Motorcycle Jump

MotorcycleJump.tns

Name _____

Class _____

Problem 1 – Maximizing Horizontal Distance

Click the slider to set different values of θ. The vertical velocity, *vy*, and distance of the jump, length, will adjust automatically. Press play to view the path of the jump.

1. What do you notice?

2. Is there a "best" value for θ that will make for the longest jump? if so, what do you believe it is?

3. What does the horizontal axis represent in this model? The vertical axis?

4. Is this model completely realistic? (Hint: What happens as θ gets close to 90°?)

Now, let's capture jump length and θ values to find the value of θ that maximizes the jump length. Return to page 1.5. Choose a value of θ and press ctrl . to capture the values of θ and length. Change the value of θ and press ctrl . to capture additional data. Repeat until you have captured 20 sets of data points. They will be displayed on page 1.9.

5. For these data, which is the independent variable, θ or length? Which is the dependent variable? Explain.

Go to the scatter plot, *θ vs. length*, on page 1.11.

6. Describe the trend in the scatter plot.

7. Is there an angle that maximizes the length of the jump? Explain how you know.

Perform a quadratic regression of the graphed data by pressing menu **> Analyze > Regression > Show Quadratic**.

$y =$ _____

Use this regression equation (stored as f2(*x*)) to calculate the angle of the ramp that maximizes the length of the jump. Show your work on page 1.14. How long will the jump be?

> **Tip:** The coefficients a, b, and c in the regression equation have been stored as the variables stat.a, stat.b, and stat.c.

8. What value of θ will maximize the length of the jump?

9. How long will the jump be?

10. What would be your advice to the rider about how to maximize her horizontal distance during the jump?

Problem 2 – Maximizing Airtime

Now turn to the problem of maximizing airtime. Use the equation for the height of a projectile over time

$$h(t) = -16t^2 + v_0t + h$$

to write an equation as f1 on page 2.2 that models the jump. Use the variables *vy* and *h* in your equation.

f1(*x*) = _____

11. What does the horizontal axis represent in this model? The vertical axis?

12. Once again, use the slider to try different values of *θ*. What do you notice?

Press ctrl . to capture additional data. Repeat until you have captured 20 sets of data points. They will be displayed on page 2.4. The scatter plot of the data is on page 2.6.

13. Describe what you see. Is there a value of θ that maximizes the airtime? Explain how you know.

14. What would be your advice to the rider about how to maximize her airtime?