实验30　Mathcad 编程举例(2)

1　鸡兔tong笼问题的Mathcad程序: 头36, 脚100, 求鸡、兔各若干.

henrabit :=
for $k \in 1..36$
　break if $k + \frac{(100 - 2\cdot k)}{4} = 36 \wedge \mathrm{mod}(100 - 2\cdot k, 4) = 0$
$\begin{pmatrix} \text{"Chickens"} & \text{"Rabbits"} \\ k & 36 - k \end{pmatrix}$

henrabit = $\begin{pmatrix} \text{"Chickens"} & \text{"Rabbits"} \\ 22 & 14 \end{pmatrix}$

henrabit1 :=
chikens ← 1
while chikens ≤ 36
　break if $\mathrm{mod}(100 - 2\cdot \text{chikens}, 4) = 0 \wedge \text{chikens} + \left(\frac{100 - 2\cdot \text{chikens}}{4}\right) = 36$
　chikens ← chikens + 1
$\begin{pmatrix} \text{"Chickens"} & \text{"Rabbits"} \\ \text{chikens} & \frac{100 - 2\cdot \text{chikens}}{4} \end{pmatrix}$

henrabit1 = $\begin{pmatrix} \text{"Chickens"} & \text{"Rabbits"} \\ 22 & 14 \end{pmatrix}$

Given

$x + y = 36$

$2x + 4y = 100$

$\mathrm{Find}(x, y) \rightarrow \begin{pmatrix} 22 \\ 14 \end{pmatrix}$

2　利用求积分的梯形公式编写程序计算函数在一个有限区间上的定积分:

Integ(a, b, n, f) :=
$h \leftarrow \frac{(b - a)}{n}$
s ← 0
for $i \in 1..n$
　$s1 \leftarrow [f[(i - 1)\cdot h] + f(i\cdot h)]\cdot \frac{h}{2}$
　s ← s + s1

$f(x) := x\cdot \sin(x)$　　$\mathrm{Integ}\left(0, \frac{\pi}{2}, 50, f\right) = 1.000082250762$

$$\text{Integ1}(a,b,n,f) := \left| \begin{array}{l} h \leftarrow \dfrac{(b-a)}{n} \\ s \leftarrow (f(a)+f(b))\cdot\dfrac{h}{2} \\ \text{for } i \in 1..n-1 \\ \quad \left| \begin{array}{l} s1 \leftarrow f(a+i\cdot h)\cdot h \\ s \leftarrow s+s1 \end{array} \right. \end{array} \right.$$

$$\text{Integ1}\left(0,\frac{\pi}{2},50,f\right) = 1.000082250762 \qquad \int_0^{\frac{\pi}{2}} f(x)\,dx \rightarrow 1 = 1$$

3 编写程序统计一个班级考试成绩的分组统计结果, 输出次数分布, 总成绩, 平均成绩以及标准差.

$$\text{stat}(\text{Data}) := \left| \begin{array}{l} n \leftarrow \text{length}(\text{Data}) - 1 \\ \text{for } i \in 0..4 \\ \quad x_i \leftarrow 0 \\ \text{for } i \in 0..n \\ \quad \left| \begin{array}{l} x_0 \leftarrow x_0 + 1 \quad \text{if } \text{Data}_i < 60 \\ x_1 \leftarrow x_1 + 1 \quad \text{if } 60 \le \text{Data}_i < 70 \\ x_2 \leftarrow x_2 + 1 \quad \text{if } 70 \le \text{Data}_i < 80 \\ x_3 \leftarrow x_3 + 1 \quad \text{if } 80 \le \text{Data}_i < 90 \\ x_4 \leftarrow x_4 + 1 \quad \text{otherwise} \end{array} \right. \\ \text{for } j \in 0..4 \\ \quad p_j \leftarrow 5 - j \\ \text{cum}_0 \leftarrow x_0 \\ \text{for } j \in 1..4 \\ \quad \text{cum}_j \leftarrow \text{cum}_{j-1} + x_j \\ \text{augment}\left(p, x, \dfrac{x\cdot 100}{n+1}, \text{cum}, \dfrac{\text{cum}\cdot 100}{n+1}\right) \end{array} \right.$$

$$\text{score} := \begin{pmatrix} 71 \\ 73 \\ 78 \end{pmatrix}$$

$$\text{stat}(\text{score}) = \begin{pmatrix} 5 & 3 & 4.615 & 3 & 4.615 \\ 4 & 14 & 21.538 & 17 & 26.154 \\ 3 & 23 & 35.385 & 40 & 61.538 \\ 2 & 20 & 30.769 & 60 & 92.308 \\ 1 & 5 & 7.692 & 65 & 100 \end{pmatrix}$$

各列顺次为: 成绩等级 , 人数, 百分比 , 累积频数 累积百分比

$$\text{mean}(\text{score}) = 75.969$$

平均成绩

$$\text{sum} := \text{mean}(\text{score})\cdot\text{length}(\text{score})$$

sum = 4938

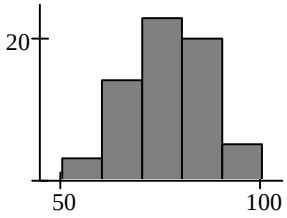
stdev(score) = 9.702

总成绩

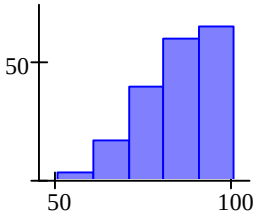
标准差

$$int := \begin{pmatrix} 55 \\ 65 \\ 75 \\ 85 \\ 95 \end{pmatrix} \qquad h := \begin{pmatrix} 3 \\ 14 \\ 23 \\ 20 \\ 5 \end{pmatrix} \qquad cum := \begin{pmatrix} 3 \\ 17 \\ 40 \\ 60 \\ 65 \end{pmatrix}$$

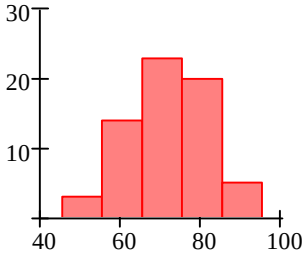
成绩频数分布图



成绩累积分布图



$$int := \begin{pmatrix} 50 \\ 60 \\ 70 \\ 80 \\ 90 \\ 100 \end{pmatrix} \qquad hist(int, score) = \begin{pmatrix} 3 \\ 14 \\ 23 \\ 20 \\ 5 \end{pmatrix}$$



4 编写程序将一个十进制的整数转换成二进制数.

$$Decimal\_bin(x) := \left| \begin{array}{l} n \leftarrow floor\left(\frac{\ln(x)}{\ln(2)}\right) \\ \text{for } k \in 0..n \\ \quad \left| \begin{array}{l} reduc_k \leftarrow x \\ reduc_{k+1} \leftarrow floor\left(\frac{reduc_k}{2}\right) \\ x \leftarrow reduc_{k+1} \end{array} \right. \\ \text{for } j \in 0..n \\ \quad digit_j \leftarrow reduc_j - 2 \cdot reduc_{j+1} \\ binary \leftarrow \sum_{i=0}^{n} digit_i \cdot 10^i \end{array} \right.$$

Decimal_bin(451) = 111000011　　Decimal_bin(127) = 1111111

5 如下的两个程序用于判断一个整数是不是素数.

Prime(n) :=
- for $k \in 2..\text{floor}(\sqrt{n})$
  - $p_k \leftarrow \text{mod}(n, k)$
- $m \leftarrow \text{floor}(\sqrt{n}) - 2$
- for $k \in 0..m$
  - $pr_k \leftarrow 1$ if $p_{k+2} \neq 0$
  - $pr_k \leftarrow p_{k+2}$ otherwise
- "The number is prime!" if $\prod_{k=0}^{m} pr_k \neq 0$
- "The number is not prime!" otherwise

x := 299　Prime(x) = "The number is not prime!"　　Prime(9013) = "The number is prime!"

FPrime(n) :=
- for $k \in 1..2$
  - $p_k \leftarrow k$
- for $k \in 2..\text{floor}(\sqrt{n})$ if $n > 2$
  - $p_k \leftarrow \text{mod}(n, k)$
- $m \leftarrow \text{floor}(\sqrt{n})$
- $s \leftarrow 0$
- for $k \in 0..m$
  - if $p_k \neq 0$
    - $pr_k \leftarrow 1$
    - $s \leftarrow s + 1$
- "Prime" if $m = s$
- "No Prime" otherwise

x := 299　FPrime(x) = "No Prime"　　FPrime(9013) = "Prime"

6 六种银行存款方案比较, r 为利率向量, 其各分量分别是1, 2, 3, 5年定期存款, 存款一律不计复利. 程序中 x 为本金. 输出结果为按照各种方案将本金x存入银行, 五年后, 本利以及利息额.

$$r0 := \begin{pmatrix} .024 \\ .0245 \\ .025 \\ .0258 \end{pmatrix}$$

$$\text{deposit}(x, r) := \left| \begin{array}{l} \text{for } k \in 0..5 \\ \quad \left| \begin{array}{l} \text{scheme}_k \leftarrow k + 1 \\ \text{corpus}_k \leftarrow x \end{array} \right. \\ p \leftarrow \begin{bmatrix} x\cdot(1 + 5\cdot r_3) \\ x\cdot(1 + 3\cdot r_2)\cdot(1 + 2\cdot r_1) \\ x\cdot(1 + 3\cdot r_2)\cdot(1 + r_0)^2 \\ x\cdot(1 + r_0)^5 \\ x\cdot(1 + 2\cdot r_1)^2\cdot(1 + r_0) \\ x\cdot(1 + 2\cdot r_1)\cdot(1 + r_0)^3 \end{bmatrix} \\ \text{accrual} \leftarrow p - \text{corpus} \\ s \leftarrow \text{augment}(\text{scheme}, p) \\ \text{augment}(s, \text{accrual}) \end{array} \right.$$

$$\text{deposit}(20000, r0) = \begin{pmatrix} 1 & 22580 & 2580 \\ 2 & 22553.5 & 2553.5 \\ 3 & 22544.38 & 2544.38 \\ 4 & 22518 & 2518 \\ 5 & 22536.21 & 2536.21 \\ 6 & 22527.1 & 2527.1 \end{pmatrix}$$