AP Statistics Worksheet
Binomial and Geometric Distributions

Name Key

Show all work.

1. A slot machine has one to nine odds of winning a prize on any given play
   a) Probability of a win is ____.
   b) Explain why this is a binomial setting if you are told you will play ten times and that X= the number of wins.
   c) Assume you play 40 times. Find the mean and standard deviation for this set-up.
   d) Assume you play 40 times. Find each:
      i. $P(X = 5)$
      ii. $P(X \le 8)$
      iii. $P(X = 3)$
      iv. $P(2 \le X \le 9)$
      v. $P(2 < X < 9)$
      vi. The probability that your number of wins is within one standard deviation of the mean.
   d) Assume X= number of plays until your first win.
      $P(X = 6)$
      $P(X \le 10)$
      $P(X = 5)$
      $P(5 \le X \le 10)$
      $P(X > 5)$

2. A recent study shows the distribution of tickets a driver under twenty has accumulated is a normal distribution with a mean of 3 and a standard deviation of 1.2.
   a) $P(X = 3)$
   b) $P(X \le 3.5)$
   c) $P(X > 2)$
   d) $P(2 \le X \le 4)$
   e) $P(1.9 < X < 4.3)$

3. A new test for the presence of steroid has a false positive rate of 5%.
   Part I: X = the number of false positives in a test of eighty students.
      a) $P(X = 0)$
      b) $P(X \le 4)$
      c) $P(X = 3)$
      d) $P(3 \le X \le 5)$
      e) $P(X \ge 4)$
   Part II: X = the number of tests until the first false positive
      f) $P(X = 1)$
      g) $P(X \le 5)$
      h) $P(X = 15)$
      i) $P(1 \le X \le 4)$
      j) $P(X > 4)$
   Part III:
      Sketch the probability distribution histogram for the binomial set-up. Label clearly.

4. A shipment is tested for defective parts. A sample of size 125 is taken from a lot. It passes if there are fewer than 3% defective parts. Let X = the number of defective parts.
   a) Probability no parts are defective
   b) Probability 3% of parts are defective
   c) Probability at most 3% of parts are defective
   d) If Y= the number of parts inspected until finding the first defective part,
      i. $P(Y = 10)$
      ii. $P(Y < 20)$
      iii. $P(Y > 10)$

5. Approximately 36% of the population of Fivonia has type $O^+$ blood. X = number of people selected until the first with type $O^+$ is found. .
   a) $\mu_X =$
   b) $P(X = 3)$
   c) $P(X \leq 5)$
   d) $P(X \geq 4)$
   e) $P(X > 2)$

6. Approximately 47% of the residents of Nordling own a pet. Let X = the number of pet owners from a sample of 100.
   a) $\mu_X =$
   b) $P(X = 47)$
   c) $P(38 \leq X \leq 52)$
   d) Probability that at least 47% of the sample are pet owners

7. Explain briefly the difference between the binomial and geometric setting.

8. Approximately 25% of the females in North Pikeville are taller than 70 inches.
   X = number of females taller than 70 inches in a sample of size 40
   Y = the number of females selected until the first female taller than 70 inches is selected

   a) $\mu_X =$ $\qquad\qquad$ $\sigma_X =$
   b) $\mu_Y =$
   c) $P(Y > 4)$
   d) $P(X \geq 25)$

Binomial

$P(X=k) = \binom{n}{k} \cdot p^k \cdot (1-p)^{n-k}$

$\mu = np$

$\sigma = \sqrt{np(1-p)}$

Geometric

$P(x=n) = (1-p)^{n-1}(p)$

$\mu = \frac{1}{p}$

$\sigma = \sqrt{\frac{(1-p)}{p^2}}$

$p(x>n) = (1-p)^n$

1. a) $\frac{1}{10}$ or .1

b) fixed # events (10)
2 outcomes (success / failure)
independent trials
constant prob. for each trial

c) $\mu = 40(.1) = 4$

$\sigma = \sqrt{40(.1)(.9)} = 1.8973$

d)

i) $P(x=5) = .16471$

ii) $P(X \leq 8) = .9845$

iii) $P(x=3) = .20032$

iv) $P(2 \leq X \leq 9) = .99494 - .08047 = .91447$

v) $P(2 < X < 9) = .9845 - .22281 = .76169$

vi) $P(2.103 \leq X \leq 5.897) = .79373 - .22281 = .57092$

e) Geom.

$P(x=6) = .05905$

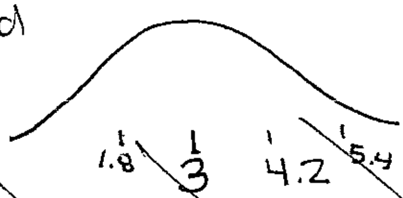
$P(X \leq 10) = .6513$

$P(x=5) = .06561$

$P(5 \leq X \leq 10) = .65132 - .3439 = .3074$

$P(x>5) = .5905 = 1 - \text{geomcdf}(.1, 5) = .9^5$

See below
for #2
Corrected




2. $\mu = 3$
$\sigma = 1.2$
normal
~~binomial~~
$P(X=3) =$ 0
$P(X \leq 10) = .999 = 1$
$P(X=5) = .054$
$P(5 \leq X \leq 10) =$ normalcdf$(5, 10, 3, 1.2) = .0478$
$P(X>5) = 1 -$ normal cdf$(5, 1000, 3, 1.2) = .9522$

3. Part I – binomial $n=80$, $p=.05$
a) .01652
b) .62888
c) .19783
d) .78922 – .23062 = .5586
e) 1 – .42845 = .57155

Part II – geom. $p=.05$
f) .05
g) .22622
h) .02438
i) .18549 – 0
j) 1 – .18549 = .81451

Part III –

#2 normalcdf –
a) 0
b) .6615
c) .7977
d) .5953
e) .6810

4) binomial
a) .0222
b) $P(X = 3\%$ of $125) = P(X = 3.75) = .2$
c) $P(X \leq 3.75) = .4814$
d) i .02281
ii .43939
iii 1 – geomcdf(.03, 10) = 1 – .26258 = .7374

5 geom .36

a) $\mu_x = \frac{1}{.36} = 2.778$

b) .1475

c) .8924

?. d) 1-geomcdf(.36, 3) = .26284

e) $P(X>2) = .64^2 = .4096$

6. Binomial

a) $\mu_x = .47(100) = 47$

b) $P(X=47) = .0797$

c) .8368

d) $P(X \geq 47) = 1 - .4609 = .5391$

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8. a) $\mu_x = 40(.25) = 10$

$\sigma_x = \sqrt{40(.25)(.75)} = 2.739$

b) $\mu_Y = \frac{1}{.25} = 4$

c) $P(Y>4) = .75^4 = .3164$

d) $P(X \geq 25) = 1 -$ binomcdf (40, .25, 24)

$= 5.9 \times 10^{-7} \doteq 0$