Absence Cost Estimator – Methods Appendix

This document describes the methodology behind IBI's Absence Cost Estimator (ACE). ACE applications combine information from Dr. Sean Nicholson's 2006 *Health Economics* paper[1] and estimates from IBI's proprietary Full Cost Estimator (FCE)[2] with user input values or default values to develop a customized absence multiplier along with estimated absence lost-productivity and wage-replacement costs.

In 2009, IBI worked with Dr. Sean Nicholson on the original Lost Productivity Calculators (LPCs) to allow IBI members to develop customized absence multipliers quickly and simply. The study featured in the 2006 *Health Economics* paper developed absence multipliers for 35 different occupations[3]. All three original LPCs -- company-wide, occupation-specific and claimant group -- rely on the analysis from the 2006 *Health Economics* paper. ACE represents the next generation of these calculators, combining the original multiplier methodology with state-of-the-art absence and wage-replacement estimates from IBI's Full Cost Estimator. This document will review the 2006 Nicholson study on which modeled multipliers are based, outline Full Cost Estimator methodology and estimates incorporated into the new model and present a process flow of how default and/or user inputs are used to generate absence cost estimates.

A. Absence Multipliers

I. The Nicholson Sample

The multipliers are based on a final survey sample of 810 managers at for-profit firms in 12 different industries. Harris Interactive created a random sample of firms within the industries and contacted managers at the firms supervising one of the 57 targeted job types and with sufficient experience to be able to describe what happens when a worker is absent.

The industry representation in the final sample with 35 job types is as follows:

Industry	% of sample
Retail sales, department stores	8.4%
Legal services	8.5%
Motor vehicle dealers (new and used)	8.2%
Hotels and motels	8.5%
Trucking and courier	8.2%
Hospitals	8.5%
Motor vehicle and equipment manufacturing	8.3%
Air transportation, scheduled and courier	8.4%
Construction, non-residential	8.3%
Aircraft parts and manufacturing	7.9%
Physicians' offices	8.5%
Eating and drinking establishments	8.3%

II. Concepts Behind the Multipliers

[1] Nicholson, S., Pauly, M.V., Polsky, D., Sharda, C., Szrek, H. and Berger, M.L. "Measuring the effects of work loss on productivity with team production." Health Economics. 2006;15(2):111-123.

[2] See this document for more information on FCE methodology

[3] Construction engineer; Aerospace engineer; Mechanical engineer; Registered nurse, hospital; Registered nurse, hospital operating room; Registered nurse, physician's office; Medical assistant, physician's office; Flight attendant; Surgical technician, hospital; Licensed practical nurse, physician office; Licensed practical nurse, hospital; Motor vehicle salesperson; General office, retail sales; Cashier, retail sales; Salesperson, retail sales; Medical records clerk, physician's office; Paralegal; Legal secretary; Desk clerk, hotels and motels; Receptionist, physician's office; Carpenter, non-residential construction; Inspector, auto manufacturer; Inspector, aircraft manufacturer; Welder, auto manufacturer; Truck driver, trucking and courier; Team assembler, automobile; Mover, trucking and courier; Construction worker, non-residential; Restaurant cook; Bartender; Maids, hotels and motels; Food service manager, restaurant and bar; Fast food server, restaurant and bar; Waiter, restaurant and bar; and Fast food cook, restaurant and bar.

Dr. Nicholson and colleagues define the cost of an absence as the dollar value of the firm's lost output that results from the absence. Typically, daily wage (salary and benefits) is used to value a lost work day, but Nicholson and colleagues argue that the costs will be higher for some occupations based on several job characteristics: the ease with which a manager can find a perfect replacement for the absent worker, the extent to which the worker functions as part of a team, and the time sensitivity of the worker's output.

The loss in output resulting from a single-day absence, L, is defined as follows:

$L=mw$.

Where m is the multiplier Nicholson and colleagues set-out to estimate in their study and w is the worker's daily wage (including salary and benefits).

The multiplier, m, is further defined as:

$m = (c + a)/a$

where a is the percentage of scheduled days a worker is absent, and c is the annual cost of the worker's absences in excess of their wage, measured as a percentage of the worker's annual pay.

The study authors hypothesize that the multiplier m is a latent variable whose value is a function of three key job characteristics: team production, time sensitivity, and the availability of substitutes.

III. Methodology Behind the Multipliers

The job-specific multipliers for 35 occupations were developed using a multi-step process.

First Step. Ordered probit regression models were run where the dependent variable was the managers' estimate of the impact of an unexpected 2-week absence on the department's output, and the independent variables were 12 indicator variables for the three job characteristics. The same models were also run on the impact of a 3-day absence and the results were qualitatively similar. The independent variables measure the extent to which each of the three job characteristics (team production or teamwork-TP, time sensitivity-TS, and the availability of substitutes or ease of substitution -AS) are present in a job. Managers indicated on a 1-5 scale the extent to which the following characteristics were present for a particular type of worker that they supervised.

> Ease of substitution: If a worker at your company is absent unexpectedly for 3-days, how easy is it to replace this worker, either with an outside temp or a transferred co-worker?
>
> 1 *(Easy to replace with a worker of similar quality or productivity)*
> 2
> 3
> 4
> 5 *(Impossible to replace with a worker of similar quality or productivity)*
>
> Note: a '1' means there is a pool of workers you can access whenever you want and these workers are just as productive as the absent worker; a '5' means there is nobody else you could possibly find in three days who could do as good a job as the absent worker.
>
> Time sensitivity: How time sensitive is the worker's output?
>
> 1 *(Work can be postponed easily)*
> 2
> 3
> 4
> 5 *(Work cannot be postponed without very severe consequences)*
>
> Note: A '1' means that the worker can complete his/her work once he/she returns and no sales are lost and no important deadlines are missed; a '5' refers to a situation where sales would be lost and/or important deadlines would be missed if a worker were absent.
>
> Teamwork: How much does this worker function as part of a team?

1 *(Worker functions entirely separately from other workers)*
2
3
4
5 *(The worker is such a crucial member of the team that the team's output or activity is wiped out by his/her absence)*

Note: A '1' might be appropriate for a person who picks crops in a field all day by himself/herself; a '5' might be appropriate for the conductor of an orchestra where the orchestra can't play without the conductor.

Managers' categorical responses to questions about the extent to which absence by a particular type of worker affect the department's output were regressed on a set of indicator variables that characterize managers' assessment of the workers' job characteristics:

$$L^* = \beta_1 TP + \beta_2 TS + \beta_3 AS + \varepsilon$$

Where L^* is a latent, continuous variable

The results of the ordered probit regression models appear below for the models of 2-week and 3-day Absences. The results from the 2-week absence appear in the 2006 *Health Economics* paper. **The 3-day absence results are used in ACE.**

	2-week Absences		**3-day Absences**	
Indicator Variable	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Team Production/Teamwork (TP)				
TP Team_2	0.360	0.144	0.351	0.152
TP Team_3	0.588	0.133	0.711	0.140
TP Team_4	0.930	0.147	0.838	0.152
TP Team_5*	0.531	0.154	0.563	0.161
Time Sensitivity (TS)				
TS Time Sensitivity_2	0.485	0.166	0.331	0.175
TS Time Sensitivity_3	0.581	0.158	0.406	0.166
TS Time Sensitivity_4	0.685	0.165	0.612	0.172
TS Time Sensitivity_5*	0.385	0.157	0.397	0.166
Availability of Substitutes/Ease of Substitution (AS)				
AS Substitution_2	0.587	0.119	0.532	0.124
AS Substitution_3	0.950	0.121	0.802	0.124
AS Substitution_4	1.08	0.129	0.934	0.131
AS Substitution_5*	1.03	0.162	0.916	0.164

* The Team_5, Time Sensitivity_5 and Substitution_5 values are not used in ACE due to only a small number of managers reporting "5's" on these scales and to retain the linearity of the relationship between absence and types of impact. Accordingly, the coefficients for "4" are used when ACE users report either 4 or 5 on any of these three attributes.

The coefficients from the 3-day probit model are used to derive predicted values for each job characteristic of a latent (L^*), continuous variable underlying the categorical dependent variable for each of the 810 manager responses.

Second Step. The coefficients from the regression associated with each of the attribute values for TP TS and AS across 35 job categories are used to construct an index of the incremental cost of absences by job. The table above shows the *average* coefficients across the 35 job categories. A mean value of the predicted latent variable was computed for each of the job types included in the survey. This mean of the predicted value for each job type is linked to the quantitative measure of the cost of absences (the manager's assessment of the overall annual cost of absences) in order to scale the index. This index is converted into actual incremental costs by scaling it relative to managers' quantitative assessments of annual absence costs for each particular job. Average values for the absence rate and cost of absence across the 35 jobs surveyed are mapped to the 9 EEOC job categories. These mapped values are used to compute weighted averages of the absence rate and cost of absence based on the occupational distribution.

For example, the occupational distribution for the Industry *Finance and Insurance* and Sub-industry *Funds, Trusts and Other Financial Vehicles* (Source: 2007 BLS data) maps to the following absence rate and cost of absence values from Dr. Nicholson's survey:

EEOC Job category	Occupational distribution from BLS	Absence rate from survey	Cost of absence from survey	Absence rate multiplied by occupational distribution)	Cost of absence multiplied by occupational distribution
1	28.5%	3.1%	2.0%	0.88%	0.56%
2	16.0%	3.1%	2.0%	0.49%	0.31%
3	0.0%	5.5%	1.8%	0.00%	0.00%
4	6.2%	5.1%	1.5%	0.31%	0.09%
5	47.0%	4.1%	1.7%	1.94%	0.79%
6	1.3%	2.9%	1.4%	0.04%	0.02%
7	0.0%	3.9%	1.2%	0.00%	0.00%
8	0.0%	8.0%	1.8%	0.00%	0.00%
9	1.0%	7.7%	0.8%	0.08%	0.01%
				3.74%	**1.78%**
				a	**c**

Third Step. The quantitative estimate of the cost of absences along with the mean absence rate of each job type is plugged into the following equation to derive the job-specific multiplier: m = (c + a)/a. In this way, the 3-day absence categorical variable is used to create an index of the relative impact of absences across different jobs, and the quantitative variables scale this index into a dollar-based value. The ordering of the multiplier was robust to the use of alternative dependent variables, scaling variables, and regression specifications. A multiplier is defined as the cost to the firm of an absence as a proportion (often greater than one) of the absent worker's daily wage (including salary and benefits). The median multiplier is 1.28, which supports the view that the cost to the firm of missed work is often greater than the wage.

Using the example provided in the second step, if the absence rate (a) = 3.74% and the cost of absence (c) = 1.78%, then the multiplier would be 1.48 using the formula m = (c+a)/a.

B. The FCE, Lost-workdays and Absence Costs

I. The IBI Full Cost Estimator (FCE)

In fall 2010 IBI released a new tool, the Full Cost Estimator, which consolidates the major components of health-related business costs into a single model. The FCE draws on nationally-representative databases[4], IBI's validated health assessment survey (the HPQ-Select) and millions of disability claims from IBI's Benefits Intelligence benchmarking database to produce industry benchmarks for:

[4] Bureau of Labor Statistics (Occupational Employment Statistics, National Compensation Survey, Injuries, Illness and Fatalities, Current Population Survey); Centers for Disease Control and Prevention (National Health Interview Survey (NHIS)); Agency for

- Sick-day absences and wage replacements
- Workers' compensation medical payments, lost workdays, and wage replacements
- Short-term disability (STD) and Long-term disability (LTD) lost workdays and wage replacements
- Non-concurrent Family medical leave (FML) absences
- Medical and pharmacy claim costs
- Presenteeism (lowered job performance due to injury or illness)
- Lost-productivity burdens of lost time

While the FCE allows a user to examine in great detail all lost-time, lost-productivity, wage-replacements and medical costs for a modeled organization, it also allows for overall estimates of absence lost-time and wage-replacement rates for a given industry. Using findings from this tool for sick day, workers' compensation, STD and non-concurrent FML absences, IBI refined the modeled absence lost-days and wage-replacement assumptions used in ACE.

II. Absence Lost-time

Health-related absences. The original Lost Productivity Calculators estimated an organization's lost days based on general absence rates reported by managers in the 2006 Nicholson study. These absences were based on the following question:

> On average, how many days per year are [supervised employees] absent due to reasons other than a planned vacation or maternity leave?

Based on the wording of this question, the resulting absence rates constituted a general *unplanned* absence rate based on estimates of the 810 managers for workers they supervised. Rather than continue to rely on general *unplanned* rates to estimate an absence figure that is unclear about the reason for the absence, that is, health or otherwise, IBI turned to rates used in the FCE for:

- Paid sick days
- Unpaid sick days
- Workers' compensation lost workdays
- Short-term disability lost workdays
- Non-concurrent FML absences

The sum of the rates of these five absence types constitutes an overall health-related unplanned absence rate, used by ACE in estimates of health-related lost-workdays.[5] Long-term disability days are excluded from ACE absence estimates because organizations are generally able to prepare for such absences in a way that minimizes the likelihood that costs are incurred beyond wage-replacements. Medical costs are also excluded.

The user may also enter total lost-workdays for the organization. For a full explanation of the FCE methodology for estimating absence rates by industry, go to www.ibiweb.org/tools/full-cost-estimator.

Other absences. To put health-related unplanned absence in context, ACE also estimates absence lost-time, though not costs, for non-health-related absences at an organization. A total "other" absences value is either entered manually by the user or estimated using industry rates from the 2009 Current Population Survey (CPS.)[6] Costs of these absences are not estimated in ACE.

III. Absence Costs

Healthcare Research and Quality (AHRQ) (Medical Expenditure Panel Survey (MEPS)); U.S. Department of Labor (Workers' Compensation Resources)

[5] The original Nicholson study established the additional cost of an unplanned absence above daily wage in the form of multipliers across a variety of occupations. We continue to use these multipliers to establish the cost of an absence, but have a more refined health-related absence rate to capture the volume of absences that are due to health reasons.)

[6] Rates may be found at http://www.bls.gov/cps/tables.htm , Table 47.

The original Lost Productivity Calculators, as well as the 2006 Nicholson research, assumed a 100% wage-replacement rate. All costs were characterized as lost-productivity costs. In ACE, absence costs are separated into wage-replacement and lost-productivity categories.

Wage-replacement. ACE estimates wage-replacement (WR) costs using the following formula:

Total Wage-replacement = (absence days) x (avg. daily wage + benefits) x (WR rate)

Users can enter their own values for absence days, average daily wage + benefits and WR rate or rely on estimated industry defaults provided by ACE.

To estimate WR rate, we again turn to the Full Cost Estimator, which models wage-replacement costs for each of the absence types included in our estimate of overall health-related absence. WR rates for days of each absence type are as follows:

- Paid sick days: 100%
- Unpaid sick days: 0%
- Workers' compensation lost workdays: varies by state (or industry if state is left blank)
- Short-term disability lost workdays: 60%
- Non-concurrent FML absences: 0%

Overall WR rate is calculated as a weighted average of WR rates across these five absence types.

Lost-productivity. ACE estimates lost-productivity costs using the absence multipliers (described in section A of this document) in the following formula:

Total Lost Productivity = (absence days) x (avg. daily wage + benefits) x (Multiplier - 1)

Users can enter their own values for absence days and average daily wage + benefits or rely on estimated industry defaults provided by ACE.

Users cannot enter their own custom multiplier. This value is derived based on the occupational distribution associated with the selected industry or a custom distribution entered by the user. Where input values are difficult for a company to specify, ACE uses default occupation distribution and wage estimates based on industry and sub-industry groupings from the Bureau of Labor Statistics.[7] As discussed above, the job-specific multipliers developed by Nicholson and colleagues have been mapped to the nine EEOC job types: officials and managers; professionals; technicians; sales workers; administrative support workers; craft workers; operatives; laborers and helpers; and service workers[8]. ACE develops a weighted multiplier across the EEOC job types associated with the selected industry. The users can adjust the occupational distribution if they like in both the company-wide and claimant estimators. In the occupation-specific estimator, users can choose one of 35 occupations included in the study, or answer the questions listed under the first step in section A.III. of this document— responses to those questions are then mapped to multipliers from the 2006 *Health Economics* paper.

Lost work days for the company are monetized using the company's own information on salary and benefits (or defaults if chosen) and the tailored multiplier. The multiplier could be greater than one if, for example, an absence causes the worker's teammates to be idle, the firm pays overtime for another worker to replace the absent worker, or the firm loses sales due to the absence. The multipliers have a minimum value of 1.0 because the authors assume labor markets are competitive, and therefore wages are set equal to the value of workers' productivity. The fractional component of the multiplier (i.e. the multiplier minus 1) is the average extra amount that an employer must spend in human capital costs when an employee is absent in order to realize the same revenue as if the employee had been at work, or the revenue lost during the absence (or a combination of these two employer responses). If a company

[7] May 2009 Occupational Employment and Wage Estimates "National 4-digit NAICS Industry-Specific estimates" http://www.bls.gov/oes/oes_dl.htm

[8] http://www.eeoc.gov/stats/census/eeo-file-crosswalk.html

does not compensate absent workers and there is no effect of the absence on the company, there will be no costs to the company of a workers' absence.

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