NAME: Key

Show all of your work.

1. 1000 machine parts are measured piece by piece for Brinell hardness and diameter, with the resulting counts as shown in the table. A single part is selected at random from this lot.

		Diameter		
		< 1 in.	$1 - 1.005$ in.	> 1.005 in.
Brinell Hardness	< 190	154	98	48
	190-210	94	307	99
	> 210	33	72	95

300

242

(a) What is the probability that it is more than 1.005 in. in diameter?

$$\frac{48+99+95}{1000} = \frac{242}{1000} = .247$$

(b) What is the probability that it is more than 1.005 in. in diameter and has Brinell hardness less than 190?

$$\frac{48}{1000} = .048$$

(c) What is the probability that that is has a diameter over 1.005 in., given that its Brinell hardness is less than 190?

$$= \frac{P(\text{Diam} > 1.005 \text{ AND Hardness} < 190)}{P(\text{Hardness} < 190)} = \frac{48/1000}{(154+97+48)/1000} = \frac{48}{154+98+48} = \frac{48}{300}$$

$$= 0.16$$

(d) Are the events Brinell hardness over 210 and diameter less than 1 inch independent? Explain.

If they are independent then $P(\text{Hard} > 210 \text{ And Diam} < 1) = P(\text{Hard} > 210) \cdot P(\text{Diam} < 1)$

$P(\text{Hard} > 210 \text{ And Diam} < 1) = 33/1000$

$P(\text{Hard} > 210) = \frac{33+72+95}{1000} = \frac{200}{1000}$

$P(\text{Diam} < 1) = \frac{154+94+33}{1000} = \frac{281}{1000}$

$\frac{33}{1000} \neq \left(\frac{200}{1000}\right)\left(\frac{281}{1000}\right)$

so they are not independent

(e) Name any two mutually exclusive events in this situation.

{Diameter < 1 in} and {Diameter > 1.005 in}

a part can't be a part of both of these events at the same time

So they are mutually exclusive.

2. Suppose I have a random variable X with probability mass function $f(x) = cx^2$ for $x = 1, 2, 3, 4$ and $f(x) = 0$ for all other values.

   (a) What value does c need to be to make this a valid probability mass function?

   we need $\sum_x f(x) = 1$

   $f(1) + f(2) + f(3) + f(4) = c1^2 + c2^2 + c3^2 + c4^2 = 30c$

   so $\boxed{c = \frac{1}{30}}$

   (b) What is $P(X = 5)$?

   0, the pmf only places positive probability at $x = 1, 2, 3, 4$

   (c) What is $P(X \neq 3)$?

   $= 1 - P(X = 3) = 1 - \frac{3^2}{30} = \frac{21}{30} = .7$

   (d) What is $P(X = 2 | X \leq 3)$?

   $= \frac{P(X = 2 \text{ And } X \leq 3)}{P(X \leq 3)} = \frac{P(X = 2)}{P(X \leq 3)} = \frac{4/30}{1 - f(4)} = \frac{4/30}{1 - 16/30} = \frac{4}{14}$

   $\boxed{= .4666}$

3. Are there any ideas/concepts that we've gone over in this course up until this point that you are struggling with?

   Answers will vary