Explorarory Data Analysis Assignment

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Sample variance → how far #s are typically away from mean

Sample covariance → x and y move in same direction = positive
opposite directions = negative

sample mean of x

1. $m(a+bX) = a + b \cdot m(X)$

$X = [2, 4, 6]$
$a = 2$
$b = 4$

$m(2+4[2,4,6]) = 2+4(4)$
$m(2+[8,16,24])$
$m[10,18,26]$
18

$2+4(m[2,4,6])$
$2+4(4)$
18

2. $\mathrm{cov}(X, a+bY) = b \cdot \mathrm{cov}(X,Y)$

$\mathrm{cov}(X,Z) = \frac{1}{N}\sum_{i=1}^{N}(x_i - m(X))(z_i - m(Z))$

$Z = a + bY$

$\mathrm{cov}(X, a+bY) = \frac{1}{N}\sum_{i=1}^{N}(x_i - m(X))\left[(a+by_i) - m(a+bY)\right]$

$m(a+bY) = a + bm(Y)$

$(a+by_i) - (a+bm(Y))$
$b(y_i - m(Y))$

$\mathrm{cov}(X, a+bY) = \frac{1}{N}\sum_{i=1}^{N}(x_i - m(X)) \cdot b(y_i - m(Y))$

$b \cdot \frac{1}{N}\sum_{i=1}^{N}(x_i - m(X))(y_i - m(Y))$

$$b \cdot \frac{1}{N} \sum_{i=1} (X_i - m(X))(Y_i - m(Y))$$

$$\frac{1}{N} \sum_{i=1}^{N} (X_i - m(X))(Y_i - m(Y)) = cov(X, Y)$$

so

$$cov(X, a + bY) = b \cdot cov(X, Y)$$

3. $X = [1, 3, 6]$ $\quad a = 5 \quad b = 2 \quad N = 3$

$Z = [7, 11, 17]$

$$m(X) = \frac{1 + 3 + 6}{3} = \frac{10}{3}$$

$$1 - \frac{10}{3} = -\frac{7}{3} \rightarrow \frac{49}{9}$$
$$3 - \frac{10}{3} = -\frac{1}{3} \rightarrow \frac{1}{9}$$
$$6 - \frac{10}{3} = \frac{8}{3} \rightarrow \frac{64}{9}$$
$$\frac{114}{9}$$

$$cov(X, X) = \frac{1}{3} \cdot \frac{114}{9} = \frac{38}{9}$$

$$m(Z) = \frac{7 + 11 + 17}{3} = \frac{35}{3}$$

$$7 - \frac{35}{3} = -\frac{14}{3} \rightarrow \frac{196}{9}$$
$$11 - \frac{35}{3} = -\frac{2}{3} \rightarrow \frac{4}{9}$$
$$17 - \frac{35}{3} = \frac{16}{3} \rightarrow \frac{256}{9}$$
$$\frac{456}{9}$$

$$cov(Z, Z) \quad \frac{}{3} = \frac{152}{9}$$

$$b^2 cov(X, X) = \frac{152}{9} \;;\; cov(a + bX, a + bX) = \frac{152}{9}$$

4. When a non-decreasing transformation is applied, relative order of the observations are preserved. Because the median and other quantiles depend only on the ordering of data, the median is just the transformation applied to the original median. However, mean and variance depend on the magnitude of values and do not behave the same way when transformed.

5. No, this works only for linear transformations like adding or multiplying by a constant. Nonlinear transformations change the distribution in a w