1. **(1 pt) mathbioLibrary/setABiocLabs/Lab121_C3_yeast_growth.pg**
Because of the accuracy of WebWork, you should use 5 or 6 significant figures on all problems.

In 1913, Carlson [1] studied the growth of a culture of yeast, *Saccharomyces cerevisiae* . Over time this culture levels off, but its initial growth is exponential or Malthusian. A Malthusian growth model is given by

$$P_{n+1} = P_n + rP_n.$$

(We will study this model shortly.) Simply put, the population at the next time $(n+1)$ is equal to the population at the current time (P_n) plus some growth term, which is simply proportional (r) to the current population. Thus, we have a growth function

$$g(P) = rP.$$

Below is a table from Carlson's data showing the population and the rate of growth at that particular population

Population P	$g(P)$ Growth/hr
19100	10900
29300	18300
47300	24300
71800	48100

a. Use Excel's Trendline on the data points to find the best straight line passing through the origin. (Note you will need to use the option in trendline of setting the y-intercept = 0.) What is the slope of the line that best fits through the data?
Slope $r =$ _____.
Find the sum of square errors with this model and the data.
Sum of Square Errors = _____.

b. In your Lab report create a graph of the data and the best fitting linear model. Briefly describe how well the line fits the data.

c. In lecture (Function Review and Quadratics), we examined a linear model for mRNA synthesis. For the linear model (passing through the origin) given above, we can readily find the sum of squares function. Consider a data point $(P_i, g(P_i))$. The absolute error between this data point and our model is given by

$$e_i = |g(P_i) - rP_i|.$$

Thus, $e_1 = |10900 - 19100r|$. Similarly, you can find e_2, e_3, and e_4. The sum of squares function is given by

$$J(r) = e_1^2 + e_2^2 + e_3^2 + e_4^2.$$

Find the expression for the quadratic function of the slope of the model, r (in simplest form).
$J(r) =$ _____r^2 + _____r + _____.
Find the coordinates of the vertex.
$(r_v, J(r_v)) =$ (_____, _____)

d. In your Lab report create a graph of $J(r)$ for $r \in [0.3, 0.8]$. Compare the value of the vertex of the parabola, r_v, and the slope of the best fitting line through the origin found by Excel's Trendline. Also, compare the sum of square errors and the value of $J(r_v)$.

e. From the best model, find the growth for a population of 100,000 yeast.
Growth for 100,000 yeast $g(100,000) =$ _____.
Determine the population of another culture of yeast given that their growth rate is measured to be 75,000 yeast/hour.
For $g(P) = 75,000$, $P =$_____.

[1] T. Carlson, Uber Geschwindigkeit und Grosse der Hefevermehrung in Wurze. Biochem. Z. 57: 313-334, 1913.