**APPENDIX 2**

**Variables used in the programme:**

**Outcome**

y: PHQ-9 score (discrete)

**Exposure**

x: trial arm (binary)

**Mediators:**

Med1a: sessions (discrete)

Med1b: homework (categorical)

Med2: levels of behavioural activation (discrete)

Med3a: number of extra sessions (categorical)

Med3b: non-response to therapy (binary)

**Confounders:**

C1: age (discrete)

C2: education (categorical)

C3: baseline PHQ-9 score (discrete)

**Interactions:**

non-response to therapy\*age: Med3b\_C1

baseline PHQ-9 score\*education: C2\_C3

**Variables to predict missingness and to set mediators:**

miss\_1: gender (binary)

miss\_2: married (binary)

miss\_3: expectations of treatment (discrete)

miss\_4: job (binary)

miss\_5: stigma (binary

miss\_6: age group (categorical)

\*The program HAP, that performs the imputation and then the Monte

\*Carlo simulations, is listed below:

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

cap program drop HAP

program define HAP, rclass

set seed 1234

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*Imputation for missing data

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

qui{

foreach var in Med2 Y {

gen imp\_`var'=`var'

}

foreach var in Med2 Y {

summ `var' if x==1

replace imp\_`var'=r(mean) if imp\_`var'==. & x==1

}

foreach var in Med2 Y {

summ `var' if x==0

replace imp\_`var'=r(mean) if imp\_`var'==. & x==0

}

forvalues cycle=1(1)10 {

\*\*\*\* for M2

regress Med2 C3 i.miss\_6 i.C2 i.miss\_1 i.miss\_2 i.miss\_3 i.miss\_4 if x==1

predict ba\_1 if x==1

replace imp\_Med2=ba\_1 + e(rmse)\*rnormal() if Med2==. & x==1

drop ba\_1

regress Med2 C3 i.miss\_6 i.C2 i.miss\_1 i.miss\_2 i.miss\_4 i.miss\_3 if x==0

predict ba\_0 if x==0

replace imp\_Med2=ba\_0 + e(rmse)\*rnormal() if Med2==. & x==0

drop ba\_0

\*FOR THE OUTCOME

regress Y i.miss\_6 i.C2 C3 C2\_C3 i.miss\_2 i.miss\_1 i.miss\_3 i.miss\_4 if x==1

predict p12\_1 if x==1

replace imp\_Y=p12\_1 + e(rmse)\*rnormal() if Y==. & x==1

drop p12\_1

regress Y i.miss\_6 i.C2 C3 C2\_C3 i.miss\_2 i.miss\_1 i.miss\_3 i.miss\_4 if x==0

predict p12\_0 if x==0

replace imp\_Y=p12\_0 + e(rmse)\*rnormal() if Y==. & x==0

drop p12\_0

}

replace Y=imp\_Y if Y==.

replace Med2=imp\_Med2 if Med2==.

drop imp\_\*

}

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

\*MONTE CARLO STEP

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

cap program drop med\_complex

program define med\_complex, rclass

set seed 123985

cap drop E\_\*

cap drop D\_\*

cap drop IIE\_M1\*

cap drop IIE\_M2\*

cap drop IIE\_M3\*

cap drop IIE\_1

cap drop IIE\_2

cap drop IIE\_3

cap drop IIE\_123

cap drop IDE

cap drop TCE

cap drop original

cap drop M1a

cap drop M1b

cap drop M2\_1

cap drop M2\_0

cap drop M3a

cap drop M3b

expand 1000

sort B\_PID

qui by B\_PID:gen original=\_n==1

\*\*\*\*Setting mediators

\*\*\*\* M1 characteristics of sessions

\*\*\*\*M1a sessions in exposed (unexposed=0)

regress med1a C1 i.C2 C3 i.miss\_1 if x==1 & original==1

qui gen A=rnormal()

gen m1a=\_b[\_cons]+\_b[C1]\*C1+\_b[C3]\*C3+\_b[1.C2]\*C2+\_b[1.miss\_1]\*miss\_1+e(rmse)\*A

sum m1a

drop A

\*M1b homework in exposed (unexposed=0)

ologit med1b C1 i.C2 i.miss\_5 i.miss\_1 if x==1 & original==1

predict p1 p2 p3 , p

generate u1 = runiform()

gen M1b=.

replace M1b=2 if u1<p1+p2+p3

replace M1b=1 if u1<p1+p2

replace M1b=0 if u1<p1

sum M1b

drop p1 p2 p3 u1

\*\*\*\*M2 - behavioural activation levels

\* exposed

regress Med2 i.miss\_2 i.miss\_5 if x==1 & original==1

qui gen B1=rnormal()

gen M2\_1=\_b[\_cons]+\_b[1.miss\_2]\*miss\_2+\_b[1.miss\_5]\*miss\_5+e(rmse)\*B1

sum M2\_1

drop B1

\*unexposed

regress Med2 C1 i.miss\_5 if x==0 & original==1

qui gen B0=rnormal()

gen M2\_0=\_b[\_cons]+\_b[C1]\*C1+\_b[1.miss\_5]\*miss\_5+e(rmse)\*B0

sum M2\_0

drop B0

\*\*\*\* M3 extra sessions for non response to therapy

\*\*\*\*M3a – extra sessions

\* exposed (unexposed==0)

ologit Med3a C1 C3 i.miss\_3 if x==1 & original==1

predict p1 p2 p3, p

generate u1 = runiform()

gen M3a=.

replace M3a=2 if u1<p1+p2+p3

replace M3a=1 if u1<p1+p2

replace M3a=0 if u1<p1

sum M3a

drop p1 p2 p3 u1

\*\*\*\*M3b – non response to therapy

\* exposed (unexposed==0)

logistic Med3b i.miss\_3 if x==1 & original==1

gen M3b=runiform()<1/(1+exp(-(\_b[\_cons]+\_b[1.miss\_3]\*miss\_3)))

sum M3b

\*\*\*\*\* Outcome models for Total effect, direct effect, indirect effect

\*\*\*\*\* E{Y(1)} \*\*\*\*\*

\*\*\* total effect exposed

syntax [varlist] [if]

save temp, replace

keep if x==1 & original==1

regress Y C1 i.C2 C3 C2\_C3 `if'

use temp, clear

predict E\_1

sum E\_1 `if'

local E\_1=r(mean)

\*\*\*\* total effect, unexposed

use temp, clear

keep if x==0 & original==1

regress Y C1 i.C2 C3 C2\_C3 `if'

use temp, clear

predict E\_0

summ E\_0 `if'

local E\_0=r(mean)

\*\* DIRECT EFFECTS

\*Calculating D\_1, exposed

use temp, clear

keep if x==1 & original==1

regress Y Med1a i.Med1b Med2 i.Med3a i.Med3b Med3a\_C1 C1 i.C2 C3 C2\_C3 `if'

use temp, clear

gen Med1a\_new=Med1a

replace Med1a=0

gen Med1b\_new=Med1b

replace Med1b=0

gen Med2\_new=Med2

replace M2=M2\_0

gen Med3b\_new=Med3b

replace Med3b=0

gen Med3b\_C1\_new=Med3b\_C1

replace Med3b\_C1=0

gen Med3a\_new=Med3a

replace Med3a=0

predict D\_1

summ D\_1 `if'

local D\_1=r(mean)

replace Med1a=Med1a\_new

drop Med1a\_new

replace Med1b=Med1b\_new

drop Med1b\_new

replace Med2=Med2\_new

drop Med2\_new

replace Med3b=Med3b\_new

drop Med3b\_new

replace Med3b\_C1=Med3b\_C1\_new

drop Med3b\_C1\_new

replace Med3a=Med3a\_new

drop Med3a\_new

\*\* direct effect, unexposed

\*Calculating D\_0

use temp, clear

keep if x==0 & original==1

regress Y C1 i.C2 C3 C2\_C3 Med2 `if'

use temp, clear

gen Med2\_new=Med2

replace M2=M2\_0

predict D\_0

summ D\_0 `if'

local D\_0 =r(mean)

replace Med2=Med2\_new

drop Med2\_new

\* Intervention indirect effect (IIE\_M1) for M1

\*M1 at levels in the exposed

use temp, clear

keep if x==1 & original==1

regress Y Med1a i.Med1b Med2 i.Med3a i.Med3b Med3a\_C1 C1 i.C2 C3 C2\_C3 `if'

use temp, clear

gen Med1a\_new=Med1a

replace Med1a=M1a

gen Med1b\_new=Med1b

replace Med1b=M1b

gen Med2\_new=Med2

replace Med2=M2\_0

gen Med3b\_new=Med3b

replace Med3b=0

gen Med3b\_C1\_new=Med3b\_C1

replace Med3b\_C1=0

gen Med3a\_new=Med3a

replace Med3a=0

predict IIE\_M1\_1

summ IIE\_M1\_1 `if'

local IIE\_M1\_1=r(mean)

replace Med1a=Med1a\_new

drop Med1a\_new

replace Med1b=Med1b\_new

drop Med1b\_new

replace Med2=Med2\_new

drop Med2\_new

replace Med3b=Med3b\_new

drop Med3b\_new

replace Med3b\_C1=Med3b\_C1\_new

drop Med3b\_C1\_new

replace Med3a=Med3a\_new

drop Med3a\_new

\*\*\*M1 at levels in the unexposed

use temp, clear

keep if x==1 & original==1

regress Y Med1a i.Med1b Med2 i.Med3a i.Med3b Med3a\_C1 C1 i.C2 C3 C2\_C3 `if'

use temp, clear

gen Med1a\_new=Med1a

replace Med1a=0

gen Med1b\_new=Med1b

replace Med1b=0

gen Med2\_new=Med2

replace Med2=M2\_0

gen Med3b\_new=Med3b

replace Med3b=0

gen Med3b\_C1\_new=Med3b\_C1

replace Med3b\_C1=0

gen Med3a\_new=Med3a

replace Med3a=0

predict IIE\_M1\_0

summ IIE\_M1\_0 `if'

local IIE\_M1\_0=r(mean)

replace Med1a=Med1a\_new

drop Med1a\_new

replace Med1b=Med1b\_new

drop Med1b\_new

replace Med2=Med2\_new

drop Med2\_new

replace Med3b=Med3b\_new

drop Med3b\_new

replace Med3b\_C1=Med3b\_C1\_new

drop Med3b\_C1\_new

replace Med3a=Med3a\_new

drop Med3a\_new

\*\*\*\* Calculate IIE\_2

\*\*\* M2 at levels in the exposed

use temp, clear

keep if x==1 & original==1

regress Y Med1a i.Med1b Med2 i.Med3a i.Med3b Med3a\_C1 C1 i.C2 C3 C2\_C3 `if'

use temp, clear

gen Med1a\_new=Med1a

replace Med1a=M1a

gen Med1b\_new=Med1b

replace Med1b=M1b

gen Med2\_new=Med2

replace Med2=M2\_1

gen Med3b\_new=Med3b

replace Med3b=0

gen Med3b\_C1\_new=Med3b\_C1

replace Med3b\_C1=0

gen Med3a\_new=Med3a

replace Med3a=0

predict IIE\_M2\_1

summ IIE\_M2\_1 `if'

local IIE\_M2\_1=r(mean)

replace Med1a=Med1a\_new

drop Med1a\_new

replace Med1b=Med1b\_new

drop Med1b\_new

replace Med2=Med2\_new

drop Med2\_new

replace Med3b=Med3b\_new

drop Med3b\_new

replace Med3b\_C1=Med3b\_C1\_new

drop Med3b\_C1\_new

replace Med3a=Med3a\_new

drop Med3a\_new

\*\* M2 at levels in the unexposed

use temp, clear

keep if x==1 & original==1

regress Y Med1a i.Med1b Med2 i.Med3a i.Med3b Med3a\_C1 C1 i.C2 C3 C2\_C3 `if'

use temp, clear

gen Med1a\_new=Med1a

replace Med1a=M1a

gen Med1b\_new=Med1b

replace Med1b=M1b

gen Med2\_new=Med2

replace M2=M2\_0

gen Med3b\_new=Med3b

replace Med3b=0

gen Med3b\_C1\_new=Med3b\_C1

replace Med3b\_C1=0

gen Med3a\_new=Med3a

replace Med3a=0

predict IIE\_M2\_0

summ IIE\_M2\_0 `if'

local IIE\_M2\_0=r(mean)

replace Med1a=Med1a\_new

drop Med1a\_new

replace Med1b=Med1b\_new

drop Med1b\_new

replace Med2=Med2\_new

drop Med2\_new

replace Med3b=Med3b\_new

drop Med3b\_new

replace Med3b\_C1=Med3b\_C1\_new

drop Med3b\_C1\_new

replace Med3a=Med3a\_new

drop Med3a\_new

**\*\*\*\* Calculate IIE\_3**

\*\*\* M3 at levels in the exposed

use temp, clear

keep if x==1 & original==1

regress Y Med1a i.Med1b Med2 i.Med3a i.Med3b Med3a\_C1 C1 i.C2 C3 C2\_C3 `if'

use temp, clear

gen Med1a\_new=Med1a

replace Med1a=M1a

gen Med1b\_new=Med1b

replace Med1b=M1b

gen Med2\_new=Med2

replace Med2=M2\_1

gen Med3b\_new=Med3b

replace Med3b=M3b

gen Med3b\_C1\_new=Med3b\_C1

replace Med3b\_C1=M3\*C1

gen Med3a\_new=Med3a

replace Med3a=M3a

predict IIE\_M3\_1

summ IIE\_M3\_1 `if'

local IIE\_M3\_1=r(mean)

replace Med1a=Med1a\_new

drop Med1a\_new

replace Med1b=Med1b\_new

drop Med1b\_new

replace Med2=Med2\_new

drop Med2\_new

replace Med3b=Med3b\_new

drop Med3b\_new

replace Med3b\_C1=Med3b\_C1\_new

drop Med3b\_C1\_new

replace Med3a=Med3a\_new

drop Med3a\_new

\*\* M3 at levels in the unexposed

use temp, clear

keep if x==1 & original==1

regress Y Med1a i.Med1b Med2 i.Med3a i.Med3b Med3a\_C1 C1 i.C2 C3 C2\_C3 `if'

use temp, clear

gen Med1a\_new=Med1a

replace Med1a=M1a

gen Med1b\_new=Med1b

replace Med1b=M1b

gen Med2\_new=Med2

replace Med2=M2\_1

gen Med3b\_new=Med3b

replace Med3b=0

gen Med3b\_C1\_new=Med3b\_C1

replace Med3b\_C1=0

gen Med3a\_new=Med3a

replace Med3a=0

predict IIE\_M3\_0

summ IIE\_M3\_0 `if'

local IIE\_M3\_0=r(mean)

replace Med2=Med2\_new

drop Med2\_new

replace Med1a=Med1a\_new

drop Med1a\_new

replace Med1b=Med1b\_new

drop Med1b\_new

replace Med3b=Med3b\_new

drop Med3b\_new

replace Med3b\_C1=Med3b\_C1\_new

drop Med3b\_C1\_new

replace Med3a\_new=Med3a

drop Med3a\_new

\*\*\* RESULTS

local IIE\_3 = `IIE\_M3\_1' - `IIE\_M3\_0'

local IIE\_2 = `IIE\_M2\_1' - `IIE\_M2\_0'

local IIE\_1 = `IIE\_M1\_1' - `IIE\_M1\_0'

local IDE = `D\_1' - `D\_0'

local TCE = `E\_1' - `E\_0'

local IIE\_123 = ((`TCE')-((`IIE\_3')+(`IIE\_2')+(`IIE\_1')+(`IDE')))

return scalar IIE\_3 = `IIE\_3'

return scalar IIE\_2 = `IIE\_2'

return scalar IIE\_1 = `IIE\_1'

return scalar IDE = `IDE'

return scalar TCE = `TCE'

return scalar IIE\_123 = `IIE\_123'

end

bootstrap r(IIE\_3) r(IIE\_2) r(IIE\_1) r(IIE\_123) r(IDE) r(TCE), noi reps(1000) cluster (clinic) idcluster(clin) seed (1234): HAP

estat bootstrap, all

ex