AP Stats Name: Key

2.2 Normal Calculations: Do you have a VOI, graph, and context for your answer?????

#1) **Serving Speed**

In the 2008 Wimbledon tennis tournament, Rafael Nadal averaged 115 miles per hour (mph) on his first serves. Assume that the distribution of his first serve speeds is Normal with a mean of 115 mph and a standard deviation of 6 mph.

(a) About what proportion of his first serves would you expect to be slower than 103 mph?

$X < 103$ mph

$z < \frac{103-115}{6}$

$z < -2$

.0228

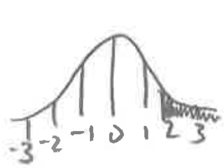
The proportion of serves slower than 103 mph is .0228.

(b) About what proportion of his first serves would you expect to exceed 120 mph?

$X > 120$ mph

$z > \frac{120-115}{6}$

$z > .83$



1 - .7967

.2033

The proportion of serves exceeding 120 mph is .2033.

(c) What percent of Rafael Nadal's first serves are between 100 and 110 mph?

100 mph $< X <$ 110 mph

$\frac{100-115}{6} < z < \frac{110-115}{6}$

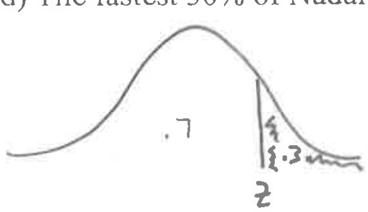
$-2.50 < z < -.83$

.2033 - .0062

.1971

19.71% of Nadal's serves are between 100 + 110mph.

(d) The fastest 30% of Nadal's first serves go at least what speed?



invNorm (area = .7, $\mu = 0, \sigma = 1$)

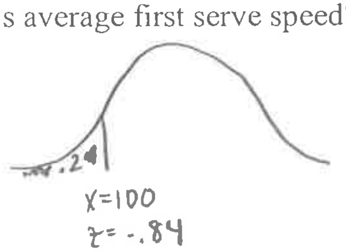
$z > .52$

$\frac{X-115}{6} > .52$

$X > 118.12$ mph

The fastest 30% of Nadals serves are at least 118.12 mph.

(e) A different player has a standard deviation of 8 mph on his first serves and 20% of his serves go less than 100 mph. If the distribution of his serve speeds is approximately Normal, what is his average first serve speed?



invNorm (area = .2, $\mu = 0, \sigma = 1$)

$z = -.84$

$\frac{100-\mu}{8} = -.84$

$\mu = 106.72$ mph

His average serve speed is 106.72 mph

#2) **Baseball**

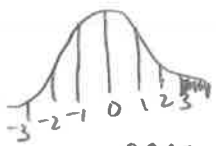
Suppose that Clayton Kershaw of the Los Angeles Dodgers throws his fastball with a mean velocity of 94 miles per hour (mph) and a standard deviation of 2 mph and that the distribution of his fastball speeds can be modeled by a Normal distribution.

(a) About what proportion of his fastballs will travel at least 100 mph?

$X > 100$ mph

$z > \frac{100-94}{2}$

$z > 3$



$1 - .9987 = .0013$

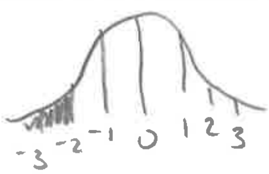
The proportion of fastballs that travel at least 100 mph is .0013.

(b) About what proportion of his fastballs will travel less than 90 mph?

$X < 90$ mph

$z < \frac{90-94}{2}$

$z < -2$



.0228

The proportion of fastballs that travel less than 90 mph is .0228.

(c) About what proportion of his fastballs will travel between 93 and 95 mph?

93 mph $< X <$ 95 mph

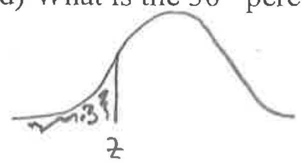
$\frac{93-94}{2} < z < \frac{95-94}{2}$

$-.50 < z < .50$

$.6915 - .3085 = .383$

The proportion of fastball traveling between 93 and 95 mph is .383.

(d) What is the 30th percentile of Kershaw's distribution of fastball velocities?



invNorm(area=.3, $\mu=0, \sigma=1$)

$z = -.52$

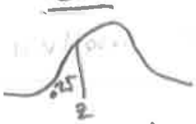
$-.52 = \frac{X-94}{2}$

$X = 92.93$ mph

A fastball at 92.93 mph is at the 30th percentile.

(e) What fastball velocities would be considered low outliers for Kershaw?

Q_1



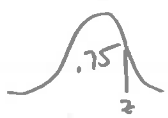
invNorm(area=.25, $\mu=0, \sigma=1$)

$z = -.67$

$-.67 = \frac{x-94}{2}$

$X = 92.66$ mph for Q_1

Q_3



invNorm(area=.75, $\mu=0, \sigma=1$)

$z = .67$

$.67 = \frac{x-94}{2}$

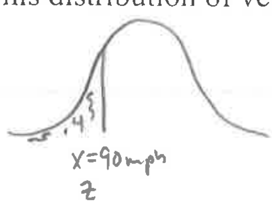
$x = 95.34$ mph for Q_3

$IQR = 95.34 - 92.66 = 2.68$

$92.66 - 1.5(2.68) = 88.64$ mph

Any fastball below 88.64 mph would be a low outlier.

(f) Suppose that a different pitcher's fastballs have a mean velocity of 92 mph and 40% of his fastballs go less than 90 mph. What is his standard deviation of his fastball velocities, assuming his distribution of velocities can be modeled by a Normal distribution?



invNorm(area=.4, $\mu=0, \sigma=1$)

$z = -.25$

$-.25 = \frac{90-92}{\sigma}$

$\sigma = 8$ mph

The standard deviation of his fastball is 8 mph.