1 (1) 300 개

(2) maximum = 105 , minmum = 0

(3) 63

(4) 61

(5) 24

(6)

range	numbers
>100	3
90-100	44
80-90	45
70-80	23
60-70	38
50-60	68
40-50	28
<40	51

(1) $n = 60 \Rightarrow$ 표준정규분포 & $\sigma \sim S$

$$\bar{X} - Z_{\alpha/2}\cdot\frac{S}{\sqrt{n}} \le \text{the bus interval} \le \bar{X} + Z_{\alpha/2}\frac{S}{\sqrt{n}}$$

$$\begin{cases} \alpha = 0.05 \\ \bar{X} = 13 \text{ min} \\ S = \cancel{3}\ 5 \text{ min} \\ n = 60 \end{cases}$$

$Z_{0.05/2} \Rightarrow$ NORMSINV(0.975) ≈ 1.960

$$\therefore\ 13 - 1.960\cdot\frac{5}{\sqrt{60}} \le \text{the bus interval} \le 13 + 1.960\cdot\frac{5}{\sqrt{60}}$$

$$\cancel{12.24}\ 11.73 \le \text{the bus interval} \le \cancel{13.76}\ 14.27$$

취소해야 한다.

(2) $n = 7 \Rightarrow$ t분포 (df = 6)

$$\bar{X} - t(df, \alpha/2)\cdot\frac{S}{\sqrt{n}} \le \text{the bus interval} \le \bar{X} + t(df, \alpha/2)\cdot\frac{S}{\sqrt{n}}$$

$$\begin{cases} \alpha = 0.05 \\ \bar{X} = 11 \text{ min} \\ S = 3 \text{ min} \\ df = 6 \end{cases}$$

$t(6, 0.025) \Rightarrow$ TINV(0.05, 6) = 2.447

$$\therefore\ 11 - 2.447\cdot\frac{3}{\sqrt{7}} \le \text{the bus interval} \le 11 + 2.447\cdot\frac{3}{\sqrt{7}}$$

$$\cancel{8.23}\ 8.226 \le \text{the bus interval} \le 13.77$$

on time

(1) 양측검정 , $n = 50 \Rightarrow$ 표준정규분포 & $\sigma \sim S$

$$\bar{X} - Z_{\alpha/2} \cdot \frac{S}{\sqrt{n}} \le IC_{50} \text{ of Taxsol} \le \bar{X} + Z_{\alpha/2} \cdot \frac{S}{\sqrt{n}}$$

$$\begin{cases} \alpha = 0.05 \\ \bar{X} = 0.61\ \mu M \\ S = 0.06\ \mu M \\ n = 50 \end{cases}$$

$Z_{0.025} \Rightarrow$ NORMSINV $(0.975) = 1.960$

$0.593 \le IC_{50}$ of Taxsol ≤ 0.627

The company cannot trust the known IC_{50} value.

(2) 단측검정 , $n = 20 \Rightarrow t$ 분포

IC_{50} of Taxol $\ge IC_{50}$ of clioplatin 임을 검정 (귀무가설)
(0.500 μM)

$$\bar{X} + t_{(df,\alpha)} \cdot \frac{S}{\sqrt{n}} \ge IC_{50} \text{ of clioplatin}$$

$$\begin{cases} \alpha = 0.05 \\ \bar{X} = 0.4955\ \mu M \\ S = 0.098059\ \mu M \\ n = 20 \quad (df = 19) \end{cases}$$

$t(19, 0.05) \Rightarrow$ TINV $(0.1, 19) = 1.729$

$\therefore$ ~~0.0533~~ 0.533 μM $\ge IC_{50}$ of clioplatin

The company cannot say that clioplatic is better than Taxol at 95% confidace

4. (1) % STAP cell division

84.9	82.7	75.6	95.2	95.5	89.4	83.4	91.2	68.5	68.8	(in %)
74.7	77.4	85.1	74.4	88.4	64.7	76.9	70.6	73.7	84.5	

양측 검정 , $n = 20 \Rightarrow t$ 분포

$$\bar{X} - t(df, \alpha/2)\frac{S}{\sqrt{n}} \le \%\text{STAP cell division} \le \bar{X} + t(df, \alpha/2)\cdot\frac{S}{\sqrt{n}}$$

$$\begin{cases} \alpha = 0.05 \\ \bar{X} = 80.1\% \\ S = 8.88\% \\ df = 19 \end{cases}$$

$t(19, 0.025) \Rightarrow$ TINV(0.05, 19) = 2.093

$\therefore$ 75.9% $\le$ % STAP cell division $\le$ 84.2%

90% STAP cell division 값이 위 범위에 포함되지 않으므로 data를 신뢰할 수 없다 (95% 신뢰도)

(2) 두 실험 결과의 분산 비교 ⇒ F 검정

The senior researcher's data ⇒ $S^2 = (0.00888)^2 = 0.007887$

The chielf researcher's data ⇒ $S^2 = 0.008599$

$$F = \frac{(0.008599)}{(0.007887)} = \underline{1.0903}$$

87.9	82.8	77.7	99.0	93.5	79.1	90.8	89.0	66.5	82.2	(in %)
80.2	71.7	71.1	85.3	70.6	91.0	71.3	78.9	73.7	69.0	

$\alpha = 0.05$ 일 때의 임계치 $f \Rightarrow$ FINV(0.025, 19, 19) = $\underline{2.5265}$

$\therefore$ $F = 1.0903 < f = 2.5265$ 이므로 . 두 data set의 분산은 같다 (at 95% 신뢰도)

따라서 STAP cell 실험의 reproducibility는 확보된다

⇒ senior researcher의 주장을 반박할 수 있다.

5 (1)

temp (K)	k (s^{-1})
273	7.8×10^{-5}
283	2.4×10^{-4}
303	9.0×10^{-4}
323	5.9×10^{-3}

(2) 위의 data를 single exponential model에 바로 적용할 수 없음.

Temperature (T)가 exponential term의 분모에 있기 때문에)

Arrehnius eq : $k = A\exp\left(-\frac{E_a}{k_B T}\right)$

$$\Rightarrow \ln k = \ln A - \frac{E_a}{k_B} \cdot \frac{1}{T}$$

위 data를 $\ln k$ (y) vs $\frac{1}{T}$ (x)로 계산하여 linear · regression 한다.

얻어진 slope $= -\frac{E_a}{k_B}$ 로 부터 E_a 계산

$$-7.366 \times 10^{3}\ \cancel{K} = -\frac{E_a}{8.617 \times 10^{-5}\ \text{eV}\ \cancel{K^{-1}}}$$

$$\underline{E_a = 0.63\ \text{eV}}$$