ISE 2211 • Exam I • 22 January 2021 (+26 pts.) NAME SOLUTION

(+8) 1) Joe Tritschler has three deranged young children. He has identified thirty-six activities in which serious damage may be inflicted to the infrastructure of the house, and that's just on the first floor (such as: swinging from curtains, jumping on boiler radiators, banging on windows, etc.). Calculate the number of ways in which the three deranged kids can accomplish these 36 activities if a) it doesn't matter which child is performing each activity and b) it does matter which child is performing each activity.

Formulae:

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

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

a) order doesn't matter → combinations (+1)

$$\binom{36}{3} = \frac{36!}{3!\,(36-3)!} = \frac{36 \times 35 \times 34 \times \cancel{33!}}{3 \times 2 \;(\cancel{33!})}$$

(+1) eqn.
(+1) numbers
(+1) math

$$= 7140 \text{ ways}$$

b) order does matter → permutations (+1)

(+1) eqn.
(+1) numbers
(+1) math

$$P\binom{36}{3} = \frac{36!}{(36-3)!} = \frac{36 \times 35 \times 34 \times \cancel{33!}}{\cancel{33!}}$$

$$= 42840 \text{ ways}$$

+10

2) The following is a sample of water temperature measurements in degrees Fahrenheit from the return line of a hydronic heating system.

110.5
181.0
173.4
164.8
152.7
109.3 ←
112.4
156.3
173.5
188.3 ←
146.6
157.3
160.0
139.4

$n = 14$

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

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

+1 $\sum x_i = 2125.5$ $\quad \bar{x} = \dfrac{2125.5}{14} = 151.8$ °F (+1) (+1)

+1 $\sum x_i^2 = 331351.4$ $\quad s^2 = \dfrac{331351.4 - \frac{2125.5^2}{14}}{14-1} = 665.8$ $(°F)^2$ (+1) (+1)

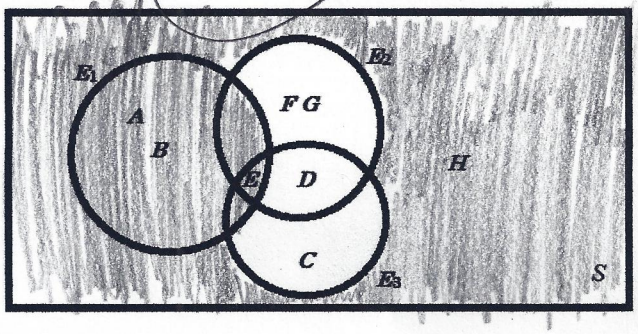
$s = +\sqrt{665.8} = 25.80$ °F (+1) (+1)

$r = 188.3 - 109.3 = 79$ °F (+1) (+1)

+8

The following Venn diagram applies to outcomes and events in the sample space *S*, along with associated probabilities.

+2



$P(A) = 0.086$
$P(B) = 0.044$
$P(C) = 0.172$
$P(D) = 0.001$
$P(E) = 0.502$
$P(F) = 0.058$
$P(G) = 0.111$
$P(H) = 0.026$

Is this an *exhaustive* set of events?

No; outcome H is not contained in any event +1

List all pairs of *mutually exclusive* events, if any.

None +1

Determine the outcomes associated with the following set operation, and the final probability. Additionally, shade this operation on your Venn diagram. Show all steps in order to receive maximum partial credit.

$(E_3 \cup E_2)' \cup E_1$

$E_3 \cup E_2 = \{CDEFG\}$ +1

$(E_3 \cup E_2)' = \{ABH\}$ +1

$(E_3 \cup E_2)' \cup E_1 = \{ABHE\}$ +1

$P\{ABHE\} = P(A) + P(B) + P(H) + P(E)$ +1

$= 0.658$