ISE 2211 • Exam I • 21 May 2019 NAME SOLUTION

1) Explain the difference between a mechanistic model and an empirical model and give an example of each.

mechanistic model: built from knowledge of physical mechanism

ex: Ohm's Law (+2)

empirical model: developed from data

ex: Young's Modulus (+2)

2) The following is a sample space of actual DC voltage measurements of a NE-51 bayonet-base miniature neon indicator lamp in volts: S{ 52.8 51.0 51.6 53.7 56.7 58.1 59.4 62.1 }

Is this a discrete or continuous sample space? (+1)

Compute the sample mean, sample range, sample variance, and sample standard deviation. Include units with your answers.

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

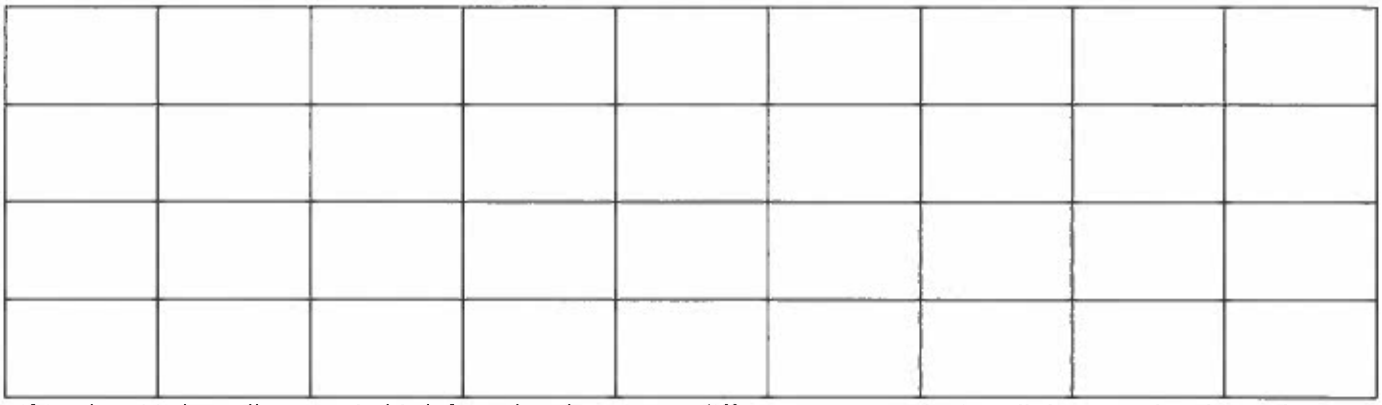
$$\bar{x} = \frac{\sum x_i}{n} = \frac{445.4}{8} = 55.675 \text{ V}$$ (+1) (+1)

$$r = x_{max} - x_{min} = 62.1 - 52.8 = 11.1 \text{ V}$$ (+1) (+1)

$$s^2 = \frac{24910.36 - 445.4^2/8}{7} = 16.10 \text{ V}^2$$ (+1) (+1)

$$s = +\sqrt{s^2} = 4.013 \text{ V}$$ (+1) (+1)

3) Joe Tritschler enjoys hanging and finishing drywall. (Really.) When he built his all-analog recording studio two summers ago, he hung 4'x12' sheets of 5/8" drywall (105 lbs. each!) on studs framed 16" on-center, with screws every twelve inches for extra rigidity. That comes out to 50 screws on each sheet of drywall, with a chalked grid that would look about like this:



If Joe has 32 drywall screws in his left pocket, how many different ways can he install them on the above sheet of drywall if the order isn't important? What if he MUST install them in order?

$$P\binom{n}{r} = \frac{n!}{(n-r)!}$$

$$\binom{n}{r} = \frac{n!}{r!\,(n-r)!}$$

ordered = permutations (+1)

$$P\binom{50}{32} = \frac{50!}{(50-32)!} = 4.75 \times 10^{48} \text{ ways}$$

(+1)

unordered = combinations (+1)

$$\binom{50}{32} = \frac{50!}{32!\,(18!)} = 1.81 \times 10^{13} \text{ ways}$$

(+0)

4) Joe Tritschler is turning 40 next month and thinks a brand new G&L Doheny would be an appropriate birthday present. According to glguitars.com, it is available in the following options:

- Maple or Caribbean Rosewood fingerboard
- Dual-Fulcrum or Saddle-lock bridge
- 28 standard and 16 premier finishes

How many different guitars are possible?

multiplication rule (+1)

$2 \times 2 \times (28 + 16)$

$= 176$ guitars (+1)

Extra credit: what is the probability of Joe getting one for his birthday?

0%

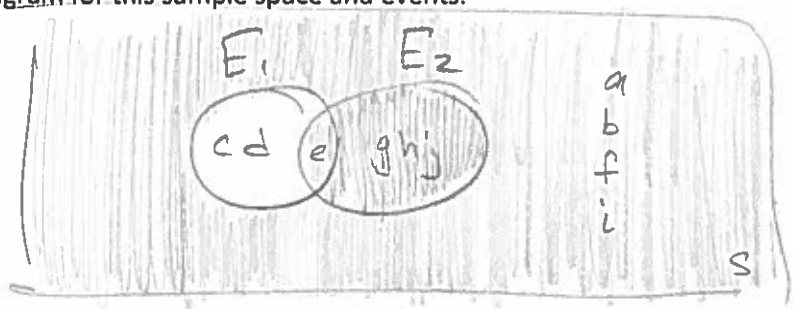
5) The following discrete sample space comprises exactly ten *equally-likely* outcomes: $S\{a\ b\ c\ d\ e\ f\ g\ h\ i\ j\}$

Events E_1 and E_2 are defined as follows:

$E_1\{c\ d\ e\}$

$E_2\{e\ g\ h\ j\}$

Draw a Venn diagram for this sample space and events.



+1 events w/ intersection

+1 outcomes not in events

+1 shading

Perform the following set operations, showing the resulting outcomes and total probability for each.

$E_1 \cup E_2$

equally-likely outcomes → P = 0.1 for each outcome

$\{cde\} \cup \{eghj\} = \{cdeghj\}$ (+1)

$P(E_1 \cup E_2) = 0.1 \times 6 = 0.6$ or 60% (+1)

percentages optional

$E_1 \cap E_2'$

$E_2' = \{cdabfi\}$ (+1)

$E_1 \cap E_2' = \{cde\} \cap \{cdabfi\} = \{cd\}$ (+1)

$P = 2 \times 0.1 = 0.2$ or 20% (+1)

$E_1' \cup E_2$ Additionally, shade this operation on the Venn diagram.

$E_1' = \{abfghij\}$ (+1)

$\{abfghij\} \cup \{eghj\} = \{abefghij\}$

$P = 0.8$ or 80% (+1)