



$$1) m(ax+bx) = \frac{1}{N} \sum_{i=1}^N ax_i + bx_i \\ = \frac{1}{N} \left(\sum_{i=1}^N a + b \sum_{i=1}^N x_i \right) \\ = \frac{1}{N} \left(Na + b \sum_{i=1}^N x_i \right) = a + b \left(\frac{1}{N} \sum_{i=1}^N x_i \right) \\ = a + b m(x)$$

$$2) \text{Cov}(x, x) = \frac{1}{N} \sum_{i=1}^N (x_i - m(x))(x_i - m(x)) \\ = \frac{1}{N} \sum_{i=1}^N (x_i - m(x))^2 \\ = s^2$$

$$3) \text{Cov}(x, a+bx) = \frac{1}{N} \sum_{i=1}^N (x_i - m(x))((a+bx_i) - (a+b m(x))) \\ = \frac{1}{N} \sum_{i=1}^N (x_i - m(x)) b(y_i - m(y)) \\ = \frac{b}{N} \sum_{i=1}^N (x_i - m(x))(y_i - m(y)) \\ = b \text{Cov}(x, y)$$

$$4) \text{Cov}(a+bx, a+bx) = \frac{1}{N} \sum_{i=1}^N ((x_i + bx_i) - (a + b m(x))) - ((a + bx_i) - (a + b m(x))) \\ = \frac{1}{N} \sum_{i=1}^N (b(x_i - m(x)) - (b(y_i - m(y)))) \\ = \frac{b^2}{N} \sum_{i=1}^N (x_i - m(x))(y_i - m(y)) \\ = b^2 \text{Cov}(x, y)$$

5) if $b > 0$, the order of the values stays the same, so $m(ax+bx) = a+m(bm(x))$
 Scaling/shifting doesn't affect median.
 But $IQR(ax+bx) \neq a+b(IQR(x))$ because scaling by b will stretch the IQR of $ax+bx$.

b) $x = [0, 2] \quad m(x) = 1 \quad m(x^2) = 2$

$m(Tx) = 2 \quad Tm(x) = 1$ not equal

$x = [1, 5] \quad m(x) = 5 \quad 2 \neq 15$