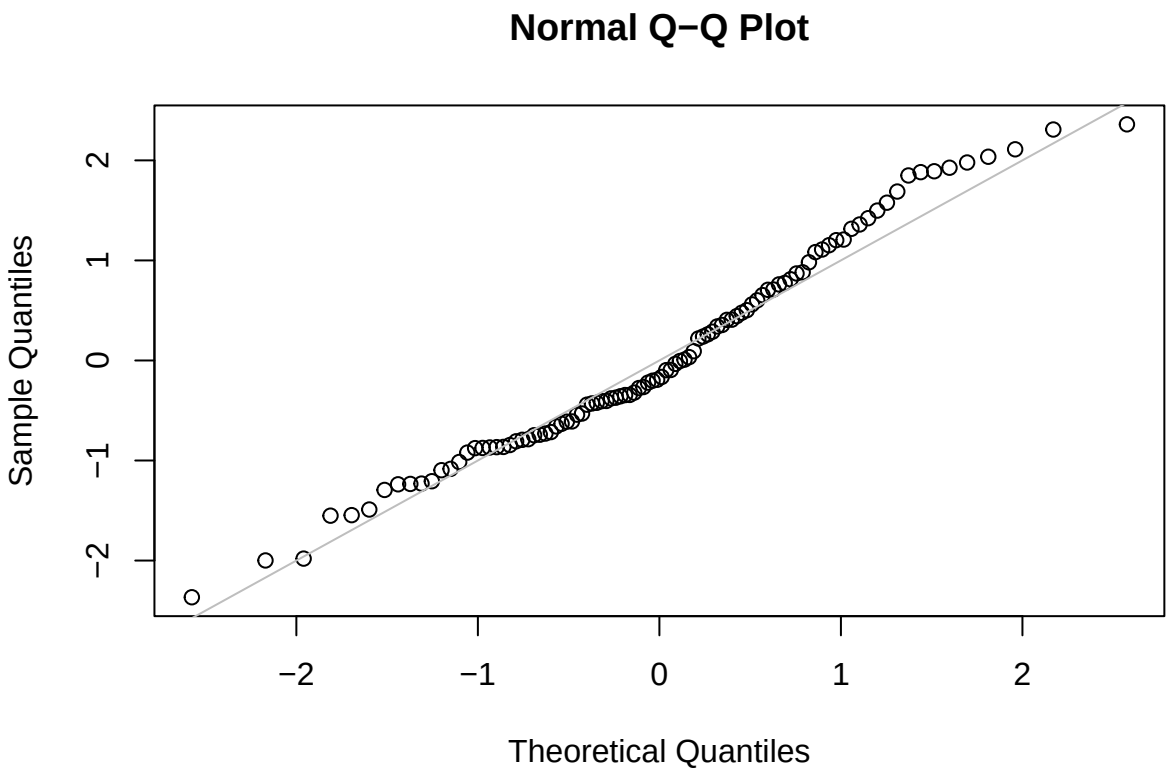
```
## [1] 1.644854
```

```r
# Verify result
pnorm(q = 1.644854) # 0.95
```

```
## [1] 0.95
```

5 QQ-Plot

```r
# A QQ-plot is used to visually determine
# how close a sample is to a specified distribution

# Example:
norm_samp <- rnorm(n = 100)
qqnorm(y = norm_samp)
abline(a=0, b=1, col='grey')
```


Normal Q−Q Plot
Sample Quantiles
Theoretical Quantiles
−2
−1
0
1
2