Project2

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```
# a) Verify that the area under f(x) is 1
theta <- 5
f <- function(x) {3*pi*theta*x^2*exp(-theta*pi*x^3)}
result <- integrate(f, lower = 0, upper = Inf)
print(result$value)
```

```
## [1] 1
```

```
# b) Calculate P(X > 1) with theta = 5
result <- integrate(f, lower = 1, upper = Inf)
print(result$value)
```

```
## [1] 1.507017e-07
```

```
# c) Generate 100,000 realizations of X with theta = 5
n <- 100000
u <- runif(n)
x <- (-(log(1-u)/(theta*pi)))^(1/3)
mean_x <- mean(x)
var_x <- var(x)
print(c(mean_x, var_x))
```

```
## [1] 0.35607734 0.01678162
```

```
# d) Rerun part (c). Do you get the same values?

# e) Rerun with different seeds. Do you get the same values?
set.seed(80)
u <- runif(n)
x <- (-(log(1-u)/(theta*pi)))^(1/3)
mean_x <- mean(x)
var_x <- var(x)
print(c(mean_x, var_x))
```

```
## [1] 0.3564284 0.0169125
```

```
# f) Conjecture what set.seed() does and compare to the help file

# g) Compare theoretical and simulated mean and variance
E_X <- 0.35656
Var_X <- 0.01679
abs_diff_mean <- abs(E_X - mean_x)
rel_error_mean <- abs_diff_mean / E_X
abs_diff_var <- abs(Var_X - var_x)
rel_error_var <- abs_diff_var / Var_X
```

```r
print(c(abs_diff_mean, rel_error_mean, abs_diff_var, rel_error_var))
```

```
## [1] 0.0001315565 0.0003689603 0.0001224967 0.0072958119
```

```r
# Define the parameters
mu <- 7
sigma <- 3

# Calculate P(X > 7.1)
p1 <- 1 - pnorm(7.1, mean = mu, sd = sigma)

# Find the value of K such that P(X < k) = 0.8
k <- qnorm(0.8, mean = mu, sd = sigma)

# Print the results
print(paste("P(X > 7.1) =", p1))
```

```
## [1] "P(X > 7.1) = 0.486704386182908"
```

```r
print(paste("The value of K such that P(X < K) = 0.8 is", k))
```

```
## [1] "The value of K such that P(X < K) = 0.8 is 9.52486370071874"
```