Problem_A_7_1

October 1, 2021

1 A 7.2

1.0.1 Imports

[37]:
```
include("channel_equalization_data.jl")
using Plots
Plots.pyplot()
```

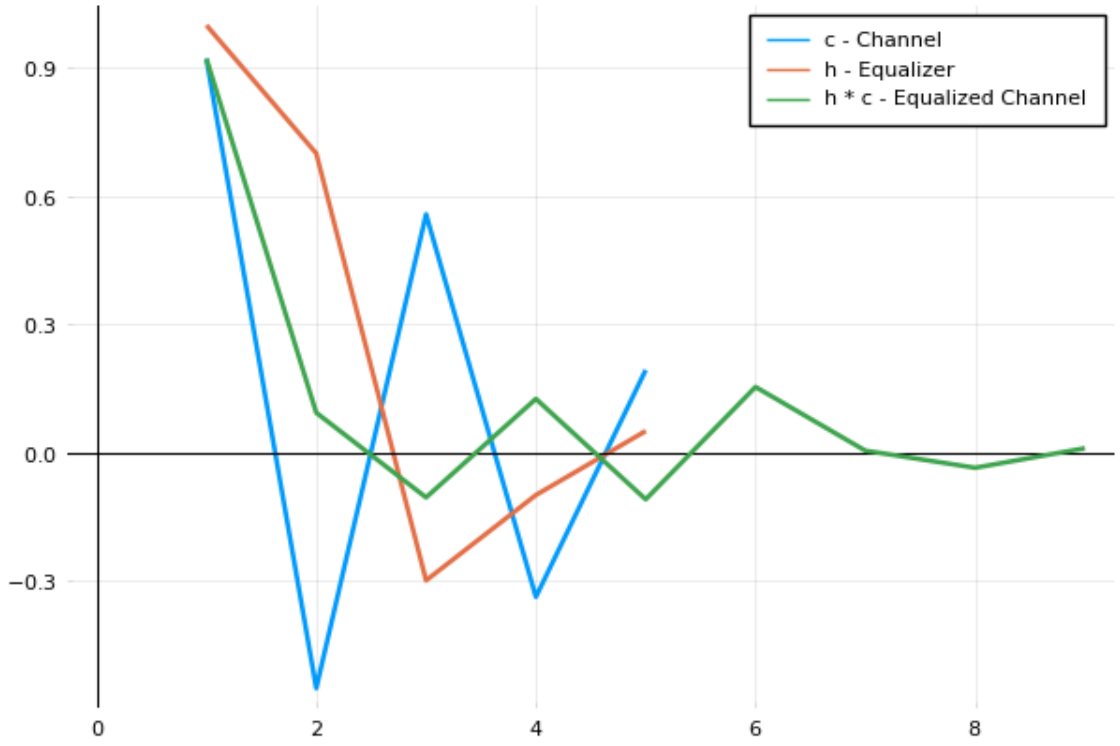
[37]:
```
Plots.PyPlotBackend()
```

1.0.2 Plot h, c, h ∗ c

[38]:
```
using DSP
println("h = ", h)
println("c = ", c)
println("h * c = ", conv(h, c))
plot([h, c, conv(h, c)], framestyle = :zerolines, label = ["c - Channel" "h -␣
 ↪Equalizer" "h * c - Equalized Channel"], lw = 1.8)
#plot(h, framestyle = :zerolines, label = "h")
```

```
h = [0.9214015838276353, -0.5521876169295151, 0.5573851982305564,
-0.33847254425948153, 0.19274372830178776]
c = [1.0, 0.7, -0.3, -0.1, 0.05]
h * c = [0.9214015838276352, 0.09279349174982951, -0.10556660876839458,
0.12521322119799888, -0.11011377126468291, 0.1531144724195644,
0.0038933958469396695, -0.03619800004315286, 0.009637186415089396]
```

[38]:



1.0.3 From the above graph it is clear that equalizer is used to equalize the frequency changes in the signal, thus resulting in a smoother Equalized Channel line h ∗ c

1.0.4 Plot s, y and $ $

[48]:
```
print(s)
plot(s, xlim = (0,100), framestyle = :zerolines, st = :sticks, label = "s")
```

```
Bool[0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 0, 1, 1, 0, 0, 1, 1, 0,
1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 1,
0, 1, 0, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0, 0, 1, 1, 1, 0, 1, 1,
0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 1, 1, 1, 0, 0, 1, 0, 0, 1, 1, 1, 0, 1, 0,
0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1,
0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 0, 1, 0, 1, 1, 0,
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1, 0, 0, 0, 1, 0, 1, 1, 0, 0, 1, 1, 1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 0,
1, 1, 0, 1, 0, 0, 1, 0, 1, 1, 1, 1, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 1, 0, 0, 1, 0,
1, 1, 0, 1, 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 0, 0, 1,
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1, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 1, 1, 0, 1, 0,
```

```
0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1,
1, 1, 1, 1, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0,
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0, 1, 1, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1,
0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 0, 0, 0, 0, 1, 0,
0, 0, 1, 0, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 1, 1, 1, 1, 0, 0, 1, 0, 1, 0, 1, 1, 1,
1, 0, 1, 1, 0, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 1, 0, 1, 1, 1, 0, 0,
0, 1, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 0, 0, 0, 0, 1,
1, 0, 0]
```
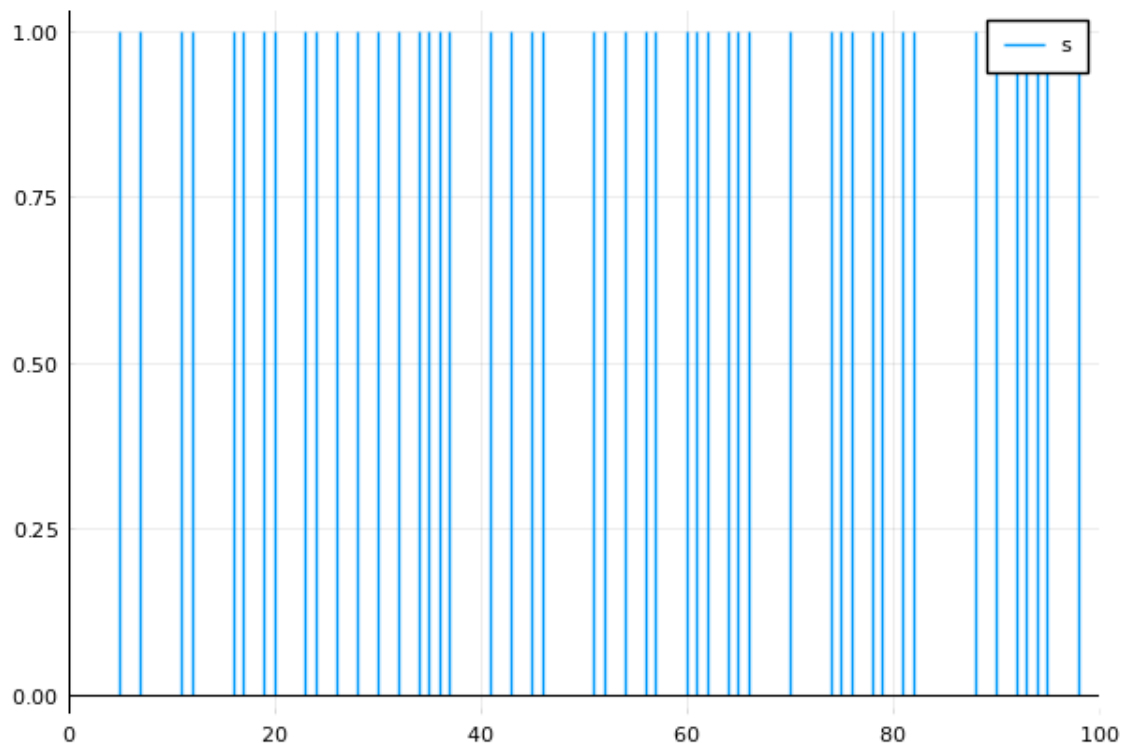
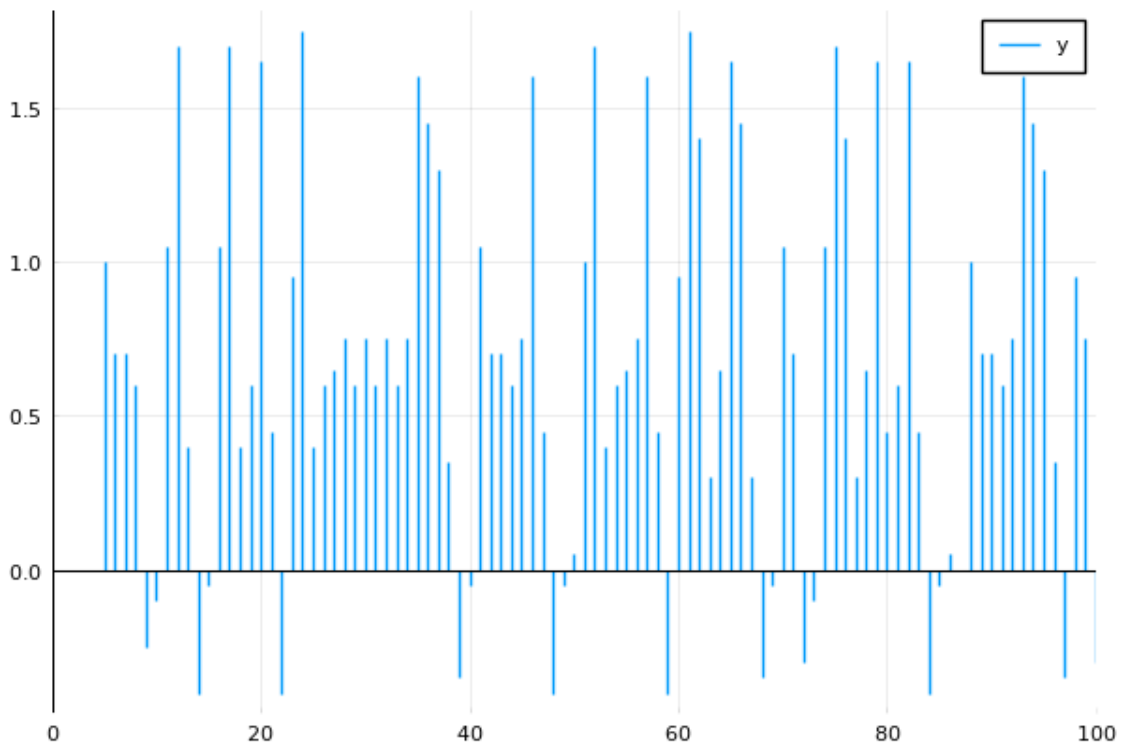

[48]:



1.0.5 Compute and plot y = c ∗ s

[49]:
```
y = conv(c, s)
#print(y)
plot(y, xlim = (0,100), framestyle = :zerolines, st = :sticks, label = "y")
```

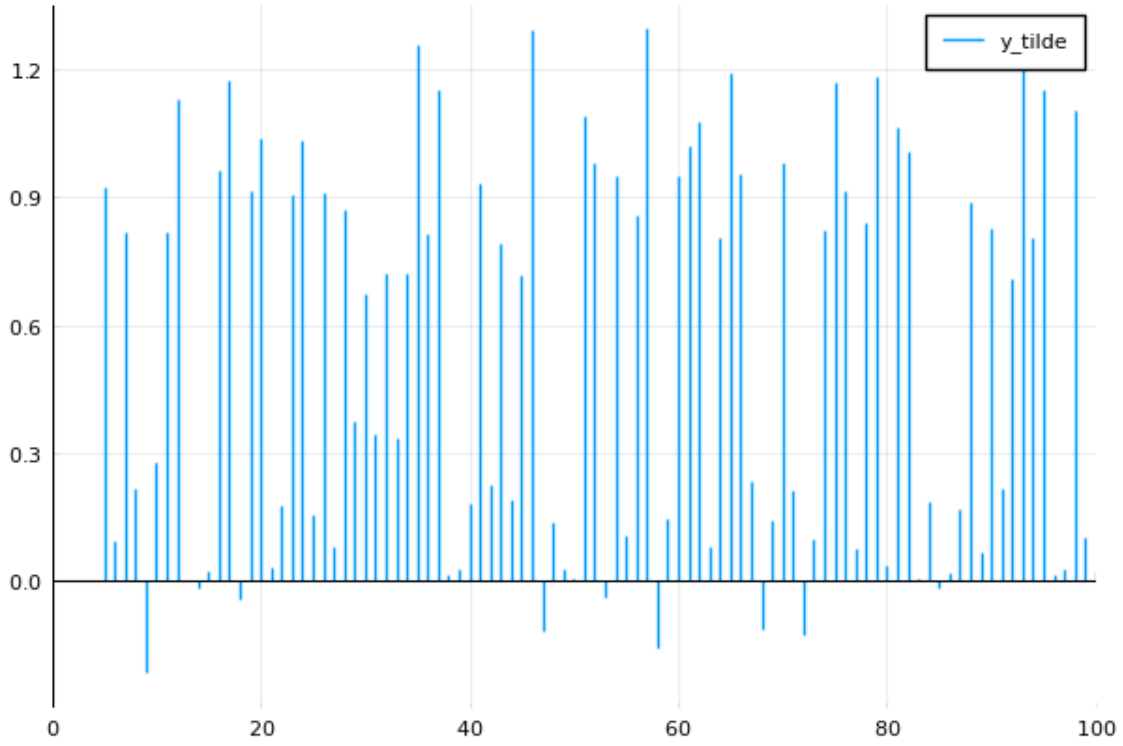
[49]:



1.0.6 Compute and plot $\tilde{y}$ = h ∗ y

[50]:
```
y_tilde = conv(h, y)
#print(y_tilde)
plot(y_tilde, xlim = (0,100), framestyle = :zerolines, st = :sticks, label =␣
 ↪"y_tilde")
```

[50]:



1.1 From the plots it looks like $\hat{s}$ will be a worse estimate of s, than $\hat{s}^{eq}$ since there are a lot of lines in the graph of y that seems to produce a different result from that of s. This can be more clearly seen after plotting the graphs of $\hat{s}$ and $\hat{s}^{eq}$

1.1.1 Function to compute round(vector)

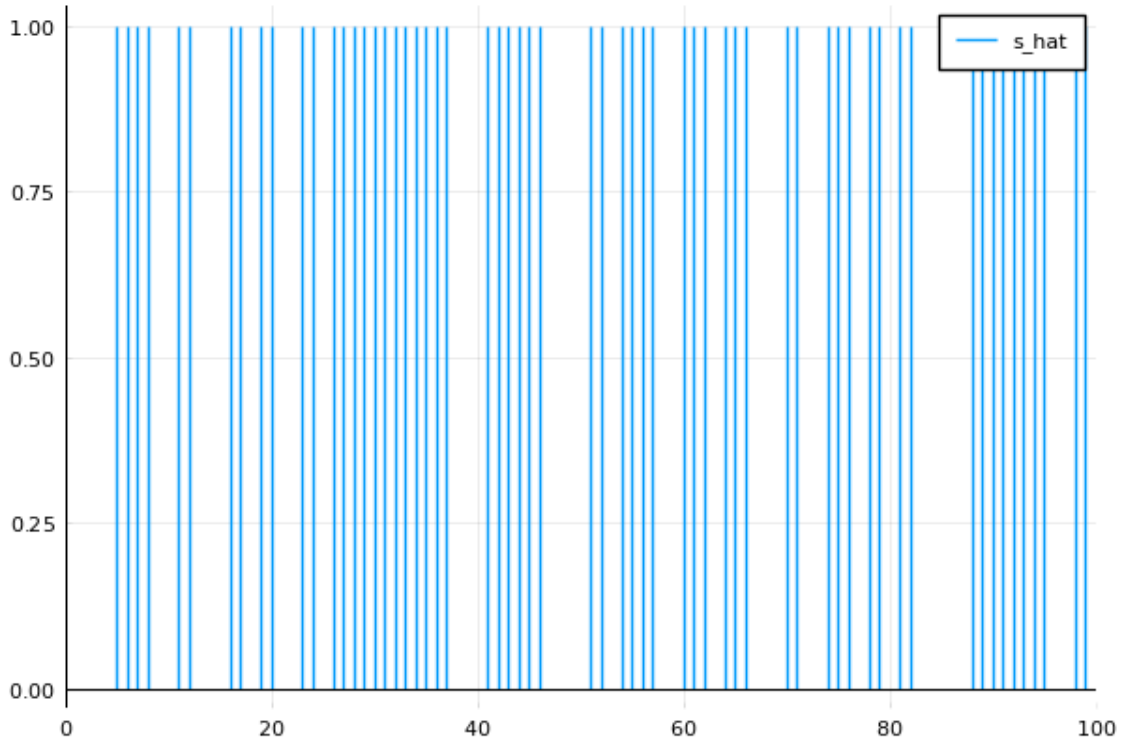
[42]:
```
function round(x)
    return 1(x .> 0.5)
end
```

[42]:
```
round (generic function with 1 method)
```

1.1.2 Compute and plot $\hat{s}$ = round(y)

[51]:
```
s_hat = round(y)
plot(s_hat, xlim = (0,100), framestyle = :zerolines, st = :sticks, label =␣
 ↪"s_hat")
```

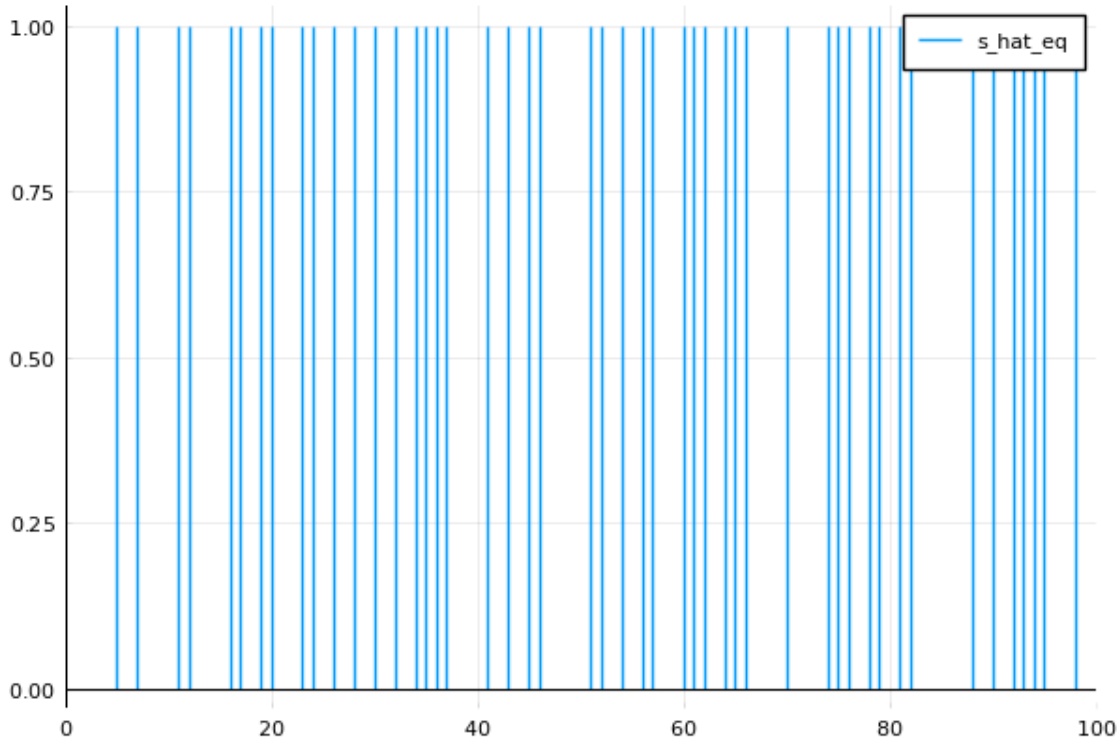
[51]:



1.1.3 Compute and plot $\hat{s}^{eq}$ = round($\tilde{y}$)

[52]:
```
s_hat_eq = round(y_tilde)
plot(s_hat_eq, xlim = (0,100), framestyle = :zerolines, st = :sticks, label =␣
 ↪"s_hat_eq")
```

[52]:



1.1.4 Computing BER for $\hat{s}$ and $\hat{s}^{eq}$

[45]:
```
ber_s_hat = count(i -> i == 0, s_hat[1:1000] .== s) / 1000
print("BER in s_hat = ", ber_s_hat)
```

```
BER in s_hat = 0.132
```

[46]:
```
ber_s_hat_eq = count(i -> i == 0, s_hat_eq[1:1000] .== s) / 1000
print("BER in s_hat_eq = ", ber_s_hat_eq)
```

```
BER in s_hat_eq = 0.0
```

1.2 The BER values in $\hat{s}$ and $\hat{s}^{eq}$, are printed as "BER in s_hat" and "BER in s_hat_eq" respectively above