

# Expectation and variance of the probit model

$$\text{Expectation}(\mu, \sigma) = \int_{-\infty}^{\infty} \Phi(y) N(y \mid \mu, \sigma^2) dy$$

```
fa[μ_, σ_] := NIntegrate[
  CDF[NormalDistribution[], y] PDF[NormalDistribution[μ, σ], y], {y, -∞, ∞}]
fa[
  -0.1,
  0.5]
0.464365
```

```
f[μ_, σ_] := CDF[NormalDistribution[0, √(1 + σ²)], μ]
f[-0.1, 0.5]
0.464365
```

$$\text{Variance}(\mu, \sigma) = \int_{-\infty}^{\infty} \Phi^2(y) N(y \mid \mu, \sigma^2) dy$$

```
ga[μ_, σ_] := NIntegrate[
  CDF[NormalDistribution[], y]^2 PDF[NormalDistribution[μ, σ], y], {y, -∞, ∞}]
ga[
  -0.1,
  0.5]
0.247449
```

```
Σ[σ_] := {{1 + σ², σ²}, {σ², 1 + σ²}}
g[μ_, σ_] := CDF[MultinormalDistribution[{0, 0}, Σ[σ]], {μ, μ}]
g[-0.1, 0.5]
0.247449
```

```
Σ[0.5] // MatrixForm
( 1.25  0.25 )
( 0.25  1.25 )
```