Hospital Example for EGDe$

1 Hospital Case Study Overview

This example contains all information required for the "Hospital Example" and the "Hospital Example with Uncertainty". If you are only interested in the example without uncertainty you may ignore any distributions or distribution related variables. For simplicity, the tables of inputs and outputs for the "with Uncertainty" example are separate from those for the example without uncertainty. This is a highly simplified example only meant for illustrative purposes and is not a true representation of a full economic or LCC analysis. Furthermore, many of the assumptions made herein are unjustified and should not be considered as recommendations.

Certain steps taken in this example require the user to take care in interpreting output.

The purpose of the *Hospital* case study is to illustrate how to incorporate certain timing aspects of cash flows that are not currently built into EDGe$ into an analysis. This method requires an additional calculation to apply a modification to benefits. It should be noted that, while EDGe$ does allow for accurate modifications when including timing for the point estimate analysis, EDGe$ has limitations with these modifications under uncertainty. Furthermore, the intermediate output is not currently designed to account for such modifications. A discussion of this is presented later in the Appendix.

<u>Narrative</u>

A medium-sized city situated near the mouth of a river recently experienced a 50-year flood. During the flood, their hospital, located in the 50-year flood plain but outside of the 25-year flood plain, flooded, requiring an evacuation of all patients and rendering it inoperable for a full year after the event (Cabbagestalk 2016). Lacking a viable hospital, all hospital traffic was required to visit nearby hospitals in other towns (assumed to have sufficient capacity for the additional patients). This meant that an average of 20 km was added to any hospital related trips from the city. A full analysis of the hospital after the disaster yielded the results in Table 1.

Recognizing the hardship caused by the loss of the hospital, the city decided to relocate the hospital to an area outside of the 50-year flood plain. Apart from increasing their resilience related to flooding events, the hospitals will be designed to current standards of hospital construction. While not necessarily state of the art, the new facility will be an upgrade to their original hospital, which was half a century old. The key decisions related to the hospital is where it will be sited. The city has determined two potential locations: 1. Construct a hospital with 3207 m^2 of floor space on 56 656 m^2 in a suburban area of the city, or 2. construct a hospital with 3601 m^2 of floor space on 32 375 m^2 in the city center.

Table 1. Estimated losses from instigating flood

Item	Loss classification	Value
Statistical lives lost (flood)	Human Life	11 people
Additional statistical lives lost (additional travel time)[1]	Human Life	40 people[2]
Structural damage	Direct	$32 million (Johannesen 2008, June 19)
Hospital income (full year)	Indirect	$276 million (Federal Emergency Management Agency 2008)
Diverting ambulances	Indirect	$1100 per trip[3] (McConnell et al. 2006)
Mold remediation	Response and Recovery	$24 million (Kisken 2007, Aug 22)
Evacuation cost	Response and Recovery	$75 000 (Zavadil 2013 July 9)

2 Assumptions

The following values are assumed for both alternatives:

Planning horizon – 100 years
Recurrence rate of Flood Event – 50 years
Real discount rate – 8 %
Value of a statistical life – 7 900 000 USD (Applebaum 2011, Feb. 16)
Value of a statistical infection - 13 577 USD[4]

Other key assumptions have been made to simplify the example. These are not necessarily realistic and should not be considered prescriptive for an actual LCC analysis.

1. The hospital is the only medical center effected. In practice, many medical procedures are performed in smaller practices that may be owned by the hospital but are not collocated with the hospital or via independent clinics. Disruption to these services can be just as fatal depending on the service provided, dialysis for instance, but such disruptions are omitted here.
2. In conjunction with the first assumption, the impact to public transportation is negligible. The cost of medical services for severe disabilities, or the nature of a disability itself, may preclude personal travel to and from services. As with the first assumption, these considerations are omitted.

[1] Lives lost in travel time are those that are a direct result of the longer time to reach the hospital over the year that the hospital is closed.
[2] Calculated assuming 2000 ambulance trips per year (U.S. Dept. of Health and Human Services 2015) over the additional 20 km per trip and an increased chance of mortality of 1 % per 10 km (Nicholl et al. 2007).
[3] 2000 trips assumed per year
[4] Value of statistical infection derived using the total cost of non-fatal nosocomial infections in the US for a year (9.8 billion USD) (Zimlichman et al. 2013) and dividing it by the number of non-fatal nosocomial infections per year (721 800) (Centers for Disease Control and Prevention 2016)

3. The effects of worker dislocation are omitted, and it is assumed that after recovering from the disaster the hospital returns to full staffing immediately.
4. Local and regional economic effects of moving the hospital are omitted.
5. The effects of floods of other magnitudes (e.g.,100-year, 25-year, 10-year, etc.) are irrelevant in the context of this analysis. In essence, lesser floods don't have the capacity to impact the hospital nor access to it at either location, while a greater flood (200-year or 500-year) is assumed to be so devastating that relocating the hospital would not have any meaningful impact on the outcome. Information on floodplains for intermediate floods (37-year flood for instance) are assumed to not exist.
6. There is no dependence between any of the distributions used for the uncertainty analysis. EDGe$ currently lacks the ability to consider dependencies.
7. The analysis compares all values relative to the implicit option of doing nothing.

Assumptions related to specific values derived for the analysis are mentioned as they arise from the narrative.

3 Data

3.1 Cost Data

Estimates made on the basic features of a hospital located on each site based on the nature of the location, the available budget, and examinations of hospitals of similar size and purpose. Table 2 outlines the estimated costs at each site.

The timeline for completion is one year for the design and bidding process, and another two for the construction and commissioning (including transfer) process (Haefner 2016, June 08). Once in operation it is expected to have a 100-year planning horizon. The old hospital, at this point back in operation, would remain in operation for the three years it takes for the new hospital to be completed, after which it will be decommissioned and sold. The decommissioning is expected to cost another three million USD and take a full year (Kulia 2013, June 5; New York City Health and Hospitals Corporation 2013, Nov. 7; Martin, Chip 2013, June 18).

Once decommissioned the old structure and the land surrounding it are expected to be sold. Based on land value and knowledge of previous sales the city expects the hospital, with land, to sell for around two million USD (Burns 2017, Jan 27; Dunn 2010, Nov. 24).

Table 2. Costs associated with the two hospital site options

Cost classification	Item	Site 1 (Suburbs)	Site 2 (City Center)
Direct	Construction[5]	$2960.77/m^2	$3336.81/m^2
	Land acquisition	$3.71/m^2 (Davis and Polumbo 2007)	$8.67/m^2 [15] (Davis and Polumbo 2007)
	Outfitting[6]	$7045.53/m^2	$7045.53/m^2
	Transfer[7]	$28 million	$30 million
Indirect	Indirect (Including contractor overhead)[8]	30 % of direct costs	30 % of direct costs
Operations, Maintenance, and Repair	Operations	34.66/m^2 (OMBHCFC 2010)	34.66/m^2 (OMBHCFC 2010)
	Maintenance	140.79/m^2 (OMBHCFC 2010)	129.17/m^2 (OMBHCFC 2010)
	Utilities	43.70/m^2 (OMBHCFC 2010)	40.69/m^2 (OMBHCFC 2010)

3.2 Benefit Data

Event-Related Benefits (*Benefits* screen in EDGe$)

In selecting each potential site, the city examined the impact on expected losses in the event of another 50-year flood event. Based on the analysis the loss reductions in Table 3 are expected.

If there is enough rain to induce flooding, it would be expected that some damage would occur to the hospital itself, but it would be limited to the basement. A similar argument is made for mold remediation. In the comparison, it's noted that Site 1's characteristics make it more susceptible to basement flooding, translating to more damage from heavy rains, and increased potential for lost revenue as any basement flooding is dealt with. No evacuation should be necessary for either hospital.

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[5] Based on ranges of cost per square foot, converted to cost per square meter, from (Design Cost Data 2014; Garske 2012, Aug 19; Groves 2007, June 5; UCLA Health; Pope 1991)
[6] Cost per square meter obtained by normalizing numbers from (Blackford 2013, June 10)
[7] Cost per square meter obtained by normalizing values from (Garrick 2009, Apr. 13); Lou 2009, Mar. 9)
[8] Base rate of 24 % from Montgomery County Department OF Housing and Community Affairs (2016) with an additional 6 % added based in part on National Academy of Sciences (1968)

Table 3. Reductions in flood related losses for each hospital site

Item	Loss classification	Site 1 Reduction	Site 2 Reduction
Statistical lives lost (flood)	Human Life	0 people	0 people
Statistical lives lost (additional travel time)	Human Life	40 people	40 people
Structural damage	Direct	$22.5 million	$27.5 million
Hospital income (full year)	Indirect	$250 million	$271 million
Diverting ambulances	Indirect	$1100 per trip	$1100 per trip
Mold remediation	Response and Recovery	$18 million	$19 million
Evacuation cost	Response and Recovery	$0.075 million	$0.075 million

Fatalities Averted

Most deaths due to flooding are a result of drowning. An operational hospital is not as vital to preventing drowning deaths as is evacuation, education, and the actions of first responders. Under this assumption, the new hospital would not prevent any deaths directly related to the flood. It's also assumed that all lives lost due to an increase in transport time to a functional hospital would be saved, as would the cost of diverting ambulances.

Non-Disaster Related Benefits (Resilience Dividend)

Apart from the flood related benefits, the city also notes that there are other positives that come from the new hospitals. Both would be built to higher standards than the old hospital, thus reducing the potential for medical errors and increasing efficiency. Given the larger amount of space in Site 1, the hospital could be better optimized for efficiency over the space, resulting in more gains than Site 2. Site 2 would have the potential to cut down on ambulance travel times as well, while they would be relatively unchanged with Site 1's location. All values are assumed yearly.

presents the potential non-flood related benefits. All values are assumed yearly.

Table 4. Non-flood related benefits for each hospital site

Item	Site 1	Site 2
Statistical lives saved due to a decrease in medical errors	4	2
Decrease in nosocomial infections (non-fatal)	20	15
Decrease in average travel distance	0	1 km

3.3 Externalities

No externalities are assumed for this example. It is highly unrealistic that none exist, but externalities are often not considered in an analysis and are unnecessary to achieve the purpose of this example besides.

4 EDGe$ inputs

Point Estimate/Baseline Analysis

The base values for cost inputs into EDGe$ are presented in Table 5. All costs are assumed as occurring in year zero, as that is when the city will set aside the funds. As such, even though the money is not actually spent, it is not available to the city for other purposes. This value is assumed to account for discounting in the three-year construction phase cash flows. OMR costs (excluding decommissioning) are annually recurring and start accruing after year three, once the hospital is completely constructed and has entered service.

Table 5. Cost inputs values for EDGe$ for each hospital site

Cost Category	Site 1	Site 2
Direct (Excluding Decommissioning)[9]	$60.30 million	$65.67 million
Indirect	$18.09 million	$19.7 million
Operations, Maintenance and Repair	$0.61 million per year	$0.57 million per year
Decommissioning (Treated as one-time OMR cost at year 3)	$2 million	$2 million

Table 6 converts the values for *Additional statistical lives lost*, *diverting ambulances*, and *Statistical lives lost* from Table 3 into input ready values. All other values in Table 3 may be input directly. Non-disaster related benefits and externalities start accruing after the third year, after the hospital is completely constructed and has entered service.

Table 6. Flood related loss reduction (Benefits) input for each hospital site

Item	Site 1 Reduction	Site 2 Reduction
Statistical lives lost (flood)	0	0
Statistical lives lost (additional travel time)[10]	40 people	40 people
Diverting ambulances[11]	$2.2 million	$2.2 million

One issue that arises in inputting this information in EDGe$ occurs when looking at the on-disaster benefits. These benefits don’t accrue until the hospital is completed, however EDGe$ automatically applies them for all years. In order to address this, their value needs to be removed from the analysis.

[9] Decommissioning is not an immediate direct cost so it is handled as a separate OMR cost in the program.
[10] Input into Fatalities Averted page
[11] 2000 trips assumed per year

This can be back ended into the program through the *Externalities* input. Doing so first requires calculating the annualized benefit of the on-disaster benefits using Eq. 1.

$$B * \lambda = A \tag{1}$$

Where: B is the value of the on-disaster benefit, λ is the Poisson distribution parameter equal to $\frac{1}{Return\ Rate}$, and A is the annualized non-discounted on-disaster benefit. Note that this assumes there is no flooding during the first three years.

These values can be entered into the *Externalities* as a negative one-time externality for years one, two, and three. This removes the on-disaster benefits for those years but means the total *Externalities* output will now be incorrect while the final values *Present Values* will now be correct. Any economic indicators omitting externalities in the output will also be incorrect. By defining the owner of the *Externalities* as "Correction" in the input, it becomes possible to easily single them out in the input and output. These inputs are found in Table 7. Similar modifications can be done to allow for the timing out of *Cost* cash flows or terminating a recurring cost before the planning horizon is reached. Alternatively, the modifications could be added via the *Benefits* input page using negative values.

Table 7. Modifications input for flood related benefits for years one through three for each hospital site.

Corrected Line Item[12]	Modification Value Site 1	Modification Value Site 2
Aggregated DRBs	$5.86 million	$6.40 million
Value of fatalities averted	$6.32 million	$6.32 million

Table 8 summarizes the non-disaster related benefits. Non-disaster related benefits are annually recurring and accrue starting after year three, after the hospital is completely constructed and has entered service.

Table 8. Non-disaster related benefits for each hospital site

Item	Site 1	Site 2
Statistical lives saved due to a decrease in medical errors (annual starting in year four)	$31.6 million	$15.8 million
Decrease in nosocomial infections (non-fatal) (annual starting in year four)	$0.272 million	$0.204 million
Decrease in average travel distance[13] (annual starting in year four)	$0	$2 million

Disaster related benefits for direct, indirect, and response and recovery loss reductions may be taken directly from Table 3.

[12] Values input in the *Externalities* page in EDGe$
[13] Calculated assuming 2000 ambulance trips a year over the reduction of 1 km per trip and an increased chance of mortality of 1 % per 10 km.

Analysis under uncertainty

The costs under uncertainty are presented in Table 9. Right skewed distributions are assumed for some costs due to a higher likelihood of cost overrun. Table 10 includes the uncertainty input for on-event benefits. Values for *Min, Max,* and *St. Dev.* are assumed without justification.

Table 9. Cost uncertainty inputs for each hospital site

Cost Category	Site 1	Site 2
Total Direct Costs (excluding decommissioning)[14]	Discrete distribution $44 million (20 %) $60.3 million (40 %) $109 million (40 %)	Discrete distribution $58 million (20 %) $66 million (40 %) $158 million (40 %)
Indirect	Discrete distribution $13 million (20 %) $18 million (40 %) $33 million (40 %)	Discrete distribution $58 million (20 %) $19.7 million (40 %) $158 million (40 %)
Operations, Maintenance and Repair (annual starting in year 4)	Gaussian (Normal) Distribution Mean – $0.611 million St Dev. – $0.050 million	Gaussian (Normal) Distribution Mean – $0.570 million St Dev. – $0.030 million
Decommissioning (Treated as one-time OMR cost at year 3)	Discrete distribution $1.7 million (25 %) $2 million (50 %) $3 million (25 %)	Discrete distribution $1.7 million (25 %) $2 million (50 %) $3 million (25 %)

Applying uncertainty to the modifications in the externalities is not obvious. For each simulation, they should be equivalent to the corresponding non-discounted annual value for whatever the sum of the simulated values for direct, indirect, and the response and recovery costs is. However, the underlying code does not allow this at present. There are multiple ways to attempt to handle the modifications for the uncertain inputs, though none provide “perfect” modifications for any simulated values that need to be removed from the analysis. Knowing the issues with including uncertainty in situations with complex timing of cash flows, it may be best to forego the uncertainty analysis in the current version of EDGe$. Future versions may add the functionality to allow a more appropriate treatment of cash flows and dependence between distributions.

One option would be simply to not add uncertainty to the modifications and instead replace them with the mean of the underlying loss distributions. Alternatively, the distribution data for each loss reduction input may be input for the negative externalities. Copying in data from Table 10 into the externality input for each year that requires modification would achieve this aim, though the ultimate result of the analysis will be incorrect due to the lack of dependency characterization.

[14] Ranges for the discrete distribution are based on a survey of completed hospital construction projects.

Table 10. Uncertainties for flood related benefits for each hospital site

Loss Reduction Category	Site 1	Site 2
Direct	Triangular distribution Min - $18.75 million Most Likely - $22.5 million Max - $26.25 million	Triangular distribution Min - $23 million Most Likely - $27.5 million Max - $32 million
Indirect	Triangular distribution Min - $227 million Most Likely - $250 million Max - $273 million	Triangular distribution Min - $245 million Most Likely - $271 million Max - $297 million
Response and Recovery (Mold Remediation)	Gaussian (Normal) Distribution Mean - $18.0 million St Dev. - $1.2 million	Gaussian (Normal) Distribution Mean - $19.0 million St Dev. - $1.3 million
Response and Recovery (Evacuation)	Gaussian (Normal) Distribution Mean - $0.075 million St Dev. - $0.005 million	Gaussian (Normal) Distribution Mean - $0.075 million St Dev. - $0.005 million
Response and Recovery (Evacuation)	Gaussian (Normal) Distribution Mean - $2.2 million St Dev. - $0.250 million	Gaussian (Normal) Distribution Mean - $2.2 million St Dev. - $0.250 million

If there are too many loss reductions to make inputting modifications individually convenient, or there is concern the proliferation of inputs may slow down computation time, Lyapunov's Central Limit Theorem[15] (LCLT) may be used, provided the corresponding conditions are met. Using LCLT takes advantage of the fact that the mean of the distribution of the sum of a series of independent random variables is:

$$E[S_n] = E[X_1 + X_2 + \cdots + X_n] = E[X_1] + E[X_2] + \cdots + E[X_n]$$

Where S_n is the sum of random variables, $X_1, X_2, \ldots, X_n$. The variance will then be defined as:

$$var(S_n) = \sum_{k=1}^{n} var(X_k) + \sum_{\substack{j=1 \\ j\neq k}}^{n} \sum_{k=1}^{n} cov(X_j, X_k)$$

If the underlying distributions are independent, then:

$$\sum_{\substack{j=1 \\ j\neq k}}^{n} \sum_{k=1}^{n} cov(X_j, X_k) = 0$$

and

[15] Lindeberg's condition could also be used, however meeting Lyapunov's condition implies that Lindeberg's is met and Lyapunov's condition is often slightly easier to calculate.

$$var(S_n) = \sum_{k=1}^{n} var(X_k)$$

Since all distributions are assumed independent in the current version of the EDGe$, LCLT allows a normal distribution of the calculated mean and variance to be used.

In this example, the mean of each distribution is used without uncertainty. All distributions for flood related benefits are symmetric, so the point estimate sums are equivalent to the sum of the means. No such consideration is required for fatalities averted as there is no uncertainty input for them in the current version of the EDGe$. Table 11 presents the non-disaster related benefits under uncertainty. All values for *Min, Max,* and *St. Dev.* are assumed without justification excluding the values for resale of the hospital, which is based on a literature survey of sale prices for decommissioned hospitals.

Table 11. Non-disaster related benefit uncertainties for each hospital site

Non-disaster related benefit	Site 1	Site 2
Medical Error Reduction (Annual starting in year four)	Rectangular distribution Min - $15.8 million Max - $47.4 million	Rectangular distribution Min - $11.85 million Max - $19.75 million
Decrease in nosocomial infections (non-fatal) (Annual starting in year four)	Triangular distribution Min - $0.122 million Most Likely - $0.272 million Max - $0.422 million	Triangular distribution Min - $0.054 million Most Likely - $0.204 million Max - $0.354 million
Sale of old hospital	Rectangular distribution Min - $1.5 million Max - $2.5 million	Rectangular distribution Min - $1.5 million Max - $2.5 million
Reduction in travel distance (Annual starting in year four)	Gaussian (Normal) Distribution Mean – $0 million St Dev. – $2.63 million	Gaussian (Normal) Distribution Mean – $15.8 million St Dev. – $3.95 million

5 EDGe$ Results

The EDGe$ output in Table 12 summarizes all pertinent output for the Point Estimate Analysis. In this case the non-event related economic benefits are larger than all others. Considering the VSL used and the rate of statistical lives saved this is not unexpected. Both options end up being a net positive in terms of NPV, with Site 1 being slightly better by roughly one million USD. Realistically speaking one million USD would be well within the expected error margin, so the two are essentially equal in NPV, as well as in all other economic indicators. Output related to *Without* Externalities is meaningless in this analysis due to the use of externalities to correct for the timing of cash flows.

The 31 million USD and 32.5 million USD represents the value of the correction applied to the analysis. This is the amount of additional benefits that would erroneously be accrued by not removing the benefits for the first three years. In practice, the two could be considered equivalent in terms of preference. In such a situation, the determining factor may be political, logistical, or based on some other economic factor. It could be argued that *Site 1* is preferable because, while the LCC suggests indifference, the first costs are lower, which may be an easier sell based on budget constraints.

The intermediate output from the analysis under uncertainty is provided in Table 13, Table 14 contains the economic indicator output from EDGe$. *Lower* and *Upper* bounds represent those values required for a 95 % prediction interval, i.e. 95 % confidence interval on the output values from the simulation. They are not confidence intervals on the mean. The point estimate in not the mean of the simulations, but the result of the point estimate calculations summarized in Table 12.

Adding uncertainty to the analysis clarifies the desired outcome in this instance, although it is important to bear in mind the previous notes on the application of uncertainty related to the use of the correction for cash flow timing. All indicators including externalities suggest that *Site 1* is preferable at the upper bound, and only the lower bound of *Non-Disaster ROI* is better for *Site 2*. *Site 1* also has a higher upper prediction interval at $491 million ($90 million larger than the upper bound for *Site 2*) and its lower prediction interval only slightly lower than the one for *Site 2* by roughly $10 million.

Table 12. EDGe$ results for each hospital site using point estimates

	Site 1 (Suburb)	Site 2 (City Center)
Disaster Economic Benefits		
Response and Recovery Costs	$4 700 332	$4 960 378
Direct Loss Reduction	$5 851 036	$7 151 266
Indirect Losses	$65 583 615	$71 044 582
Disaster Non-Market Benefits		
Value of Statistical Lives Saved	$82 174 553	$82 174 553
Number of Statistical Lives Saved	80	80
Non-disaster Related Benefits		
One-Time	$1 452 298	$1 452 298
Recurring	$300 891 247	$300 250 361
Costs		
Direct Costs	$60 300 000	$65 670 000
Indirect Costs	$18 090 000	$19 700 000
OMR		
One-Time	$1 573 256	$1 573 256
Recurring	$5 758 858	$5 381 228
Externalities		
Positive		
One-Time	$0	$0
Recurring	$0	$0
Negative		
One-Time	$31 203 796	$32 587 215
Recurring	$0	$0
Present Expected Value		
Benefits	$460 653 081	$467 033 440
Costs	$85 722 113	$92 324 483
Externalities	($31 203 796)	($32 587 215)
With Externalities		
Net	$343 727 172	$342 121 741
Benefit-to-Cost Ratio	5.01	4.71
Internal Rate of Return (%)	26.13	25.04
Return on Investment (%)	2.94	2.74
Non-Disaster ROI (%)	1.59	1.42
Without Externalities		
Net	$374 930 968	$374 708 956
Benefit-to-Cost Ratio	5.37	5.06
Internal Rate of Return (%)	31.29	29.94
Return on Investment (%)	4.37	4.06
Non-Disaster ROI (%)	2.53	2.27

Table 13. Intermediate EDGe$ results for each hospital site under uncertainty[16]

	Site 1 (Suburb)			Site 2 (City Center)		
	Point Estimate	Lower Bound	Upper Bound	Point Estimate	Lower Bound	Upper Bound
Disaster Economic Benefits						
Response and Recovery Costs	$4 700 332	$4 090 814	$5 319 415	$4 960 378	$4 313 715	$5 637 252
Direct Loss Reduction	$5 851 036	$5 099 508	$6 600 024	$7 151 266	$6 250 401	$8 071 386
Indirect Losses	$65 583 615	$60 965 408	$70 236 522	$71 044 582	$65 775 548	$76 387 748
Disaster Non-Market Benefits						
Value of Statistical Lives Saved	$82 174 553	$82 174 553	$82 174 553	$82 174 553	$82 174 553	$82 174 553
Number of Statistical Lives Saved	80.00	80.00	80.00	80.00	80.00	80.00
Non-disaster Related Benefits						
One-Time	$1 452 298	$1 108 098	$1 799 425	$1 452 298	$1 108 272	$1 796 672
Recurring	$300 891 247	$147 558 123	$458 103 369	$300 250 361	$216 772 825	$384 603 070
Costs						
Direct Costs	$60 300 000	$44 000 000	$109 000 000	$65 670 000	$58 000 000	$158 000 000
Indirect Costs	$18 090 000	$13 000 000	$33 000 000	$19 700 000	$17 400 000	$47 400 000
OMR						
One-Time	$1 573 256	$1 337 267	$2 359 884	$1 573 256	$1 337 267	$2 359 884
Recurring	$5 758 858	$4 824 266	$6 689 972	$5 381 228	$4 824 101	$5 948 485
Externalities						
Positive						
One-Time	$0	$0	$0	$0	$0	$0
Recurring	$0	$0	$0	$0	$0	$0
Negative						
One-Time	$31 203 796	$31 203 796	$31 203 796	$32 587 215	$32 587 215	$32 587 215
Recurring	$0	$0	$0	$0	$0	$0

[16] These values will differ based on the selected "Seed" and "Monte Carlo Bounds Tolerance" values on the "Analysis Information" pages

Table 14. Economic Indicator EDGe$ results for each hospital site under uncertainty[17]

	Site 1 (Suburb)			Site 2 (City Center)		
	Point Estimate	**Lower Bound**	**Upper Bound**	**Point Estimate**	**Lower Bound**	**Upper Bound**
Present Expected Value						
Benefits	$460 653 081	$307 315 993	$618 033 252	$467 033 440	$382 630 103	$551 570 932
Costs	$85 722 113	$65 124 201	$150 044 445	$92 324 483	$82 895 501	$213 060 091
Externalities	($31 203 796)	($31 203 796)	($31 203 796)	($32 587 215)	($32 587 215)	($32 587 215)
With Externalities						
Net	$343 727 172	$157 622 166	$491 708 712	$342 121 741	$169 202 420	$411 331 360
Benefit-to-Cost Ratio	5.01	2.06	7.67	4.71	1.82	5.68
Internal Rate of Return (%)	26.13	14.58	33.52	25.04	12.88	27.91
Return on Investment (%)	2.94	0.87	4.59	2.74	0.71	3.39
Non-Disaster ROI (%)	1.59	-0.06	3.05	1.42	0.01	2.01
Without Externalities						
Net	$374 930 968	$188 825 962	$522 912 507	$374 708 956	$201 789 635	$443 918 576
Benefit-to-Cost Ratio	5.37	2.27	8.13	5.06	1.98	6.06
Internal Rate of Return (%)	31.29	16.95	40.44	29.94	14.41	33.37
Return on Investment (%)	4.37	1.27	7.13	4.06	0.98	5.06
Non-Disaster ROI (%)	2.53	0.16	4.82	2.27	0.18	3.13

6 References

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[17] These values will differ based on the selected "Seed" and "Monte Carlo Bounds Tolerance" values on the "Analysis Information" pages

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