
Table of Contents

.....	1
Part 1	1
Part 2	1
Functions	8

Part 1

Part 1

The \hat{x} Matrix (Centroids of Regions) is :

```
x_hat(1) = -5.186456   x_hat(2) = -4.216786   x_hat(3) = -2.370590   x_hat(4)
= -0.722767   x_hat(5) = 0.459855   x_hat(6) = 1.510012   x_hat(7) = 3.282648
x_hat(8) = 5.186456
```

Variance Of Quantization Noise = 0.177026

SQNR = 7.519628 dB

Part 2

Part 2

N = 4

Var = 1

Number Of Iterations = 39

```
a(1) = -0.977296   a(2) = 0.004228   a(3) = 0.984719
```

```
x_hat(1) = -1.506347   x_hat(2) = -0.448246   x_hat(3) = 0.456703   x_hat(4)
= 1.512735
```

Distortion = 0.117703

SQNR = 9.292111 dB

N = 8

Var = 1

Number Of Iterations = 121

```
a(1) = -1.735475   a(2) = -1.036334   a(3) = -0.486551   a(4) = 0.013710   a(5)
= 0.513287   a(6) = 1.060890   a(7) = 1.756567
```

```
x_hat(1) = -2.140278   x_hat(2) = -1.330672   x_hat(3) = -0.741995   x_hat(4)
= -0.231106   x_hat(5) = 0.258526   x_hat(6) = 0.768048   x_hat(7) = 1.353733
x_hat(8) = 2.159402
```

Distortion = 0.034691
SQNR = 14.597805 dB

N = 16
Var = 1
Number Of Iterations = 207

a(1) = -2.441401 a(2) = -1.890652 a(3) = -1.488591 a(4) = -1.153623 a(5) = -0.856784
a(6) = -0.581942 a(7) = -0.318674 a(8) = -0.060907 a(9) = 0.197344
a(10) = 0.462103 a(11) = 0.739480 a(12) = 1.040335 a(13) = 1.380467
a(14) = 1.790462 a(15) = 2.354049

x_hat(1) = -2.769524 x_hat(2) = -2.113278 x_hat(3) = -1.668027 x_hat(4) = -1.309154
x_hat(5) = -0.998092 x_hat(6) = -0.715477 x_hat(7) = -0.448407
x_hat(8) = -0.188940 x_hat(9) = 0.067126 x_hat(10) = 0.327562 x_hat(11) = 0.596644
x_hat(12) = 0.882316 x_hat(13) = 1.198353 x_hat(14) = 1.562580
x_hat(15) = 2.018343 x_hat(16) = 2.689754

Distortion = 0.009571
SQNR = 20.190297 dB

N = 32
Var = 1
Number Of Iterations = 529

a(1) = -2.918737 a(2) = -2.438512 a(3) = -2.099619 a(4) = -1.825956 a(5) = -1.590555
a(6) = -1.381032 a(7) = -1.190344 a(8) = -1.014246 a(9) = -0.849391
a(10) = -0.693380 a(11) = -0.544258 a(12) = -0.400314 a(13) = -0.260325
a(14) = -0.123305 a(15) = 0.011733 a(16) = 0.145531 a(17) = 0.278583
a(18) = 0.411628 a(19) = 0.545657 a(20) = 0.681657 a(21) = 0.820616
a(22) = 0.963521 a(23) = 1.111587 a(24) = 1.266518 a(25) = 1.430948
a(26) = 1.608503 a(27) = 1.803650 a(28) = 2.023852 a(29) = 2.282250
a(30) = 2.604911 a(31) = 3.065413

x_hat(1) = -3.208383 x_hat(2) = -2.629092 x_hat(3) = -2.247933 x_hat(4) = -1.951305
x_hat(5) = -1.700606 x_hat(6) = -1.480504 x_hat(7) = -1.281560
x_hat(8) = -1.099128 x_hat(9) = -0.929364 x_hat(10) = -0.769418 x_hat(11) = -0.617341
x_hat(12) = -0.471174 x_hat(13) = -0.329454 x_hat(14) = -0.191196
x_hat(15) = -0.055415 x_hat(16) = 0.078880 x_hat(17) = 0.212182
x_hat(18) = 0.344983 x_hat(19) = 0.478273 x_hat(20) = 0.613040 x_hat(21) = 0.750274
x_hat(22) = 0.890959 x_hat(23) = 1.036082 x_hat(24) = 1.187091
x_hat(25) = 1.345945 x_hat(26) = 1.515951 x_hat(27) = 1.701054 x_hat(28) = 1.906246
x_hat(29) = 2.141459 x_hat(30) = 2.423041 x_hat(31) = 2.786782
x_hat(32) = 3.344044

Distortion = 0.002584
SQNR = 25.876280 dB

$N = 4$

$\text{Var} = 5$

Number Of Iterations = 54

$a(1) = -2.200289$ $a(2) = -0.005704$ $a(3) = 2.189648$

$\hat{x}(1) = -3.382396$ $\hat{x}(2) = -1.018182$ $\hat{x}(3) = 1.006773$ $\hat{x}(4) = 3.372524$

Distortion = 0.587413

SQNR = 9.300267 dB

$N = 8$

$\text{Var} = 5$

Number Of Iterations = 73

$a(1) = -3.925549$ $a(2) = -2.367517$ $a(3) = -1.140434$ $a(4) = -0.021721$ $a(5) = 1.097918$ $a(6) = 2.328133$ $a(7) = 3.891588$

$\hat{x}(1) = -4.827286$ $\hat{x}(2) = -3.023811$ $\hat{x}(3) = -1.711223$ $\hat{x}(4) = -0.569645$ $\hat{x}(5) = 0.526203$ $\hat{x}(6) = 1.669633$ $\hat{x}(7) = 2.986632$ $\hat{x}(8) = 4.796544$

Distortion = 0.172752

SQNR = 14.615466 dB

$N = 16$

$\text{Var} = 5$

Number Of Iterations = 340

$a(1) = -5.415779$ $a(2) = -4.176507$ $a(3) = -3.272577$ $a(4) = -2.520523$ $a(5) = -1.852683$ $a(6) = -1.234560$ $a(7) = -0.644974$ $a(8) = -0.068305$ $a(9) = 0.509606$ $a(10) = 1.102175$ $a(11) = 1.724286$ $a(12) = 2.397339$ $a(13) = 3.156499$ $a(14) = 4.070267$ $a(15) = 5.323185$

$\hat{x}(1) = -6.153635$ $\hat{x}(2) = -4.677923$ $\hat{x}(3) = -3.675091$ $\hat{x}(4) = -2.870062$ $\hat{x}(5) = -2.170985$ $\hat{x}(6) = -1.534381$ $\hat{x}(7) = -0.934739$ $\hat{x}(8) = -0.355209$ $\hat{x}(9) = 0.218599$ $\hat{x}(10) = 0.800612$ $\hat{x}(11) = 1.403738$ $\hat{x}(12) = 2.044834$ $\hat{x}(13) = 2.749844$ $\hat{x}(14) = 3.563154$ $\hat{x}(15) = 4.577381$ $\hat{x}(16) = 6.068990$

Distortion = 0.047540

SQNR = 20.219070 dB

N = 32

Var = 5

Number Of Iterations = 609

a(1) = -6.621632 a(2) = -5.561815 a(3) = -4.815780 a(4) = -4.216625 a(5)
= -3.704053 a(6) = -3.249385 a(7) = -2.836403 a(8) = -2.454279 a(9)
= -2.095377 a(10) = -1.754401 a(11) = -1.427458 a(12) = -1.111368 a(13)
= -0.803428 a(14) = -0.501675 a(15) = -0.204130 a(16) = 0.091686 a(17)
= 0.387501 a(18) = 0.684796 a(19) = 0.985552 a(20) = 1.291501 a(21)
= 1.604605 a(22) = 1.927329 a(23) = 2.262833 a(24) = 2.615511 a(25)
= 2.990685 a(26) = 3.395512 a(27) = 3.840563 a(28) = 4.342502 a(29)
= 4.930776 a(30) = 5.665653 a(31) = 6.712785

x_hat(1) = -7.261330 x_hat(2) = -5.981933 x_hat(3) = -5.141696 x_hat(4)
= -4.489865 x_hat(5) = -3.943386 x_hat(6) = -3.464720 x_hat(7) = -3.034049
x_hat(8) = -2.638757 x_hat(9) = -2.269800 x_hat(10) = -1.920954 x_hat(11)
= -1.587848 x_hat(12) = -1.267069 x_hat(13) = -0.955667 x_hat(14)
= -0.651189 x_hat(15) = -0.352162 x_hat(16) = -0.056098 x_hat(17)
= 0.239470 x_hat(18) = 0.535532 x_hat(19) = 0.834060 x_hat(20) = 1.137044
x_hat(21) = 1.445957 x_hat(22) = 1.763252 x_hat(23) = 2.091405 x_hat(24)
= 2.434261 x_hat(25) = 2.796761 x_hat(26) = 3.184610 x_hat(27) = 3.606415
x_hat(28) = 4.074711 x_hat(29) = 4.610293 x_hat(30) = 5.251258 x_hat(31)
= 6.080047 x_hat(32) = 7.345523

Distortion = 0.012540

SQNR = 26.006637 dB

N = 4

Var = 10

Number Of Iterations = 40

a(1) = -3.109708 a(2) = -0.006330 a(3) = 3.098365

x_hat(1) = -4.781304 x_hat(2) = -1.438113 x_hat(3) = 1.425452 x_hat(4)
= 4.771277

Distortion = 1.174823

SQNR = 9.300277 dB

N = 8

Var = 10

Number Of Iterations = 165

a(1) = -5.522451 a(2) = -3.314427 a(3) = -1.576525 a(4) = 0.006584 a(5)
= 1.589248 a(6) = 3.325907 a(7) = 5.532333

```
x_hat(1) =-6.800568   x_hat(2) =-4.244333   x_hat(3) =-2.384521   x_hat(4)
=-0.768529   x_hat(5) =0.781698   x_hat(6) =2.396799   x_hat(7) =4.255015
x_hat(8) =6.809651
```

```
Distortion = 0.345479
```

```
SQNR = 14.615785 dB
```

```
*****
```

```
N = 16
```

```
Var = 10
```

```
Number Of Iterations = 436
```

```
a(1) =-7.648709   a(2) =-5.894655   a(3) =-4.615528   a(4) =-3.551756   a(5)
=-2.607500   a(6) =-1.733579   a(7) =-0.899606   a(8) =-0.083564   a(9)
=0.733712   a(10) =1.571160   a(11) =2.450296   a(12) =3.401488   a(13)
=4.474362   a(14) =5.765356   a(15) =7.535493
```

```
x_hat(1) =-8.693153   x_hat(2) =-6.604264   x_hat(3) =-5.185045   x_hat(4)
=-4.046010   x_hat(5) =-3.057502   x_hat(6) =-2.157498   x_hat(7) =-1.309660
x_hat(8) =-0.489551   x_hat(9) =0.322424   x_hat(10) =1.145000   x_hat(11)
=1.997320   x_hat(12) =2.903271   x_hat(13) =3.899704   x_hat(14) =5.049021
x_hat(15) =6.481690   x_hat(16) =8.589296
```

```
Distortion = 0.095063
```

```
SQNR = 20.219881 dB
```

```
*****
```

```
N = 32
```

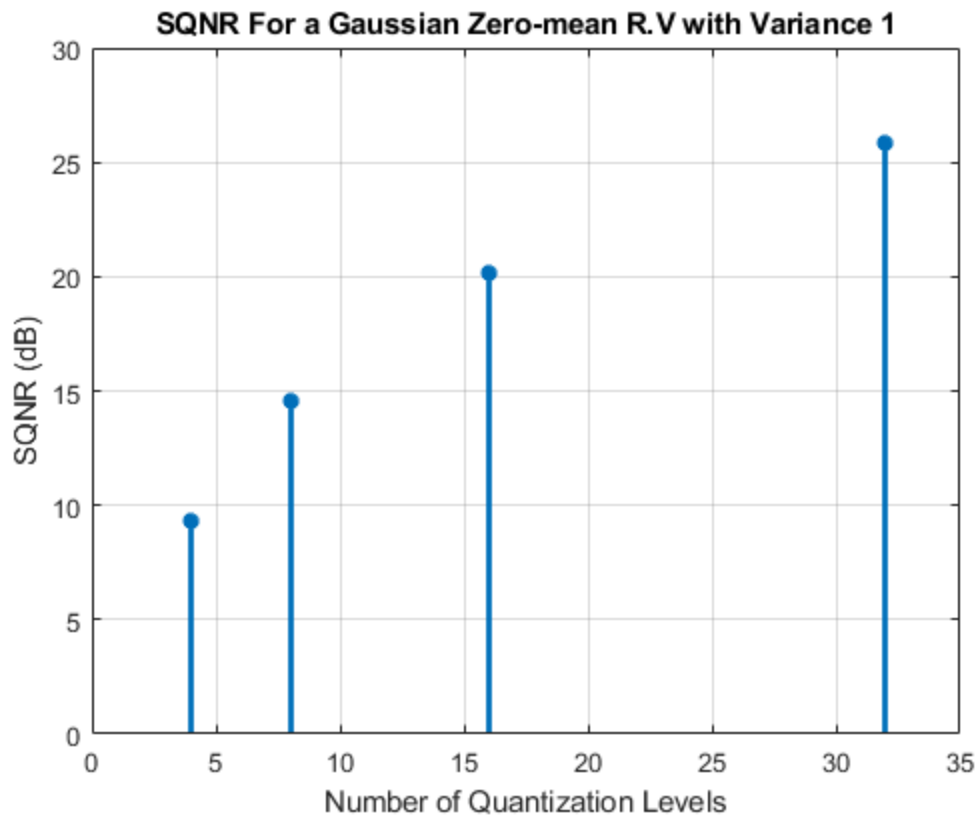
```
Var = 10
```

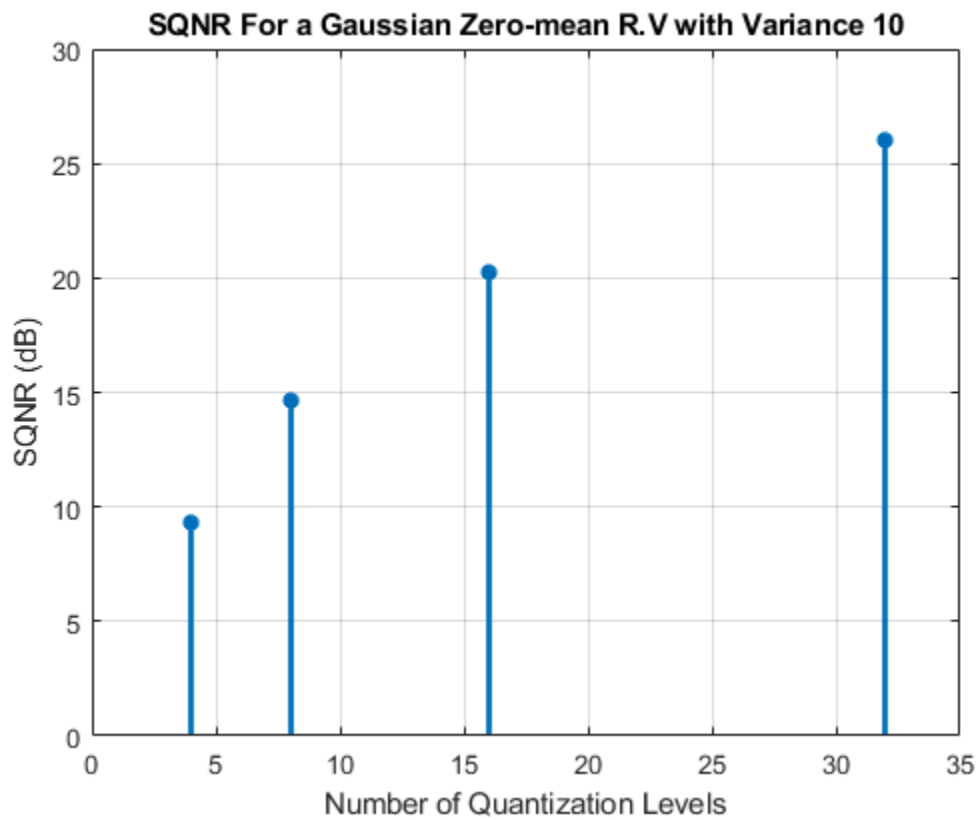
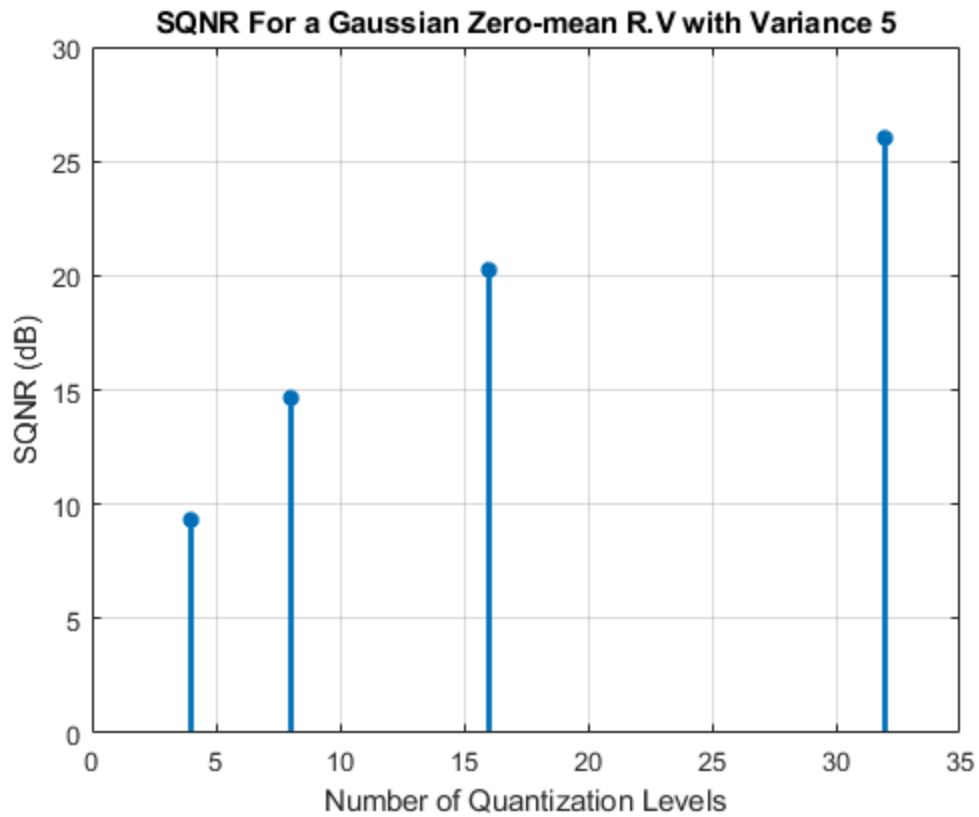
```
Number Of Iterations = 697
```

```
a(1) =-9.597739   a(2) =-8.128507   a(3) =-7.097690   a(4) =-6.272531   a(5)
=-5.568601   a(6) =-4.944522   a(7) =-4.376522   a(8) =-3.849587   a(9)
=-3.353698   a(10) =-2.881607   a(11) =-2.427461   a(12) =-1.986875   a(13)
=-1.556660   a(14) =-1.133598   a(15) =-0.714734   a(16) =-0.297595   a(17)
=0.120295   a(18) =0.541407   a(19) =0.968462   a(20) =1.404425   a(21)
=1.852496   a(22) =2.316362   a(23) =2.800423   a(24) =3.310274   a(25)
=3.853391   a(26) =4.440500   a(27) =5.087138   a(28) =5.817037   a(29)
=6.671747   a(30) =7.736692   a(31) =9.248696
```

```
x_hat(1) =-10.485711   x_hat(2) =-8.709766   x_hat(3) =-7.547248   x_hat(4)
=-6.648131   x_hat(5) =-5.896932   x_hat(6) =-5.240270   x_hat(7) =-4.648773
x_hat(8) =-4.104272   x_hat(9) =-3.594901   x_hat(10) =-3.112494   x_hat(11)
=-2.650720   x_hat(12) =-2.204201   x_hat(13) =-1.769548   x_hat(14)
=-1.343771   x_hat(15) =-0.923424   x_hat(16) =-0.506043   x_hat(17)
=-0.089147   x_hat(18) =0.329736   x_hat(19) =0.753078   x_hat(20) =1.183846
x_hat(21) =1.625003   x_hat(22) =2.079988   x_hat(23) =2.552736   x_hat(24)
=3.048111   x_hat(25) =3.572438   x_hat(26) =4.134343   x_hat(27) =4.746657
x_hat(28) =5.427620   x_hat(29) =6.206455   x_hat(30) =7.137039   x_hat(31)
=8.336345   x_hat(32) =10.161047
```

$Distortion = 0.025224$
 $SQNR = 25.981815 \text{ dB}$





Functions

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