VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

WINTER SEMESTER 2021-2022

Activity Sheet -7

Normal Distribution
Answer to be presented below each question
Write R- Code with Visualisation

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Syntax Used:

dnorm(x,mean,sd) **->**returns the value of the probability density function for the normal distribution.

pnorm(x,mean,sd)->returns the integral from $-\infty-\infty$ to qq of the pdf of the normal distribution where qq is a Z-score

polygon(x_coordinates,y_coordinates)-> **draws a polygon to** a plot

I.) Find the area under the standard Normal Curve

1. P (0 < Z < 1.25)

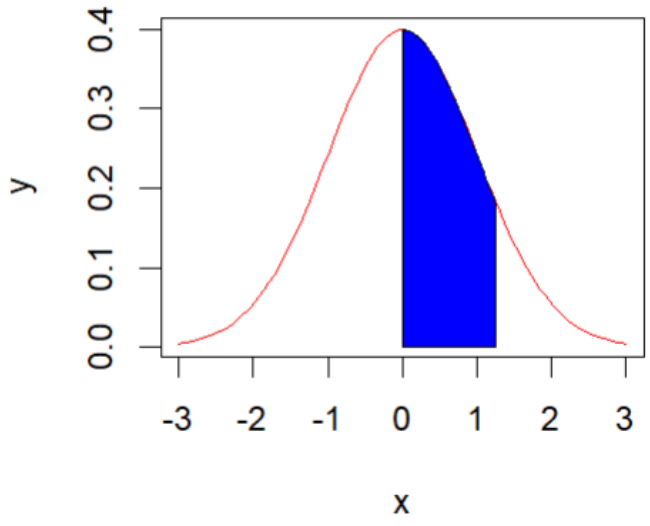
Code:

```
x=seq(-3,3,length=100)
y=dnorm(x,mean=0,sd=1)
plot(x,y,type="l",col="red")
x=seq(0,1.25,length=100)
y=dnorm(x,mean=0,sd=1)
polygon(c(0,x,1.25),c(0,y,0),col="blue")
pnorm(1.25,mean=0,sd=1)-pnorm(0,0,1)
```

Output:

```
> x=seq(-3,3,length=100)
> y=dnorm(x,mean=0,sd=1)
> plot(x,y,type="l",col="red")
> x=seq(0,1.25,length=100)
> y=dnorm(x,mean=0,sd=1)
> polygon(c(0,x,1.25),c(0,y,0),col="blue")
> pnorm(1.25,mean=0,sd=1)-pnorm(0,0,1)
[1] 0.3943502
```

Plot



2. P (-1.25 < Z < 0)

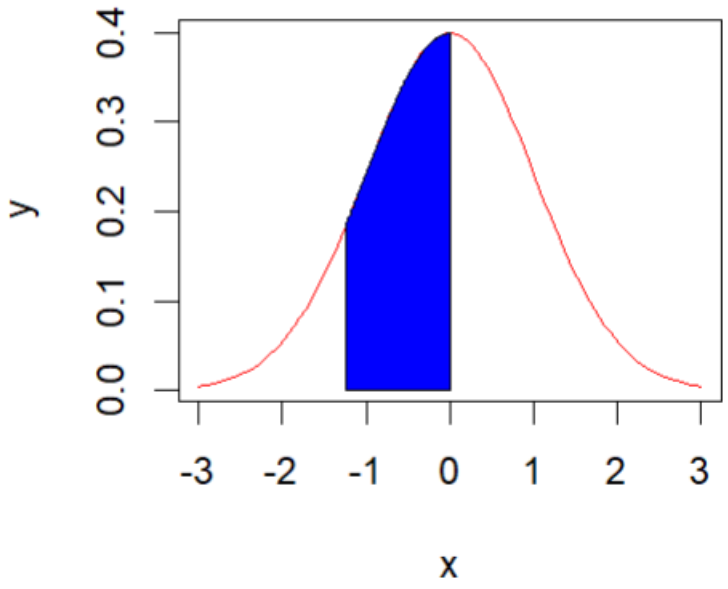
Code:

```
x=seq(-3,3,length=100)
y=dnorm(x,mean=0,sd=1)
plot(x,y,type="l",col="red")
x=seq(-1.25,0,length=100)
y=dnorm(x,mean=0,sd=1)
polygon(c(-1.25,x,0),c(0,y,0),col="blue")
pnorm(0,0,1)-pnorm(-1.25,mean=0,sd=1)
```

Output:

```
> x=seq(-3,3,length=100)
> y=dnorm(x,mean=0,sd=1)
> plot(x,y,type="l",col="red")
> x=seq(-1.25,0,length=100)
> y=dnorm(x,mean=0,sd=1)
> polygon(c(-1.25,x,0),c(0,y,0),col="blue")
> pnorm(0,0,1)-pnorm(-1.25,mean=0,sd=1)
[1] 0.3943502
```

Plot:



3. P(0.6 < Z < 1.25)

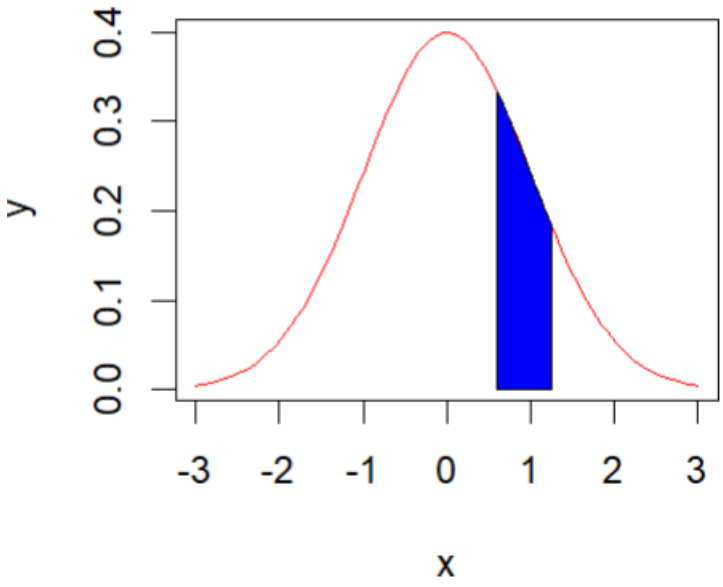
Code:

```
x=seq(-3,3,length=100)
y=dnorm(x,mean=0,sd=1)
plot(x,y,type="l",col="red")
x=seq(0.6,1.25,length=100)
y=dnorm(x,mean=0,sd=1)
polygon(c(0.6,x,1.25),c(0,y,0),col="blue")
pnorm(1.25,mean=0,sd=1)-pnorm(0.6,0,1)
```

Output:

```
> x=seq(-3,3,length=100)
> y=dnorm(x,mean=0,sd=1)
> plot(x,y,type="l",col="red")
> x=seq(0.6,1.25,length=100)
> y=dnorm(x,mean=0,sd=1)
> polygon(c(0.6,x,1.25),c(0,y,0),col="blue")
> pnorm(1.25,mean=0,sd=1)-pnorm(0.6,0,1)
[1] 0.1686033
```

Plot:



4. P(Z > 2.5)

Code:

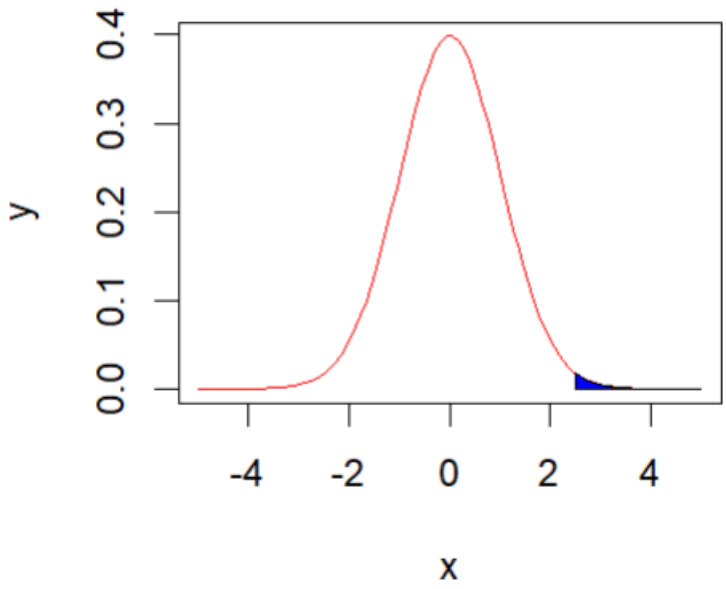
```
x=seq(-5,5,length=100)
y=dnorm(x,mean=0,sd=1)
plot(x,y,type="l",col="red")
x=seq(2.5,5,length=100)
y=dnorm(x,mean=0,sd=1)
polygon(c(2.5,x,5),c(0,y,0),col="blue")
1-pnorm(2.5,mean=0,sd=1)

```

Output:

```
> x=seq(-5,5,length=100)
> y=dnorm(x,mean=0,sd=1)
> plot(x,y,type="l",col="red")
> x=seq(2.5,5,length=100)
> y=dnorm(x,mean=0,sd=1)
> polygon(c(2.5,x,5),c(0,y,0),col="blue")
> 1-pnorm(2.5,mean=0,sd=1)
[1] 0.006209665
```

Plot:



5. P(Z < 2.5)

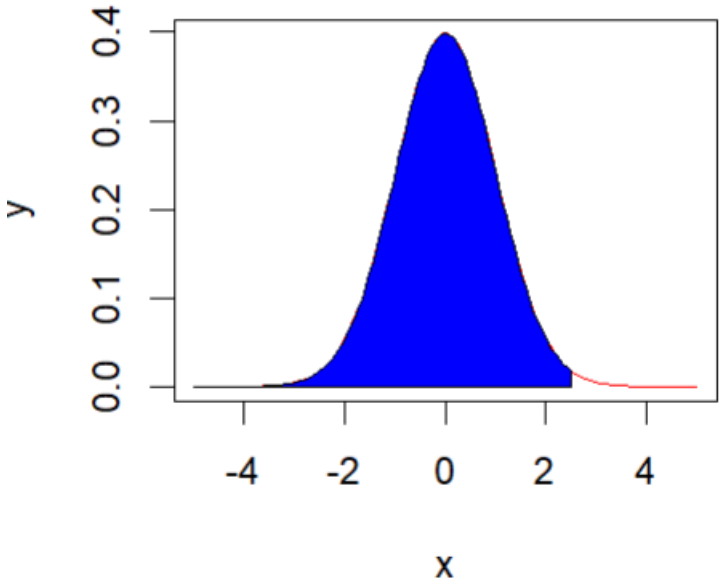
Code:

```
x=seq(-5,5,length=100)
y=dnorm(x,mean=0,sd=1)
plot(x,y,type="l",col="red")
x=seq(-5,2.5,length=100)
y=dnorm(x,mean=0,sd=1)
polygon(c(-5,x,2.5),c(0,y,0),col="blue")
pnorm(2.5,mean=0,sd=1)
```

Output:

```
> x=seq(-5,5,length=100)
> y=dnorm(x,mean=0,sd=1)
> plot(x,y,type="l",col="red")
> x=seq(-5,2.5,length=100)
> y=dnorm(x,mean=0,sd=1)
> polygon(c(-5,x,2.5),c(0,y,0),col="blue")
> pnorm(2.5,mean=0,sd=1)
[1] 0.9937903
```

Plot:



6. P(Z > -2.5)

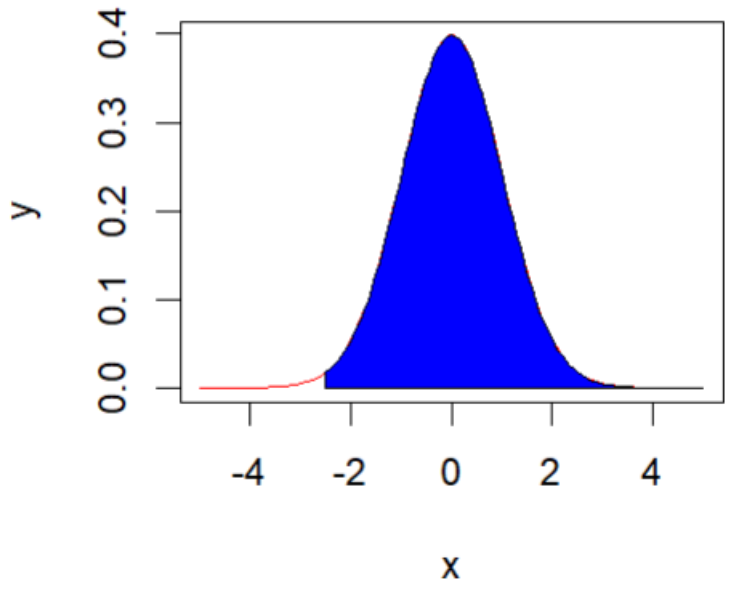
Code:

```
x=seq(-5,5,length=100)
y=dnorm(x,mean=0,sd=1)
plot(x,y,type="l",col="red")
x=seq(-2.5,5,length=100)
y=dnorm(x,mean=0,sd=1)
polygon(c(-2.5,x,5),c(0,y,0),col="blue")
pnorm(2.5,mean=0,sd=1)
```

Output:

```
> x=seq(-5,5,length=100)
> y=dnorm(x,mean=0,sd=1)
> plot(x,y,type="l",col="red")
> x=seq(-2.5,5,length=100)
> y=dnorm(x,mean=0,sd=1)
> polygon(c(-2.5,x,5),c(0,y,0),col="blue")
> pnorm(2.5,mean=0,sd=1)
[1] 0.9937903
```

Plot:



7. P(Z < -2.5)

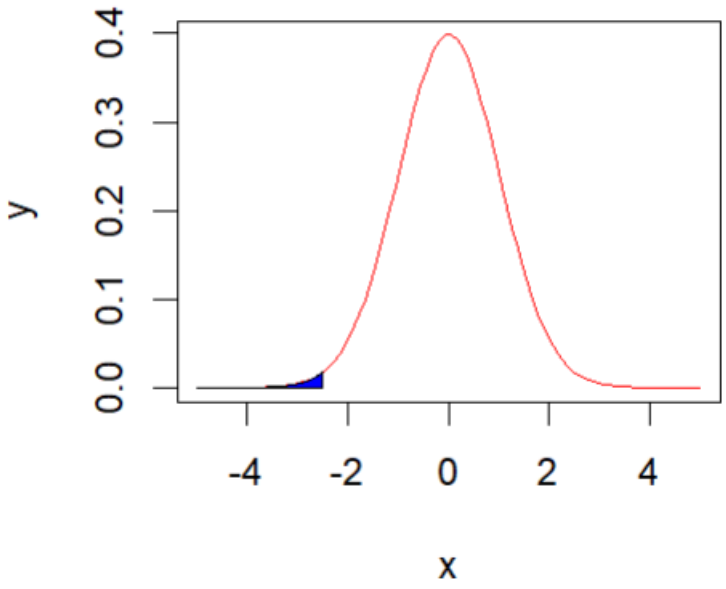
Code:

```
x=seq(-5,5,length=100)
y=dnorm(x,mean=0,sd=1)
plot(x,y,type="l",col="red")
x=seq(-5,-2.5,length=100)
y=dnorm(x,mean=0,sd=1)
polygon(c(-5,x,-2.5),c(0,y,0),col="blue")
pnorm(-2.5,mean=0,sd=1)
```

Output:

```
> x=seq(-5,5,length=100)
> y=dnorm(x,mean=0,sd=1)
> plot(x,y,type="l",col="red")
> x=seq(-5,-2.5,length=100)
> y=dnorm(x,mean=0,sd=1)
> polygon(c(-5,x,-2.5),c(0,y,0),col="blue")
> pnorm(-2.5,mean=0,sd=1)
[1] 0.006209665
```

Plot:



II) If X ~ N (50, 10^2) ,find the probability that the value of the random variable X will be greater than 60.

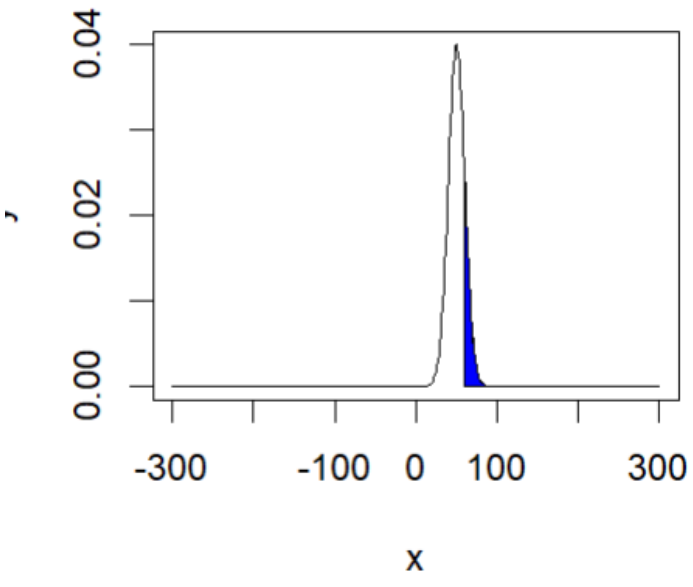
Code:

```
x=seq(-300,300,length=500)
y=dnorm(x,mean=50,sd=10)
plot(x,y,type="l")
x=seq(60,300,length=50)
y=dnorm(x,mean=50,sd=10)
polygon(c(60,x,300),c(0,y,0),col="blue")
1-pnorm(60,mean=50,sd=10)
```

Output:

```
> x=seq(-300,300,length=500)
> y=dnorm(x,mean=50,sd=10)
> plot(x,y,type="l")
> x=seq(60,300,length=50)
> y=dnorm(x,mean=50,sd=10)
> polygon(c(60,x,300),c(0,y,0),col="blue")
> 1-pnorm(60,mean=50,sd=10)
[1] 0.1586553
```

Plot:



III) The weekly wage of 2000 workmen is normally distribution with mean wage of Rs 70 and wage standard deviation of Rs 5. Estimate the number of workers whose weekly wages are

(a) between Rs 70 and Rs 71

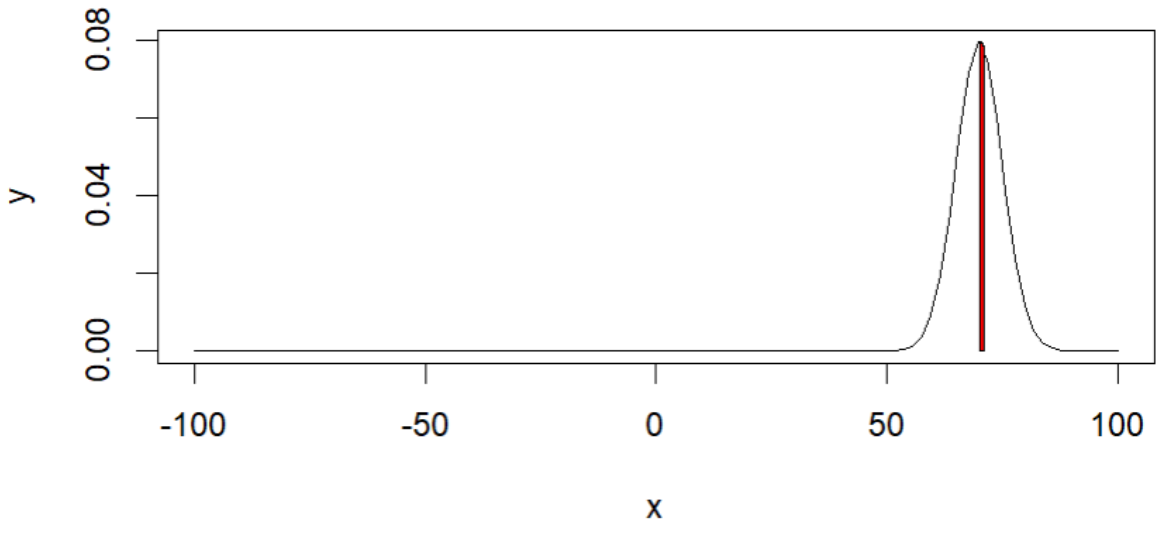
Code:

```
x=seq(-100,100,length=100)
y=dnorm(x,mean=70,sd=5)
plot(x,y,type="l")
x=seq(70,71,length=50)
y=dnorm(x,mean=70,sd=5)
polygon(c(70,x,71),c(0,y,0),col="red")
a=pnorm(71,mean=70,sd=5)-pnorm(70,mean=70,sd=5)
a*2000
```

Output:

```
> x=seq(-100,100,length=100)
> y=dnorm(x,mean=70,sd=5)
> plot(x,y,type="l")
> x=seq(70,71,length=50)
> y=dnorm(x,mean=70,sd=5)
> polygon(c(70,x,71),c(0,y,0),col="red")
> a=pnorm(71,mean=70,sd=5)-pnorm(70,mean=70,sd=5)
> a*2000
[1] 158.5194
```

Plot:



(b) between Rs 69 and Rs 73

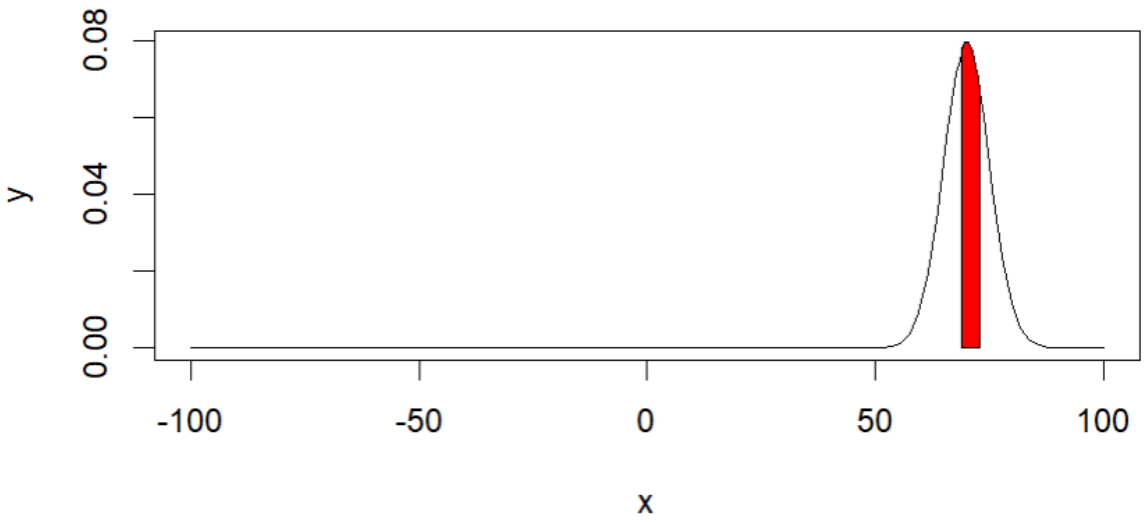
Code:

```
x=seq(-100,100,length=100)
y=dnorm(x,mean=70,sd=5)
plot(x,y,type="l")
x=seq(69,73,length=50)
y=dnorm(x,mean=70,sd=5)
polygon(c(69,x,73),c(0,y,0),col="red")
a=pnorm(73,mean=70,sd=5)-pnorm(69,mean=70,sd=5)
a*2000
```

Output:

```
> x=seq(-100,100,length=100)
> y=dnorm(x,mean=70,sd=5)
> plot(x,y,type="l")
> x=seq(69,73,length=50)
> y=dnorm(x,mean=70,sd=5)
> polygon(c(69,x,73),c(0,y,0),col="red")
> a=pnorm(73,mean=70,sd=5)-pnorm(69,mean=70,sd=5)
> a*2000
[1] 610.0132
>
```

Plot:



(c) more than Rs 72

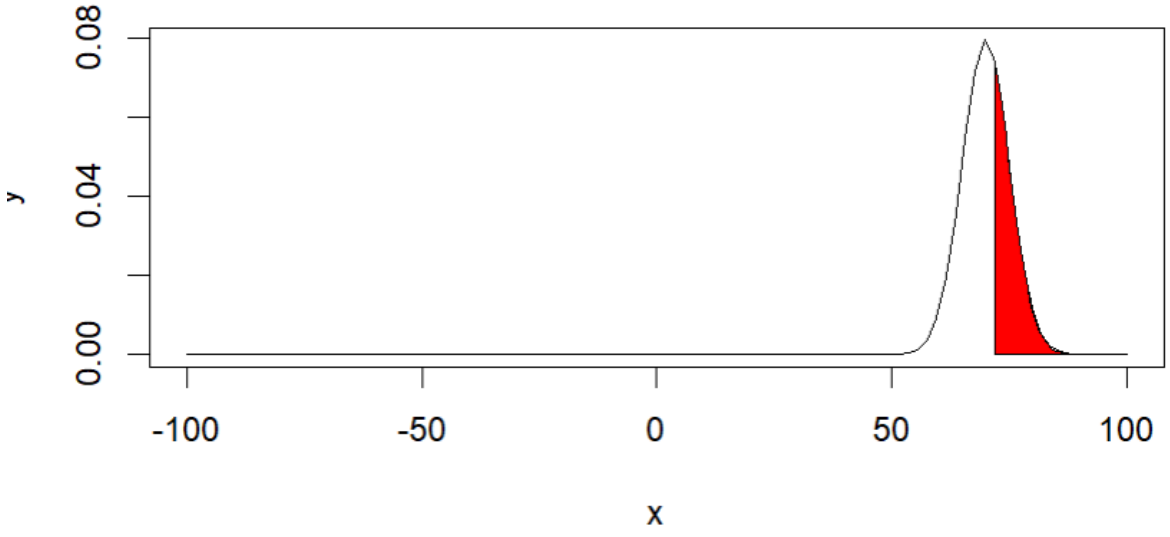
Code:

```
x=seq(-100,100,length=100)
y=dnorm(x,mean=70,sd=5)
plot(x,y,type="l")
x=seq(72,100,length=50)
y=dnorm(x,mean=70,sd=5)
polygon(c(72,x,100),c(0,y,0),col="red")
a=pnorm(100,mean=70,sd=5)-pnorm(72,mean=70,sd=5)
a*2000
```

Output:

```
> x=seq(-100,100,length=100)
> y=dnorm(x,mean=70,sd=5)
> plot(x,y,type="l")
> x=seq(72,100,length=50)
> y=dnorm(x,mean=70,sd=5)
> polygon(c(72,x,100),c(0,y,0),col="red")
> a=pnorm(100,mean=70,sd=5)-pnorm(72,mean=70,sd=5)
> a*2000
[1] 689.1565
```

Plot:



(d) less than Rs 65

Code:

```
x=seq(-100,100,length=100)
y=dnorm(x,mean=70,sd=5)
plot(x,y,type="l")
x=seq(-100,65,length=50)
y=dnorm(x,mean=70,sd=5)
polygon(c(-100,x,65),c(0,y,0),col="red")
a=pnorm(65,mean=70,sd=5)-pnorm(-100,mean=70,sd=5)
a*2000
```

Output:

```
> x=seq(-100,100,length=100)
> y=dnorm(x,mean=70,sd=5)
> plot(x,y,type="l")
> x=seq(-100,65,length=50)
> y=dnorm(x,mean=70,sd=5)
> polygon(c(-100,x,65),c(0,y,0),col="red")
> a=pnorm(65,mean=70,sd=5)-pnorm(-100,mean=70,sd=5)
> a*2000
[1] 317.3105
```

Plot: