ISE 2211 • Exam I • 1 September 2021 24 pts. NAME SOLUTION

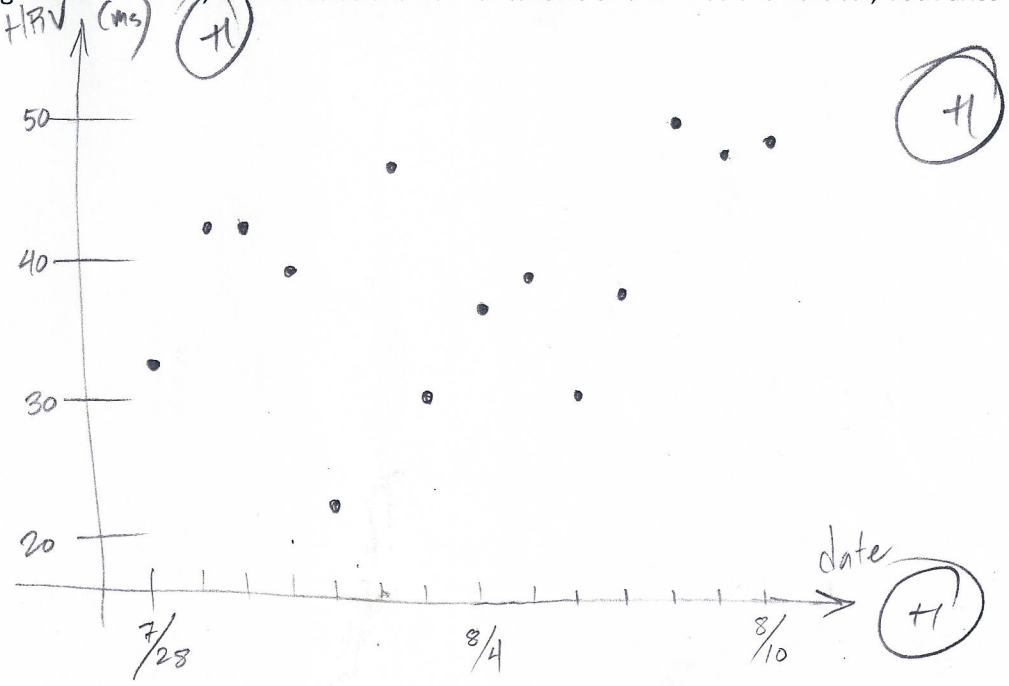
1) Joe Tritschler's esteemed colleague uses an electronic device/software application called Whoop to track her health and fitness. One metric that is measured and assessed by this device is called Heart Rate Variability, or HRV, measured in milliseconds. According to https://www.health.harvard.edu/blog/heart-rate-variability-new-way-track-well-2017112212789:

> *HRV is simply a measure of the variation in time between each heartbeat. This variation is controlled by a primitive part of the nervous system called the autonomic nervous system (ANS). It works regardless of our desire and regulates, among other things, our heart rate, blood pressure, breathing, and digestion.*
>
> *People who have a high HRV may have greater cardiovascular fitness and be more resilient to stress. HRV may also provide personal feedback about your lifestyle and help motivate those who are considering taking steps toward a healthier life.*

Said colleague recently had a "breakthrough" infection of COVID-19 despite being fully vaccinated. The following is actual HRV data from her Whoop app by date, with notes.

Day	Date	HRV	Notes
W	7/28	33	
R	7/29	43	
F	7/30	43	
S	7/31	39	
U	8/1	23	Low number likely reflects excessive alcohol consumption the previous night
M	8/2	47	
T	8/3	31	
W	8/4	37	Presentation of COVID symptoms
R	8/5	40	Confirmed positive COVID test
F	8/6	31	
S	8/7	39	
U	8/8	52	Reported feeling "loads better"
M	8/9	48	
T	8/10	49	

Hand-sketch a scatter diagram of this data, with date as the horizontal axis and HRV as the vertical, both axes as linear as possible.



Compute the sample mean, sample variance, sample standard deviation, and sample range of HRV. Include a unit with each answer.

Hint: $s^2 = \frac{\sum x_i^2 - \frac{(\sum x_i)^2}{n}}{n-1}$

$n = 14$

$\bar{x} = 39.64$ ms (+2)

$s^2 = \frac{22867 - \frac{555^2}{14}}{13} = 66.55$ $(ms)^2$ (+3)

$s = +\sqrt{66.55} = 8.158$ ms (+2)

$r = 52 - 23 = 29$ ms (+2)

Hand sketch a histogram showing relative frequency. Use bins corresponding to HRV in the 20-, 30-, and 40, 50-range.

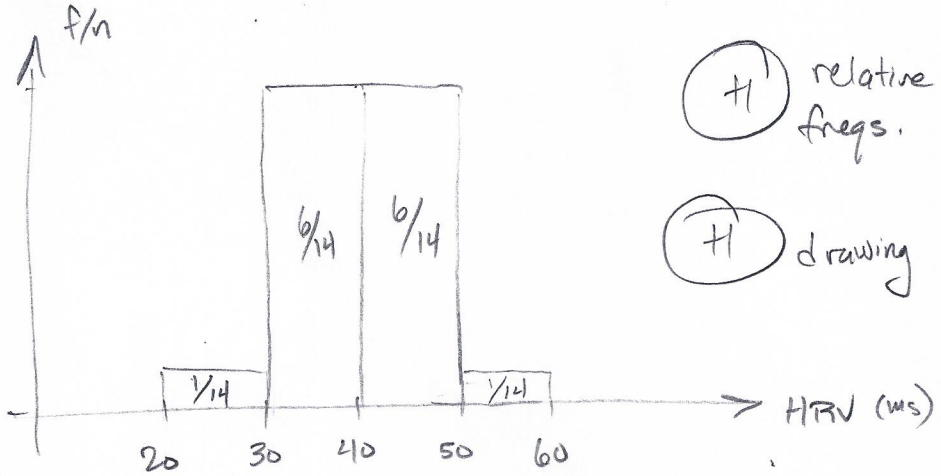
Ordered data: (+1)

52
49
48
47
43
43
40
39
39
37
33
31
31
23

$f_{20} = 1$ $f_{40} = 6$

$f_{30} = 6$ $f_{50} = 1$

(+1) freqs.



(+1) relative freqs.

(+1) drawing

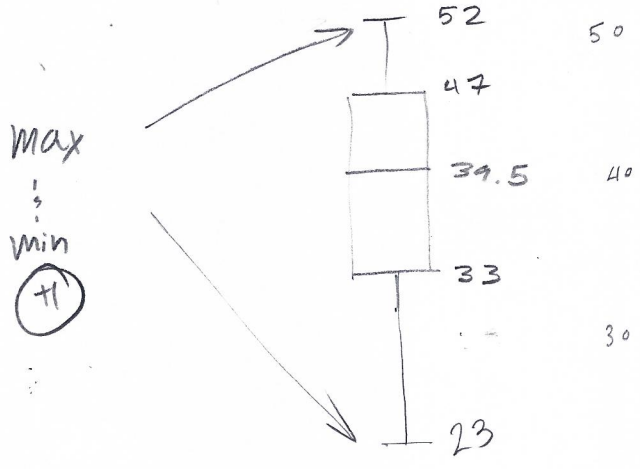
Draw a box-and-whisker plot for this data. Show how you determined the first, second, and third quartiles.

median (Q2) = $\frac{39+40}{2}$ = 39,5

Q_1 = median of lower half = 33

Q_3 = median of upper half = 47

(+3)

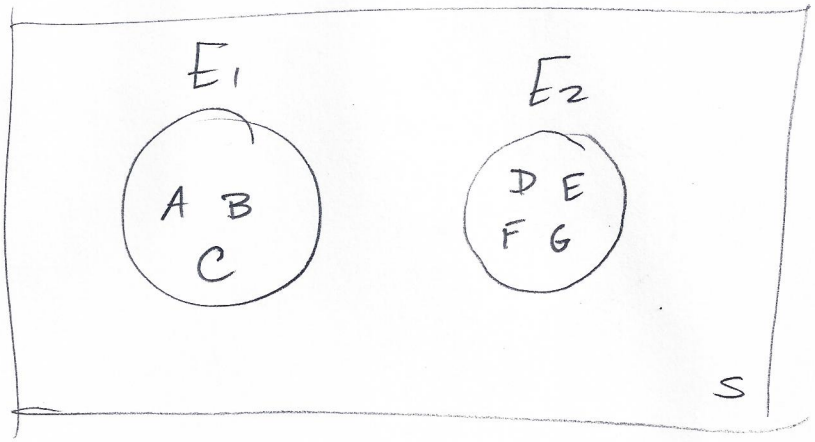


(+1)

approximately to scale

(+1)

2) Consider two exhaustive, mutually-exclusive events contained in a sample space such that E_1 is the event {A B C} with respective probabilities 0.22, 0.23, and 0.07, and E_2 is the event {D E F G} with respective probabilities 0.04, 0.21, 0.09, and 0.14. Draw a Venn diagram for this sample space and compute the probability associated with $E_1 \cap E_2$.



+1

$E_1 \cap E_2 = \emptyset$ [mutually exclusive!]

+1

$\therefore P(E_1 \cap E_2) = 0$

+1