(1) 16 Points. Suppose that \(X\) and \(Y\) are independent random variables with \(E(X) = 2\), \(E(Y) = 4\), \(\text{Var}(X) = 25\) and \(\text{Var}(Y) = 4\). Find the expected value of \(W\) and the variance of \(W\) if \(W = 3X - 5Y + 2\).

(2) 16 Points. A random sample of size 64 is taken from an infinite population having population mean 52 and population variance 400.0. Find the probability that a sample mean from this population will have a value that is between 48.4 and 53.4.

(3) 16 Points. For a certain process for making bearings, a random sample of 16 bearings is selected. The bearings in this sample had a mean diameter of 0.4853 cm with a standard deviation of 0.0084 cm. Assume that the bearing diameters have a normal distribution. Construct a 90% confidence interval for the mean diameter of all bearings made by this process.

(4) 16 Points. An experimental method for determining the specific heat of iron ingots is claimed to have a variance which is at most 0.03.

(a) Formulate this claim as the null hypothesis for a hypothesis test and state the alternative hypothesis.

(b) Assume that these measurements of specific heat have a normal distribution. Specify a decision rule for accepting or rejecting the null hypothesis at the 5% level of significance based upon a random sample of 16 determinations of specific heat.
(5) 24 Points. A random regression sample of size \( n = 18 \) was collected from a bivariate normal population and the following sums were calculated:

\[
\sum x_i = 63 \quad \sum y_i = 2610 \\
\sum x_i^2 = 380.5 \quad \sum x_i y_i = 9995 \quad \sum y_i^2 = 403450
\]

(a) Find the equation for the estimated regression line.

(b) Find the sample correlation coefficient.

(c) We use this sample for the hypothesis test

\[
H_0 : \rho = 0 \\
H_1 : \rho \neq 0
\]

Should we accept or reject the null hypothesis at the 5\% level of significance? Show your work!

(6) 12 Points. Write a brief essay in which you answer the following questions. What is a Type I error? What is a Type II error? How can we avoid Type I errors? How can we avoid Type II errors?