	$\bar{x}$	$\bar{y}$	s_X	s_Y	$r_{X,Y}$
January	15	20	1	1	0.8
February	17	21	1	1	0.8
March	19	22	1.5	2	0.7
April	21	23	1.5	2	0.7
May	23	24	1.5	2	0.7
June	25	25	2	3	0.6
July	27	26	2	3	0.6
August	25	25	2	3	0.6
September	23	24	1.5	2	0.7
October	21	23	1.5	2	0.7
November	19	22	1.5	2	0.7
December	17	21	1	1	0.8

Assignment

Evaluate the aggregated annual bias, MSE and correlation, from the given monthly statistics

Alternative:
Evaluate the aggregated summer (JJA) or winter (DJF) correlation, from the given monthly statistics
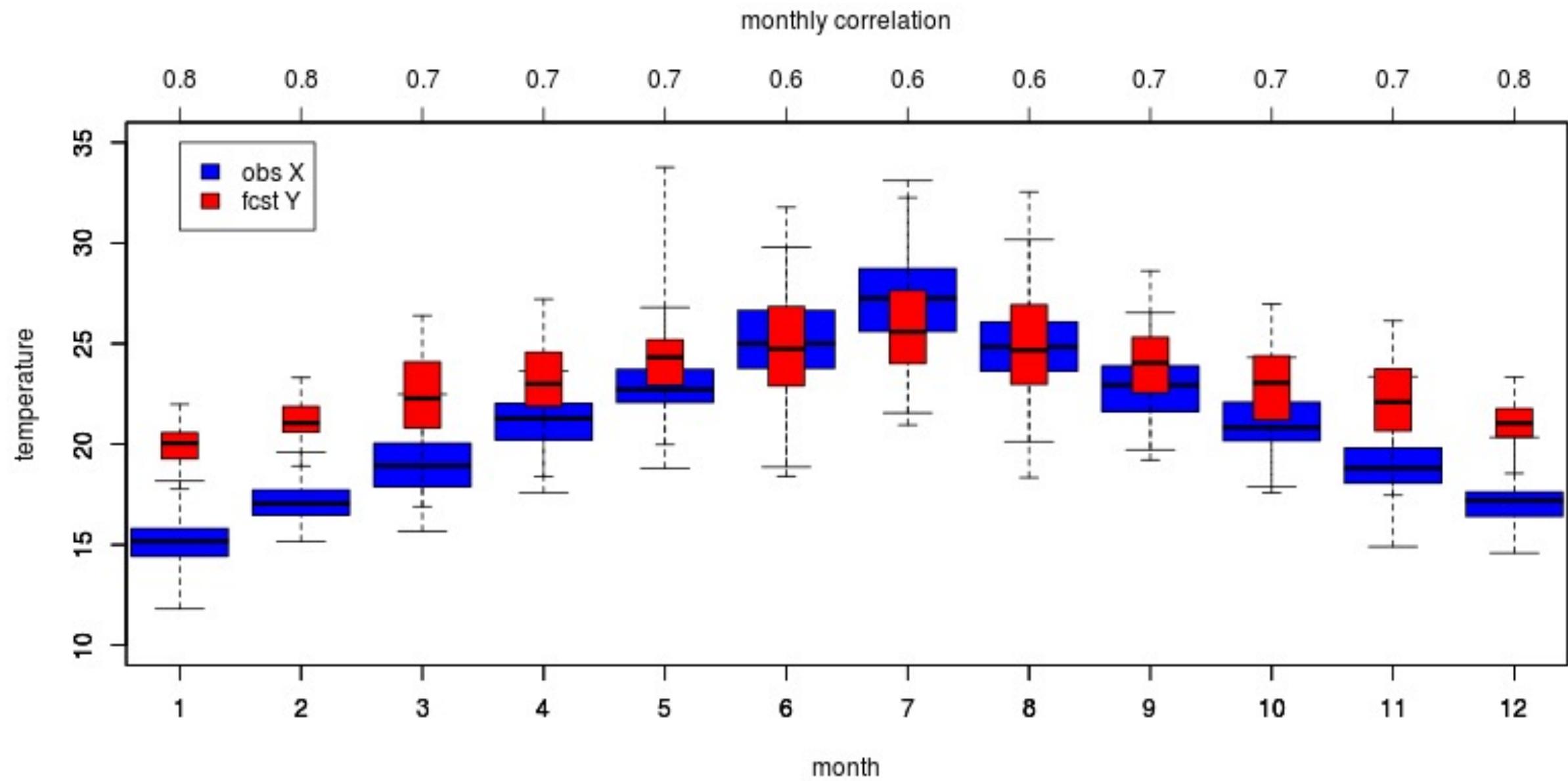
R code is available on the GitHub

```r
#------ initializing arrays with monthly values

samplemm=c(31,28,31,30,31,30,31,31,30,31,30,31)

meanXmm=c(15,17,19,21,23,25,27,25,23,21,19,17)
meanYmm=c(20,21,22,23,24,25,26,25,24,23,22,21)

stdevXmm=c(1,1,1.5,1.5,1.5,2,2,2,1.5,1.5,1.5,1)
stdevYmm=c(1,1,2,2,2,3,3,3,2,2,2,1)

corrXYmm=c(0.8,0.8,0.7,0.7,0.7,0.6,0.6,0.6,0.7,0.7,0.7,0.8)

#-------
```

```
#------- evaluate the aggregated annual bias

weightmm=samplemm/sum(samplemm)


meanXaggr=sum(meanXmm*weightmm)                    # 21.02192
meanYaggr=sum(meanYmm*weightmm)                    # 23.01096


biasYXaggr=meanYaggr-meanXaggr                     # 1.989041


#-------
```

```
#------- evaluate the aggregated annual stdev

# key equation: var(X)=mean(X^2)-[mean(X)]^2

meanX2mm=(stdevXmm)^2+(meanXmm)^2
meanY2mm=(stdevYmm)^2+(meanYmm)^2


meanX2aggr=sum(meanX2mm*weightmm)          # 457.0158
meanY2aggr=sum(meanY2mm*weightmm)          # 537.2027


varXaggr=meanX2aggr-(meanXaggr)^2          # 15.09473
varYaggr=meanY2aggr-(meanYaggr)^2          # 7.69851


stdevXaggr=sqrt(varXaggr)                  # 3.885193
stdevYaggr=sqrt(varYaggr)                  # 2.774619


#-------
```

#------- evaluate the aggregated annual correlation

key equations:
cov(X,Y)=corr(X,Y)*stdev(X)*stdev(Y)
cov(X,Y)=mean(X*Y)-mean(X)*mean(y)

covXYmm=corrXYmm*stdevXmm*stdevYmm

meanXYmm=covXYmm+meanXmm*meanYmm
meanXYaggr=sum(meanXYmm*weightmm)   # 492.2479

covXYaggr=meanXYaggr-meanXaggr*meanYaggr   # 8.513458
corXYaggr=covXYaggr/(stdevXaggr*stdevYaggr)   # 0.7897508

#-------

\#------- evaluate the aggregated MSE

MSEaggr=(biasYXaggr)^2+varXaggr+varYaggr-2*covXYaggr   **# 9.722603**

\#------- buddy check!

MSEmm=(meanYmm-meanXmm)^2+(stdevXmm)^2+(stdevYmm)^2-2*covXYmm

controlMSEaggr=sum(MSEmm*weightmm)   **# 9.722603**

\#------- the end -------