



Treatment in the hospital versus at home; a cost analysis using SAS



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Introduction

- ▶ Rapid growth of health care expenditures over the last 30 years

- ▶ Reasons for that growth:
 - ▶ Progress in innovation of medical technology
 - ▶ Variation in medical practice
 - ▶ Increase in income
 - ▶ Unhealthy lifestyles
 - ▶ Increase of population globally
 - ▶ New epidemiological needs



Solutions – Economic Perspective

- ▶ Crisis demands solutions to contain costs and promote efficiency in health care sector
- ▶ Hence, economic evaluation of health technologies has been introduced
- ▶ Various types



Types of economic evaluation

Type of economic evaluation	Measures of costs	Measures of consequences
Cost analysis	Monetary units	None
Cost effectiveness analysis	Monetary units	Natural units (e.g. points of blood pressure reduction)
Cost utility analysis	Monetary units	Quality-adjusted life years
Cost benefit analysis	Monetary units	Monetary units



Cost analysis example

- ▶ Fictional data
- ▶ Hospital and home related data
- ▶ Assuming in each category same costs for all the patients



Hospital costs

HOSPITAL COSTS (per day)	
Bed	€ 200
Overhead E.g. electricity, administration costs, laundry	€ 50
Medical use E.g. Doctor, nurses, physiotherapists	€ 60
Total per day	€ 310



Home costs

HOME COSTS (per day)	
Physician visit	€ 120
Monitoring visit	€ 30
Total per day	€ 150



Analysis data

WORK.COSTPERDAY

Contains one row per treatment location, and the cost per day for one patient at that location.

LOCATION	COST
HOSPITAL	310
HOME	150



Analysis data

WORK.PATIENTS

Contains one row per patient and displays the patient number, and the number of days spent under treatment.

LOCATION	PATIENT	DAYS
HOME	P1	7
HOME	P2	9
<... 98 other patients in HOME>		
HOSPITAL	P101	3
HOSPITAL	P102	4
<... 98 other patients in HOSPITAL>		



Code to link costs and days

```
data work.costperpatient;  
  merge work.patients  
        work.costperday;  
  by location;  
  
  treatmentcost = days * cost;  
  
  label location      = "Rehabilitation location"  
        cost          = "Cost"  
        treatmentcost = "Cost of rehabilitation"  
        days          = "Number of days";  
  
run;
```



Output dataset

VIEWTABLE: Work.Costperpatient

	Rehabilitation location	patient	Number of days	Cost	Cost of rehabilitation
97	HOME	P97	10	150	1500
98	HOME	P98	10	150	1500
99	HOME	P99	8	150	1200
100	HOME	P100	7	150	1050
101	HOSPITAL	P101	3	310	930
102	HOSPITAL	P102	4	310	1240
103	HOSPITAL	P103	5	310	1550
104	HOSPITAL	P104	5	310	1550



Calculate the sum and mean

```
proc means data=work.costperpatient noobs  
            maxdec=2 mean median std;  
by location;  
var treatmentcost days;  
output out=work.results sum=sum mean=mean  
                        median=median std=std;  
run;
```



PROC MEANS output

The SAS System

The MEANS Procedure

Rehabilitation location=HOME

Variable	Label	Sum	Mean	Median	Std Dev
treatmentcost	Cost of rehabilitation	114300.00	1143.00	1050.00	202.01
days	Number of days	762.00	7.62	7.00	1.35

Rehabilitation location=HOSPITAL

Variable	Label	Sum	Mean	Median	Std Dev
treatmentcost	Cost of rehabilitation	128650.00	1286.50	1240.00	318.88
days	Number of days	415.00	4.15	4.00	1.03

Results



- ▶ We can observe that for the number of 100 observations the total costs related to home are € 114.000 while the total costs for hospital are € 128.650.
- ▶ However, we can also observe that the days spent on hospital on average are 4.15 while at home are 7.62.
- ▶ The difference in costs is € 14.350.
- ▶ The difference in days is 3.47 on average
- ▶ The results shows that Hospital costs are higher than the ones related to Home.



Sensitivity Analysis

- ▶ Small sample
- ▶ Hence, important to include a sensitivity analysis to extrapolate our data and results

How?

- ▶ **Non-parametric bootstrapping method**
- ▶ **Produce N subsamples which are redrawn from our original sample**
- ▶ **Produce 1000 replications from our data which consists of 100 patients**



Prepare the bootstrap

```
data work.boot_hosp (rename = (treatmentcost =  
                                cost_hospital))  
      work.boot_home (rename = (treatmentcost =  
                                cost_home));  
  
set work.costperpatient;  
keep patient treatmentcost;  
  
if location = "HOME" then  
  output work.boot_home;  
else if location = "HOSPITAL" then  
  output work.boot_hosp;  
  
run;
```



Execute the bootstrap

```
%macro bootstrap(type);  
  
    data work.boot_&type.1;  
        do sampnum = 1 to 10000;  
            do i=1 to nobs;  
                x = round(ranuni(0) * nobs);  
                set work.boot_&type nobs = nobs point = x;  
                output;  
            end;  
        end;  
        stop;  
    run;  
  
    data work.boot_&type.2;  
        set work.boot_&type.1;  
        recno = _n_;  
    run;  
  
%mend bootstrap;  
  
%bootstrap(home);  
%bootstrap(hosp);
```



Resulting dataset



VIEWTABLE: Work.Boot_final

	sampnum	i	patient	Cost of rehabilitation	recno	Cost of rehabilitation	cost_diff
1	1	1	P62	930	1	1200	-270
2	1	2	P91	2790	2	900	1890
3	1	3	P50	1240	3	750	490
4	1	4	P98	1550	4	1500	50



Calculate confidence intervals

```
proc univariate data=work.boot_final noprint;  
  var cost_diff;  
  output out=work.stat_boot  
    mean=mean_diff  
    pctlpre=P_ pctlpts= 2.5, 97.5;  
run;
```



Results



VIEWTABLE: Work.Stat_boot (Selected Summary Statistics (Percentile Definition=5))

	the mean, cost_diff	the 2.5000 percentile, cost_diff	the 97.5000 percentile, cost_diff
1	141.42989	-420	1280

Conclusion



- ▶ SAS has all the necessary tools to conduct any kind of economical analysis compared to the other tools already used in the health economics field.
- ▶ Faster than the others and time is money.
- ▶ Only drawback the extensive documentation needed to prove transparency and support understanding from the decision makers' perspective.

Questions



Thank you for your attention and please don't be shy...

However, feel free to contact me for further discussion:

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