ON MEASURES OF CONTINGENCY

By

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1. *Introduction.* When we deal with the problem of relationship of attributes, we may classify each attribute into a number of groups. To illustrate: If the attributes are x_i $(i=1,2,3,\cdots,n)$ and if the group belonging to X_1 is x_1^i $(i=1,2,3,\cdots,m_1)$, that belonging to X_2 is x_2^j $(j=1,2,3,\cdots,m_2)$, ..., that belonging to X_i is x_i^k $(k=1,2,3,\cdots\cdots,m_i)$, ..., we may form an $m_1\times m_2\times\cdots\times m_i\times\cdots$ table which contains $m_1\times m_2\times\cdots\times m_i\times\cdots$ compartments. In this fashion, it is possible to distribute the total frequency of the "universe" or the "sub-universe" into sub-groups which correspond to these $m_1\times m_2\times\cdots\times m_i\times\cdots$ compartments.

For such situations, Pearson[1] and others[2] have suggested certain measures of relation between the attributes. We shall in this paper be interested primarily in Pearson's measures of contingency. In the case of two attributes, Pearson proceeds as follows: Suppose that A is any attribute and let it be classified into the groups A_i $(i=1,2,3,\cdots\cdots,s)$ and let B be another attribute classified into the groups B_j $(j=1,2,3,\cdots\cdots,t)$. Let the total number of individuals examined be N. Now, the probability a-priori of an individual falling into the respective groups A_i is n_i/N where n_i is the number which fall into A_i. Again, if m_j is the number which fall into B_j, then the probability a-priori of an individual falling into the respective groups B_j is m_j/N where m_j is the number which fall into B_j. If the attributes are independent in the probability sense, then, if N pairs of attri-

[1] Pearson, Karl, "On the Theory of Contingency and its Relation to Association and Normal Correlation," Drapers' Company Research Memoirs, Biometric Series i.; Dulau & Co., London, 1904.

[2] Yule, G. Udny, "An Introduction to the Theory of Statistics," Charles Griffin & Company, Limited, London, 1927, pp. 17–74.