

RESUMO

O propósito deste trabalho é testar algumas equações para definir a relação diâmetro—altura da *Araucaria angustifolia*.

SUMMARY

The purpose of this paper is to test some regression equations to define the relation high—diameter of *Araucaria angustifolia*.

1. Introdução

Sabe-se que em crescimento biométrico de um povoamento florestal, a variável altura está intimamente correlacionada com a qualidade do sítio e o crescimento diametral relacionado à densidade florestal.

O problema a resolver seria o comportamento da altura em relação ao crescimento diametral e determinar os coeficientes que caracterizem o índice de local e a densidade florestal.

Este trabalho visa elucidar algumas equações de $h = (f) D$ para *Araucaria angustifolia* e que servirá como subsídio para o manejo florestal.

2. Material e método

Foram testadas 1.030 árvores para seis equações, as mais recomendadas por vários autores que se dedicam aos estudos hipsométricos, quais sejam:

1. $h = a + \frac{b}{D} + cD$
2. $h = a + bD^2$
3. $h = a + bD$
4. $h = aD^b$ ou $\log h = \log a + b \log D$
5. $h = a + bD + cD^2$
6. $h = a + bD + cD^2 + dD^3$

Onde:

h = altura em metros

D = diâmetro a altura do peito, em cm

a, b, c e d = incógnitas a determinar.

```
// FOR
* LIST SOURCE PROGRAM
* ONE WORD INTEGERS
  SUBROUTINE DATA (M.D.)
  DIMENSION D (1)
  COMMON MX, MY.
C  FACULDADE DE FLORESTAS
  READ (2.12) DIAM, ALTT
12  FORMAT (2 F 3.1)
    I = 1
    D (I) = ALTT
    I = 2
    D (I) = DIAM.
    I = 1
    D (I) = D (I)
    I = 2
```

* Diretor Executivo da Fundação de Pesquisas Florestais do Paraná.
** Engenheiro Florestal.

```

D (I) = 1/D (I)
I = 3
D (I) = D (I-1)
RETURN
END

```

FEATURES SUPPORTED

ONE WORD INTEGERS

CORE REQUIREMENTS FOR DATA

COMMON 2 VARIABLES 3 PROGRAM 104

RELATIVE ENTRY POINT ADDRESS IS 000F (HEX)

END OF COMPILATION

// DUP

```

* DELETE          DATA
CART ID 0007      DB ADDR 4F  33  DB CNT 0007
* STORE          WS      UA      DATA
CART ID 0007      DB ADDR 4F  38  DB CNT 0008

```

// XEQ REGRE 1

* LOCALREGRE, MULTR, ORDER, MINV

MULTIPLE REGRESSION ALTT D3
SELECTION 1

VARIABLE NO	MEAN	STANDARD DEVIATION	CORRELATION X VS Y
3	0.07572	0.05566	— 0.83779

REGRESSION COEFFICIENT	STD. ERROR OF REG. COEF.	COMPUTED I VALUE
13.10631	8061.82813	0.00162
0.00000	8061.82911	0.00000

DEPENDENT		
1	12.58539	2.99178
INTERCEPT		11.59294
MULTIPLE CORRELATION		0.36130
STD. ERROR OF ESTIMATE		3.18467

ANALYSIS OF VARIANCE FOR THE REGRESSION			MEAN	F VALUE
SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	SQUARES	
ATTRIBUTABLE TO REGRESSION	2	—1205.68603	—602.84301	—59.43917
DEVIATION FROM REGRESSION	1027	10416.02346	10.14218	
TOTAL	1029	9210.33596		

```

// JOB
LOG DRIVE      CART SPEC      CART AVAIL      PHY DRIVE
0000           0007           0007           0000

```

V2 M10 ACTUAL 8K CONFIG 8K

// FOR

```

* LIST SOURCE PROGRAM
* ONE WORD INTEGERS
  SUBROUTINE DATA (M.D.)
  DIMENSION D (1)
  COMMON MX. MY.

```

```

C   FACULDADE DE FLORESTAS
    READ (2.12) DIAM. ALTT
12  FORMAT (2 F3.1)
    I = 1
    D (I) = ALTT
    I = 2
    D (I) = DIAM
    I = 1
    D (I) = D (I)
    I = 2
    D (I) = D (I) **2
    RETURN
    END

```

FEATURES SUPPORTED

ONE WORD INTEGERS

CORE REQUIREMENTS FOR DATA

COMMON 2 VARIABLES 6 PROGRAM 80

RELATIVE ENTRY POINT ADDRESS IS 000B (HEX)

END OF COMPILATION

// DUP

* DELETE DATA

CART ID 0007 DB ADDR 4BFD DB CNT 0007

* STORE WS UA DATA

CART ID 0007 DB ADDR 4F38 DB CNT 0007

// XEQ REGRE 1

* LOCALREGRE. MULTR, ORDER, MINV

MULTIPLE REGRESSION ALTT D2

SELECTION 1

VARIABLE NO	MEAN	STANDARD DEVIATION	CORRELATION X VS Y	REGRESSION COEFFICIENT
2	317.00903	263.61261	0.69936	0.00793

STD. ERROR OF REG. COEF	COMPUTED I VALUE
0.00025	31.37163

DEPENDENT		
1	12.58539	2.99176

INTERCEPT 10.06924

MULTIPLE CORRELATION 0.69936

STD. ERROR OF ESTIMATE 2.13945

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DEGRES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE
ATTRIBUTABLE TO REGRES- SION	1	4504.83497	4504.83497	984.17907
DEVIATION FROM REGRES	1028	4705.41505	4.57725	
TOTAL	1029	9210.25002		

// JOB

LOG DRIVE	CART SPEC	CART AVAIL	PHY DRIVE
0000	0007	0007	0000
V2 M10	ACTUAL 8K	CONFIG 8K	

```

// FOR
* LIST SOURCE PROGRAM
* ONE WORD INTEGERS
  SUBROUTINE DATA (M.D.)
  DIMENSION D (1)
  COMMON MX. MY
C  FACULDADE DE FLORESTAS
  READ (2,12) DIAM. ALTT
12  FORMAT (2 F3.1)
    I = 1
    D (I) = ALTT
    I = 2
    D (I) = DIAM
    I = 1
    D (I) = D (I)
    I = 2
    D (I) = D (I)
  RETURN
  END

```

FEATURES SUPPORTED

ONE WORD INTEGERS
 CORE REQUIREMENTS FOR DATA
 COMMON 2 VARIABLES 6 PROGRAM 78
 RELATIVE ENTRY POINT ADDRESS IS 0008 (HEX)
 END OF COMPILATION

```

// DUP
* DELETE          DATA
CART ID 0007  DB ADDR 4D 60  DB CNT  0007
* STORE  WS  UA DATA
CART ID 0007  DB ADDR 4D 60  DB CNT  0007
// XEQ REGRE 1
* LOCALREGRE, MULTR, ORDER, MINV

```

MULTIPLE REGRESSION ALTTD1
 SELECTION 1

VARIABLE NO	MEAN	STANDARD DEVIATION	CORRELATION X VS Y	REGRESSION COEFFICIENT
2	16.29639	7.17528	0.77713	0.32403

STD. ERROR OF REG. COEF.	COMPUTED T VALUE
0.00818	39.59294

DEPENDENT

1	12.58539	2.99176
INTERCEPT		7.30484
MULTIPLE CORRELATION		0.77713
STD. ERROR OF ESTIMATE		1.88372

ANALYSIS OF VARIANCE OF THE REGRESSION

SOURCE OF VARIATION	DEGRES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE
ATTRIBUTABLE TO REGRESSION	1	5562.48634	5562.48634	1567.60083
DEVIATION FROM REGRESSION	1028	3647.76318	3.54840	
TOTAL	1029	9210.25002		

```
// JOB
LOG DRIVE    CART SPEC    CART AVAIL    PHY DRIVE
  0000        0007        0007        0000
V2 M10      ACTUAL 8K      CONFIG      8K
```

```
// FOR
* LIST SOURCE PROGRAM
* ONE WORD INTEGERS
  SUBROUTINE DATA (M.D.)
  DIMENSION D (1)
  COMMON MX, MY
C  FACULDADE DE FLORESTAS
  READ (2, 12) DIAM, ALTT
12  FORMAT (2F3.1)
  I = 1
  D (I) = ALTT
  I = 2
  D (I) = DIAM
  I = 1
  D (I) = ALOG D (I)
  I = 2
  D (I) = ALOG D (I)
  RETURN
  END
```

FEATURES SUPPORTED

```
ONE WORD INTEGERS
CORE REQUIREMENTS FOR DATA
COMMON      2 VARIABLES      8 PROGRAM      106
RELATIVE ENTRY POINT ADDRESS IS 000D (HEX)
END OF COMPILLATION
```

```
// DUP
* DELETE      DATA
CART ID 0007  DB ADDR  4E 5C  DB CNT  000A
* STORE  WS  UA  DATA
CART ID 0007  DB ADDR  50 CE  DB  CNT  0008
// XEQ REGRE  1
* LOCALREGRE, MULTR, ORDER, MINV
```

```
MULTIPLE REGRESSION ..... ALTT D6
SELECTION ..... 1
```

VARIABLE NO	MEAN	STANDARD DEVIATION	CORRELATION X VS Y	REGRESSION COEFFICIENT
2	2.68814	0.46341	0.82674	0.46241

STD. ERROR OF REG. COEF.	COMPUTED I VALUE
0.00981	47.11840

```
DEPENDENT
  1      2.50095      0.25919
INTERCEPT      1.25792
MULTIPLE CORRELATION      0.82674
STD. ERROR OF ESTIMATE      0.14588
```

```
ANALYSIS OF VARIANCE FOR THE REGRESSION
SOURCE OF VARIATION    DEGRES    SUM OF    MEAN    F VALUE
                      OF FREEDOM  SQUARES  SQUARES  SQUARES
```

ATRIBUTABLE TO REGRES-				
SION	1	47.25239	47.25239	2220.14453
DEVIATTION FROM REGRES-				
SION	1028	21.87942	0.02128	
TOTAL	1029	69.13182		

// FOR

* LIST SOURCE PROGRAM

* ONE WORD INTEGERS

SUBROUTINE DATA (M.D.)

DIMENSION D (1)

COMMON MX, MY

C FACULDADE DE FLORESTAS

READ (2.12) DIAM, ALTT

12 FORMAT (2F3.1)

I = 1

D (I) = ALTT

I = 2

D (I) = DIAM

I = 1

D (I) = D (I)

I = 2

D (I) = D (I)

I = 3

D (I) = D (I-1) **2

RETURN

END

FEATURES SUPPORTED

ONE WORD INTEGERS

CORE REQUIREMENTS FOR DATA

COMMON 2 VARIABLES 8 PROGRAM 102

RELATIVE ENTRY POINT ADDRESS IS 000E (HEX)

END OF COMPILATION

// DUP

* DELETE DATA

CART ID 0007 DB ADDR 4F 38 DB CNT 0008

* STORE WS UA DATA

CART ID 0007 DB ADDR 4F 38 DB CNT 0008

// XEQ REGRE 1

* LOCALREGRE, MULT, ORDER, MINV

MULTIPLE REGRESSION ALTT D4

SELECTION 1

VARIABLE NO.	MEAN	STANDARD DEVIATION	CORRELATION X VS Y	REGRESSION COEFFICIENT	STD. ERROR	COMPUTED T VALUE
3	317.00903	263.61572	0.69936	-0.01554	0.00094	-16.46965
2	16.29639	7.17533	0.77713	0.88226	0.03466	25.44871

DEPENDENT

1 12.58539 2.99178

INTERCEPT 3.13437

MULTIPLE CORRELATION 0.82866

STD. ERROR OF ESTIMATE 1.67624

ANALYSIS OF VARIANCE FOR THE REGRESSION				
SOURCE OF VARIATION	DEGRES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE
ATTRIBUTABLE TO REGRES- SION	2	6324.67188	3162.33594	1125.46655
DEVIATION FROM REGRES- SION	1027	2885.66553	2.80980	
TOTAL	1029	9210.33791		

```
// JOB
LOG DRIVE    CART SPEC    CART AVAIL    PHY DRIVE
   0000         0007         0007         0000
V2  M10  ACTUAL 8K  CONFIG 8K
```

```
// FOR
* LIST SOURCE PROGRAM
* ONE WORD INTEGERS
  SUBROUTINE DATA (M.D.)
  DIMENSION D (1)
  COMMON, MX, MY
C  FACULDADE DE FLORESTAS
  READ (2,12) DIAM, ALTT
12  FORMAT (2F3.1)
    I = 1
    D (I) = ALTT
    I = 2
    D (I) = DIAM
    I = 1
    D (I) = D (I)
    I = 2
    D (I) = D (I)
    I = 3
    D (I) = D (I-1) **2
    I = 4
    D (I) = D (I-2) **3
  RETURN
  END
```

FEATURES SUPPORTED
ONE WORD INTEGERS
CORE REQUIREMENTS FOR DATA
COMMON 2 VARIABLES 8 PROGRAM 128

RELATIVE ENTRY POINT ADDRESS IS 000F (HEX)
END OF COMPILATION

```
// DUP
* DELETE            DATA
CART ID 0007    DB ADDR 4EEA    DB    CNT    0008
* STORE        WS        UA        DATA
CART ID 0007    DB ADDR    4F 3D    DB CNT    000A
// XEQ REGRE 1
* LOCALREGRE, MULTR, ORDER, MINV
```

MULTIPLE REGRESSION ALTT D5
SELECTION 1

VARIABLE NO	MEAN	STANDARD DEVIATION	CORRELATION X VS Y	REGRESSION COEFFICIENT
2	16.29637	7.17517	0.77711	1.74464

3	317.00909	263.61413	0.69932	—0.06358
4	7013.63477	8458.96682	0.60757	0.00079

STD. ERROR OF REG. CORF.	COMPUTED T VALUE
0.11344	15.37818
0.00610	—10.41104
0.00010	7.95224

DEPENDENT		
1	12.58538	2.99154
INTERCEPT		—128813
MULTIPLE CORRELATION		083962
STD. ERROR OF ESTIMATE		162730

ANALYSIS OF VARIANCE FOR THE REGRESSION				
SOURCE OF VARIATION	DEGRES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE
ATTRIBUTALE TO REGRES- SION	3	6491.92579	2163.97510	817.17797
DEVIATION FROM REGRES- SION	1026	2716.95850	2.64810	
TOTAL	1029	9208.88479		

Após a determinação das incógnitas, as equações adquiriram as seguintes configurações:

$$\begin{aligned}
 E_1 - h &= 11.59294 + \frac{13.10631}{D} + \text{O.D.} \\
 E_2 - h &= 10.06924 + 0.00793 D^2 \\
 E_3 - h &= 7.30484 + 0.32403 D \\
 E_4 - h &= 1.25792 \times D + 0.46241 \\
 E_5 - h &= 3.13437 + 0.88226 D - 0.01554 D^2 \\
 E_6 - h &= -1.28813 + 1.74464 D - 0.06358 D^2 + 0.00079 D^3
 \end{aligned}$$

Conclusões

A análise de regressão demonstrou os seguintes graus de correlação para E_1 — 36% de graus de correlação múltipla

para E_2 — 70% de graus de correlação múltipla

para E_3 — 78% de graus de correlação múltipla

para E_4 — 83% de graus de correlação múltipla

para E_5 — 83% de graus de correlação múltipla

para E_6 — 84% de graus de correlação múltipla

Do exposto, conclue-se que as equações não são satisfatórias.

Sugere-se que sejam testadas mais equações que definam melhor a relação

diâmetro e altura, e também para diâmetros superiores a 30 cm, pois a presente pesquisa foi realizada com amostras de até 30 cm de diâmetro.

LITERATURAS CONSULTADAS

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Analysis
4. Dillewijn. F. Von e Sebastião do Amaral
Machado
Curso de Dendrometria
5. Bruce and Schumacher
Forest Mensuration



REFLORIL S.A.

EMPREENDIMENTOS FLORESTAIS

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APLIQUE BEM SEU INCENTIVO FISCAL,
ESCOLHENDO UM DE NOSSOS PROJETOS:

PALMITO

NOGUEIRA

PECAN

PINUS SPP

EUCALIPTUS SPP

CONTRIBUA PARA O DESENVOLVIMENTO DA REGIAO OPTANDO

EM SUA DECLARAÇÃO DE RENDA EM "REFLORESTAMENTO"

(DECRETO-LEI 1.134)