

# Package ‘pbv’

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**Type** Package

**Title** Probabilities for Bivariate Normal Distribution

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**Description** Computes probabilities of the bivariate normal distribution in a vectorized R function (Drezner & Wesolowsky, 1990, <[doi:10.1080/00949659008811236](https://doi.org/10.1080/00949659008811236)>).

**Depends** R (>= 3.1)

**Imports** Rcpp

**Suggests** pbivnorm

**LinkingTo** Rcpp, RcppArmadillo

**URL** <https://github.com/alexanderrobitzsch/pbv>,  
<https://sites.google.com/site/alexanderrobitzsch2/software>

**License** GPL (>= 2)

**NeedsCompilation** yes

**Repository** CRAN

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pbv-package

*Probabilities for Bivariate Normal Distribution*

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### Description

Computes probabilities of the bivariate normal distribution in a vectorized R function (Drezner & Wesolowsky, 1990, <doi:10.1080/00949659008811236>).

### Author(s)

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### References

Drezner, Z., & Wesolowsky, G. O. (1990). On the computation of the bivariate normal integral. *Journal of Statistical Computation and Simulation*, 35(1-2), 101-107. doi: [10.1080/00949659008811236](https://doi.org/10.1080/00949659008811236)

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pbvnorm

*Probabilities for Bivariate Normal Distribution*

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### Description

The function pbvnorm computes probabilities  $\Phi_2(x, y, \rho)$  for the standardized bivariate normal distribution (Drezner & Wesolowsky, 1990; West, 2004).

The function dbvnorm computes the corresponding density  $\phi_2(x, y, \rho)$ .

### Usage

```
pbvnorm(x, y, rho)
```

```
dbvnorm(x, y, rho, log=FALSE)
```

```
## exported Rcpp functions  
pbv_rcpp_pbvnorm0( h1, hk, r)  
pbv_rcpp_pbvnorm( x, y, rho)  
pbv_rcpp_dbvnorm0( x, y, rho, use_log)  
pbv_rcpp_dbvnorm( x, y, rho, use_log)
```

**Arguments**

x	Vector of first ordinate
y	Vector of second ordinate
rho	Vector of correlations
log	Logical indicating whether logarithm of the density should be calculated
h1	Numeric
hk	Numeric
r	Numeric
use_log	Logical

**Value**

A vector

**Note**

The **pbv** package can also be used to include **Rcpp** functions for computing bivariate probabilities at the C++ level. Numeric and vector versions are

```
double pbv::pbv_rcpp_pbvnorm0( double h1, double hk, double r)
```

```
Rcpp::NumericVector pbv::pbv_rcpp_pbvnorm( Rcpp::NumericVector x,
Rcpp::NumericVector y, Rcpp::NumericVector rho)
```

**References**

- Drezner, Z., & Wesolowsky, G. O. (1990). On the computation of the bivariate normal integral. *Journal of Statistical Computation and Simulation*, 35(1-2), 101-107. doi: [10.1080/00949659008811236](https://doi.org/10.1080/00949659008811236)
- Genz, A. (1992). Numerical computation of multivariate normal probabilities. *Journal of Computational and Graphical Statistics*, 1(2), 141-149.
- West, G. (2005). Better approximations to cumulative normal functions. *Wilmott Magazine*, 9, 70-76.

**See Also**

See `pbivnorm::pbivnorm` in the **pbivnorm** package and `mnormt::biv.nt.prob` in the **mnormt** package for alternative implementations (Genz, 1992).

**Examples**

```
#####
# EXAMPLE 1: Comparison with alternative implementations
#####

*** simulate different values of ordinates and correlations
set.seed(9898)
N <- 3000
```

```
x <- stats::runif(N,-3,3)
y <- stats::runif(N,-3,3)
rho <- stats::runif(N,-.95,.95)

#### compute probabilities
res1 <- pbv::pbvnorm(x=x,y=y,rho=rho)

##-- compare results with pbivnorm package
library(pbivnorm)
res2 <- pbivnorm::pbivnorm(x=x, y=y, rho=rho)

summary(abs(res1-res2))

#### compute density values
log <- TRUE # logical indicating whether log density should be evaluated
res1 <- pbv::dbvnorm(x=x, y=y, rho=rho, log=log )

## Not run:
##-- compare results with mvtnorm package
library(mvtnorm)
res2 <- rep(NA, N)
sigma <- diag(2)
for (ii in 1:N){
  sigma[1,2] <- sigma[2,1] <- rho[ii]
  res2[ii] <- mvtnorm::dmvnorm(x=c(x[ii],y[ii]), sigma=sigma, log=log)
}
summary(abs(res1-res2))

## End(Not run)
```

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