Question 1

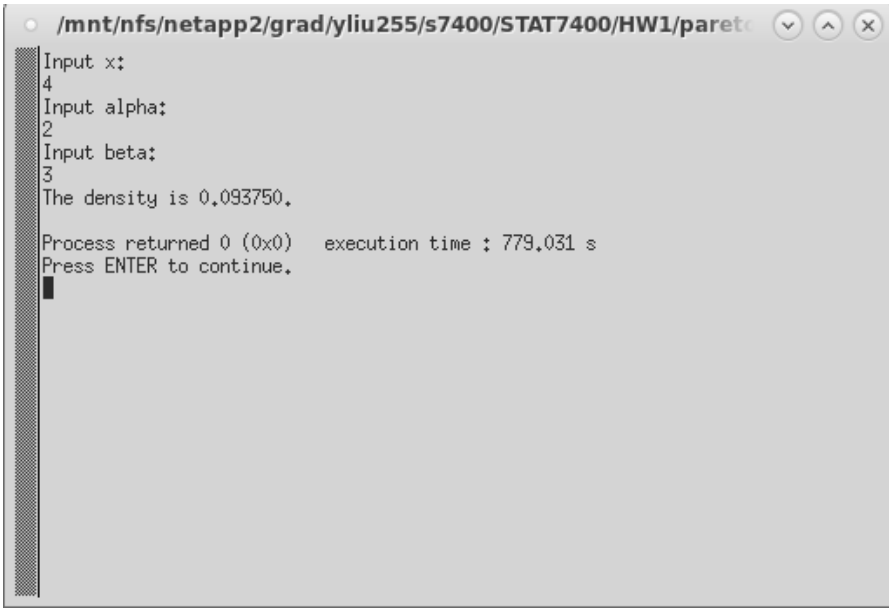
The C program *paretodnes.c* is attached in the Appendix. We use the following code to compile it.

```
gcc  paretodens.c -o paretodens -lm -Wall -pedantic
```

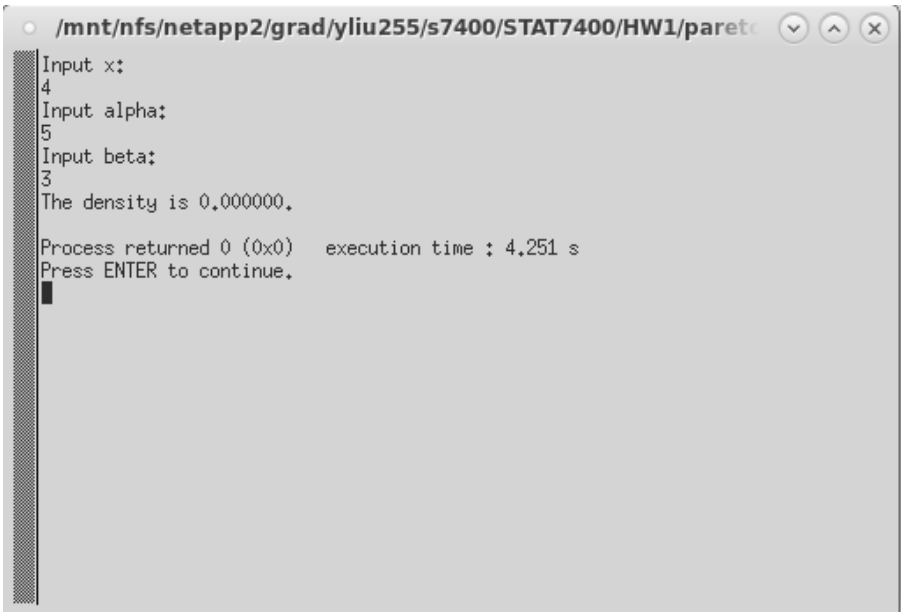
In this way we have generated an executable file called *paretodens*. Run this program, the following window will pop up. Users will enter the values of x, alpha and beta for pareto distribution one by one.

Three sets of values are used to test it.

1. x = 4, alpha = 2, beta = 3



2. x = 4, alpha = 5, beta = 3



3. x = 4, alpha = 2, beta = -3

Question 2

The R program *dpareto.r* is as follows.

```
dpareto <- function(x,alpha,beta){

  #Calculate the maximum length of inputs
  L <- max(length(x), length(alpha), length(beta))

  #Align all the inputs
  x <- rep(x,length.out = L)
  alpha <- rep(alpha,length.out = L)
  beta <- rep(beta,length.out = L)

  #Initialize the densities with NaN
  dens <- rep(NaN, length.out = L)

  for (i in 1:L){
    if (alpha[i] <= 0 || beta[i] <= 0){
      warning("NaNs produced")
      next
    } else if (x[i] < alpha[i]){
      dens[i] <- 0
    } else{
      dens[i] <- beta[i]*alpha[i]^beta[i]/x[i]^(beta[i]+1)
    }
  }
  return(dens)
}
```

I use the following set of values to test it.

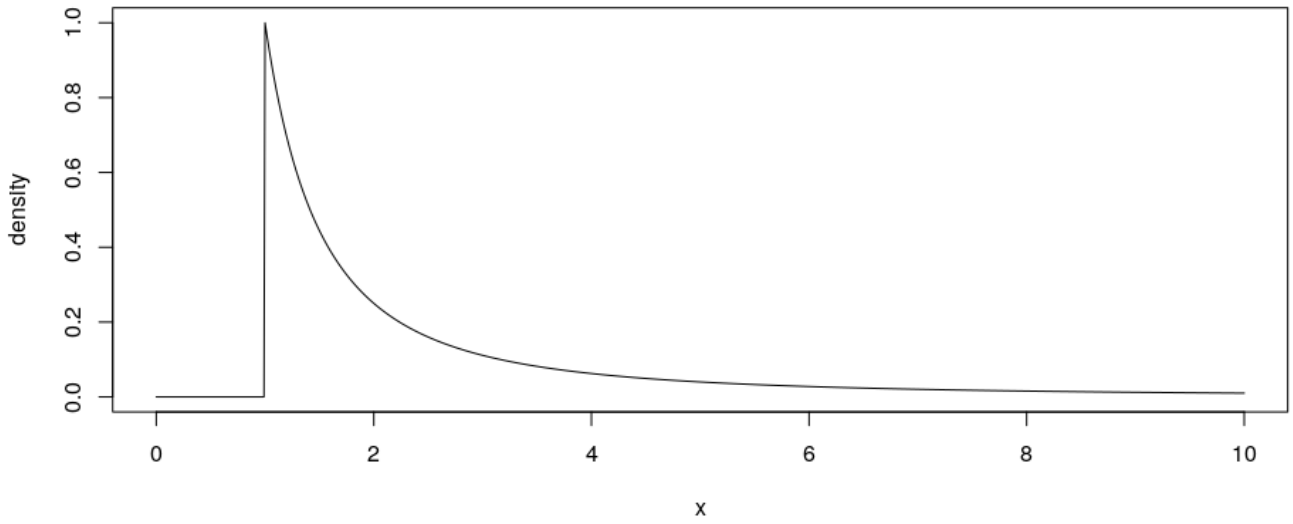
- x = c(4,4,4)
- alpha = c(2,5,2)
- beta = c(3,3,-3)

The results are as follows.

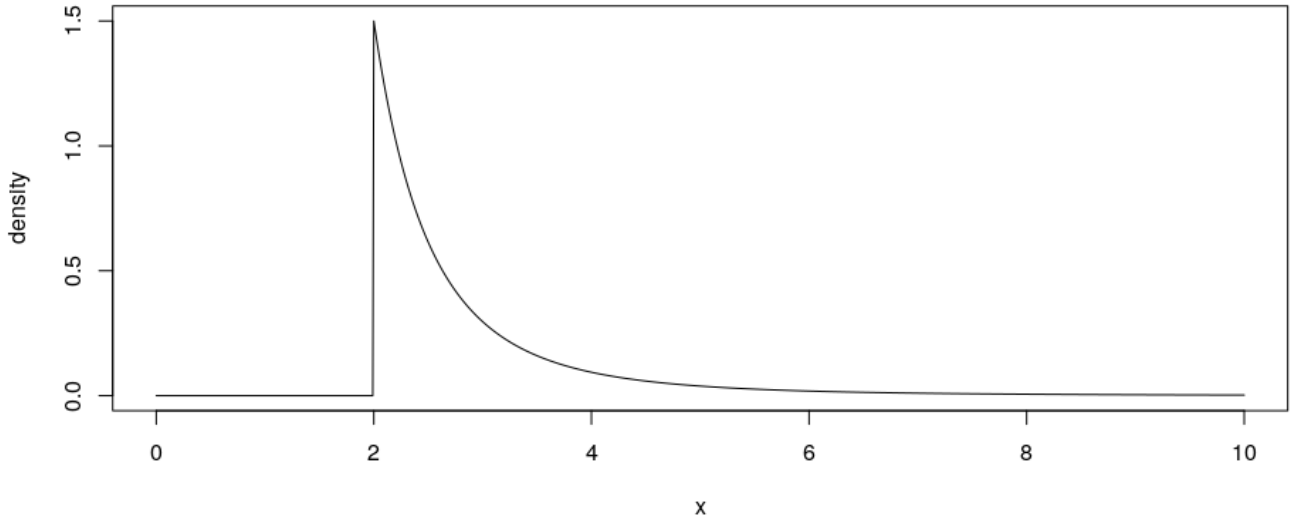
```
> dpareto(c(4,4,4),c(2,5,2),c(3,3,-3))
[1] 0.09375 0.00000     NaN
Warning message:
In dpareto(c(4, 4, 4), c(2, 5, 2), c(3, 3, -3)) : NaNs produced
```

Then I use this function to plot the density in R. Two sets of parameters are used.

1. alpha = 1, beta = 1



2. alpha = 2, beta = 3



Appendix

paretodens.c

```
#include <stdio.h>
#include <math.h>

/*Define parto density function*/
double paretodens(double x, double alpha, double beta) {
    /*Check whether alpha and beta are positve*/
    if (alpha <=0 || beta <= 0){
        printf("Warning message: The parameters are not meaningful! NaN
produced!\n");
        return NAN;
    }
    /*Check whether x is greater than alpha*/
    else if (x < alpha){
        return 0;
    }
    else {
        return beta*pow(alpha,beta)/pow(x,beta+1);
    }
}

int main() {
    double x,alpha,beta;

    printf("Input x:\n");
    scanf("%lf",&x);

    printf("Input alpha:\n");
    scanf("%lf",&alpha);

    printf("Input beta:\n");
    scanf("%lf",&beta);

    printf("The density is %lf.\n", paretodens(x,alpha,beta));
    return 0;
}
```