

# Problem Solving Set 1

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```
## Warning: package 'knitr' was built under R version 4.3.2
```

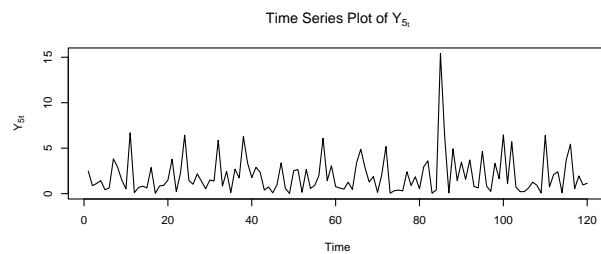
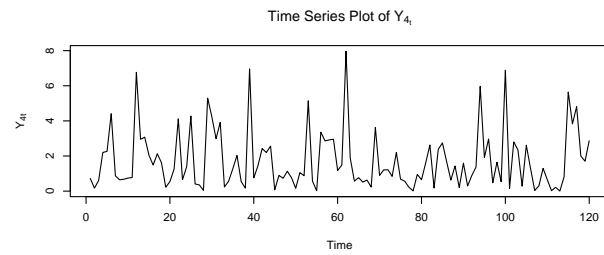
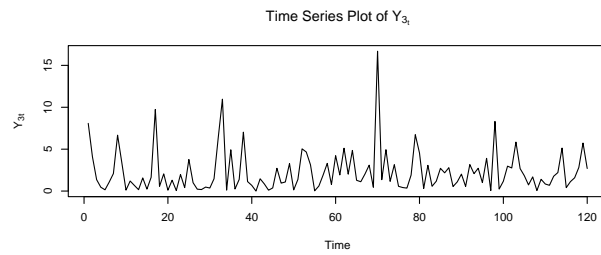
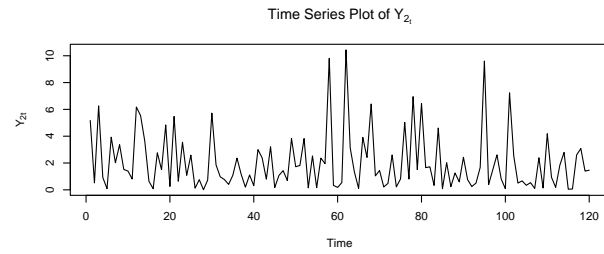
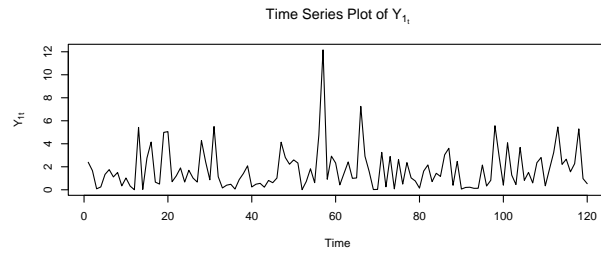
```
set.seed(1401)
```

## Part 1

```
n <- 120
```

```
series1 <- as.ts(rchisq(n, 2, ncp = 0))
series2 <- as.ts(rchisq(n, 2, ncp = 0))
series3 <- as.ts(rchisq(n, 2, ncp = 0))
series4 <- as.ts(rchisq(n, 2, ncp = 0))
series5 <- as.ts(rchisq(n, 2, ncp = 0))
```

```
# pdf.options() pdf('PS1TSPlotsPt1.pdf')
par(mfrow = c(3, 2))
plot(series1, xlab = expression("Time"), ylab = expression(paste("Y"[1][t])),
      main = expression(paste("Time Series Plot of Y"[1][t]))))
plot(series2, xlab = expression("Time"), ylab = expression(paste("Y"[2][t])),
      main = expression(paste("Time Series Plot of Y"[2][t]))))
plot(series3, xlab = expression("Time"), ylab = expression(paste("Y"[3][t])),
      main = expression(paste("Time Series Plot of Y"[3][t]))))
plot(series4, xlab = expression("Time"), ylab = expression(paste("Y"[4][t])),
      main = expression(paste("Time Series Plot of Y"[4][t]))))
plot(series5, xlab = expression("Time"), ylab = expression(paste("Y"[5][t])),
      main = expression(paste("Time Series Plot of Y"[5][t]))))
# dev.off()
```



$Y_1$

- spikes between 50 and 70
- centered around 2
- no patterns / random scatter

$Y_2$

- more variation than  $Y_1$
- still centered at 2
- no patterns

$Y_3$

- similar to  $Y_1$
- spike at 70

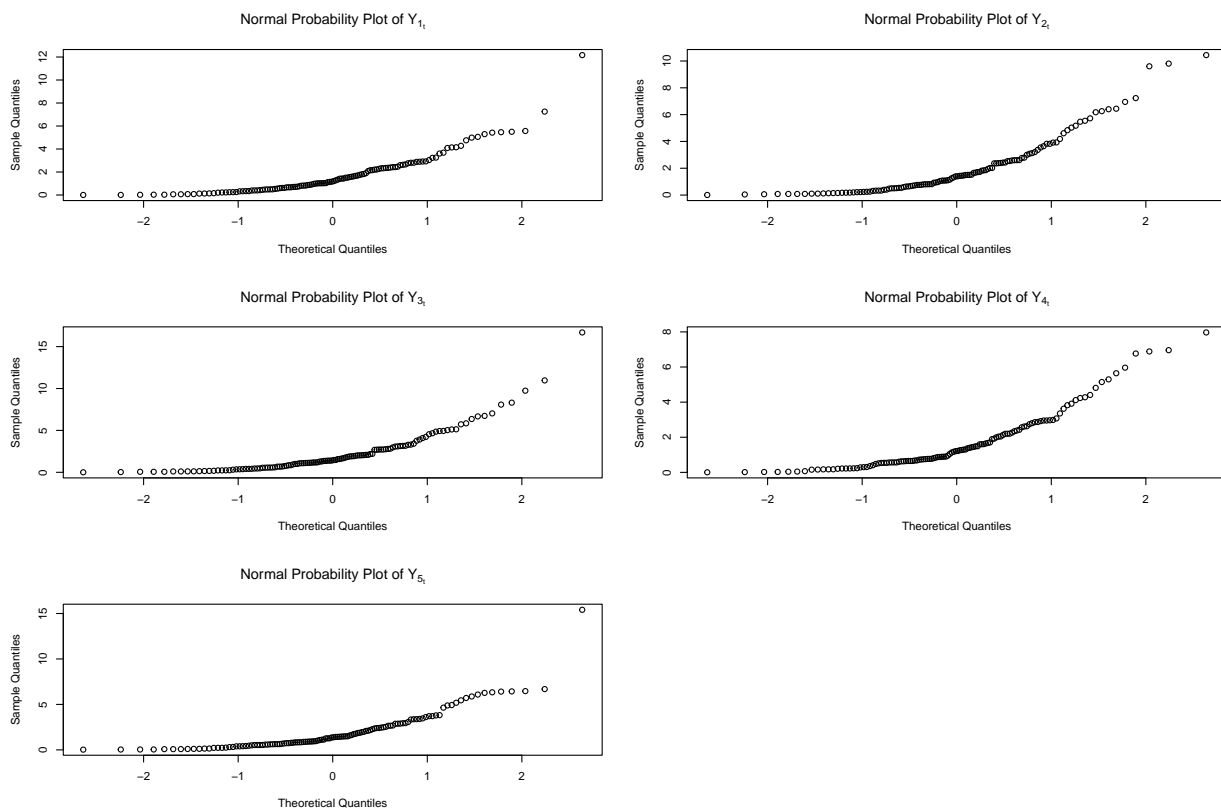
$Y_4$

- centered at 2
- spike near 60
- random scatter

$Y_5$

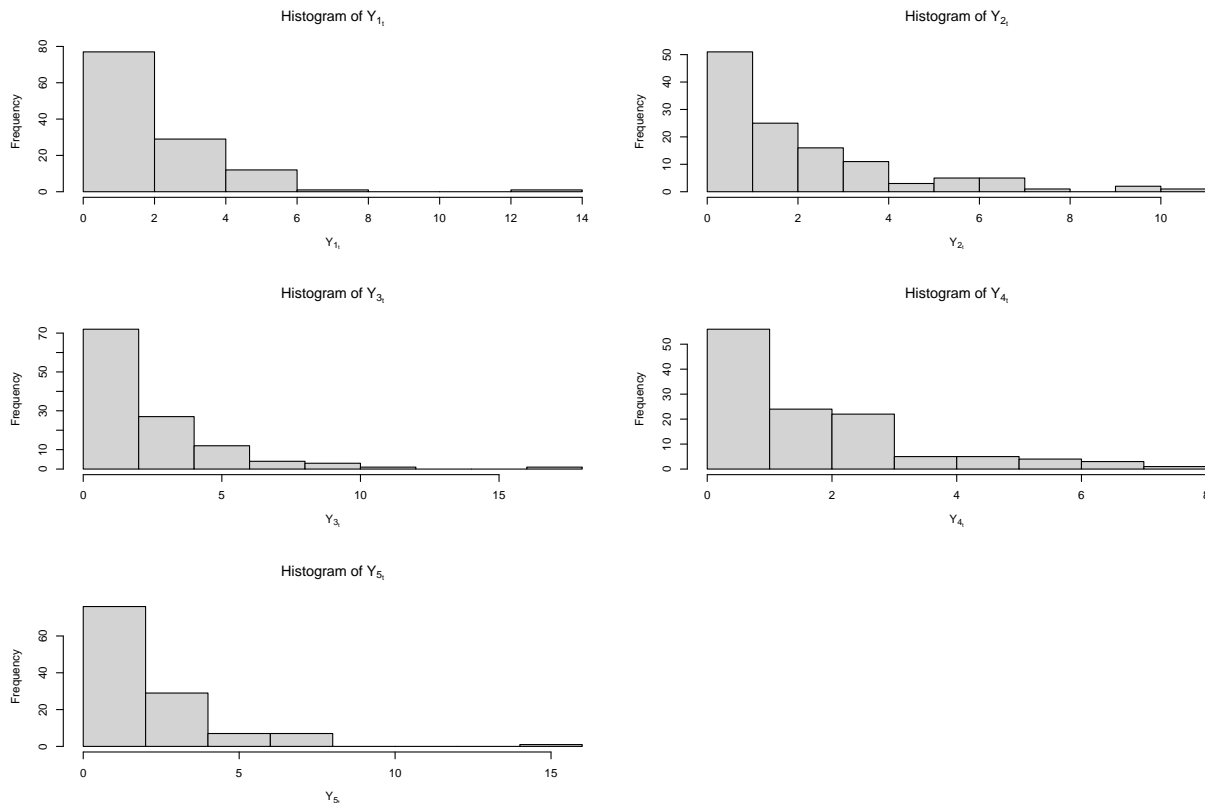
- similar to  $Y_1, Y_3$
- spike at / around 90

```
# pdf.options() pdf('PS1NPPlotsPt1.pdf')
par(mfrow = c(3, 2))
qqnorm(series1, main = expression(paste("Normal Probability Plot of Y"[1[t]])))
qqnorm(series2, main = expression(paste("Normal Probability Plot of Y"[2[t]])))
qqnorm(series3, main = expression(paste("Normal Probability Plot of Y"[3[t]])))
qqnorm(series4, main = expression(paste("Normal Probability Plot of Y"[4[t]])))
qqnorm(series5, main = expression(paste("Normal Probability Plot of Y"[5[t]])))
# dev.off()
```



- not linear, - heavy right tail -> skewed right

```
# pdf.options() pdf('PS1HistsPt1.pdf')
par(mfrow = c(3, 2))
hist(series1, xlab = expression(paste("Y"[1[t]])), main = expression(paste("Histogram of Y"[1[t]])))
hist(series2, xlab = expression(paste("Y"[2[t]])), main = expression(paste("Histogram of Y"[2[t]])))
hist(series3, xlab = expression(paste("Y"[3[t]])), main = expression(paste("Histogram of Y"[3[t]])))
hist(series4, xlab = expression(paste("Y"[4[t]])), main = expression(paste("Histogram of Y"[4[t]])))
hist(series5, xlab = expression(paste("Y"[5[t]])), main = expression(paste("Histogram of Y"[5[t]])))
# dev.off()
```



# Part 2

## Expectations

- properties of a t-dist.
- look somewhat normal
- unimodal
- symmetric
- centered about 0
- random scatter / no patterns - property of random sample

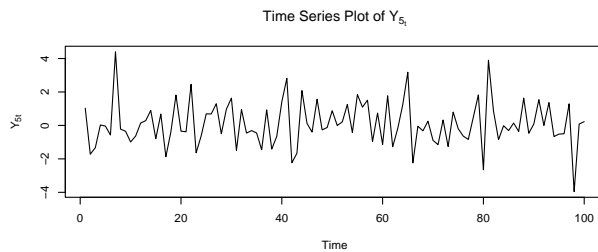
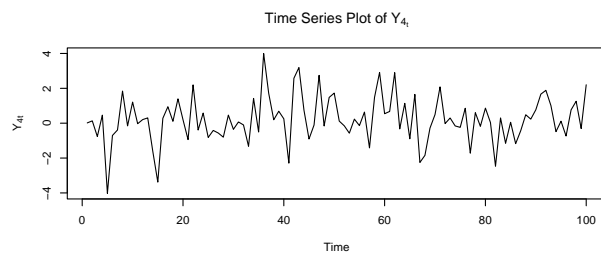
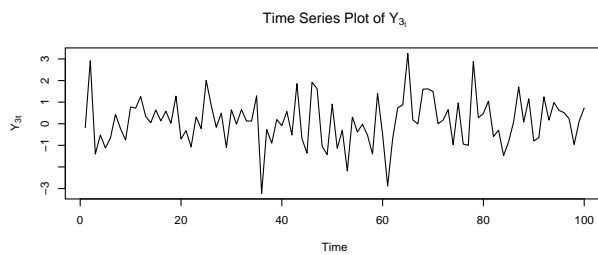
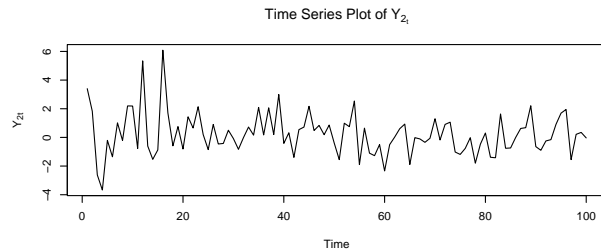
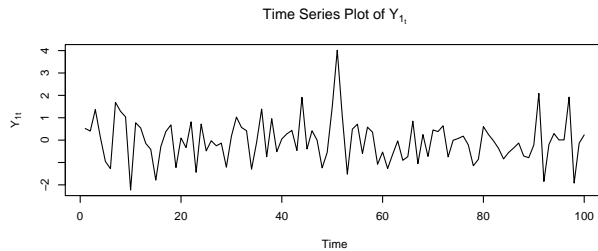
```
n <- 100
series1 <- as.ts(rt(n, 5, ncp = 0))
series2 <- as.ts(rt(n, 5, ncp = 0))
series3 <- as.ts(rt(n, 5, ncp = 0))
series4 <- as.ts(rt(n, 5, ncp = 0))
series5 <- as.ts(rt(n, 5, ncp = 0))

# pdf.options() pdf('PS1TSPlotsPt2.pdf')
par(mfrow = c(3, 2))
plot(series1, xlab = expression("Time"), ylab = expression(paste("Y"[1][t])),
      main = expression(paste("Time Series Plot of Y"[1][t])))
plot(series2, xlab = expression("Time"), ylab = expression(paste("Y"[2][t])),
      main = expression(paste("Time Series Plot of Y"[2][t])))
plot(series3, xlab = expression("Time"), ylab = expression(paste("Y"[3][t])),
      main = expression(paste("Time Series Plot of Y"[3][t])))
```

```

plot(series4, xlab = expression("Time"), ylab = expression(paste("Y"[4][t])),
     main = expression(paste("Time Series Plot of Y"[4][t])))
plot(series5, xlab = expression("Time"), ylab = expression(paste("Y"[5][t])),
     main = expression(paste("Time Series Plot of Y"[5][t])))
# dev.off()

```



$Y_1$

- centered at 0
- spike at 50
- random scatter / no patterns

$Y_2$

- signs of uneven spread
- suggests nonstationary series
- centered at 0
- no patterns

$Y_3$

- centered at 0
- random scatter
- fairly even spread

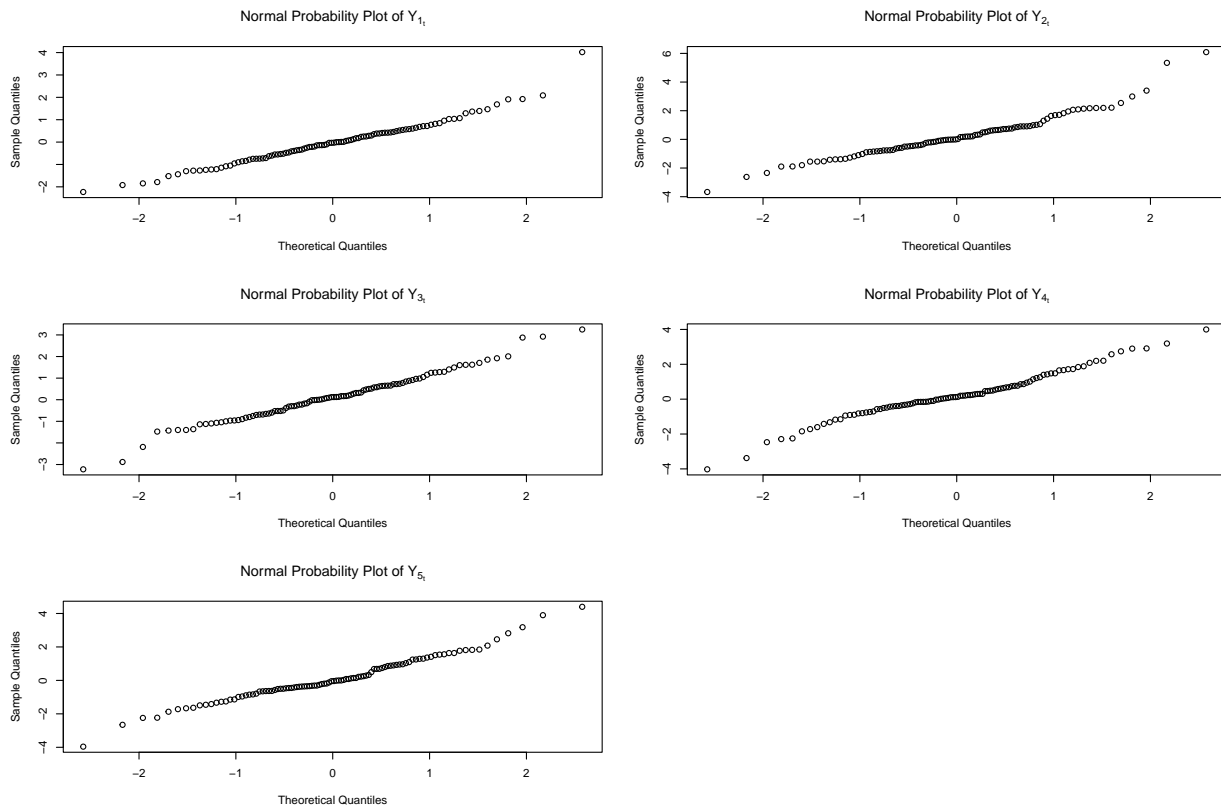
$Y_4$

- centered at 0
- possible periodic pattern
- fairly even spread

$Y_5$

- centered at 0
- random scatter
- fairly even spread

```
# pdf.options() pdf('PS1NPPlotsPt2.pdf')
par(mfrow = c(3, 2))
qqnorm(series1, main = expression(paste("Normal Probability Plot of Y"[1[t]])))
qqnorm(series2, main = expression(paste("Normal Probability Plot of Y"[2[t]])))
qqnorm(series3, main = expression(paste("Normal Probability Plot of Y"[3[t]])))
qqnorm(series4, main = expression(paste("Normal Probability Plot of Y"[4[t]])))
qqnorm(series5, main = expression(paste("Normal Probability Plot of Y"[5[t]])))
# dev.off()
```



$Y_1$

- heavy right tail
- left side - tail resembles that of a normal distribution

$Y_2$

- two heavy tails
- middle looks really normal

$Y_3$

- heavy tails
- middle looks okay
- lighter than tails of  $Y_2$

$Y_4$

- both tails are heavy
- middle is linear

$Y_5$

- similar to  $Y_4$

```
# pdf.options() pdf('PS1HistsPt2.pdf')
par(mfrow = c(3, 2))
hist(series1, xlab = expression(paste("Y"[1][t])), main = expression(paste("Histogram of Y"[1][t])))
hist(series2, xlab = expression(paste("Y"[2][t])), main = expression(paste("Histogram of Y"[2][t])))
hist(series3, xlab = expression(paste("Y"[3][t])), main = expression(paste("Histogram of Y"[3][t])))
hist(series4, xlab = expression(paste("Y"[4][t])), main = expression(paste("Histogram of Y"[4][t])))
hist(series5, xlab = expression(paste("Y"[5][t])), main = expression(paste("Histogram of Y"[5][t])))
# dev.off()
```

