Further Modelling

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Which languages?
… and why?

HTML / CSS
R
SAS
Fortran
Berkeley Madonna
Java
Excel
C / C++
Perl
STATA
Matlab
Python
BEAST XML
…
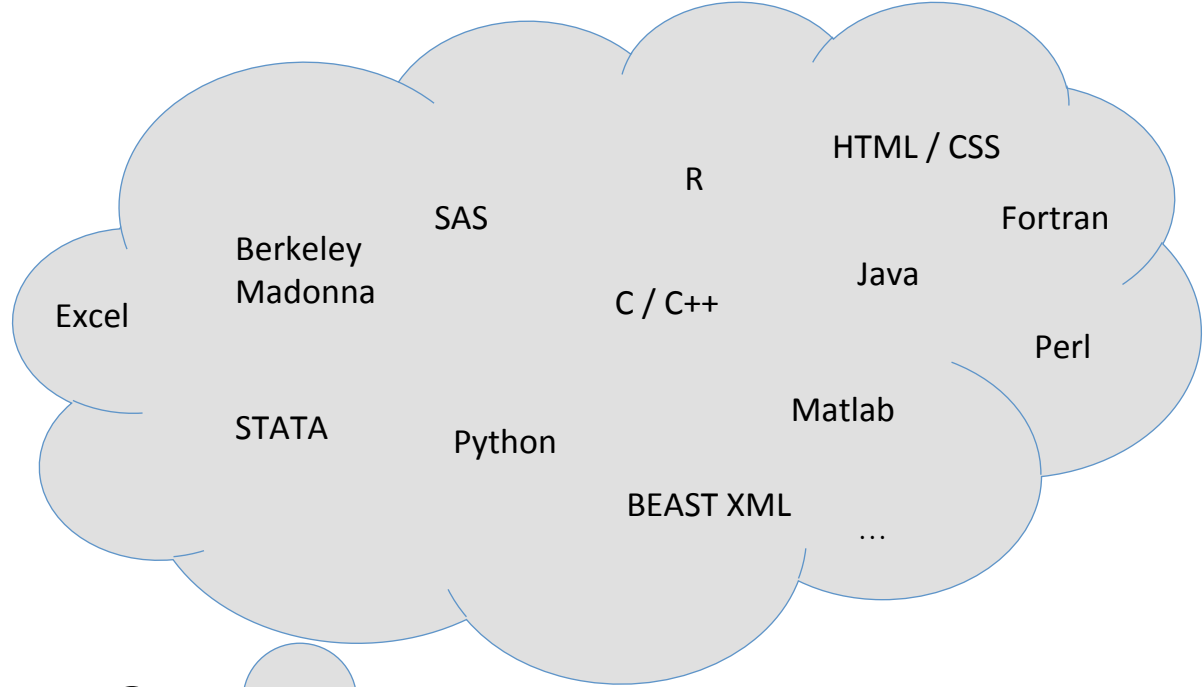
This session you will…

Discuss:

 - **Any questions you have about modelling software**

Think about:

 - How do you choose your language for modelling?

 - How do you find help when modelling?

 - How do you tell people about your code and work with others?

 - Using : examples from modelling
 - What are the next steps?

How do you chose your language for modelling?

Is it free?

YES (R, Python, C/C++, BEAST XML, Java, Perl)
NO (Matlab, STATA, SAS, Berkeley Madonna, Excel)

Can other people read and use my code (is it 'portable')?

GENERALLY YES (R, Python, C/C++, BEAST XML, Java, Perl)
-ISH (Matlab…)
NOT REALLY (Berkeley Madonna, Excel)

Is it popular in my field (modelling)?

YES (R, Python, C/C++, Matlab)
NO (STATA, SAS, Excel)

Is it easy to learn, easy to use, intuitive, and logical?

… depends on what you like / what you've seen …
… are there multiple ways of doing the same thing / how readable is the code?

Does it have the correct tools for my work?

In principle "YES" for any "Complete" language
But easier if there are 'packages' or 'functions' that are written for you already!

#1 programming rule: Don't reinvent the wheel

Readability

Prints "Hello World" to screen

```c
#include "stdio.h"
#define    e 3
#define    g (e/e)
#define    h ((g+e)/2)
#define    f (e-g-h)
#define    j (e*e-g)
#define k (j-h)
#define    l(x) tab2[x]/h
#define    m(n,a) ((n&(a))==(a))

long tab1[]={ 989L,5L,26L,0L,88319L,123L,0L,9367L };
int tab2[]={ 4,6,10,14,22,26,34,38,46,58,62,74,82,86 };

main(m1,s) char *s; {
    int a,b,c,d,o[k],n=(int)s;
    if(m1==1){ char b[2*j+f-g]; main(l(h+e)+h+e,b); printf(b); }
    else switch(m1-=h){
            case f:
                a=(b=(c=(d=g)<<g)<<g)<<g;
                return(m(n,a|c)|m(n,b)|m(n,a|d)|m(n,c|d));
            case h:
                for(a=f;a<j;++a)if(tab1[a]&&!(tab1[a]%
((long)l(n))))return(a);
            case g:
                if(n<h)return(g);
                if(n<j){n-=g;c='D';o[f]=h;o[g]=f;}
                else{c='\r'-'\b';n-=j-g;o[f]=o[g]=g;}
               if((b=n)>=e)for(b=g<<g;b<n;++b)o[b]=o[b-h]+o[b-g]+c;
                return(o[b-g]%n+k-h);
            default:
                if(m1-=e) main(m1-g+e+h,s+g); else *(s+g)=f;
               for(*s=a=f;a<e;) *s=(*s<<e)|main(h+a++,(char *)m1);
            }
}
```

Readability

```c
#include <stdio.h>
#include <unistd.h>
#include <time.h>
#define p return
#define X typedef
#define E {
#define B }
#define stup(y)printf("%.11s\n",(char*)y);
#define $ printf("\x1b")
#define G(y)usleep(y);fflush(stdout);
#define O __DATE__+7
#define K printf{
X unsigned short P;
X int _;
_ s=41456; //Sleeping time factor
X char H;
_ o,b,a,f,g,k, m; // Oh, be a fine girl, kiss me
FILE *W;
X enum  {T,F}  z; //True & False
X double w;
_ a5_, N = 11,A4=1<<3,a8_=17,A8=2*2,aI_=~-(__FLT_MAX_EXP__<<F);
H l[]="uDSYT8|TCPZ8|TVCTKp]X^EY|XKPC8aYTRUPp]ZPXU";H I[]="Fo~y*lcdn*yego*Oky~ox*ommy";/*
                                                          /\
                                                          c
                                                         [9];
                  alpha Ursae Minoris A           main
                                                  */_ a1,
                                                  a3 ,a4=
                                                  024;P a2
                                                 ,a5;w Z( w
                                              D,_ Y)E if(Y
                                              ==T)p F;if(Y
                                              ==!0)p D; w b=
                                             Z(D,Y/2);if(Y>2        /* alpha Ursae Minoris Ab*/
                                             )p b*b*D;p b*b ;
                                             B _ u(_ x) E if( x                            <2)p
                                             F;p x*u(x-unix); B
         /*alpha Ursae Minoris B*/          _ vir(H __[]) E _ e,
                                            q=0;for(e=T;e[__];e++)
              q=q*                          -~9+__[e]-48;p q;B P A
                                            (H *a7_, _ a6_ );w V(_ v
                                           ,_ i){v%=0550;w D='-'-'-';
                                           for(i-=i;i^__CHAR_BIT__;i++
  )D+=Z(_POSIX_TRACE,i)*Z(0x1.1df46a226e211p-6 *v,2*i)/u(2*i);p D;B _ main(a6,n)_ a6;H**n;E _ a7,A1,a1_,a8,t,
   A6,D,Y;size_t a3_;_ A2[]=E'q',W_OK,5911774,'y',13,1052160,77,15,1709568,'5',a8_,1314816,34,18,1446400
         ,91,22,1314816,12,28,F_OK B;time_t j =time(NULL);a4 *= ' ' ;float and [] =/*trolling is a art */
     E 4612954808543207739097088.0, 207.285645,  214354950132336733650542884425029386240.0 B ;
        struct tm  R = *localtime (&j) ;for (;t=aI_ ,a5_[l]);l[a5_++] ^=~-__LINE__ ; A6=a4 +=
       R.tm_year;a4 ='d';ssize_t A3 =1;k=A6/'d',k=k/A8,a=k%4,o=(k-((k+A4)/25)+1)/F_TEST
         ,m=(19*(A6%a4 )+k-b-o+__DBL_DIG__)%30,k=(A6%'d')/R_OK;H*a2 =NULL;f=(A6%'d')%
       R_OK,g=(' '+2*a+SEEK_END*k-m-f)%7,k=__ATOMIC_SEQ_CST;W=fopen(__FILE__,
        "r" ); $"[40m\033[2J\033[;H\x1b[?25l");if(*(H *_((])E X_OK B)stup
       (and)A3 =getdelim(&a2_,&a3_,'\0', W);b=(A6%8))+N*m+22*g)/(N*
       ')'),o=m+g-(~-A4)*b+'r',D=o/31;for(;a1[I];a1++,a5_=0xb3)
        I[a1 ]^= '-'-'#';Y=o% ~-' ' +F;for(a3 =T;a3<A3_;++
         a3_)a2 =(a2_ +a2_[a3_])%255,a5 =(a5_+a2_)%t;
            if((a5 <<8|a2 )^s) goto a4_;$ "[1;12H  " )
          ;G(a4 *s)a4_^=a4 ;k*=2172211;while(a5_-->-1)
           E $ "[40m\x1b[2J");for(a6=W_OK;a6<025;a6 +=3)
            E a7  = A2 [ a6_-__FLT_RADIX__] - 0102, a8 =k
             + a6 [A2],a1 = A2[~-a6_] *0x1.db6db6db6a92ap+0 ;
            a1-=~-__DBL_DIG__ ,a1_=a7 *V(a5_,_XOPEN_VERSION )-
           a1*V(90-a5_,a7 )+66,A1 =(a7*V(90-a5_,a1_) +a1 *V (
          a5_,a8 )+0xe)/1.8571428571;if(A1 >T&&a1_>0) E $"[3"
         "8;2;%d;%d;%dm", (a8>> 16 )&t,(a8>>8)& 255,a8 &t);$
         "[%d;%dH%c %.*s",A1,a1_   ,a5_>90?46:111,6,a5_>45
        ?"":1+ ((a6-F_TLOCK) /     __ATOMIC_RELEASE*6);
       B B B G(u(A4 ) )B/**/          a4_:$  "[H\x1b[0m"
        "\x1b[?25h") ;if(            ( D^ (R.tm_mon+1))
        == (Y-= R./* */               tm_mday) ) E  K
       "%s\n",I);B K                   ""       "%d\n",
       vir(O)  );p                             a4 ;B //END\
        OF  THIS                                ENTRY IS\
       N E A R                                  SO NEAR\
      .*****                                    ******\
       ****                                       ***\
                .                                      .
```
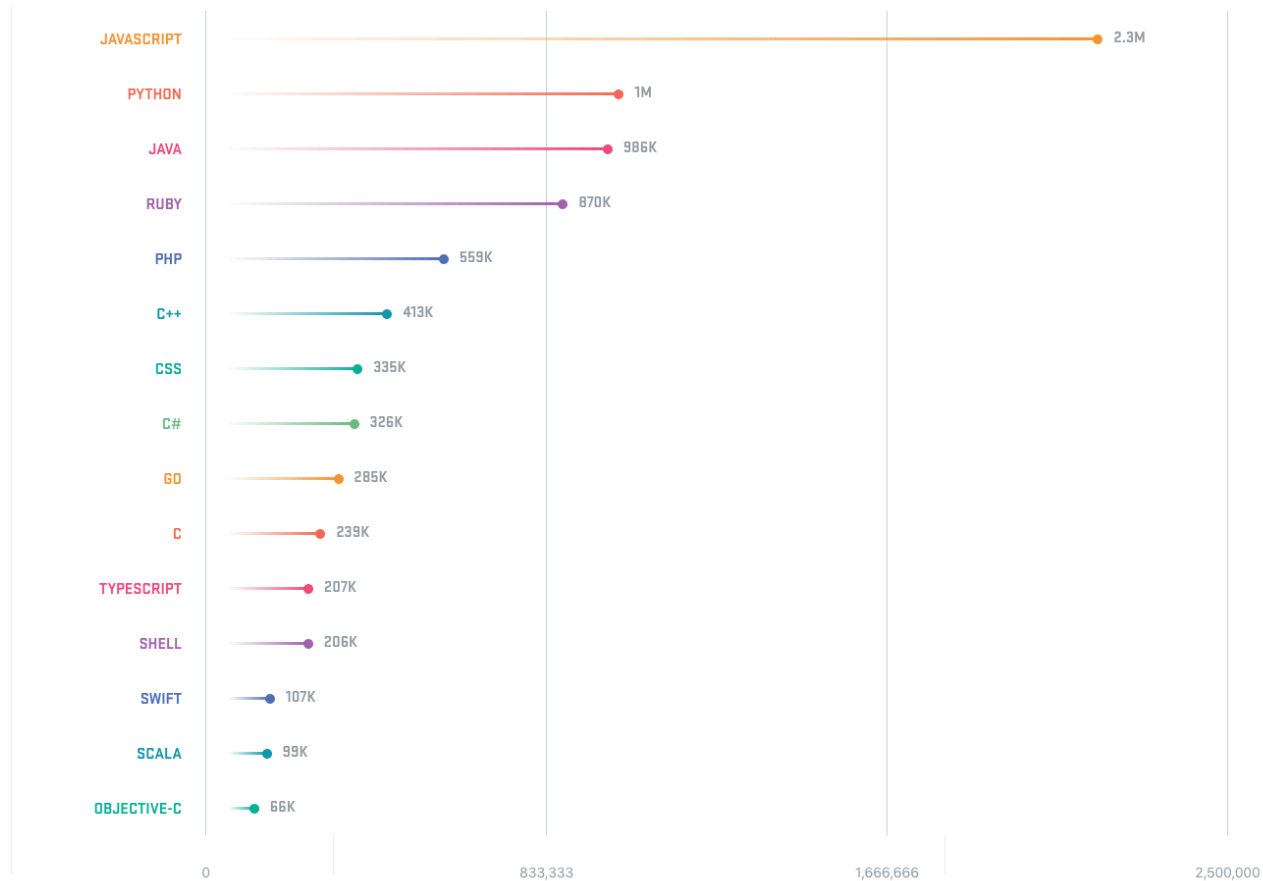
Low vs. high level languages

Low level (e.g C++)

High level (e.g. Python, R)

```
#include <iostream>

 int main()
 {
       std::cout << "Hello, World.";

 }
```

```
print "hello world"
```

```
print("Hello World!")
```

What's popular?

JAVASCRIPT	2.3M
PYTHON	1M
JAVA	986K
RUBY	870K
PHP	559K
C++	413K
CSS	335K
C#	326K
GO	285K
C	239K
TYPESCRIPT	207K
SHELL	206K
SWIFT	107K
SCALA	99K
OBJECTIVE-C	66K

0   833,333   1,666,666   2,500,000

How do you find help when coding?

Point-by-point help
- STACKOVERFLOW is a very useful tool
- Paste exact error/warning message into Google

Resources (R)
- http://tryr.codeschool.com/
- https://www.datacamp.com/courses/free-introduction-to-r
- https://www.r-bloggers.com/how-to-learn-r-2/

Resources (Python)
- https://github.com/mattharrison/Tiny-Python-3.6-Notebook/blob/master/python.rst
- https://hub.mybinder.org/user/alfaromurillo-sir_models_intro-i5acnjcw/notebooks/SIR_models.ipynb
- (LEARN X in Y MINUTES) https://learnxinyminutes.com/docs/python3/

How do you tell people about your code and work with others?

Sharing Code:

'Push' your code & 'pull' other people's code

Best practices:

1. Make sure your code is correct
- Test every tiny addition is doing the right thing before writing more
- Update and fix bugs using 'version control' (e.g. git) which is very handy for ASCII files
  - For how to use 'git' lots of online resources incl. **try.github.io/**

2. Make your code readable
-Comment everything
e.g. CFR_bias = @(c) cumul_deaths_R(c) / cumul_inf_R(c) # function to calculate biased CFR for a given country
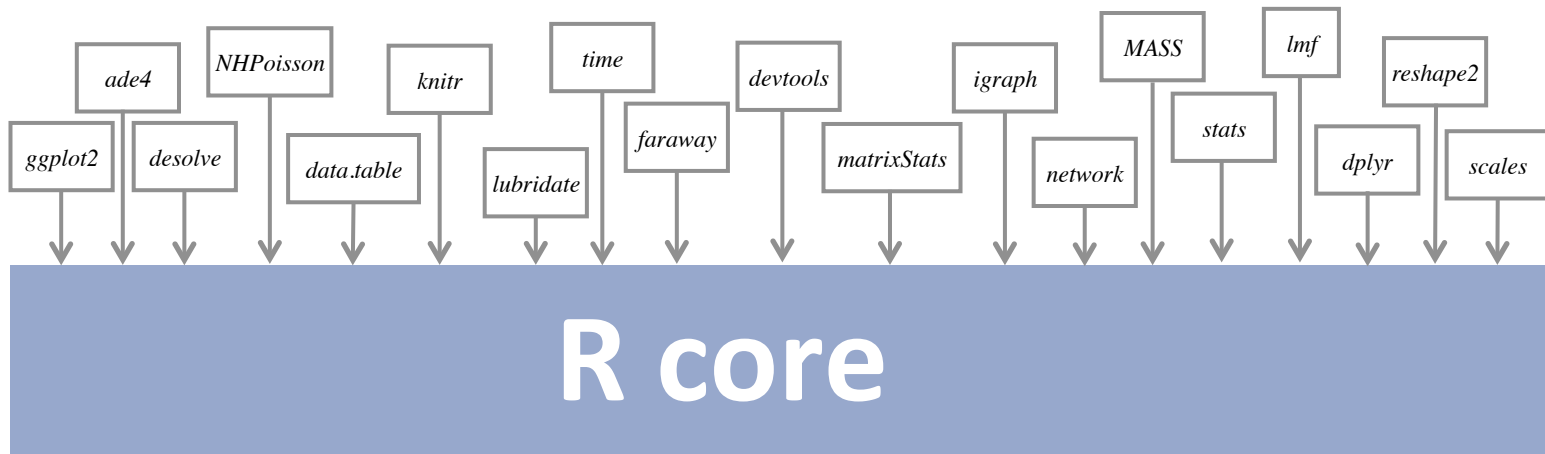-Give variables *sensible* names
e.g. IncidenceRate <- mydata[, 2] is better than A <- mydata[, 2]

#2 programming rule: Write code for two people (you now and you in a year)

What is R?

- Programming language
  - Free, open source core, maintained and regularly updated
  - Statistics and data-focussed
  - Add-on packages made by users

Why use R?

- Free
- Active development
- No limit on what you can do:
  - Statistics
  - Data cleaning/processing
  - Interacting with websites
  - …