

## 2023년 1학기 회귀모형 출석수업 과제물

1번. 연습문제 1장 1번(p. 39) 자료를 이용하여 1.7 분석사례와 같이 분석하고, 설명하시오.

```
# 교재의 데이터 입력 및 확인
X = c(3, 1, 5, 8, 1, 4, 2, 6, 9, 3, 5, 7, 2, 6)
Y = c(39, 24, 115, 105, 50, 86, 67, 90, 140, 112, 70, 186, 43, 126)
# X, Y 두 변수의 마지막 3개의 값을 확인
tail(cbind(X, Y), 3)
```

### 1) 교재의 데이터 입력 및 확인

```
##      X      Y
## [12,] 7 186
## [13,] 2  43
## [14,] 6 126
```

```
# 산점도를 그린다.
plot(X, Y, pch=19, main="기계의 사용연도와 정비비용의 산점도",
      xlab = "사용연도 (단위:년)", ylab = "정비비용 (단위:1000원)")
```

### 2) 산점도를 그려본다.

```
## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbcsToSbcs': dot substituted for <ea>

## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbcsToSbcs': dot substituted for <b8>

## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbcsToSbcs': dot substituted for <b0>

## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbcsToSbcs': dot substituted for <ea>

## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbcsToSbcs': dot substituted for <b3>

## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbcsToSbcs': dot substituted for <84>

## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbcsToSbcs': dot substituted for <ec>

## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbcsToSbcs': dot substituted for <9d>
```

```
## Warning in title(...): conversion failure on '기계의 사용 연도와 정비비용의
## 산점도' in 'mbscsToSbcs': dot substituted for <98>
```

```
## Warning in title(...): conversion failure on '기계의 사용 연도와 정비비용의
## 산점도' in 'mbscsToSbcs': dot substituted for <ec>
```

```
## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbscsToSbcs': dot substituted for <82>
```

```
## Warning in title(...): conversion failure on '기계의 사용 연도와 정비비용의
## 산점도' in 'mbscToSbcs': dot substituted for <ac>
```

```
## Warning in title(...): conversion failure on '기계의 사용 연도와 정비비용의
## 산점도' in 'mbscToSbcs': dot substituted for <ec>
```

```
## Warning in title(...): conversion failure on '기계의 사용 연도와 정비비용의
## 산점도' in 'mbscToSbcs': dot substituted for <9a>
```

```
## Warning in title(...): conversion failure on '기계의 사용 연도와 정비비용의
## 산점도' in 'mbscToSbcs': dot substituted for <a>
```

```
## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbscsToSbcs': dot substituted for <ec>
```

```
## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbscToSbcs': dot substituted for <97>
```

```
## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbscsToSbcs': dot substituted for <b>
```

```
## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbscToSbcs': dot substituted for <eb>
```

```
## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbscsToSbcs': dot substituted for <8f>
```

```
## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbscToSbcs': dot substituted for <84>
```

```
## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbscToSbcs': dot substituted for <ec>
```

```
## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbscsToSbcs': dot substituted for <99>
```

```
## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 사절도' in 'mbscsToSbcs': dot substituted for <80>
```

```
## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 사절도' in 'mbscsToSbcs': dot substituted for <ec>
```



```

## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbcsToSbcs': dot substituted for <ec>

## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbcsToSbcs': dot substituted for <a0>

## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbcsToSbcs': dot substituted for <90>

## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbcsToSbcs': dot substituted for <eb>

## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbcsToSbcs': dot substituted for <8f>

## Warning in title(...): conversion failure on '기계의 사용연도와 정비비용의
## 산점도' in 'mbcsToSbcs': dot substituted for <84>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <ec>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <82>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <ac>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <ec>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <9a>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <a9>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <ec>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <97>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <b0>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <eb>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <8f>

```

```

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <84>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <eb>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <8b>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <a8>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <ec>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <9c>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <84>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <eb>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <85>

## Warning in title(...): conversion failure on '사용연도 (단위:년)' in
## 'mbcsToSbcs': dot substituted for <84>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <ec>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <a0>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <95>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <eb>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <b9>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <84>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <eb>

```

```
## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <b9>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <84>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <ec>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <9a>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <a9>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <eb>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <8b>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <a8>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <ec>

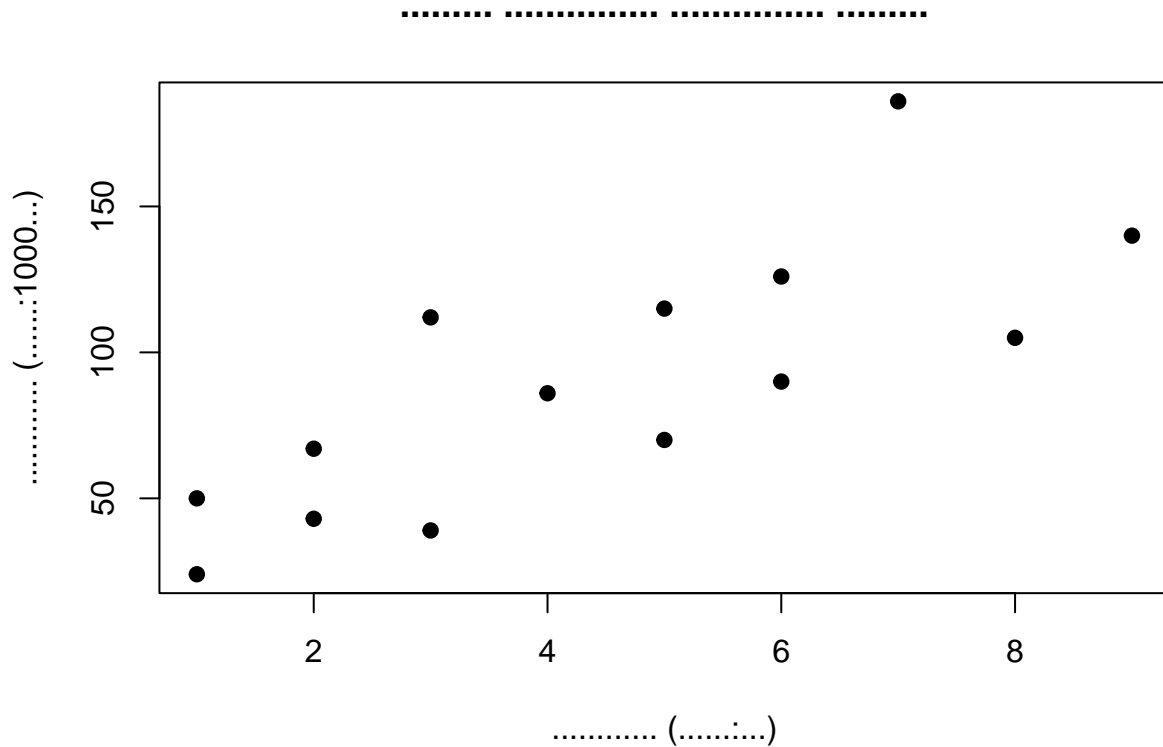
## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <9c>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <84>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <ec>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <9b>

## Warning in title(...): conversion failure on '정비비용 (단위:1000원)' in
## 'mbcsToSbcs': dot substituted for <90>
```



### # 회귀모형 적합 및 요약 정보 확인

```
machine.lm = lm(Y~X)
summary(machine.lm)
```

### 3) 회귀모형 적합 및 요약 정보 확인

```
##
## Call:
## lm(formula = Y ~ X)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -33.204 -20.383  -4.748  13.957  61.433
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)   29.107     15.969   1.823 0.093341 .
## X             13.637       3.149   4.330 0.000978 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 29.11 on 12 degrees of freedom
## Multiple R-squared:  0.6098, Adjusted R-squared:  0.5773
```

```
## F-statistic: 18.75 on 1 and 12 DF, p-value: 0.0009779
```

```
anova(machine.lm)
```

#### 4) 분산분석표 확인

```
## Analysis of Variance Table
##
## Response: Y
##           Df Sum Sq Mean Sq F value    Pr(>F)
## X             1  15887  15887.2   18.753 0.0009779 ***
## Residuals    12   10166    847.2
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
# 회귀모형 적합 결과(machine.lm)의 변수 확인
names(machine.lm)
```

#### 5) 잔차와 추정값 보기

```
## [1] "coefficients" "residuals"      "effects"      "rank"
## [5] "fitted.values" "assign"        "qr"           "df.residual"
## [9] "xlevels"       "call"         "terms"        "model"
```

```
# X와 Y와 잔차 및 추정값을 합쳐서 보기
cbind(X, Y, resid(machine.lm), fitted(machine.lm))
```

```
##      X      Y
## 1  3  39 -31.018395  70.01839
## 2  1  24 -18.744147  42.74415
## 3  5 115  17.707358  97.29264
## 4  8 105 -33.204013 138.20401
## 5  1  50   7.255853  42.74415
## 6  4  86   2.344482  83.65552
## 7  2  67  10.618729  56.38127
## 8  6  90 -20.929766 110.92977
## 9  9 140 -11.841137 151.84114
## 10 3 112  41.981605  70.01839
## 11 5  70 -27.292642  97.29264
## 12 7 186  61.433110 124.56689
## 13 2  43 -13.381271  56.38127
## 14 6 126  15.070234 110.92977
```

```
# 잔차를 독립변수 X에 대해 산점도를 그려본다.
plot(X, resid(machine.lm), pch=19, main="잔차와 X 산점도", xlab="X", ylab="잔차")
```



## 6) 잔차와 독립변수 X 에 대한 산점도를 그려본다.

```
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':  
## dot substituted for <ec>  
  
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':  
## dot substituted for <9e>  
  
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':  
## dot substituted for <94>  
  
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':  
## dot substituted for <ec>  
  
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':  
## dot substituted for <b0>  
  
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':  
## dot substituted for <a8>  
  
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':  
## dot substituted for <ec>  
  
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':  
## dot substituted for <99>  
  
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':  
## dot substituted for <80>  
  
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':  
## dot substituted for <ec>  
  
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':  
## dot substituted for <82>  
  
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':  
## dot substituted for <b0>  
  
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':  
## dot substituted for <ec>  
  
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':  
## dot substituted for <a0>  
  
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':  
## dot substituted for <90>  
  
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':  
## dot substituted for <eb>
```

```
## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':
## dot substituted for <8f>

## Warning in title(...): conversion failure on '잔차와 X 산점도' in 'mbsToSbcs':
## dot substituted for <84>

## Warning in title(...): conversion failure on '잔차' in 'mbsToSbcs': dot
## substituted for <ec>

## Warning in title(...): conversion failure on '잔차' in 'mbsToSbcs': dot
## substituted for <9e>

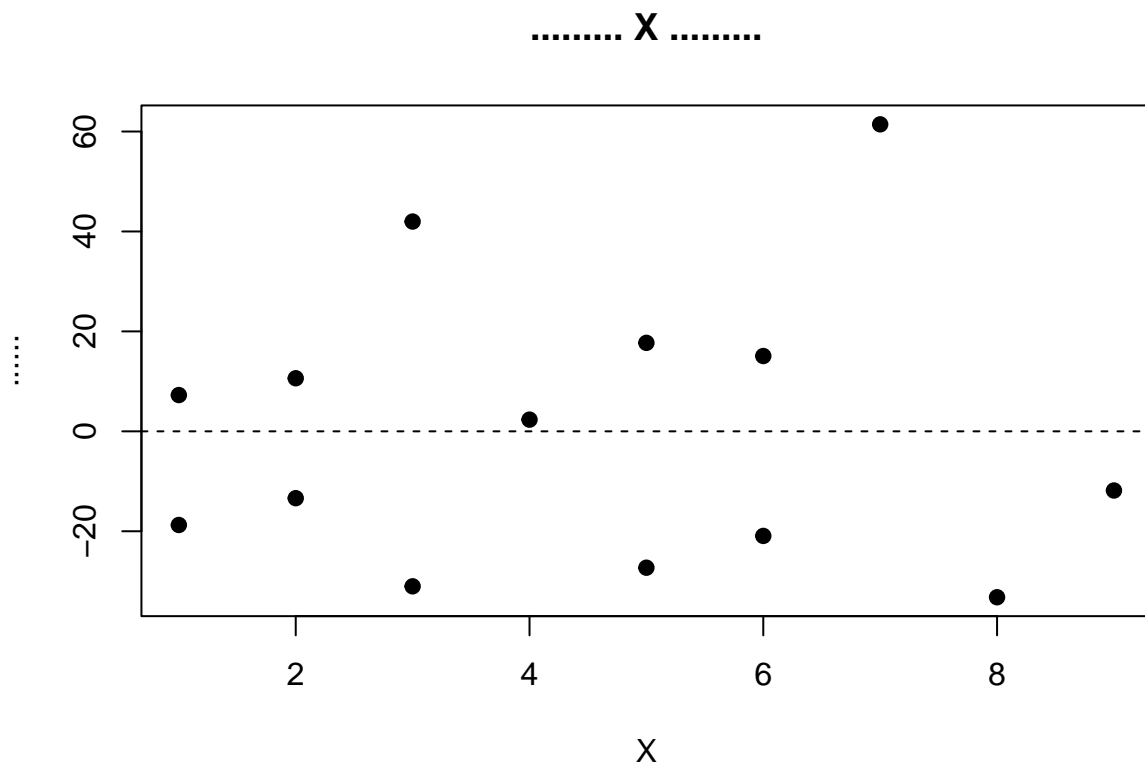
## Warning in title(...): conversion failure on '잔차' in 'mbsToSbcs': dot
## substituted for <94>

## Warning in title(...): conversion failure on '잔차' in 'mbsToSbcs': dot
## substituted for <ec>

## Warning in title(...): conversion failure on '잔차' in 'mbsToSbcs': dot
## substituted for <b0>

## Warning in title(...): conversion failure on '잔차' in 'mbsToSbcs': dot
## substituted for <a8>
```

```
# 잔차가 0인 라인 타입 2번 선을 그린다.
abline(h=0, lty=2)
```



# X의 범위와 갯수에 맞게 생성

```
machine.frame = data.frame(X=seq(from = min(X), to=max(X),by=((max(X)-min(X))/(length(X)-1))))
pc = predict(machine.lm, int="c", newdata=machine.frame)
pp = predict(machine.lm, int="p", newdata=machine.frame)
plot(X, Y, ylim=range(Y, pc), main="추정값의 신뢰대", xlab="사용연도(X)", ylab="정비비용(Y)")
```

## 7) 추정값의 신뢰대 그리기

```
## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbcsToSbcs':  
## dot substituted for <ec>
```

```
## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbcsToSbcs':  
## dot substituted for <b6>
```

```
## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbcsToSbcs':  
## dot substituted for <94>
```

```
## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbcsToSbcs':  
## dot substituted for <ec>
```

```
## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbcsToSbcs':  
## dot substituted for <a0>
```

```
## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbcsToSbcs':  
## dot substituted for <95>
```

```
## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbcsToSbcs':  
## dot substituted for <ea>
```

```
## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbcsToSbcs':  
## dot substituted for <b0>
```

```
## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbcsToSbcs':  
## dot substituted for <92>
```

```
## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbcsToSbcs':  
## dot substituted for <ec>
```

```
## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbcsToSbcs':  
## dot substituted for <9d>
```

```
## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbcsToSbcs':  
## dot substituted for <98>
```

```
## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbcsToSbcs':  
## dot substituted for <ec>
```

```
## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbcsToSbcs':  
## dot substituted for <8b>
```

```

## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbsToSbcs':
## dot substituted for <a0>

## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbsToSbcs':
## dot substituted for <eb>

## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbsToSbcs':
## dot substituted for <a2>

## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbsToSbcs':
## dot substituted for <b0>

## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbsToSbcs':
## dot substituted for <eb>

## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbsToSbcs':
## dot substituted for <8c>

## Warning in title(...): conversion failure on '추정값의 신뢰대' in 'mbsToSbcs':
## dot substituted for <80>

## Warning in title(...): conversion failure on '사용연도(X)' in 'mbsToSbcs': dot
## substituted for <ec>

## Warning in title(...): conversion failure on '사용연도(X)' in 'mbsToSbcs': dot
## substituted for <82>

## Warning in title(...): conversion failure on '사용연도(X)' in 'mbsToSbcs': dot
## substituted for <ac>

## Warning in title(...): conversion failure on '사용연도(X)' in 'mbsToSbcs': dot
## substituted for <ec>

## Warning in title(...): conversion failure on '사용연도(X)' in 'mbsToSbcs': dot
## substituted for <9a>

## Warning in title(...): conversion failure on '사용연도(X)' in 'mbsToSbcs': dot
## substituted for <a9>

## Warning in title(...): conversion failure on '사용연도(X)' in 'mbsToSbcs': dot
## substituted for <ec>

## Warning in title(...): conversion failure on '사용연도(X)' in 'mbsToSbcs': dot
## substituted for <97>

## Warning in title(...): conversion failure on '사용연도(X)' in 'mbsToSbcs': dot
## substituted for <b0>

## Warning in title(...): conversion failure on '사용연도(X)' in 'mbsToSbcs': dot
## substituted for <eb>

```

```

## Warning in title(...): conversion failure on '사용연도(X)' in 'mbsToSbcs': dot
## substituted for <8f>

## Warning in title(...): conversion failure on '사용연도(X)' in 'mbsToSbcs': dot
## substituted for <84>

## Warning in title(...): conversion failure on '정비비용(Y)' in 'mbsToSbcs': dot
## substituted for <ec>

## Warning in title(...): conversion failure on '정비비용(Y)' in 'mbsToSbcs': dot
## substituted for <a0>

## Warning in title(...): conversion failure on '정비비용(Y)' in 'mbsToSbcs': dot
## substituted for <95>

## Warning in title(...): conversion failure on '정비비용(Y)' in 'mbsToSbcs': dot
## substituted for <eb>

## Warning in title(...): conversion failure on '정비비용(Y)' in 'mbsToSbcs': dot
## substituted for <b9>

## Warning in title(...): conversion failure on '정비비용(Y)' in 'mbsToSbcs': dot
## substituted for <84>

## Warning in title(...): conversion failure on '정비비용(Y)' in 'mbsToSbcs': dot
## substituted for <eb>

## Warning in title(...): conversion failure on '정비비용(Y)' in 'mbsToSbcs': dot
## substituted for <b9>

## Warning in title(...): conversion failure on '정비비용(Y)' in 'mbsToSbcs': dot
## substituted for <84>

## Warning in title(...): conversion failure on '정비비용(Y)' in 'mbsToSbcs': dot
## substituted for <ec>

## Warning in title(...): conversion failure on '정비비용(Y)' in 'mbsToSbcs': dot
## substituted for <9a>

## Warning in title(...): conversion failure on '정비비용(Y)' in 'mbsToSbcs': dot
## substituted for <a9>

```

```

matlines(machine.frame$X, pc, lty=c(1,2,2), col="BLUE")
matlines(machine.frame$X, pp, lty=c(1,3,3), col="RED")

```

