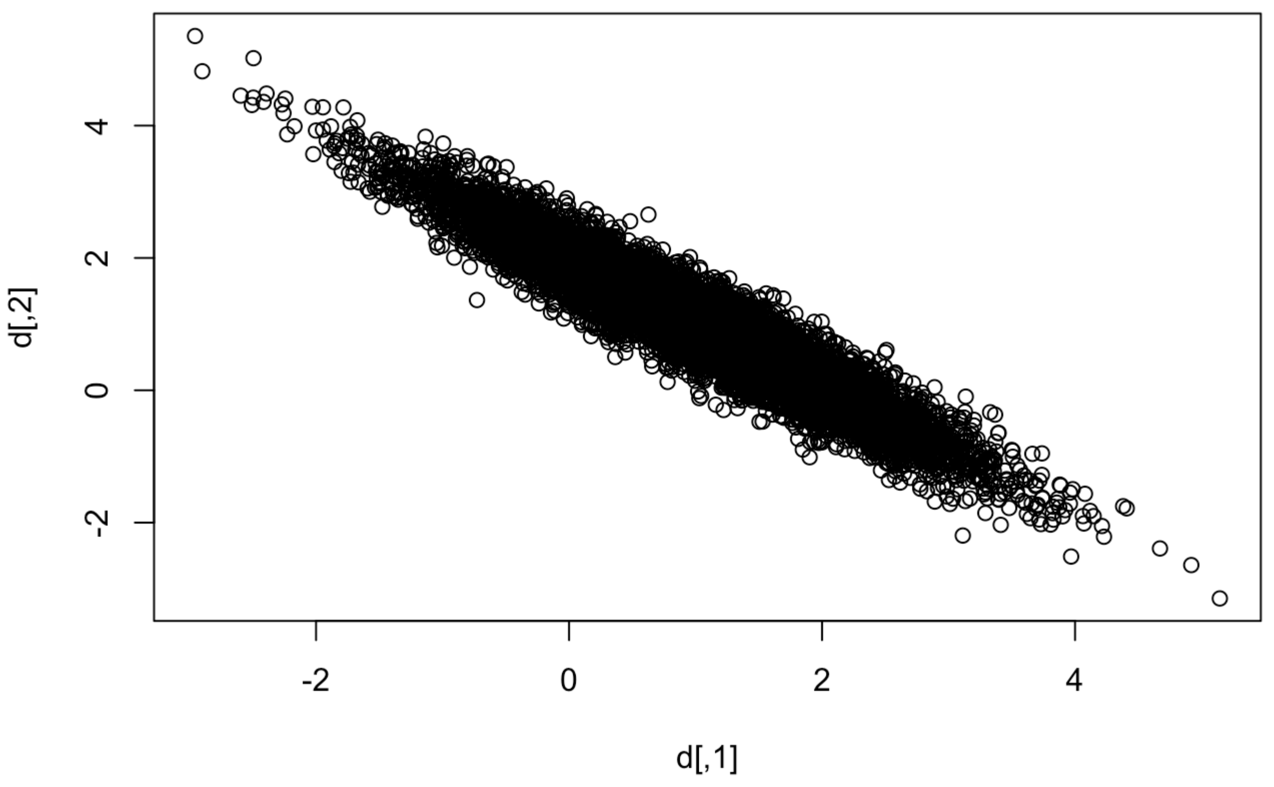
Multivariate Normal Example

rmvnorm

```cpp
// [[Rcpp::depends(RcppArmadillo)]]
#include <RcppArmadillo.h>

// [[Rcpp::export]]
arma::mat rmvnorm(int n, arma::vec mu, arma::mat Sigma) {
  unsigned int k = mu.n_elem;

  if (k != Sigma.n_rows || Sigma.n_rows != Sigma.n_cols) {
    Rcpp::stop("Bad dimensions");
  }

  arma::mat L = arma::chol(Sigma, "lower");
  arma::mat rnorm = arma::randn<arma::mat>(k, n);


  return (mu * arma::ones<arma::mat>(1,n) + L * rnorm).t();
}
```

```r
Sigma = diag(1,2)
Sigma[1,2] = Sigma[2,1] = -0.95

d = rmvnorm(10000, rep(1,2), Sigma)
plot(d)
```



```
bench::mark(
  rmvnorm(10000, mu = rep(0, 1000), Sigma = diag(1,1000,1000)),
  MASS::mvrnorm(10000, mu = rep(0, 1000), Sigma = diag(1,1000,1000)),
  check=FALSE
)
```

```
Warning: Some expressions had a GC in every iteration; so filtering is
disabled.

# A tibble: 2 × 6
  expression                                  min median `itr/sec` mem_alloc `gc/sec`
  <bch:expr>                                <bch> <bch:>     <dbl> <bch:byt>    <dbl>
1 rmvnorm(10000, mu = rep(0, 1000), S… 385ms   387ms      2.58    83.9MB     1.29
2 MASS::mvrnorm(10000, mu = rep(0, 10… 524ms   524ms      1.91   431.8MB     5.72
```

dmvnorm

```
// [[Rcpp::depends(RcppArmadillo)]]
#include <RcppArmadillo.h>

// [[Rcpp::export]]
```

```
arma::mat dmvnorm(arma::mat x, arma::vec mu, arma::mat Sigma, bool use_log = true
  //unsigned int n = mu.n_elem;
  unsigned int n_obs = x.n_cols;

  arma::mat X = x - mu * arma::ones<arma::mat>(1, n_obs);
  arma::mat L = arma::chol(Sigma, "lower");
  arma::mat L_inv_t = arma::inv(arma::trimatl(L)).t();
  arma::mat XL = X.t() * L_inv_t;
  arma::vec XLLX = arma::sum(XL % XL, 1);

  arma::vec L_diag = L.diag();

  double norm = pow(2 * arma::datum::pi, n_obs) * sqrt( arma::prod(arma::square(L

  if (use_log) {
    return -XLLX/2 - log(norm)/2;
  } else {
    return arma::exp(-XLLX/2) / sqrt(norm);
  }
}
```

```
dmvnorm(matrix(0, 1, 3), 0, matrix(1,1,1))
```

```
          [,1]
[1,] -2.756816
[2,] -2.756816
[3,] -2.756816
```