3.2 Consider the following modal-split model between two zones i and j (but we will omit the zone indices to alleviate notation):

$$P_1(\Delta t/\theta) = \frac{\exp(-\theta t_1)}{\exp(-\theta t_1) + \exp(-\theta t_2)} = \frac{1}{1 + \exp -\theta(t_2 - t_1)} = \frac{1}{1 + \exp(-\theta\ \Delta t)}$$

$$P_2(\Delta t/\theta) = 1 - P_1 = \frac{\exp(-\theta\ \Delta t)}{1 + \exp(-\theta\ \Delta t)}$$

where t_k is the total travel time in mode k, and θ a parameter to be estimated.

During the development of a study, travel times were calculated as the average of five measurements (observations) for each mode, at a cost of \$1 per observation, and the following values were obtained:

$$t_1 = 12 \pm 2 \text{ min} \qquad t_2 = 18 \pm 3 \text{ min}$$

(a) If the estimated value for θ is 0.1, compute a confidence interval for P_1.

(b) Assume you would be prepared to pay \$3 per each percentage point of reduction in the error of P_1; find out whether in that case it would be convenient for you to take 10 extra observations in each mode whereby the following values for t_k would be obtained:

$$t_1 = 12 \pm 1 \text{ min} \qquad t_2 = 17.5 \pm 1.5 \text{ min}$$