EN 2040

Random Signals and Processes

Simulation Assignment

Report

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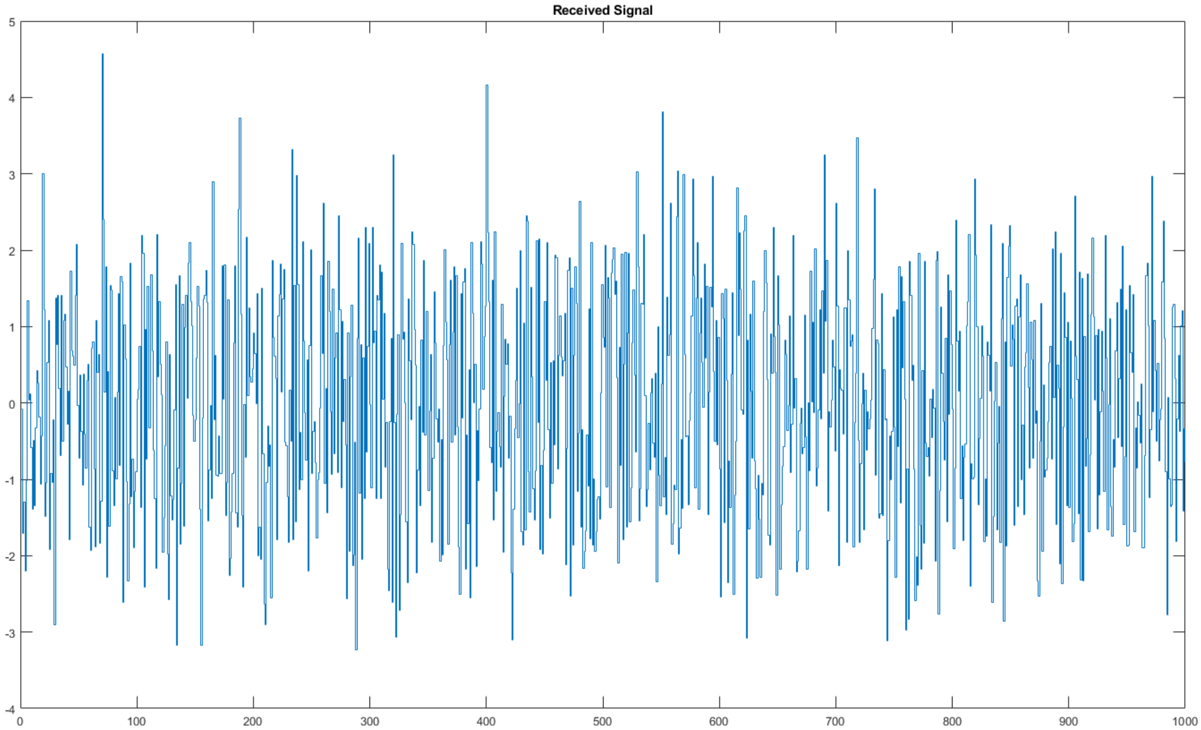
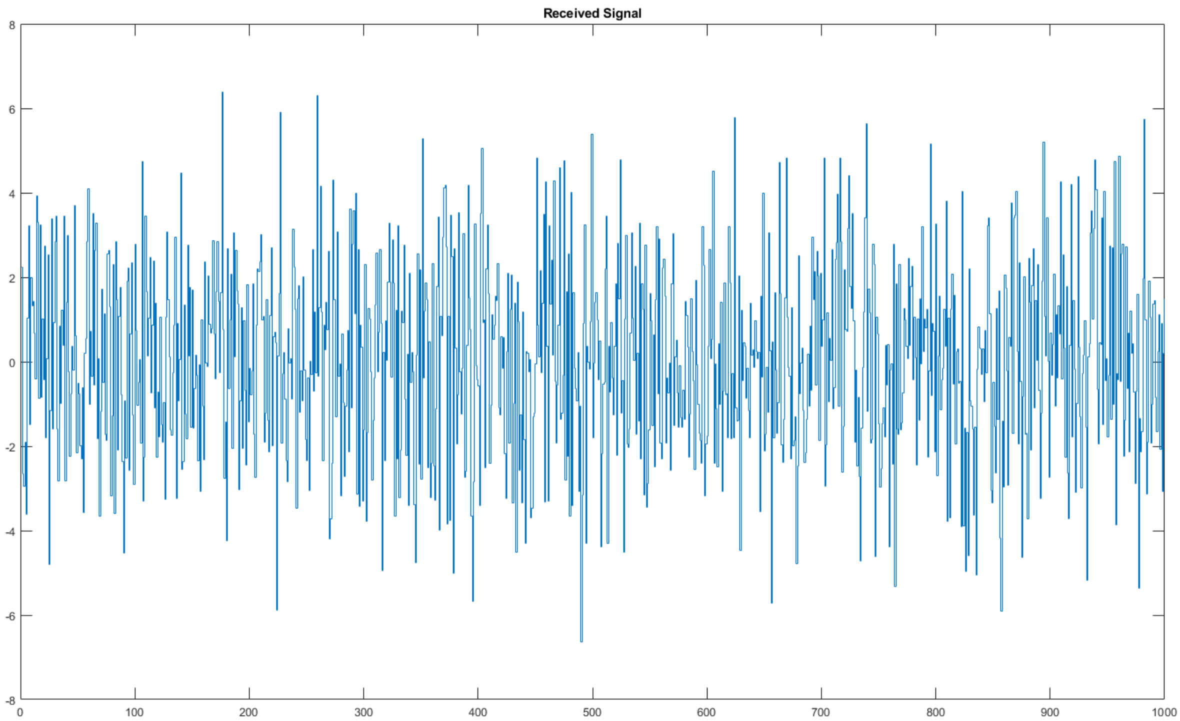
180205H

Q3)

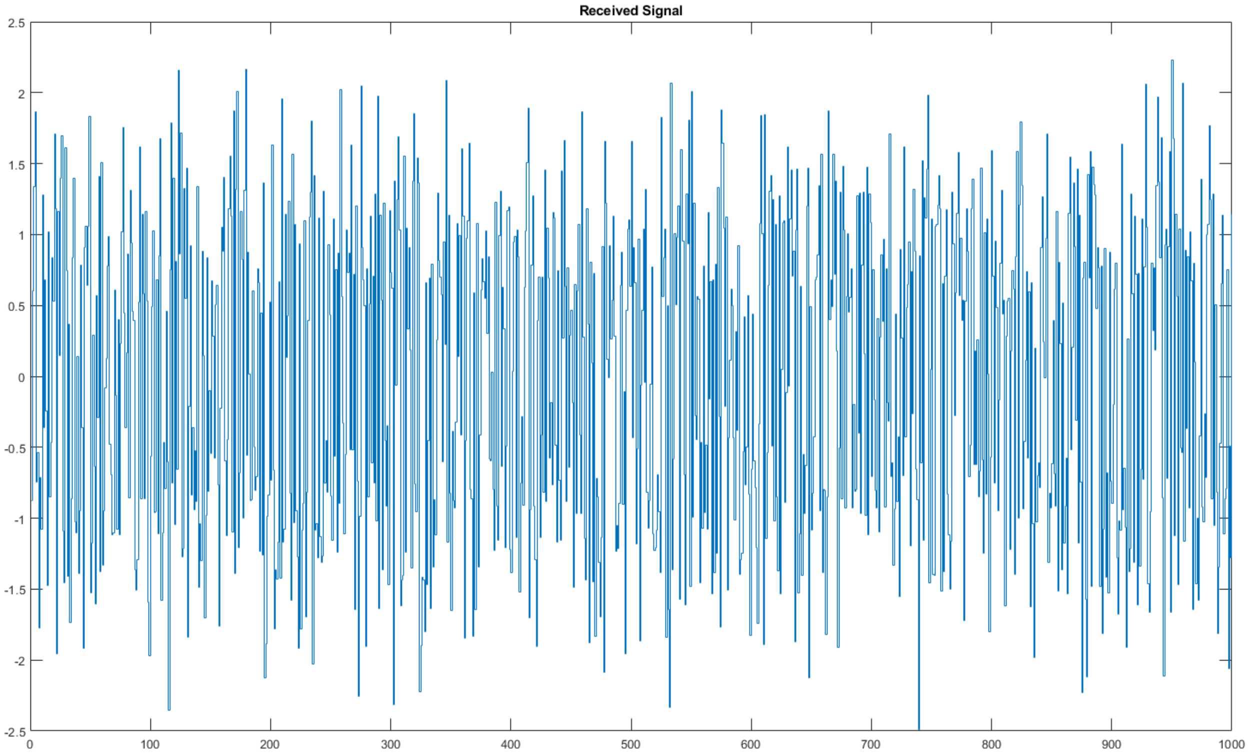
$$\sigma^2 = 1\,, \mu = 0$$



$$\sigma^2 = 4\,, \mu = 0$$

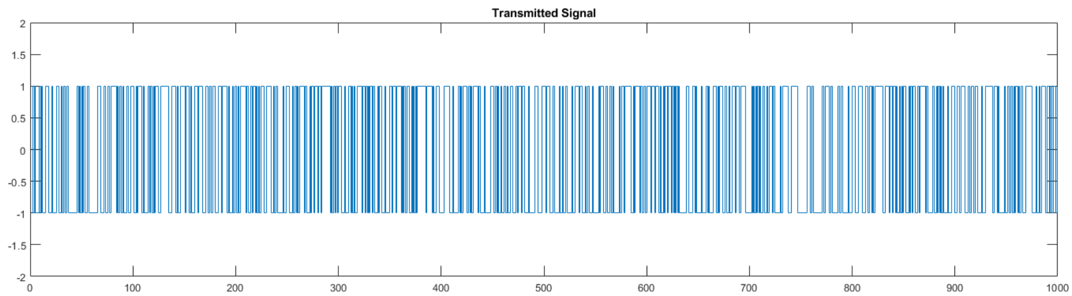


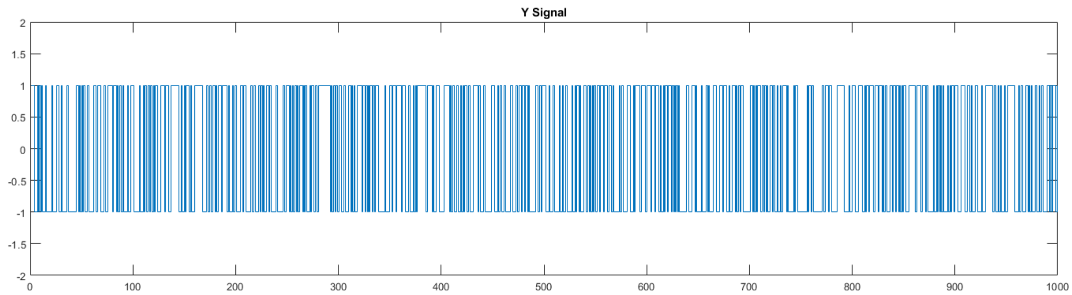
$$\sigma^2 = 0.5^2, \mu = 0$$



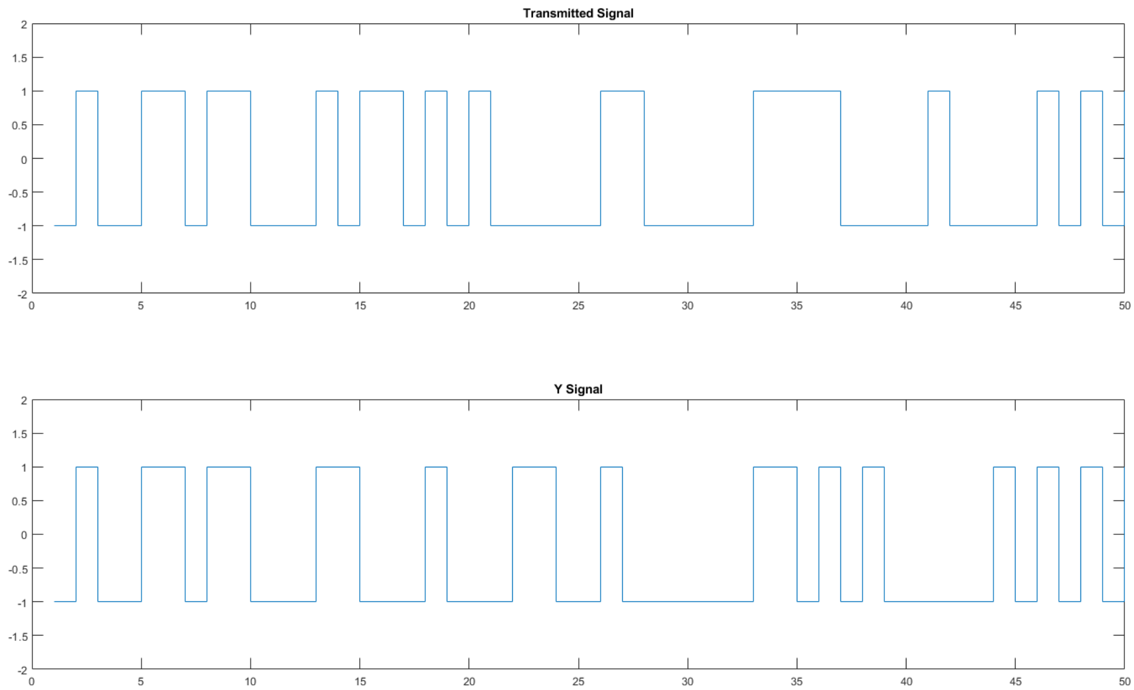
$$When\ \ \sigma\ increases\ the\ deviation\ from\ the\ original\ signal\ value\ increases$$

Q4)



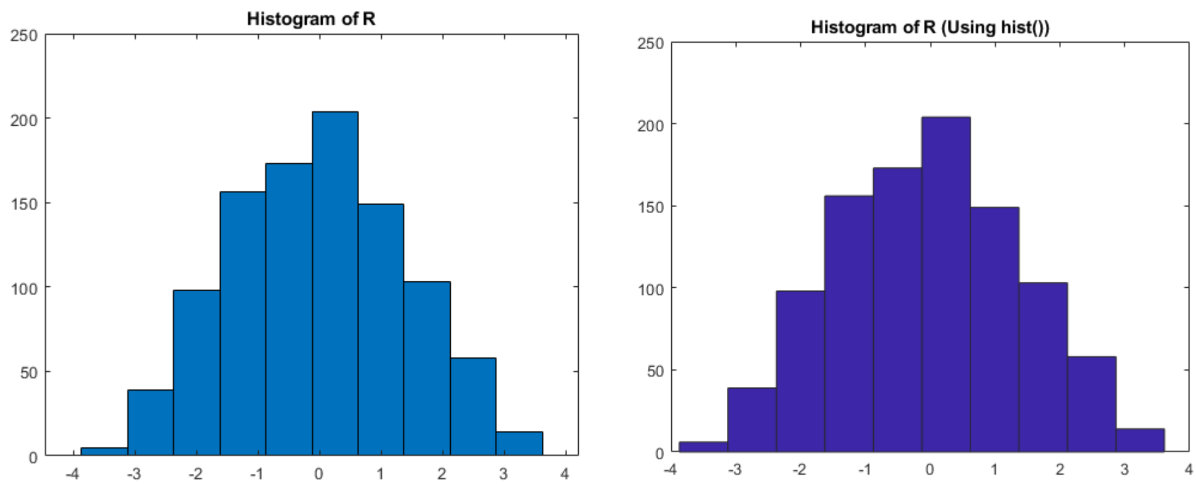


There can be erros in decoding, as shown below



Q5)

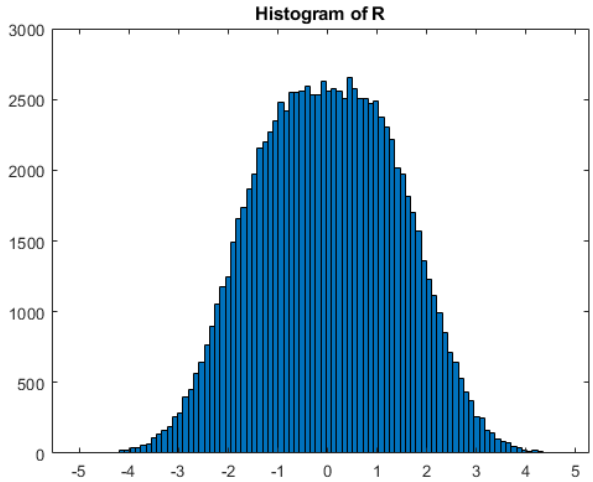
Comparison between builtin function and written function $(no\ of\ bins = 10)$

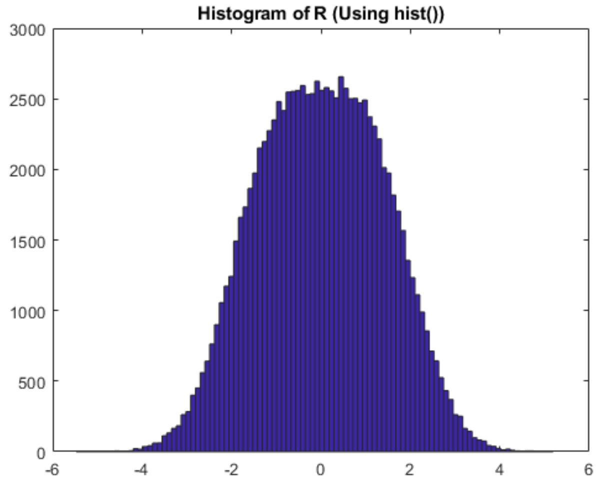


The histograms have a distant appearance of Gaussian distribution.

a)

$$Comparison\ between\ builtin\ function\ and\ written\ function\ (no\ of\ bins = 100)$$

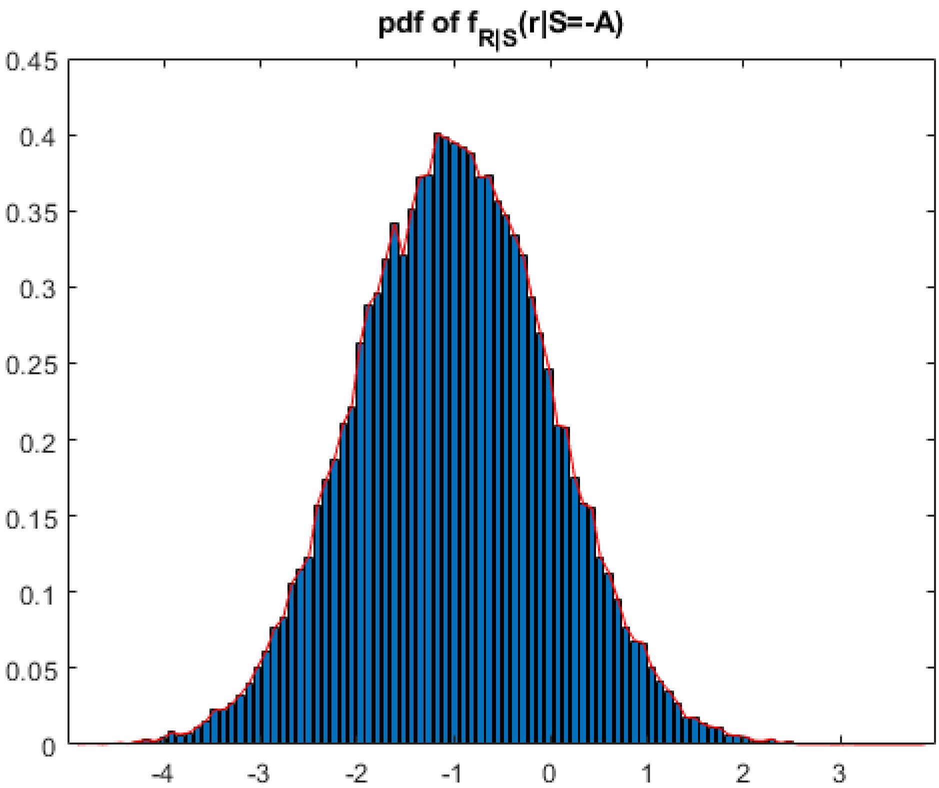




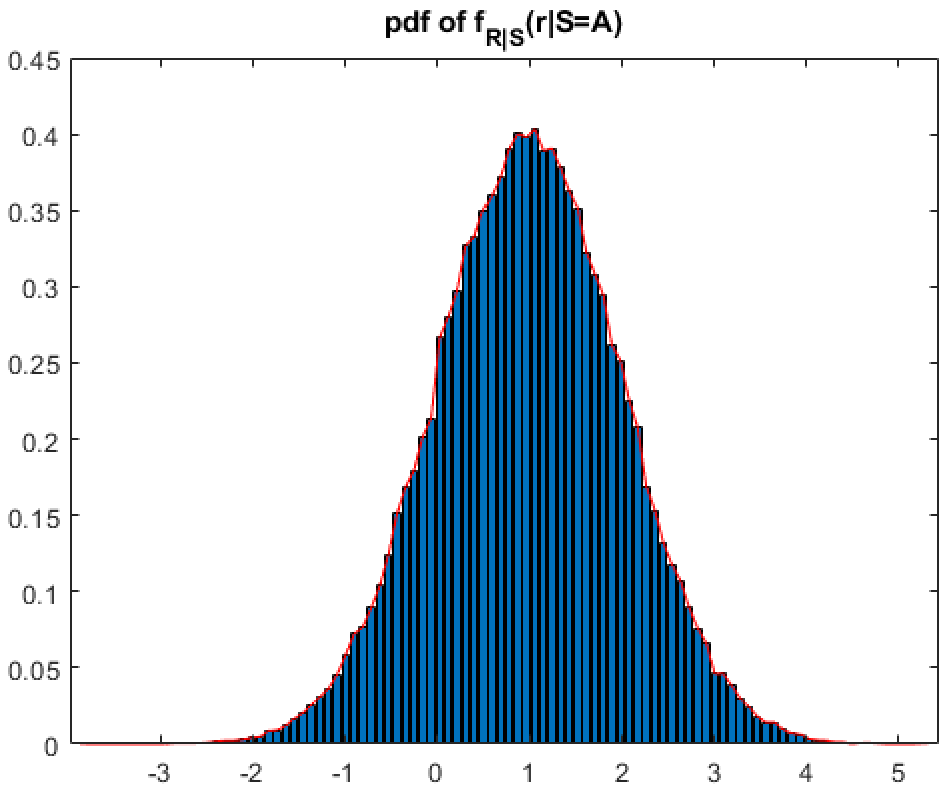
Upon increasing the no of bins, histograms have obtained a close look of Gaussian distribution.

b)

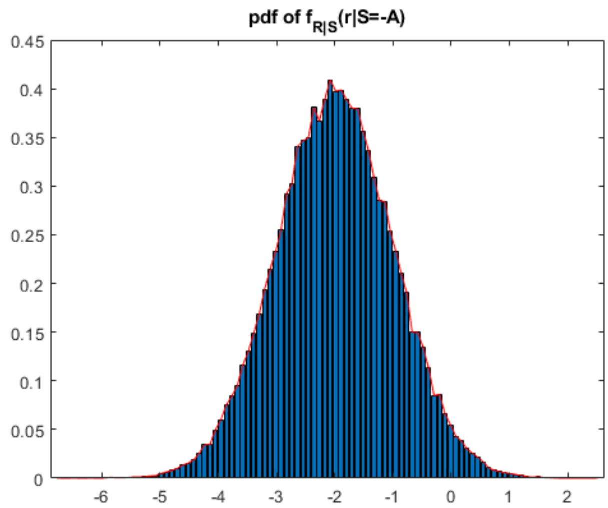
$$f_{R|S}(r|S = -A), A = 1$$



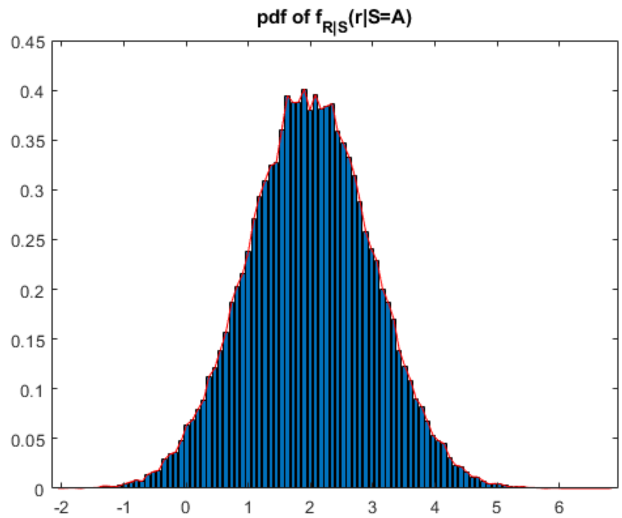
$f_{R|S}(r|S = A), A = 1$



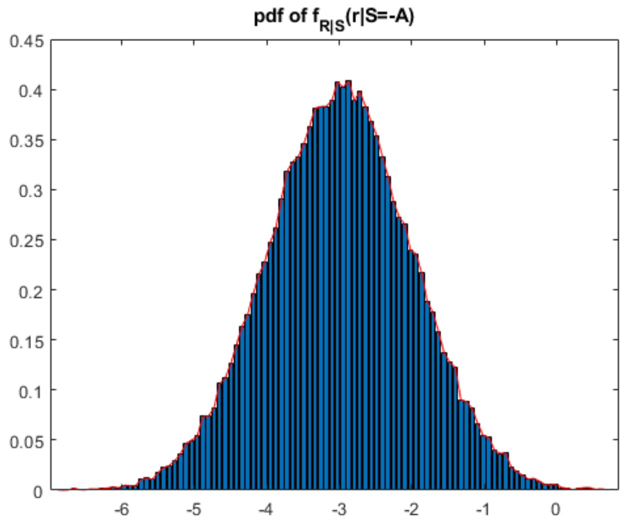
$f_{R|S}(r|S = -A), A = 2$

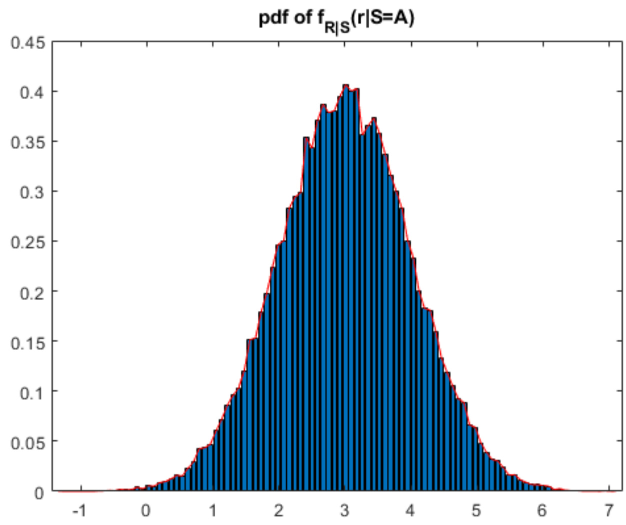


$f_{R|S}(r|S = A), A = 2$



$f_{R|S}(r|S = -A), A = 3$ $\qquad$ $f_{R|S}(r|S = A), A = 3$





When A increases the pdfs deviates from its initial positions when A=1.

This is due to mean values of the pdfs is -A for $f_{R|S}(r|S = -A)$ and A for $f_{R|S}(r|S = A)$

c)

For the expected value,

$$E[X] = \sum_{i=1}^{N} x_i \, f_{x_i} \Delta x_i$$

Where,

$$f_{x_i} = frequency\ of\ each\ bin$$

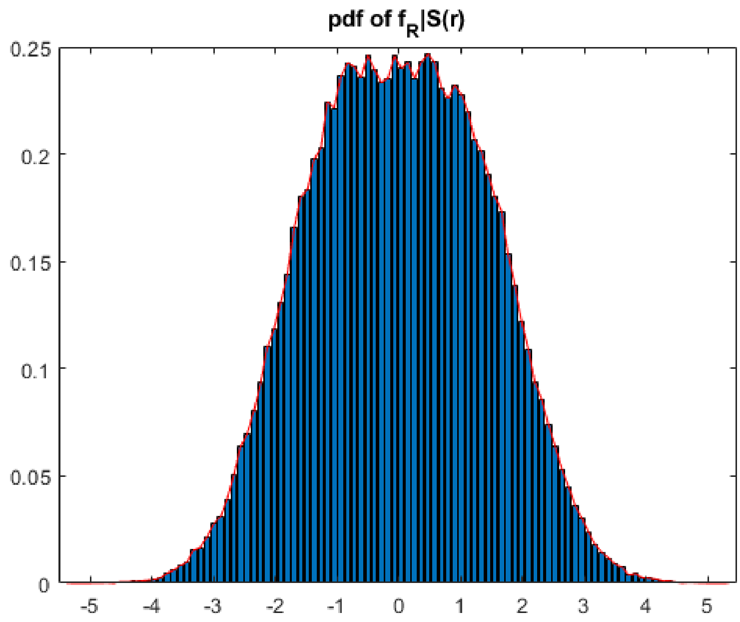
$$x_i = mid\ value\ of\ bin$$

$$\Delta x_i = width\ of\ bin$$

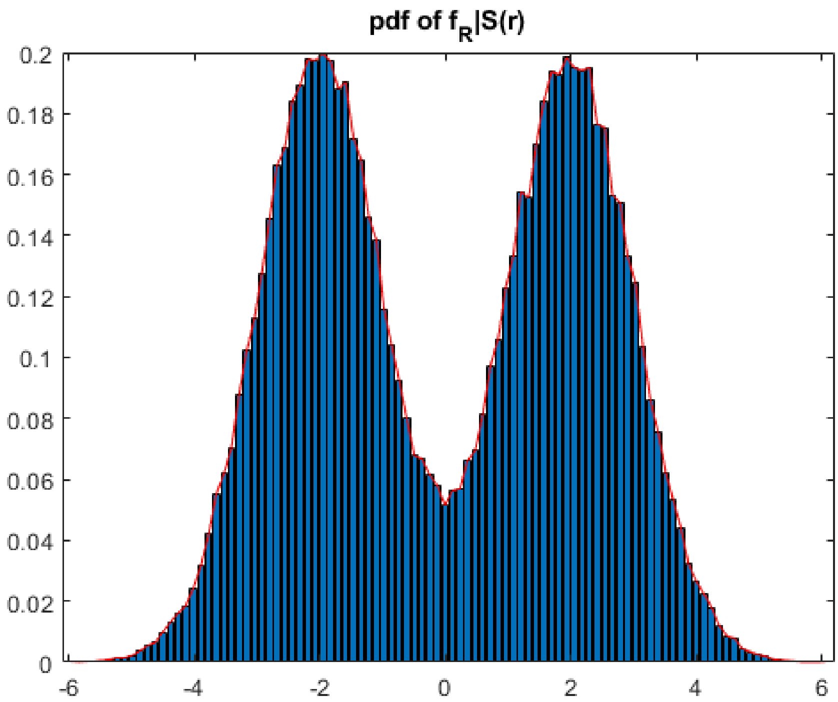
A	E [R|S = A]	E [R|S = -A]	E [R]
1	1.0025	-1.0017	0.003864
2	1.9976	-2.0006	-0.0012
3	3.0006	-3.0068	-0.0029

d)

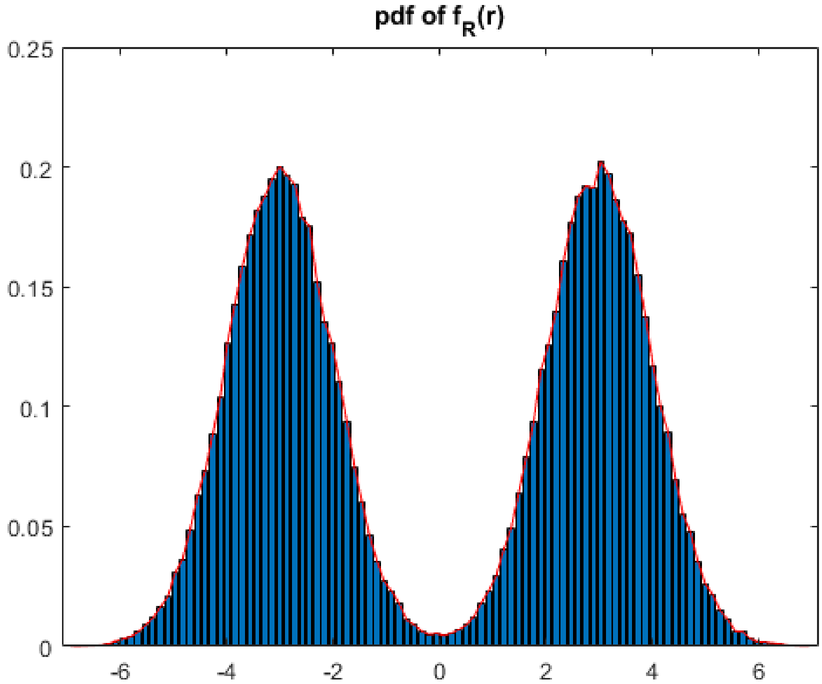
$$f_R(r), A = 1$$



$$f_R(r), A = 2$$



$f_R(r), A = 3$

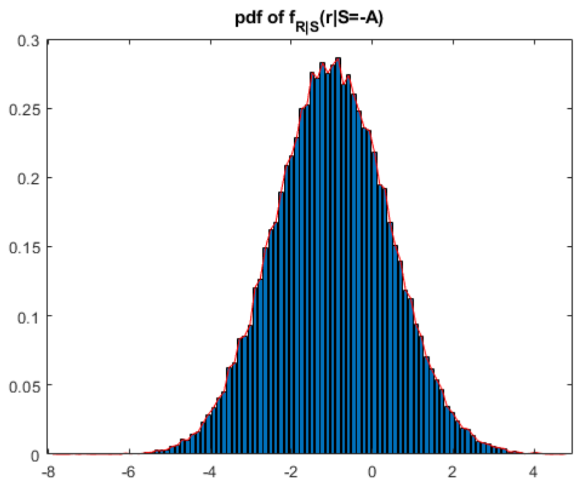


Q6)

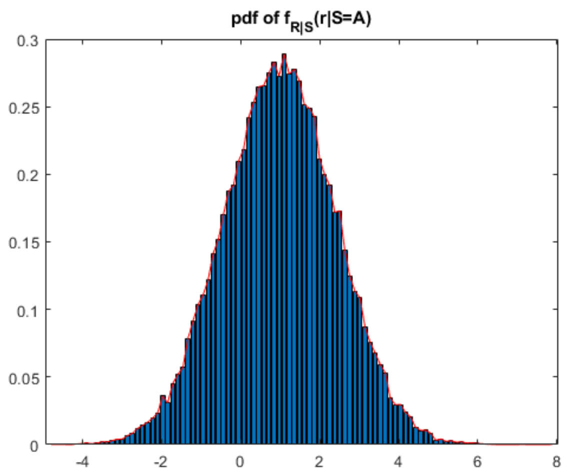
b)

$A = 1$

$f_{R|S}(r|S = -A)$

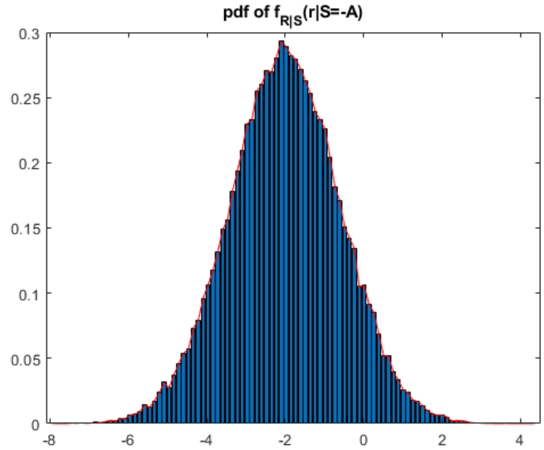


$f_{R|S}(r|S = A)$

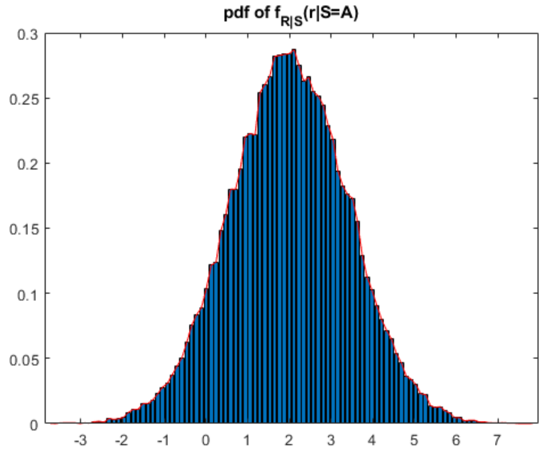


$$A = 2$$

$f_{R|S}(r|S = -A)$

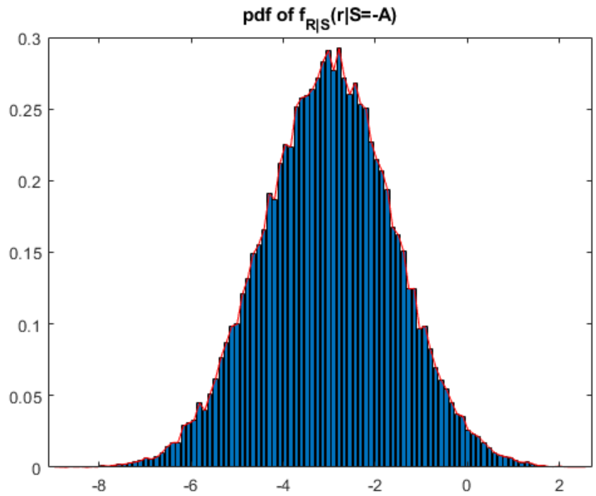


$f_{R|S}(r|S = A)$

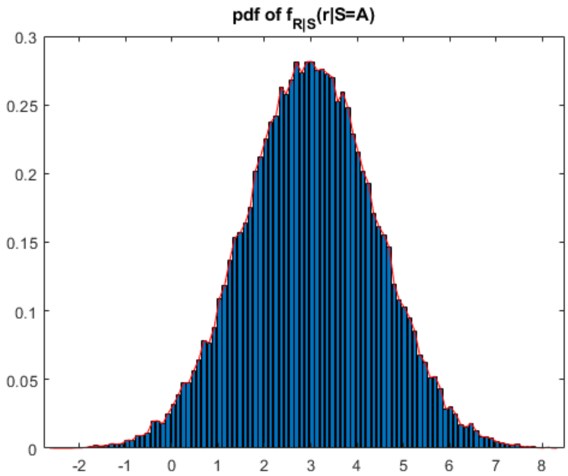


$$A = 3$$

$f_{R|S}(r|S = -A)$



$f_{R|S}(r|S = A)$

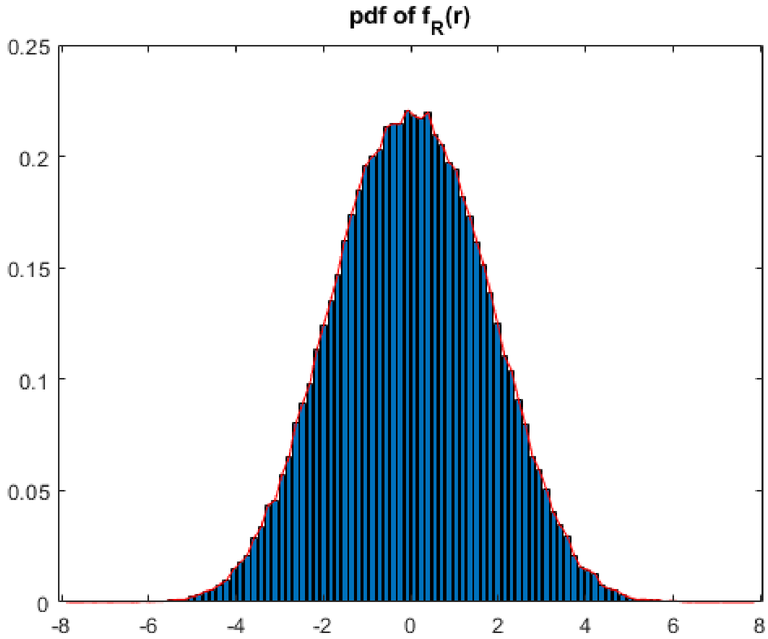


c)

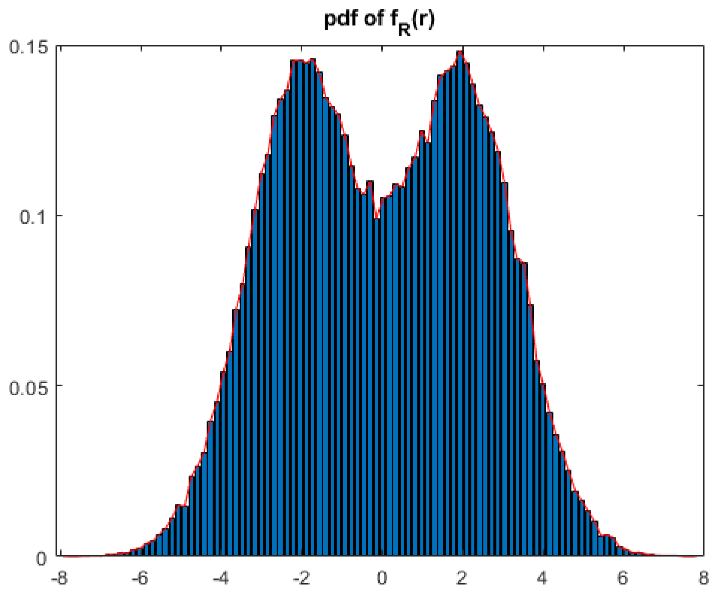
A	E [R|S = A]	E [R|S = -A]	E [R]
1	0.9965	-0.9965	-0.000091
2	2.0001	-2.0088	-0.0044
3	2.999	-3.0159	-0.0081

d)

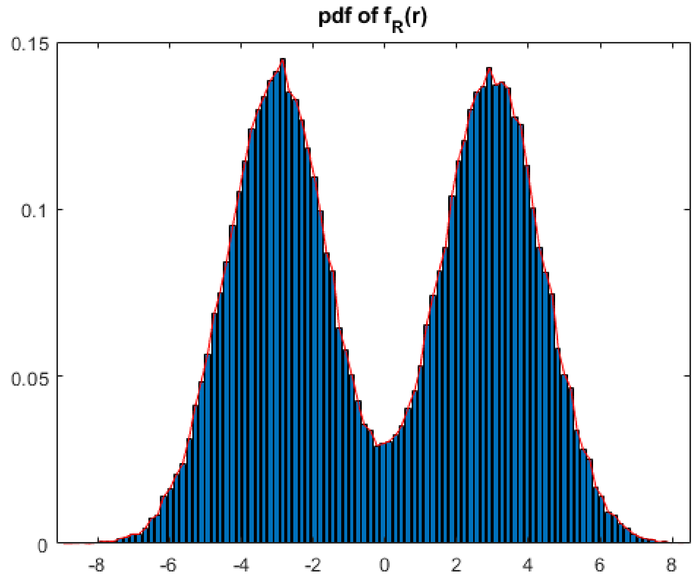
$$f_R(r), A = 1$$



$$f_R(r), A = 2$$



$$f_R(r), A = 3$$



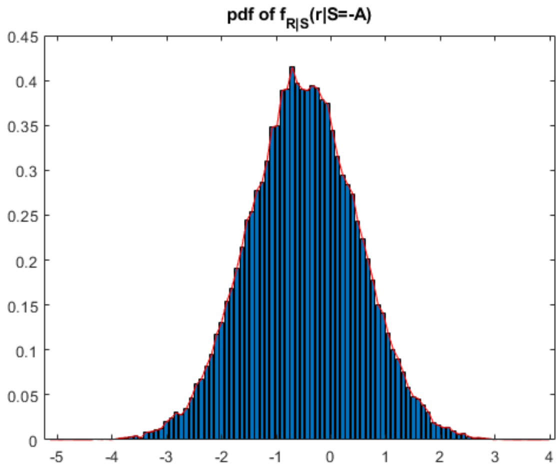
When increasing A, the middle separation of $f_R(r)$ increases, but it is not quite dominant as without the interference (in Q5-d). This is due to interference another Gaussian random signal gets added to the Initial Signal which increased the variance of both $f_{R|S}(r|S = -A)$ and $f_{R|S}(r|S = -A)$.

Q7)

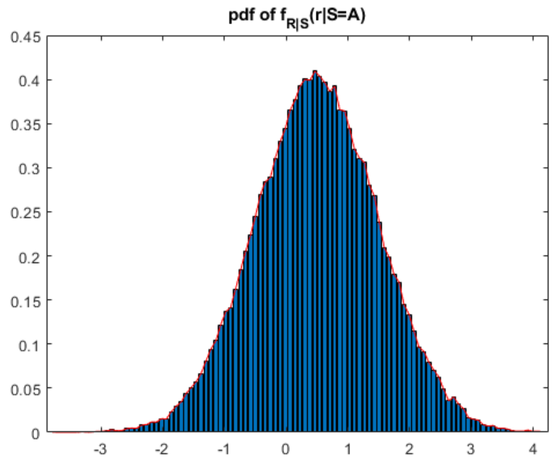
b)

$$\alpha = 0.5, A = 1$$

$f_{R|S}(r|S = -A)$

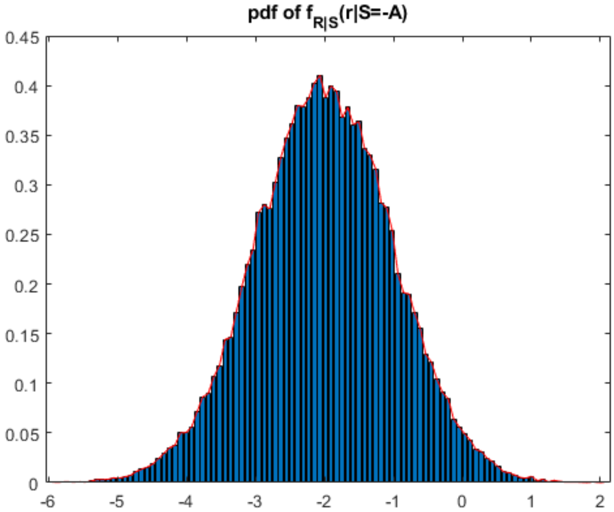


$f_{R|S}(r|S = A)$

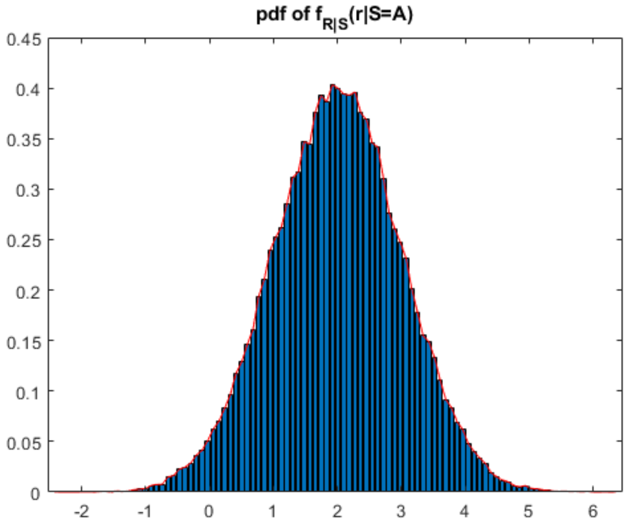


$\alpha = 2, A = 1$

$f_{R|S}(r|S = -A)$

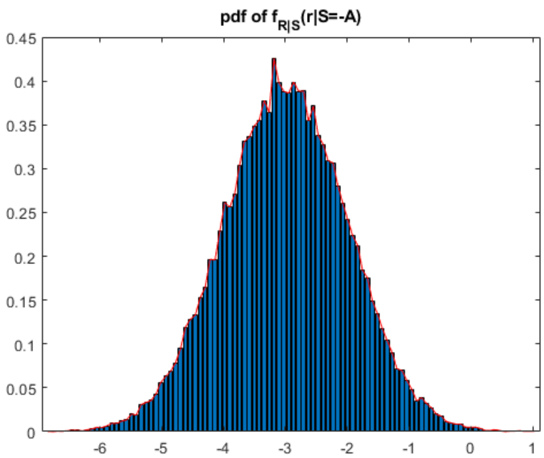


$f_{R|S}(r|S = A)$

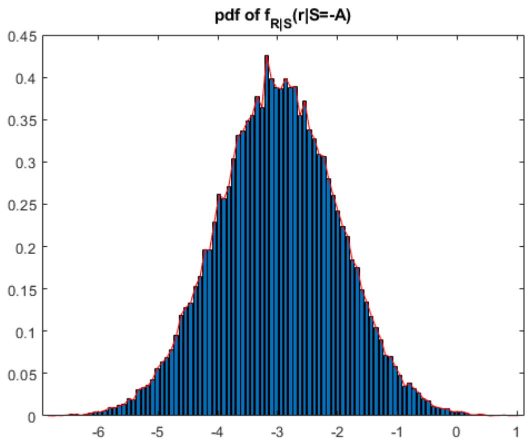


$\alpha = 3, A = 1$

$f_{R|S}(r|S = -A)$



$f_{R|S}(r|S = A)$

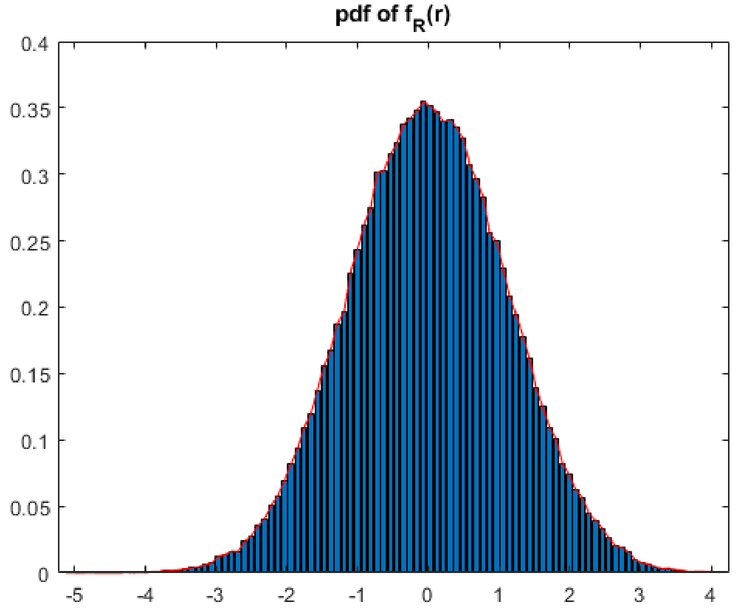


c) $A = 1$

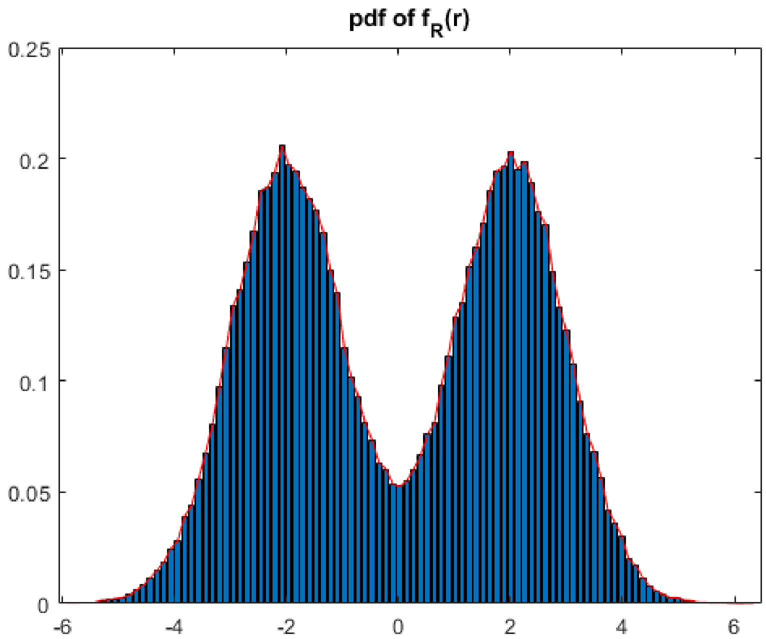
α	E [R | S = A]	E [R | S = -A]	E [R]
0.5	0.5011	-0.5090	-0.0038
2	1.9994	-2.0056	-0.0031
3	2.9899	-2.9972	-0.0035

d)

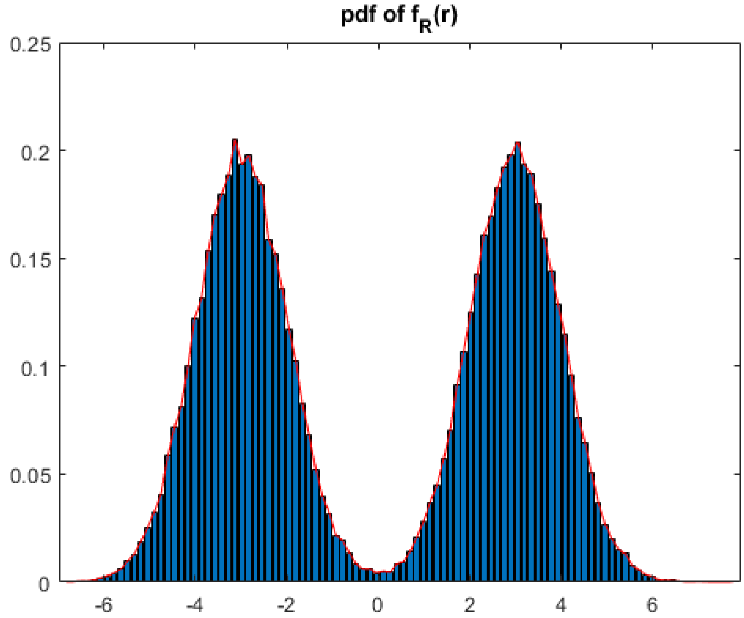
$f_R(r), A = 1, \alpha = 0.5$



$f_R(r), A = 1, \alpha = 2$



$f_R(r), A = 1, \alpha = 3$



When increasing α, the middle separation of $f_R(r)$ increases. This is due to mean values of the pdfs is - α A for $f_{R|S}(r|S = -A)$ and α A for $f_{R|S}(r|S = A)$.