<u>High School:</u> Read and answer questions

1. The Rockies' revenue comes from ticket sales, concessions, parking, TV and radio contracts, as well as other sources. The Rockies' greatest expense is player salaries. In 2019, the Rockies are expected to have an estimated payroll of $145.9 million. In 2018, the Rockies sold 3,015,880 tickets at an average price of about $26 per ticket, for a total ticket revenue of $78,412,880. This means ticket revenue in 2018 was enough to pay for about 53.7% of 2019 player salaries.

   In 2020, the Rockies estimated payroll is expected to rise to $177.3 million. To help pay for this, the team would like to see if they can generate more revenue through ticket sales. After studying the effects of raising ticket prices, the Rockies estimate that for every $1 *decrease* in average ticket price, they would sell 100,000 additional tickets in a year. Likewise, for every $1 *increase* in average ticket price, they would sell 100,000 fewer tickets in a year.

   The team calculates ticket revenue with the following model:

   ticket revenue = (number of tickets sold)(price per ticket)

   Let x = the change in average ticket price, in dollars. Refine the Rockies' model by defining the number of tickets sold as 3,015,880 tickets minus the estimated decrease in ticket sales per dollar of average ticket price increase, and define the price per ticket as $26 plus the increase in average ticket price.

   With your refined model, what change in average ticket price results in the maximum increase in ticket revenue?

   Is the increased ticket revenue enough to keep paying for 53.7% of player salaries in 2020?

   What other factors influence ticket sales and how might you include them to further refine the ticket revenue model?

2. Some people believe that hitters have struggled to produce more offense as pitchers' pitch velocity has increased over time. In 2003, the average fastball speed was about 89 miles per hour. Fifteen years later, in 2018, the average fastball speed was about 92 miles per hour.

   Some people have suggested that the pitching mound be moved further from home plate to give hitters extra time to swing at these increasingly fast pitches. Currently the pitcher's rubber is 60 feet, 6 inches away from home plate.

   How far away would you need to put the pitcher's rubber from home plate so that a 92-mph fastball took the same amount of time to reach home plate as an 89-mph fastball does from 60 feet, 6 inches away?

3. Because of Colorado's thin air, a lot of people think Coors Field is a great place to hit home runs. This is only partly true; yes, the balls fly further in Denver's less-dense mile-high air, but the outfield fences are further away than average, too.

   A statistic known as a *park factor* is commonly used to compare how hitter-friendly a ballpark is compared to other parks. It does this by comparing the rate of a statistic (such as hits or home runs) in the home park to the rate of the statistic in road parks. In 2018, the Great American Ball Park in Cincinnati, Ohio, led the major leagues with a park factor for home runs of 1.395. Coors Field came in second with a park factor for home runs of 1.28.

   Below are the park factors for several statistics from a sample of major league ballparks (just the ones in the National League). Park factors greater than 1.0 favors hitters, while park factors below 1.0 favors pitchers.

PARK NAME	RUNS	HR	H	2B	3B	BB
Busch Stadium (St. Louis, Missouri)	0.926	0.856	0.979	0.907	0.75	0.857
Chase Field (Phoenix, Arizona)	1.057	0.955	1.033	0.962	2.136	1.069
Citi Field (New York, New York)	0.731	0.888	0.84	0.643	0.758	0.862
Citizens Bank Park (Philadelphia, Pennsylvania)	1.042	1.19	0.98	0.967	0.879	0.943
Coors Field (Denver, Colorado)	1.271	1.28	1.233	1.475	2.025	1.005
Dodger Stadium (Los Angeles, California)	0.872	1.057	0.939	1.003	0.285	0.808
Great American Ball Park (Cincinnati, Ohio)	1.128	1.395	1.023	1.038	1.364	1.16
Marlins Park (Miami, Florida)	0.747	0.65	0.941	0.885	0.732	0.988
Miller Park (Milwaukee, Wisconsin)	1.011	1.116	0.952	0.929	0.893	1.012
Nationals Park (Washington, D.C.)	1.134	1.173	1.084	1.219	0.821	1.051
Oracle Park (San Francisco, California)	1.012	0.752	1.008	1.06	1.483	1.025
Petco Park (San Diego, California)	1.032	0.983	1.028	1.09	1	1.25
PNC Park (Pittsburgh, Pennsylvania)	0.88	0.849	0.991	1.081	0.693	1.075
SunTrust Park (Cumberland, GA)	1.12	0.802	1.011	0.979	0.774	1.014
Wrigley Field (Chicago, Illinois)	1.079	1.025	0.996	1.007	1.199	1.039

MATH WORKSHEETS

In this sample, the mean park factor for home runs is 0.998 and the standard deviation is 0.207. Coors Field's park factor for home runs is 1.28, which is about 1.36 standard deviations above the mean.

For what statistic (park factor for runs, home runs, hits, doubles, triples, and walks) in the table is Coors Field the greatest number of standard deviations above the mean?

What does this number tell you about the rarity of Coors Field amongst other baseball stadiums?