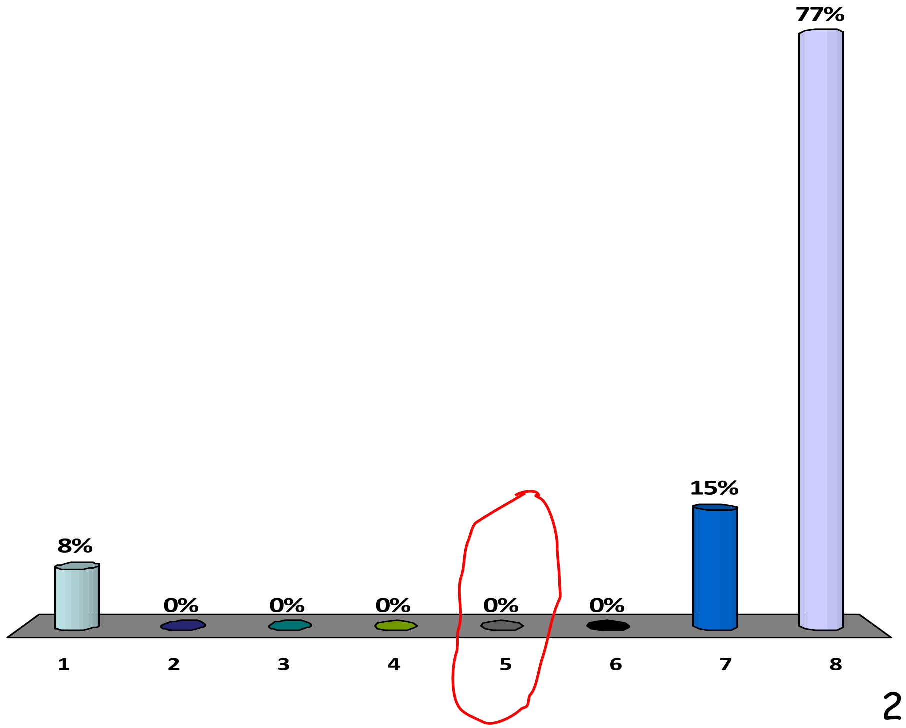
For which items do we need to identify the intensity of the load ?

A Compare Windows 2000 Professional versus Linux.
B Design a rate control for an internet audio application.
C Compare various wireless MAC protocols.
D Say how many servers a video on demand company needs to install.

1. None
2. A
3. B
4. C
5. D
6. A and B
7. C and D
8. All

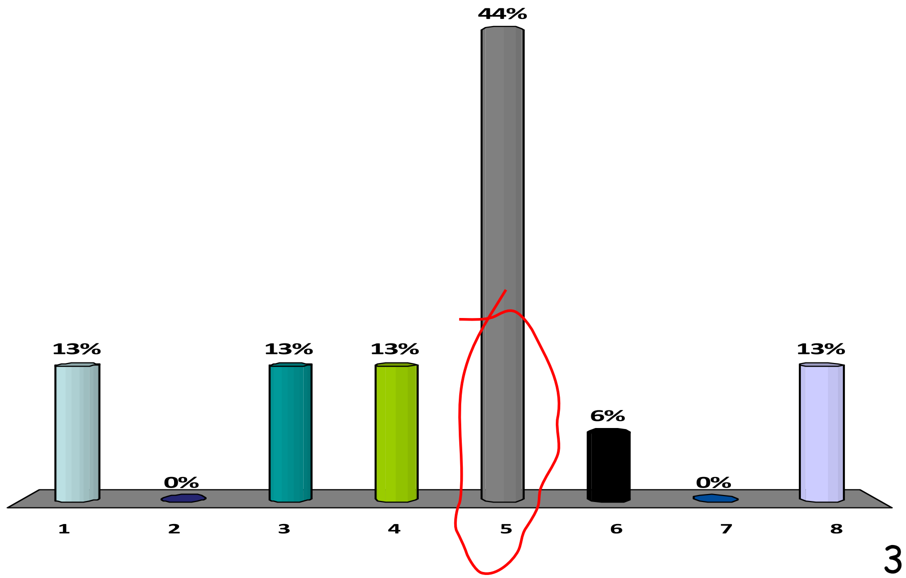


Say what is true

a «non dominated metric» means

A. a metric value that is better than or equal to all others
B. a metric value that is better than all others
C. a metric vector that is better or as good as all others
D. a metric vector for which no other vector is better

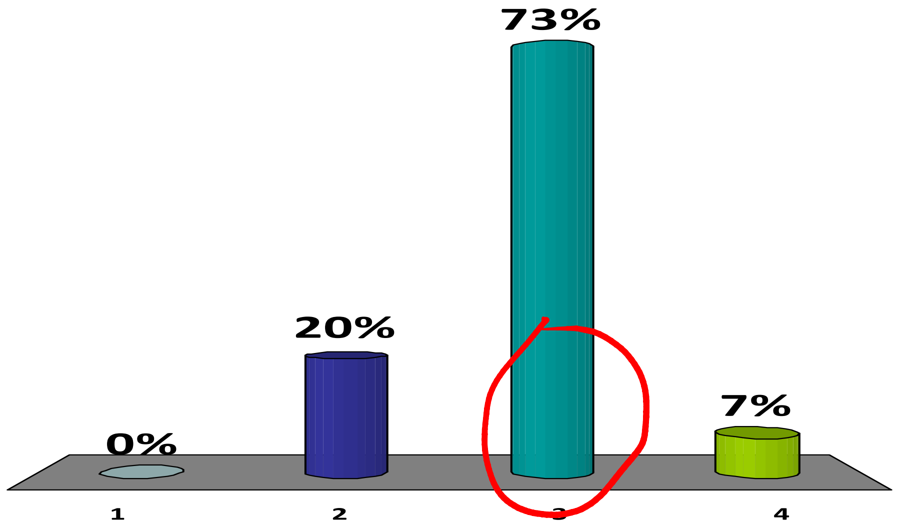
1. None
2. A
3. B
4. C
5. D
6. A and C
7. B and D
8. All



Items are classified as X1, X2, X3, Y1, Y2 or Y3. Every item has a chance of failing or not. We test all X1 and Y1 items and find that the X1 items have a higher chance of failing than the Y1; idem for X2 vs Y2, X3 vx Y3.

⇒ an X item has a higher chance of failing than a Y item

1. True
2. False
3. It depends
4. I don't know



p_{X1} = proba that an item fails given it is X1

$$p_{X1} > p_{Y1}$$
$$p_{X2} > p_{Y2}$$
$$p_{X3} > p_{Y3}$$

Bayes ⇒

$$p_X = p_{X1}p(1|X) + p_{X2}p(2|X) + p_{X3}p(3|X)$$
$$p_Y = p_{Y1}p(1|Y) + p_{Y2}p(2|Y) + p_{Y3}p(3|Y)$$

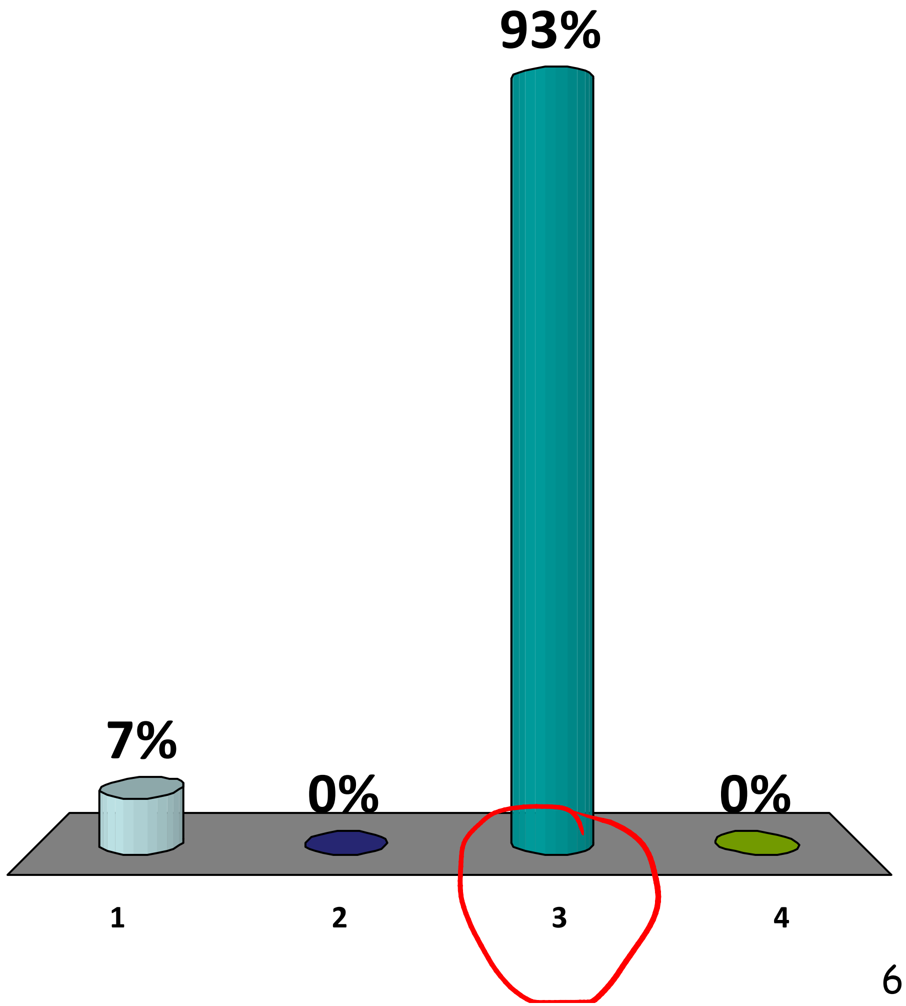
In general $p(1|X) \neq p(1|Y)$, the weights are different

It may be that $p_X > p_Y$ or $p_X < p_Y$, depending on values

If $p(i|X) = p(i|Y)$ for all i (randomized experiments) then $p_X > p_Y$

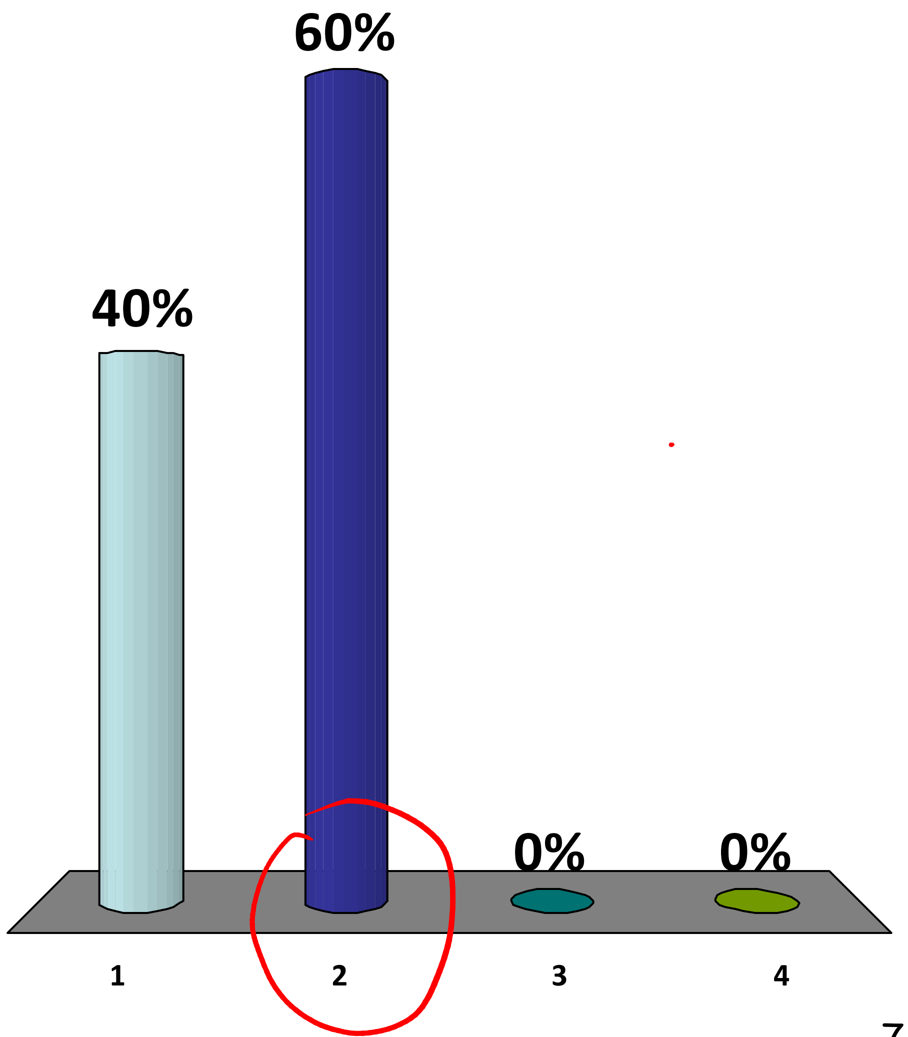
The «scientific method» means

1. Carefully screen all experimental conditions
2. Beware of hidden factors
3. Do not draw a conclusion until you have exhausted all attempts to invalidate it
4. I do not know



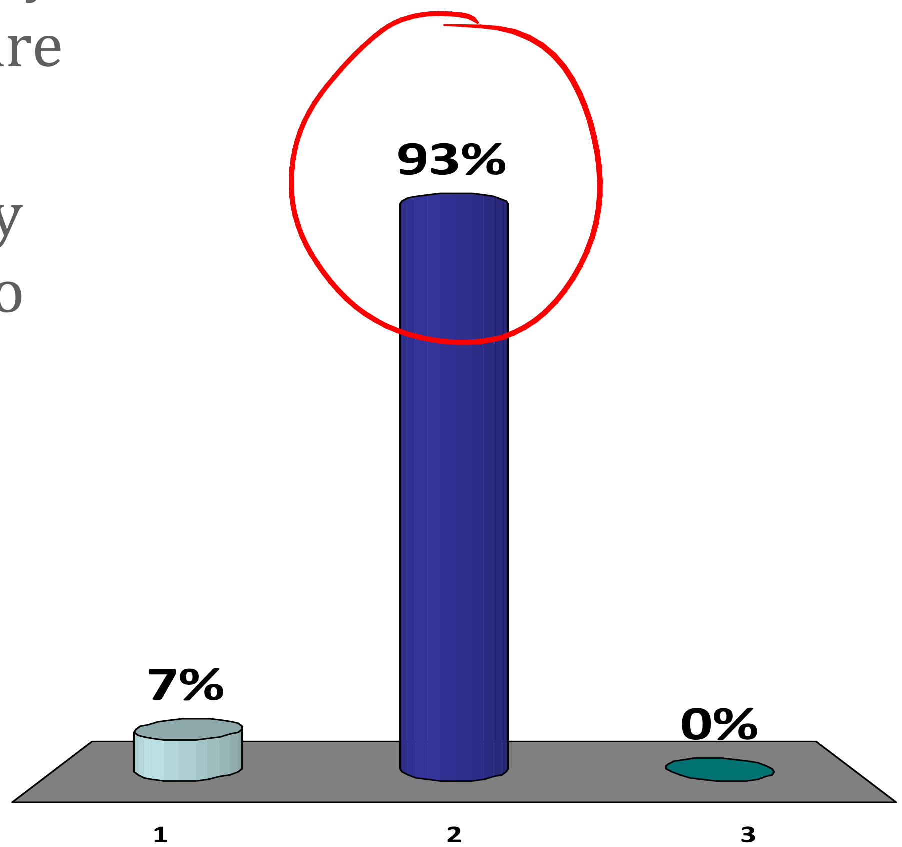
A nuisance factor is

1. An unanticupated experiemental condition that corrupts the results
2. A condition in the system that affects the performance but that we are not interested in
3. An unpleasant part of the performance evaluation
4. I do not know



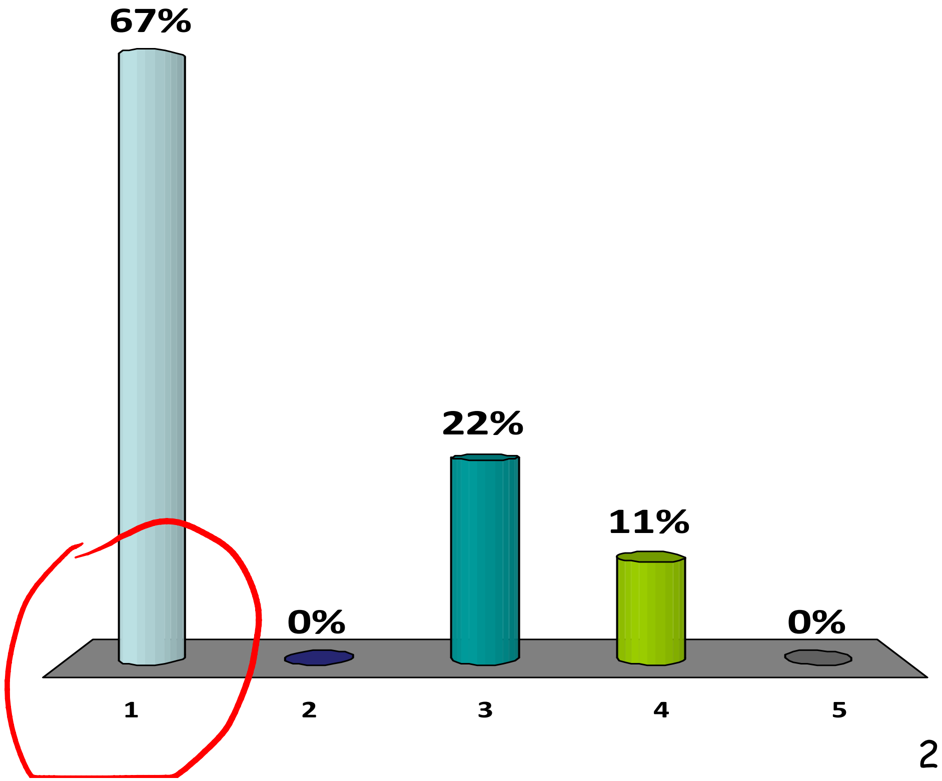
Joe increases the number of gateways and throughput decreases.

1. This is impossible in theory, it must be due to a software bug
2. This may happen in a fully functional system, with no software bug
3. I do not know



We increase the number of gateways and throughput decreases. Which pattern can explain this?

1. Latent congestion collapse
2. Bottleneck
3. Competition side effect
4. Congestion collapse
5. I don’t know

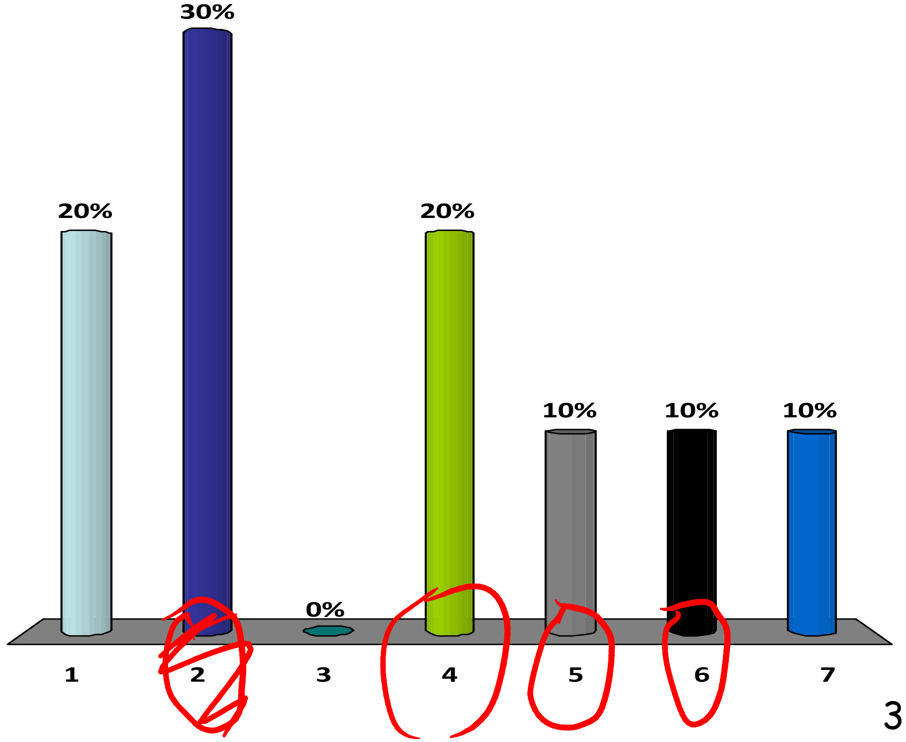


We do 10 independent simulations to measure a response time and obtain (in ms):

1.01
1.02
0.98
1.00
1.02
100.00
1.01
0.99
1.00
1.01

Give a 95% confidence interval for the response time.

1. [0.98 ; 100]
2. [0.98 ; 1.02]
3. [0.99; 100.00]
4. [0.99 ; 1.02]
5. [-7.5   29.3]
6. [-8.5   30.3]
7. I don't know



Solution

- Method 1: 95% confidence interval for median
  $[x_{(2)}, x_{(9)}]$ = [0.99 ; 1.02]

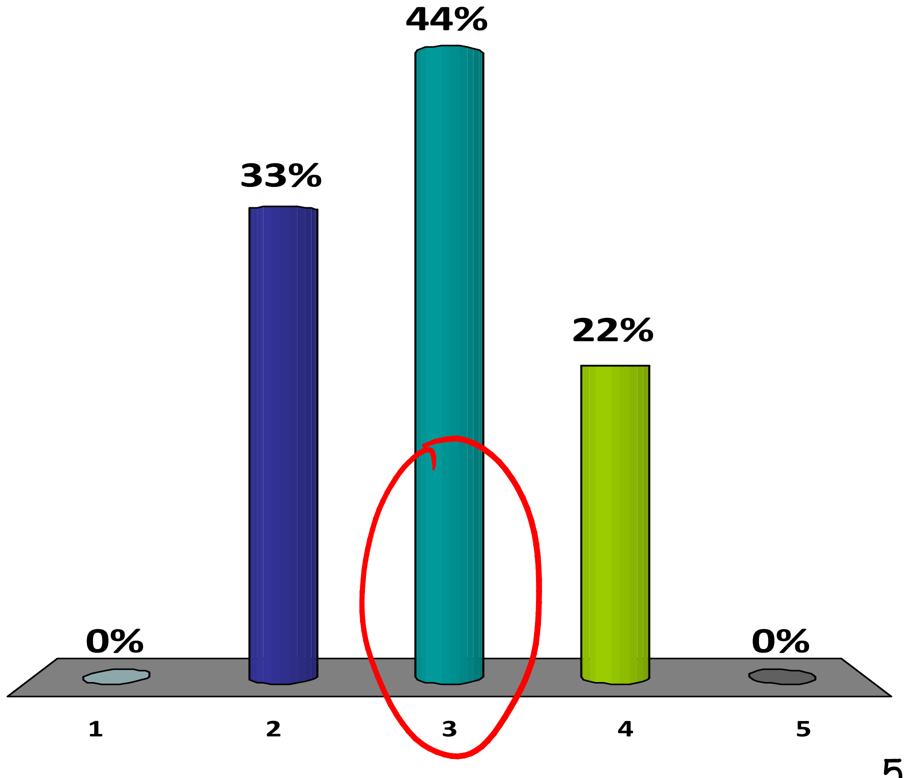
  Median is $\frac{x_{(5)}+x_{(6)}}{2}$ =1.01
  answer 4 is correct

- Method 2: 95% confidence interval for mean is $m \pm 1.96\ \frac{s}{\sqrt{n}}$
  mean $m = 10.9$
  $s = 31.3$ with $\frac{1}{n}$ formula
  $\sigma = 29.7$ with $\frac{1}{n-1}$ formula
  CI = [-8.5 30.3] or [-7.5 29.3]
  answers 5 and 6 are correct

- Method 1 is more robust

We have tested a system for errors and found 0 error in 37 runs. Give a confidence interval for the probability of error.

1. [0% ; 2.7%]
2. [0% ; 5.3%]
3. [0% ; 9.5%]
4. [0% ; 19.5%]
5. I don't know



Solution

CI is $[0\,;p_0(n)]$

For $\gamma = 0.95$, Eq.(2.28) gives $p_0(n) \approx \frac{3.689}{n}$ and this is accurate with less than 10% relative error for $n \geq 20$ already.

$$p_0(n) = 1 - \left(\frac{1-\gamma}{2}\right)^{\frac{1}{n}}$$

$$p_0(37) \approx \frac{3.689}{37} \approx 10\%$$

Which algorithm is a correct bootstrap-computation of a 95%-confidence-interval for Jain's fairness index ?

(we are given a set of 37 independent results $S = \{x_1, \dots, x_{37}\}$)

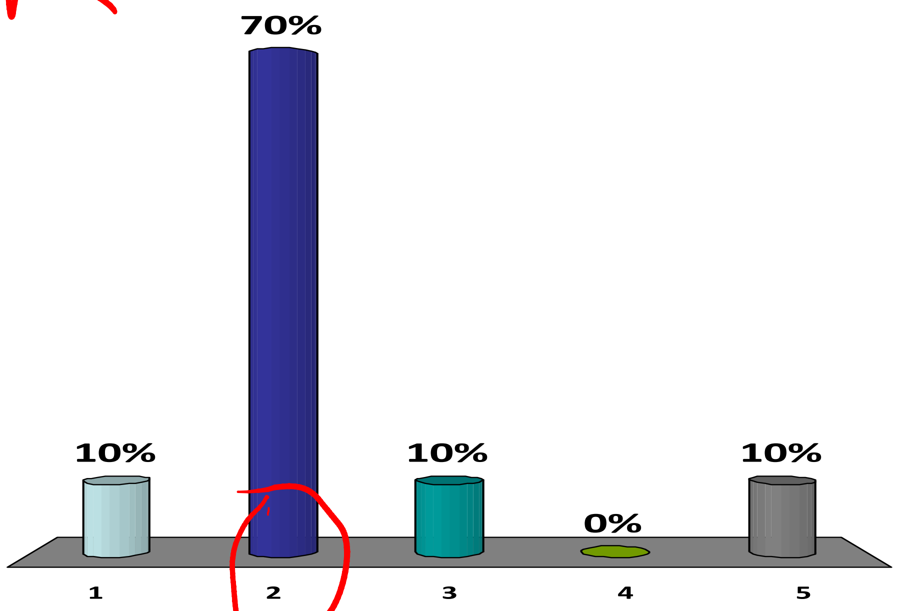
Algorithm A

for $n = 1{:}37$
  for $r = 1{:}99$
    draw one sample $y_{n,r}$ from S
  end
end
for $r = 1{:}99$
  compute Jain's fairness index f_r of $y_{1,r}, \dots, y_{37,r}$
end
CI = $[f_{(5)}, f_{(95)}]$

Algorithm B

for $r = 1{:}99$
  draw one random permutation σ_r of $\{1, \dots, 37\}$
end
for $r = 1{:}99$
  compute Jain's fairness index f_r of $x_{\sigma_r(1)}, \dots, x_{\sigma_r(37)}$
end
CI = $[f_{(5)}, f_{(95)}]$

1. None
2. A
3. B
4. Both
5. I don't know



Solution

```
for r = 1:99
  for n = 1:37
    draw one sample y_{n,r} from S
  end
end
for r = 1:99
  compute Jain's fairness index
  f_r of y_{1,r}, …, y_{37,r}
end
CI = [f_(5), f_(95)]
```

The textbook implementation of the boostrap consists in making R replay experiments by re-sampling with replacement from the data.

This is the same as Algorithm A

We have two independent measurements $X_1 = 7.4$ and $X_2 = 8.0$. Let $L = \min(X_1, X_2)$ and $U = \min(X_1, X_2)$. ax

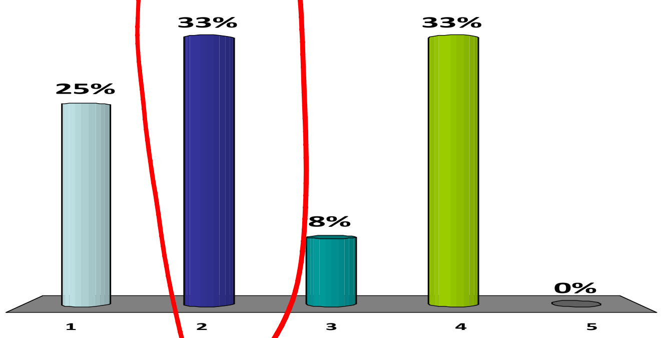
A.
The probability of the event $\{L \leq \theta \leq U\}$ is 0.5

OK

B.
The probability of the event $\{7.4 \leq \theta \leq 8.0\}$ is 0.5

Say which statement is correct about the median θ of the distribution of X_1 and X_2.

1. None
2. A
3. B
4. Both
5. I don't know

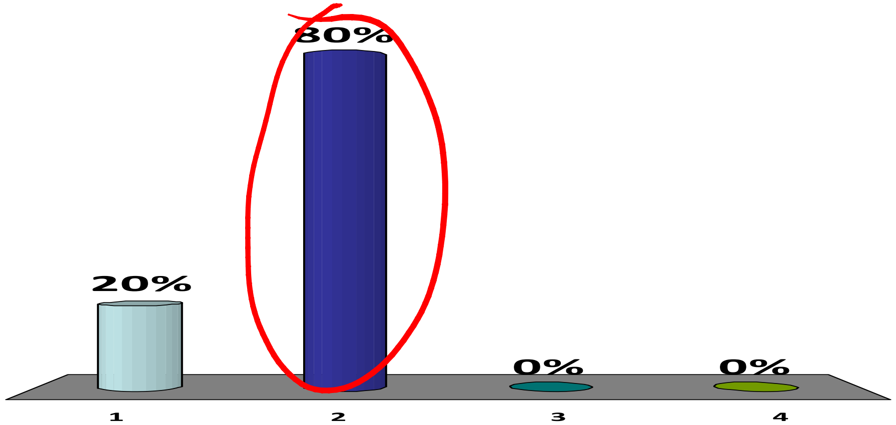


Solution

1. Imagine that the distribution is continuous with a density. Thus the probability that one measurement is $\geq \theta$ is 0.5 and the probability that one measurement is $\leq \theta$ is 0.5.
   The event in statement A means: one of the measurements is $\geq \theta$, the other is $\leq \theta$. This happens with proba 0.5. Statement A is correct.
2. Statement B does not have a meaning, there is no probability assigned to events expressed in terms of the parameter θ.

We expect…

1. … a 95%-confidence interval to be wider than a 99%-confidence interval .
2. … a 95%-confidence interval to be narrower than a 99%-confidence interval.
3. It depends on the data
4. I don't know



Solution

If we want to be more certain, we need the interval to be wider.

Check this with the confidence interval for the median ($n = 37$):

95% : $[x_{(13)}, x_{(25)}]$

99% : $[x_{(11)}, x_{(27)}]$

For the mean

95%: $m \pm 1.96 \frac{s}{\sqrt{n}}$

99%: $m \pm 2.58 \frac{s}{\sqrt{n}}$

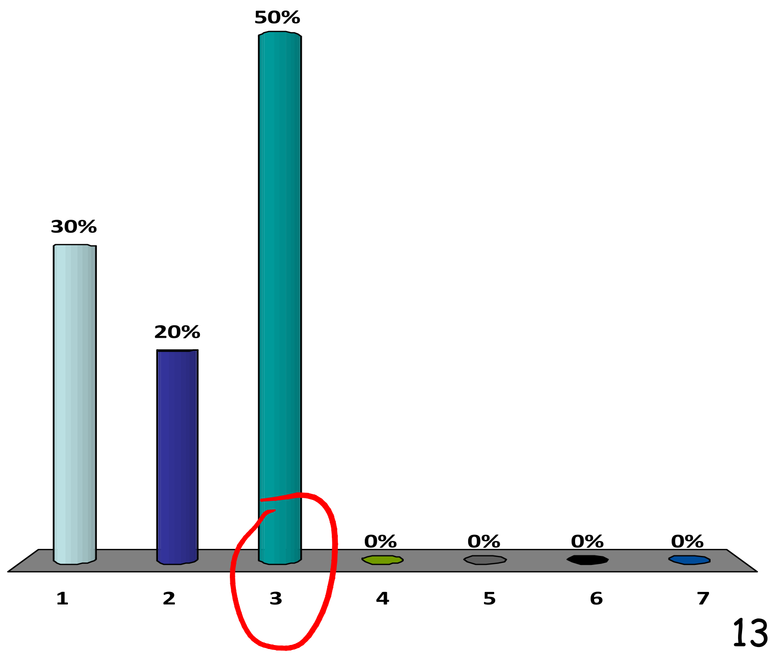
A data set $\{x_i , i = 1 \ldots 39\}$ contains 39 independent values. Which interval is a prediction interval at level 95% ?

A: $[x_{(13)}, x_{(27)}]$

B: $[x_{(1)}, x_{(39)}]$

C: $m \pm 1.96 \frac{s}{\sqrt{37}}$ where m is the mean and s is the standard deviation

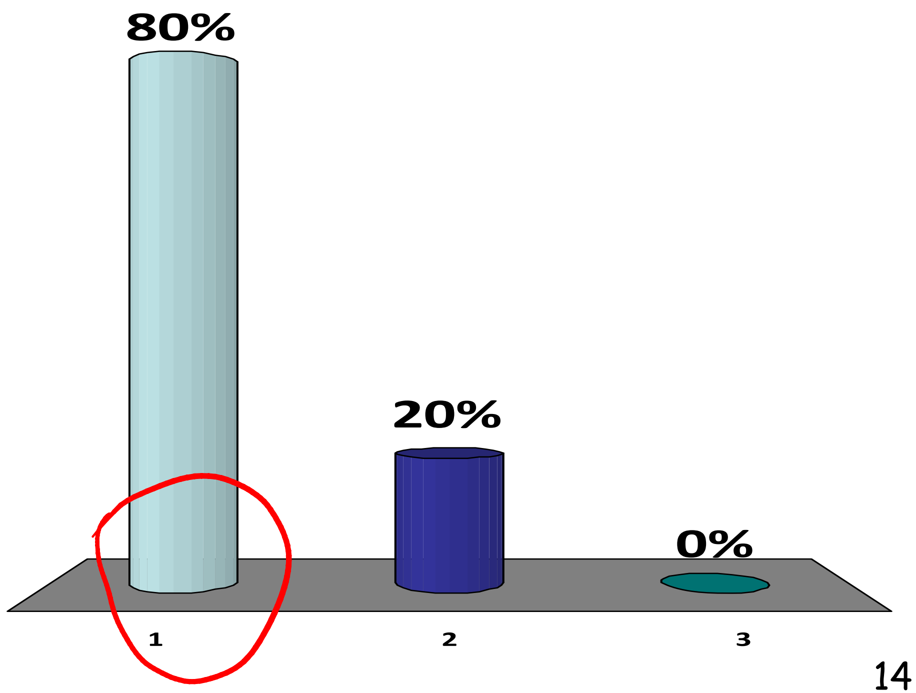
1. None
2. A
3. B
4. C
5. A and C
6. B and C
7. I don't know



A data set x_i is such that $y_i = \log(x_i)$ looks normal. A 95%-prediction interval for y_i is $[L, U]$.

Is it true that a 95%- prediction interval for x_i is $[e^L, e^U]$?

1. True
2. False
3. I don't know



Solution

$$P\{L \le Y_{n+1} \le U\} \ge 95\%$$

thus

$$P\{e^L \le e^{Y_{n+1}} \le e^U\} \ge 95\%$$

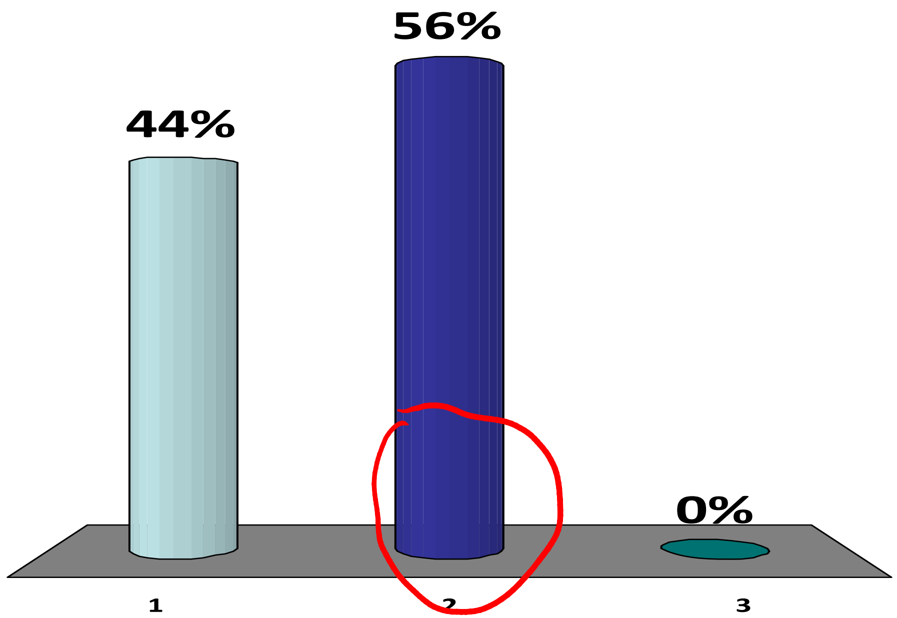
$$P\{e^L \le X_{n+1} \le e^U\} \ge 95\%$$

True

A data set x_i is such that $y_i = \log(x_i)$ looks normal. A 95%-confidence interval for the mean of y_i is $[L, U]$.

Is it true that a 95%-confidence interval for the mean of x_i is $[e^L, e^U]$?

1. True
2. False
3. I don't know



Solution

$$g_x = \left(\prod x_i\right)^{1/n}$$

False:

$X_i = e^{Y_i}$, but $m_X \neq e^{m_Y}$ in general

It is the geometric mean g_X

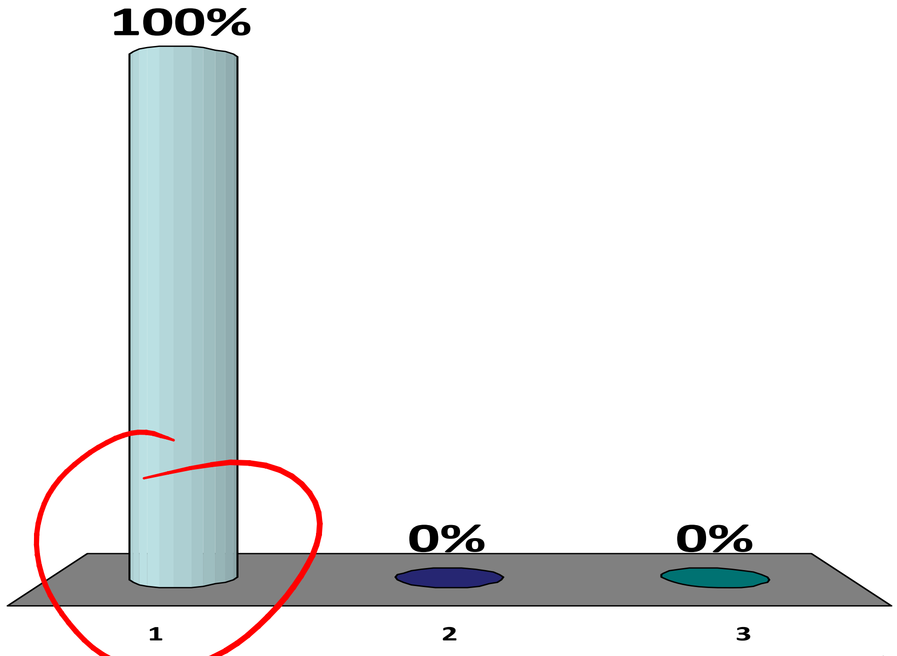
$$g_X = e^{m_Y}$$

$[e^L ; e^U]$ is a confidence interval for the geometric mean g_X

A data set x_i is such that $y_i = \log(x_i)$ looks normal. A 95%-confidence interval for the median of y_i is $[L, U]$.

Is it true that a 95%- confidence interval the median of x_i is $[e^L, e^U]$?

1. True
2. False
3. I don't know



Solution

A confidence interval for the median of y_i is given by $L = y_{(j)}, U = y_{(k)}$

where j and k are given by the table and depend on n

A confidence interval for the median of x_i is given by $L_X = x_{(j)}, U_X = x_{(k)}$

where j and k are the same as for y_i

$x_{(j)} = e^{y_{(j)}}$ and $x_{(k)} = e^{y_{(k)}}$ because exp is monotonic ↑

$[e^L ; e^U]$ is a confidence interval for the median of x_i

True

A set of measurements is positively correlated. We compute a confidence interval for the median as if it were iid. The true confidence interval is …

1. Larger
2. Smaller
3. It depends on the data
4. I don’t know