The present investigation is a search into the intellectual social and physical development of ICDS beneficiary pre-school children in Anganwadies to get the necessary information regarding the impact of ICDS on pre-school child beneficiary, so that it can be compared with that of their non-ICDS peers.

Assessment of intellectual development is effective in evaluating the academic readiness of children. In order to assess the intellectual development, the investigator designed seven mental abilities test based on Thurstone's seven primary mental abilities.

The Indian adaptation of the Vineland social maturity scale is commonly used to assess the social development of children. But it deals with some physical skills and was found unsuitable for the present study. So a closed type observation schedule was prepared by the investigator. Closed type schedule was easy to fill up and convenient for scoring (Good and Hatt, 1962; Bhandarkar and Wilkinson, 1983). An observation schedule enables an investigator to gather ample information about the area of study. Moreover it provides certain extra tips of knowledge to the investigator about some grey aspects of the study. Further the information gathered by direct observation is more valid than those from the secondary source.
In the present study, the investigator observed the children in the school informally using the observation schedule and elicited the genuine behaviour of the children.

In order to assess the physical development of pre-school children, measurement of anthropometric measurements was found to be suitable

### 3.1 Research Design

The design of the study thus formulated is as follows.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Aspects of measurement</th>
<th>Criteria of measurement</th>
<th>Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intellectual development</td>
<td>The seven primary mental abilities, verbal comprehension, word fluency, numerical ability, space visualization, memory, perceptual speed, and reasoning</td>
<td>Oral tests and simple ability tests</td>
<td>Self-made tool for the measurement of intellectual abilities based on Thurstone's primary-mental abilities</td>
</tr>
<tr>
<td>Social development</td>
<td>Four desirable social patterns: Competition, cooperation, leadership, and sympathy. Four undesirable social patterns: Dependency, aggression, negativism, and jealousy.</td>
<td>Informal observation by the investigator of the children's activities, reactions and behaviours in the Anganwadi and Balwadi centres.</td>
<td>Structured observation schedule.</td>
</tr>
<tr>
<td>General physical development</td>
<td>Height, weight, head circumference, chest circumference, and mid-arm circumference</td>
<td>Weight in kg, height, head circumference, and mid-arm circumference in cm.</td>
<td>Weighing machine and measuring tape.</td>
</tr>
</tbody>
</table>
3.2 Type of the Study

The present study is a comparative study. Bajpai (1985) states that the comparative method is a scientific method in which comparative data is collected with a specific purpose, analysed and specific conclusions derived from the results.

In this study a comparison is made between the ICDS beneficiary pre-school children and the non-ICDS beneficiary pre-school children, a representative sample, covering 3 districts of North, South and Central Kerala.

3.3 Sample

The pre-school children in Anganwadies and Balwadies from Calicut, Kottayam and Thiruvananthapuram districts formed the universe of the study.

The sample of the study comprises four-year old Anganwadi and Balwadi attending boys and girls of the selected regions. The investigator wanted to draw the sample from a similar socio-economic strata. Both are of the same socio-economic status. But the functioning method of two types of nursery schools have slight differences. So that the difference in performance can be attributed to differential methods of interaction pattern and imparting information and services. So for the control group children from Balwadies were selected and for the experimental group children
from Anganwadies. Thus the true impact of ICDS can be clearly noticed.

Though two to six year old children were considered as pre-school children, the investigator decided to fix the age at four to make the analysis uniform and easy. In order to get the sample from the same socio-economic status the investigator was strict in selecting the four-year-old children attending the Anganwadi and Balwadi centres only. The Anganwadi centres are the pre-school centres run by the Department of Women and Child Development under the ICDS project. All the Anganwadi teachers are given the same training by the Government and the same syllabus followed in all the Anganwadi centres. The Balwadi centres are pre-school centres run by the Indian Council for Child Welfare. It is a most expanding and non-plan programme (Hameeda, 1989). Both the programmes are for children of low socio-economic status.

There is a well thought out, detailed plan to achieve the objectives in the Anganwadies. The feeding programme is more regular in the Anganwadies and it is usually given twice daily 300 days a year. The beneficiaries of the feeding programme are children of the 0-6 age group. That is pregnant and lactating mothers are also fed. They are given education in health and nutrition. Health check ups and growth monitoring is done regularly and systematically for them. whereas in Balwadies, the feeding programme is not so regular and it is given only once daily, 270 days a year. The beneficiaries being only the children in the
age group of 3-5 years. Health check-ups and growth monitoring are not systematic.

The curriculum in Anganwadies are well planned in order to develop all the areas of development to the maximum. Importance is given to non-formal learning mainly through play. Thematic approach is followed here and it is usually related to the life in the community and society in which the child lives. Each week a particular theme is taken up and is introduced to the children through different methods like songs, stories, dramatic play, group play, creative activities, etc. Such a thematic approach helps the children to get an in-depth understanding of facts; stimulate them to think for themselves and to come up with original ideas; while at the same time enjoying themselves to the full. School is not now a chore whereas in Balwadies there is no well thought out curriculum; the 'Thematic approach' is not followed, and there is minimal child participation.

All the activities conducted by the teacher in the Anganwadies are strictly supervised and monitored by frequent visits from supervisors, ACDPOs, CDPOs and the project officer whereas in Balwadies, strict supervision is not conducted.

The small honorarium given to the teachers in both the pre-schools are the same. But only the teachers in Anganwadies get it regularly at the end of every month whereas the Balwadi teachers are irregularly paid.
3.4 Sampling Procedure

The investigator visited office in Thiruvananthapuram and found out the districts having both ICDS and non-ICDS blocks. The investigator selected Thiruvananthapuram, Kottayam and Kozhikode districts for the study, as they represented South Central and North Kerala respectively. From the collectorate in each district, the list of ICDS and non-ICDS blocks were collected. Next the investigator visited the block office and collected the list of Anganwadies and Balwadies. From these districts the rural Anganwadies and Balwadies which could be easily reached were selected. Out of these 4 Anganwadies and 4 Balwadies were picked by the lottery method. All children in the 4-year group were chosen from these selected pre-school centres.

The pre-school children were selected from Kakkody, Thodannoor, Thuneri, Vadappara (Anganwadies), Padinjattumury, Puthur, Bhothannoor, Badiroor (Balwadi) in Kozhikode district; Madappally, Pallom, Ettumanoor, Vazhoor (Anganwadi), Manarcadu, Kanjiram, Kanjikuzhy (Balwadi) in Kottayam district; Vellanad, Chirayinkal, Kazhakkottam (Anganwadi), Vellarikonam, Parayankavu, Vettampally, Annad (Balwadi) in Thiruvananthapuram district.

Thus eventually 50 children were selected from each section in each district. This amounted to 100 children from each district.
which meant a total of 300 children. The sampling pattern is shown in Table 3.1.

Table 3.1. District-wise selection pattern of sample

<table>
<thead>
<tr>
<th>Districts</th>
<th>Anganwadi</th>
<th>Balwadi</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kozhikode</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Kottayam</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Thiruvananthapuram</td>
<td>50</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>150</strong></td>
<td><strong>150</strong></td>
<td><strong>300</strong></td>
</tr>
</tbody>
</table>

3.5 Tools used in the Study

The data concerning the various areas of study was collected using different tools.

In collecting general information about the children a schedule was constructed first.

An observation schedule for assessing social development and a tool for the measurement of intellectual abilities based on Thurstone's Primary Mental Abilities were constructed by the investigator. For assessing physical development anthropometric measurements were taken into consideration.

3.5.1 General Information Schedule

The general information sheet consists of questions concerning name, place, date of birth age, sex, birth order of the child, number
of children in the family, name and occupation of the parents, monthly income of the family. Name of the Anganwadi or Balwadi where the child is studying (Appendix 1).

3.5.2 Observation Schedule to Measure Social Development

An observation schedule was prepared by the investigator for assessing the social development. The constructed schedule is described in the following headings:

(a) Selection of the test items
(b) Preliminary test
(c) Description of the final schedule
(d) Scoring

(a) Selection of the test items

A scanning of the available literature and the direct observation of the pre-school children by the investigator provided the necessary materials for the observation schedule.

The guidelines given by Hurlock (1972), Craig (1989), Reddy (1988), Wentzel (1991), Hendrick (1990), Malon (1990) and Romanello (1987) about the various aspects of social behaviour of pre-school children and the relevant social behaviour recognised by the investigator through the direct and frequent observation of the pre-school children in the nearby nursery schools helped the
investigator in identifying behaviour responses and were arranged in the form of a schedule.

Reshaping of the schedule was done by eliminating 8 questions which provided the same information and also questions with an ambiguous meaning. Thus a second schedule was formulated with 32 questions.

The social development of twenty preschool children was assessed as a preliminary test to finalise the second schedule. Items that proved irrelevant and repetitive were deleted again and the schedule was finalised with twenty-nine items.

(c) **Description of the final schedule**

The twenty-nine items indicating different social behaviours were grouped under eight aspects of social development four positive aspects and four negative aspects.

The areas covered and the number of questions concerning each area are as follows (Appendix 1).

1. Competition - 3 questions (Question Nos. 1, 2, 3)
2. Co-operation - 4 questions (Question Nos. 4, 5, 6, 7)
3. Leadership - 2 questions (Question Nos. 8, 9)
4. Sympathy - 4 questions (Question Nos. 10, 11, 12, 13)
5. Dependency - 4 questions (Questions Nos. 14, 15, 16, 17)
6. Aggression - 4 questions (Questions Nos. 18, 19, 20, 21)

7. Negativism - 4 questions (Questions Nos. 22, 23, 24, 25)

8. Jealousy - 4 questions (Questions Nos. 26, 27, 28, 29)

The question on competition deals with the child's ability to surpass other children's activity. His ability to excel another child in academics, in play activities and other activities.

Information regarding cooperation indicate how the child gets along with others, that is, his ability to mingle freely, willingness to share things while working, playing and eating together.

Questions concerning leadership indicate the ability of the child in taking the first step in various performances.

Questions on sympathy reveal the child's ability to understand others' feelings, willingness in giving and asking assistance in difficulty.

The questions on dependency deal with the dependant attitude of the child on his friends and teacher.

Information regarding negativism indicate how the child is resistant towards adult authority.

Questions concerning Jealousy indicate the child's feeling of angry resentment directed towards other people due to actual, supposed or threatened loss of affection or anything.
Questions on aggression reveal the child’s reaction to frustration including hitting, kicking, destroying, property, quarrelling and attacking others verbally and resisting requests.

‘Always,’ ‘Sometimes’ and ‘rarely’ are the three choices given to all the questions. After observing the child’s behaviour the investigator has to encircle or tick the suitable choice (Appendix 1).

(d) Scoring

Each item of the schedule is to be scored on a three-point scale. A score of ‘3’ is to be given to the choice ‘always’ in the case of positive behaviour and to ‘rarely’ for the negative behaviour. The choice ‘sometimes’ indicating the middle path is to be given a score of ‘2’. The last choice which denotes the least expression of positive behaviour and frequent expression of negative behaviour is to be given a score of 1 (Appendix 1). Thus the maximum score for the individual child would be 87 and the minimum score 29. The higher the score the higher the social skills.

3.5.3 Simple Ability Test for Measuring Intellectual Abilities

In order to measure the intellectual abilities the investigator developed the Simple Ability Test, based on Thurstone’s Primary Mental Abilities.
The ability test is described in the following steps:

(a) Selection of the test item
(b) Preliminary test
(c) Final test
(d) Description of the test materials
(e) Testing procedure
(f) Scoring

(a) Selection of the test items

Based on Thurstone's Primary Mental Abilities, the information gathered from the available literature and first-hand experiences from direct observation, the investigator formulated fourteen items for the intellectual test. These fourteen items were grouped under seven sub-headings consisting of 2 items each. The seven areas and their sub-tests are as follows:

(i) Verbal comprehension
   (a) Picture chart with five items.
   (b) Picture chart with ten items.

(ii) Word fluency
   (a) Poem for recitation
   (b) Story for narration
(iii) **Numerical ability**

(a) Charts with dots to be joined

(b) Picture chart with items of varying numbers.

(iv) **Space visualization**

(a) Cats drawn at various distances

(b) Charts showing the pictures of four animals and their corresponding shadows

(v) **Memory**

(a) Short term memory test

(b) Immediate memory test

(vi) **Perceptual speed**

(a) Identification of differences

(b) Identification of similarities

(vii) **Reasoning**

(a) Maze

(b) Puzzle

(b) **Preliminary test**

In order to test the feasibility of the test items, a preliminary test was conducted among ten pre-school children in a nearby Anganwadi centre. The child had to perform all the tests according to the instruction given by the investigator. A score of 1 is given to each sub-test and the total score was calculated for the child’s ability.
After the preliminary test, the maze and the puzzles were found too difficult for the children and were replaced by more simple maze and puzzle.

(c) Final test

In order to find the suitability of the added items the test was repeated in the same manner on another sample of ten children. All items were systematically completed by the children. Thus the test items for intellectual development were finalised.

The seven areas, the test items and the materials needed for each item of the finalised cognitive tests are as follows.

(a) Description of the test materials

All the materials for the ability test were prepared by the investigator (Appendix 2) and the description of each material and the testing procedure is as follows:

(i) Test materials for verbal comprehension

There are two picture charts. One showing pictures a mango, ball, ink bottle and apple (Figure 3.1a) and another chart showing 10 pictures (Fruits and other things) (Figure 3.1b).
Figure 3.1. The test materials used for verbal comprehension
(ii) Test material for word fluency

For testing word fluency no particular test material was used. It was done by poem recitation and story narration.

(iii) Test material for numerical ability

Two charts, one with dots to be joined in ascending order (Figure 3.2a) and another with items of varying numbers are used (Figure 3.2b).

![Diagram](#)

(a) ![Diagram](#)

(b) ![Diagram](#)

Figure 3.2. The test materials used for numerical ability
(iv) **Test material for space visualization**

A picture chart showing four running cats drawn at varying distances from the finishing point (Figure 3.3a) and a chart showing the picture of four animals and their corresponding shadows at different levels (Figure 3.3b).

![Figure 3.3](image)

Figure 3.3. The test material used for space visualization
(v) Test material for memory

Recitation of a poem learnt in the class and a chart showing the pictures of three animals and a chart showing the pictures of six animals are used for testing memory.

Figure 3.4. The test material used for memory
(vi) **Test material for perceptual speed**

A chart showing four teddy bears (Figure 3.5a) and another chart showing 4 sail boats (Figure 3.5b) used to test perceptual speed.

![Chart showing four teddy bears and four sail boats](image)

Figure 3.5. The test material used for perceptual speed

(vii) **Test material for reasoning**

A puzzle of eight pieces showing the picture of an elephant (Figure 3.6a) and a maze (Figure 3.6b) is used.
(e) Testing Procedure

The ability of each child can be assessed individually. The child is shown the material and asked to perform each task. The procedures for testing cognitive abilities are as follows:

Verbal comprehension

Show the pictures of mango, ball, ink-bottle and apple and ask the child to identify the ball, give one point for the correct answer. Show the pictures of leaves, sun, bird, scissors, sheep,
banana, mango and grapes and ask the child to identify the fruits only. Give one point for the correct answer.

**Word fluency**

Ask the child to recite a particular poem which is taught in the class and note the fluency of words.

Ask the child to narrate a particular story which is taught in the class and note the fluency of words.

**Numerical ability**

Show the incomplete picture and ask the child to join the number with lines in the ascending order in order to find the picture. Give one point for correct answer.

Show the picture of three squirrels and ask the child to count and number it.

**Space visualization**

Show the picture of four runner cats and ask the child to show which cat is near the finishing line and which cat is far away.

Show the picture of a rabbit, cat, owl and squirrel and the corresponding shadows given but not in the order. Ask the child to show the corresponding shadow of each picture.

**Memory**

Ask the child to recite a poem already learnt in the class.
Show three pictures for one minute and then show six pictures which include the previously shown 3 pictures. Ask the child to recall the pictures that were shown seen just before.

**Perceptual speed**

Show the pictures of teddy bears with only one showing a slight difference. Ask the child to find out that difference.

Show the pictures of 4 boats and ask the child to find out the sail boat twins.

**Reasoning**

Show the picture and ask the child to show the little elephant the way to the circus tent. Give a jigsaw puzzle of an elephant and ask the child to arrange the pieces to get a picture of an elephant.

**Scoring**

One point is given to each correct answer. The total score of each child can be calculated by adding all the score obtained for each of the task.

A child who does each task correctly will have a high score and is considered as a high achiever. Thus in this ability test, the higher the score, the higher the ability.

**3.5.4 Tool used for Measuring Physical Development**

Physical development was assessed by taking anthropometric measurements and is concerned with the measurements of the
various physical dimensions and the gross composition of the human body at different ages.

Five measurements of body are considered. They are described below:

(a) **Weight**

Weighing of body weight using weighing machine. ICMR (1981) recommended that the mean weight for normal Indian boys should be 11.8, 13.5 and 14.8 kg for third, fourth and fifth year respectively. The mean weight for normal Indian girls should be 12.2, 12.9 and 14.5 kg for third, fourth and fifth year respectively. The children falling below these normal standards should be labelled as malnourished.

(b) **Height**

Measuring the height of children using a measuring tape. Height for age gives a picture of past nutritional history (Srivastava et al., 1980).

ICMR (1981) suggested standard heights for Indian boys should be 88.8, 96.0 and 102.1 cm for third, fourth and fifth year respectively. The standard heights for Indian girls should be 87.2, 94.5 and 101.4 cm for third, fourth and fifth year respectively.

(c) **Head circumferences**

Measuring tape was used to measure mid-arm circumference in centimetres. The standard mid-arm circumference of pre-school
children should be 50, 50.5 and 50.8 cm for the third, fourth and fifth year respectively (Harvard, 1987).

(d) **Mid-arm circumference**

Measuring tape was used to measure mid-arm circumference in centimetres.

According to Harvard Standards (1987) the mid-arm circumference of boys should be 13.3, 14 and 14.1 cm for the third, fourth and fifth year respectively. The standard mid-arm circumference of girls should be 12.9, 13.7 and 13.9 cm for the third, fourth and fifth year respectively.

(e) **Chest circumference**

The measuring tape was used to measure chest circumference in centimetres. The standard chest circumference of pre-school children should be 52, 53 and 55 cm for the third, fourth and fifth year respectively.

**Testing Procedure**

The anthropometric measurements of each child can be measured individually. The procedure is as follows.

*Weight*

Ask the child to stand straight on the weighing machine without wearing footwear and extra things. The weight is noted down.
**Height**

The child should be made to stand on a flat floor by the scale with feet parallel and with heels, buttocks shoulders and back of head touching the upright. The head should be held comfortably erect. Then the height is measured.

**Head circumference**

The child's head should be steadied and the greatest circumference measured, by placing the tape firmly round the frontal bones, passing it round the head at the same level on each side and the measurement noted.

**Chest circumference**

Measurement is made at the nipple line, in mid-inspiration.

**Mid-arm circumference**

The left arm is measured while hanging free at the mid-point, that is, halfway between the acromial process of the scapula and the olecranon process of the ulna.

**Scoring**

Height, weight, chest and mid-arm circumference of each child were considered for statistical analysis.

Thus the investigator finalised the tools to measure social development, intellectual development and physical development of the pre-school children.
3.6 Pilot Study

A pilot study was conducted on 50 pre-school children selected at random from a total of 150 children from Kottayam district to find out the reliability and validity of the observation schedule to assess the social development and of the intellectual tools. ICDS and non-ICDS beneficiary pre-school children formed the sample for the pilot study.

The split half-method was applied to find out the reliability of the observation schedule for measuring social development. The test-retest method was used to find out the reliability of the ability test.

The reliability coefficient obtained for the observation schedule was corrected using the Spearman Brown prophecy formula.

\[ r = \frac{2r}{1+r} \]

The results obtained are presented in Table 3.2.

<table>
<thead>
<tr>
<th>Test</th>
<th>Method</th>
<th>Coefficient obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation schedule for assessing social development</td>
<td>Split-half</td>
<td>0.96</td>
</tr>
<tr>
<td>Intelligence test</td>
<td>Test retest</td>
<td>0.95</td>
</tr>
</tbody>
</table>
The highly significant reliability coefficients ($P<0.001$) shown in Table 3.2 predicted that the tests are highly reliable. The face validity of the two tests was also considered.

For physical development, there is no necessity for finding reliability and validity.

### 3.7 Main Study

The main study was conducted after establishing the reliability and validity of the tools. The intellectual development, social development and general physical development of 300 pre-school children from the Anganwadi centres belonging to Kozhikode, Kottayam and Thiruvananthapuram districts of Kerala were assessed using their respective tools.

Permission to carry out these studies in the Anganwadi centres and Balwadi centres was sought before-hand from the Directorate of Social Welfare, Panchayat Office and the respective child development project officers in the Anganwadies.

The investigator was in each Anganwadi for one day to conduct the various assessments. Information was collected after establishing rapport with the children.

The general information about the children was drawn by the investigator in the morning itself. The social development was assessed, by observing the child for the whole day and by asking the
opinion of the teacher about the particular child. The intellectual
development of the children was measured individually by using the
constructed tool which took ten minutes for each child. General
physical development was assessed by measuring anthropometric
measurements of pre-school children.

On that day the investigator assessed the social development
of the children by informally observing each child's behaviour using
the observation schedule. The schedule for each child was filled in
that very evening.

The intellectual development of children was assessed by
making the child do the ability tests. All the children were allowed
to play outside along with the Anganwadi teacher and all the test
materials were kept ready. Then the children were called one by
one to do the ability test. The investigator personally conducted the
test and noted the answer and the score of each student.

To test verbal comprehension, the child was shown the picture
of a ball, mango, ink-bottle and apple, and asked to point out the
mango. Next the child was asked to show fruits from a group of
pictures.

To test word fluency, the investigator previously asked the
teacher about the story and poem which was taught in the class.
Then the investigator asked the child to narrate that particular story
first and noted his/her performance. The child was then asked to
recite a poem, and observed whether he recited it fluently.
For measuring numerical ability the child was shown an incomplete picture with numbers till 14 and the child was asked to join the numbers with lines in ascending order, in order to find the picture and observed whether he joined it correctly.

Next the child was shown the picture of three squirrels with number one, two, three and four written below it. The child was asked to circle the number corresponding to the number of squirrels. The correct response was noted.

To test space visualization the child was shown the picture of four running cats and asked to point out the cat nearest to the finishing point, and to the one farthest from the finishing point.

Next a picture of four animals was shown and the child was asked to identify their corresponding shadows.

For testing perceptual speed, each child was shown the picture of four teddy bears, and has asked to identify the one that had a slight difference.

Then by showing the picture of four boats, the child was asked to find out which were sailboat twins.

To test reasoning ability, the child was shown the picture of an elephant and a circus-tent. He was asked to show the little elephant the way to the tent. The child was also asked to arrange the pieces of puzzle to get the picture of an elephant.

The physical development of children was measured by taking anthropometric measurements. To take the weight of the child, the
child was made to stand on the weighing machine and the weight noted. To measure height, the child was made to stand straight and the measurement was taken. The head circumference was taken by placing the tape firmly around the frontal bones, passing it round the head.

Chest measurement and mid-arm measurement was also taken by using a measuring tape.

3.8 Treatment of the Data

The collected data was classified, tabulated and scores were assigned as per the scoring techniques. Z test for large samples was applied to find out the inter-group comparison.

\[
CR = \frac{M_1 - M_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}
\]

Standardised partial regression coefficient was used to find out the difference in the effect of explanatory variables on intellectual, social and physical development scores of ICDS beneficiary children.

\[
b_{i'} = b_i \frac{S_i}{S_y}
\]

where \( b_i \) = partial regression coefficient
\( S_i \) = standard deviation of \( i^{th} \) variable.
\( S_y \) = standard deviation of dependent variable.
Correlation coefficient was used to find out the interrelationship between the study variables—intellectual, social and physical development.

Karl Pearson coefficient of correlation \(r = \frac{\text{CoV}(x,y)}{\sqrt{V(x).V(y)}}\)

\[
\text{CoV}(x,y) = \frac{\Sigma xy}{n} - \left[ \frac{\Sigma x}{n} \right] \left[ \frac{\Sigma y}{n} \right]
\]

\[
V(x) = \frac{\Sigma x^2}{n} - \left[ \frac{\Sigma x}{n} \right]^2
\]

\[
V(y) = \frac{\Sigma y^2}{n} - \left[ \frac{\Sigma y}{n} \right]^2
\]

This correlation coefficient is tested for significance using the formula

\[
t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}
\]

follows \(t\) distribution with \((n-2)\) degrees of freedom.