Hamiltonian Mechanics

Ivar Ekeland[1] and Roger Temam[2]

[1] Princeton University, Princeton NJ 08544, USA
[2] Université de Paris-Sud, Laboratoire d'Analyse Numérique, Bâtiment 425, F-91405 Orsay Cedex, France

Abstract. Cyber-insurance is a powerful economic concept that can help companies in the fight against cybercrime. From the early 80s, several researchers claimed that cyber-insurance had a bright future, were it would become a huge economical tool for handling residual cyber-risks. However, both the European and US cyber-insurance market have failed to grasp its promising potential. To fully grasp this potential they need innovative approaches to handle the unique problems of cyber-insurance. This paper find and characterize network structures with properties that make them superior as cyber-insurance. And creates several models for forming these network structures. In every model, new properties that relate the model to the real-world and real-world insurance products are added. The results show that insurers can use the insurance premium as a tool for determining the resulting formation of the network, and if set to the right level, these superior structures will evolve.
We believe our findings could help the cyber-insurance market evolve, by giving the insurers a proper tool to better analyze and control formation of cyber-insurance networks.

1 Introduction to cyber-insurance

2 Fixed-Period Problems: The Sublinear Case

With this chapter, the preliminaries are over, and we begin the search for periodic solutions ...

2.1 Autonomous Systems

In this section we will consider the case when the Hamiltonian $H(x)$ ...

The General Case: Nontriviality. We assume that H is (A_∞, B_∞)-subquadratic at infinity, for some constant ...

Notes and Comments. The first results on subharmonics were ...

Proposition 1. *Assume* $H'(0) = 0$ *and* $H(0) = 0$. *Set* ...

Proof (of proposition). Condition (8) means that, for every $\delta' > \delta$, there is some $\varepsilon > 0$ such that ... □

Example 1 (External forcing). Consider the system ...

Corollary 1. *Assume H is C^2 and (a_∞, b_∞)-subquadratic at infinity. Let ...*

Lemma 1. *Assume that H is C^2 on $\mathbb{R}^{2n}\backslash\{0\}$ and that $H''(x)$ is ...*

Theorem 1 (Ghoussoub-Preiss). *Let X be a Banach Space and $\Phi : X \to \mathbb{R}$ ...*

Definition 1. *We shall say that a C^1 function $\Phi : X \to \mathbb{R}$ satisfies ...*

3 Fine Tuning of the Text

The following should be used to improve the readability of the text:

`\,`	a thin space, e.g. between numbers or between units and numbers; a line division will not be made following this space
`--`	en dash; two strokes, without a space at either end
`␣--␣`	en dash; two strokes, with a space at either end
`-`	hyphen; one stroke, no space at either end
`$-$`	minus, in the text *only*

Input

```
21\,$^{\circ}$C etc.,
Dr h.\,c.\,Rockefellar-Smith \dots
20,000\,km and  Prof.\,Dr Mallory \dots
1950--1985 \dots
this -- written on a computer -- is now printed
$-30$\,K \dots
```

Output

21 °C etc., Dr h. c. Rockefellar-Smith ...
20,000 km and Prof. Dr Mallory ...
1950–1985 ...
this – written on a computer – is now printed
−30 K ...

4 Special Typefaces

Normal type (roman text) need not be coded. *Italic* (`{\em <text>}` better still `\emph{<text>}`) or, if necessary, **boldface** should be used for emphasis.

`{\itshape Text}`	*Italicized Text*
`{\em Text}`	*Emphasized Text – if you would like to emphasize a* definition *within an italicized text (e.g. of a* theorem*) you should code the expression to be emphasized by* `\em`.
`{\bfseries Text}`	**Important Text**
`\vec{Symbol}`	Vectors may only appear in math mode. The default LaTeX vector symbol has been adapted[3] to LLNCS conventions. `$\vec{A \times B\cdot C}` yields $\vec{A \times B\cdot C}$ `$\vec{A}^{T} \otimes \vec{B} \otimes \vec{\hat{D}}}$`yields $\vec{A}^{T} \otimes \vec{B} \otimes \vec{\hat{D}}}$

[3] If you absolutely must revive the original LaTeX design of the vector symbol (as an arrow accent), please specify the option `[orivec]` in the `documentclass` line.

5 Footnotes

Footnotes within the text should be coded:

```
\footnote{Text}
```

Sample Input

Text with a footnote`\footnote{The footnote is automatically numbered.}` and text continues ...

Sample Output

Text with a footnote[4] and text continues ...

6 Lists

Please code lists as described below:

Sample Input

```
\begin{enumerate}
  \item First item
  \item Second item
  \begin{enumerate}
    \item First nested item
    \item Second nested item
  \end{enumerate}
  \item Third item
\end{enumerate}
```

Sample Output

1. First item
2. Second item
   (a) First nested item
   (b) Second nested item
3. Third item

7 Figures

Figure environments should be inserted after (not in) the paragraph in which the figure is first mentioned. They will be numbered automatically.

Preferably the images should be enclosed as PostScript files – best as EPS data using the epsfig package.

If you cannot include them into your output this way and use other techniques for a separate production, the figures (line drawings and those containing

[4] The footnote is automatically numbered.

halftone inserts as well as halftone figures) *should not be pasted into your laser-printer output*. They should be enclosed separately in camera-ready form (original artwork, glossy prints, photographs and/or slides). The lettering should be suitable for reproduction, and after a probably necessary reduction the height of capital letters should be at least 1.8 mm and not more than 2.5 mm. Check that lines and other details are uniformly black and that the lettering on figures is clearly legible.

To leave the desired amount of space for the height of your figures, please use the coding described below. As can be seen in the output, we will automatically provide 1 cm space above and below the figure, so that you should only leave the space equivalent to the size of the figure itself. Please note that "`x`" in the following coding stands for the actual height of the figure:

```
\begin{figure}
\vspace{x cm}
\caption[ ]{...text of caption...}          (Do type [ ])
\end{figure}
```

Sample Input

```
\begin{figure}
\vspace{2.5cm}
\caption{This is the caption of the figure displaying a white
eagle and a white horse on a snow field}
\end{figure}
```

Sample Output

Fig. 1. This is the caption of the figure displaying a white eagle and a white horse on a snow field

8 Tables

Table captions should be treated in the same way as figure legends, except that the table captions appear *above* the tables. The tables will be numbered automatically.

8.1 Tables Coded with LaTeX

Please use the following coding:

Sample Input

```
\begin{table}
\caption{Critical $N$ values}
\begin{tabular}{llllll}
\hline\noalign{\smallskip}
${\mathrm M}_\odot$ & $\beta_{0}$ & $T_{\mathrm c6}$ & $\gamma$
  & $N_{\mathrm{crit}}^{\mathrm L}$
  & $N_{\mathrm{crit}}^{\mathrm{Te}}$\\
\noalign{\smallskip}
\hline
\noalign{\smallskip}
 30 & 0.82 & 38.4 & 35.7 & 154 & 320 \\
 60 & 0.67 & 42.1 & 34.7 & 138 & 340 \\
120 & 0.52 & 45.1 & 34.0 & 124 & 370 \\
\hline
\end{tabular}
\end{table}
```

Sample Output

Table 1. Critical N values

$M_\odot$	β_0	T_{c6}	γ	N_{crit}^{L}	N_{crit}^{Te}
30	0.82	38.4	35.7	154	320
60	0.67	42.1	34.7	138	340
120	0.52	45.1	34.0	124	370

Before continuing your text you need an empty line. ...

For further information you will find a complete description of the tabular environment on p. 62 ff. and p. 204 of the *LaTeX User's Guide & Reference Manual* by Leslie Lamport.

8.2 Tables Not Coded with LaTeX

If you do not wish to code your table using LaTeX but prefer to have it reproduced separately, proceed as for figures and use the following coding:

Sample Input

```
\begin{table}
\caption{text of your caption}
\vspace{x cm}     % the actual height needed for your table
\end{table}
```

8.3 Signs and Characters

Special Signs. You may need to use special signs. The available ones are listed in the *LaTeX User's Guide & Reference Manual* by Leslie Lamport, pp. 41 ff. We have created further symbols for math mode (enclosed in $):

`\grole`	yields	$\gtrless$	`\getsto`	yields	$\leftrightarrows$
`\lid`	yields	$\leqq$	`\gid`	yields	$\geqq$

Gothic (Fraktur). If gothic letters are *necessary*, please use those of the relevant $\mathcal{AMS}$-TEX alphabet which are available using the amstex package of the American Mathematical Society.

In LaTeX only the following gothic letters are available: `$\Re$` yields $\Re$ and `$\Im$` yields $\Im$. These should *not* be used when you need gothic letters for your contribution. Use $\mathcal{AMS}$-TEX gothic as explained above. For the real and the imaginary parts of a complex number within math mode you should use instead: `$\mathrm{Re}$` (which yields Re) or `$\mathrm{Im}$` (which yields Im).

Script. For script capitals use the coding

`$\mathcal{AB}$` which yields $\mathcal{AB}$

(see p. 42 of the LaTeX book).

Special Roman. If you need other symbols than those below, you could use the blackboard bold characters of $\mathcal{AMS}$-TEX, but there might arise capacity problems in loading additional $\mathcal{AMS}$-TEX fonts. Therefore we created the blackboard bold characters listed below. Some of them are not esthetically satisfactory. This need not deter you from using them: in the final printed form they will be replaced by the well-designed MT (monotype) characters of the phototypesetting machine.

`\bbbc`	(complex numbers)	yields $\mathbb{C}$	`\bbbf`	(blackboard bold F)	yields $\mathbb{F}$
`\bbbh`	(blackboard bold H)	yields $\mathbb{H}$	`\bbbk`	(blackboard bold K)	yields $\mathbb{K}$
`\bbbm`	(blackboard bold M)	yields $\mathbb{M}$	`\bbbn`	(natural numbers N)	yields $\mathbb{N}$
`\bbbp`	(blackboard bold P)	yields $\mathbb{P}$	`\bbbq`	(rational numbers)	yields $\mathbb{Q}$
`\bbbr`	(real numbers)	yields $\mathbb{R}$	`\bbbs`	(blackboard bold S)	yields $\mathbb{S}$
`\bbbt`	(blackboard bold T)	yields $\mathbb{T}$	`\bbbz`	(whole numbers)	yields $\mathbb{Z}$
`\bbbone`	(symbol one)	yields $\mathbb{1}$			

$$\mathbb{C}^{\mathbb{C}^{\mathbb{C}}} \otimes \mathbb{F}_{\mathbb{F}_{\mathbb{F}}} \otimes \mathbb{H}_{\mathbb{H}_{\mathbb{H}}} \otimes \mathbb{K}_{\mathbb{K}_{\mathbb{K}}} \otimes \mathbb{M}^{\mathbb{M}^{\mathbb{M}}} \otimes \mathbb{N}_{\mathbb{N}_{\mathbb{N}}} \otimes \mathbb{P}^{\mathbb{P}^{\mathbb{P}}}$$
$$\otimes \mathbb{Q}_{\mathbb{Q}_{\mathbb{Q}}} \otimes \mathbb{R}^{\mathbb{R}^{\mathbb{R}}} \otimes \mathbb{S}^{\mathbb{S}_{\mathbb{S}}} \otimes \mathbb{T}^{\mathbb{T}^{\mathbb{T}}} \otimes \mathbb{Z} \otimes \mathbb{1}^{\mathbb{1}_{\mathbb{1}}}$$

9 References

There are three reference systems available; only one, of course, should be used for your contribution. With each system (by number only, by letter-number or by author-year) a reference list containing all citations in the text, should be included at the end of your contribution placing the LaTeX environment `thebibliography` there. For an overall information on that environment see the *LaTeX User's Guide & Reference Manual* by Leslie Lamport, p. 71.

There is a special BibTeX style for LLNCS that works along with the class: `splncs.bst` – call for it with a line `\bibliographystyle{splncs}`. If you plan to use another BibTeX style you are customed to, please specify the option `[oribibl]` in the `documentclass` line, like:

```
\documentclass[oribibl]{llncs}
```

This will retain the original LaTeX code for the bibliographic environment and the `\cite` mechanism that many BibTeX applications rely on.

9.1 References by Letter-Number or by Number Only

References are cited in the text – using the `\cite` command of LaTeX – by number or by letter-number in square brackets, e.g. [1] or [E1, S2], [P1], according to your use of the `\bibitem` command in the `thebibliography` environment. The coding is as follows: if you choose your own label for the sources by giving an optional argument to the `\bibitem` command the citations in the text are marked with the label you supplied. Otherwise a simple numbering is done, which is preferred.

```
The results in this section are a refined version
of \cite{clar:eke}; the minimality result of Proposition~14
was the first of its kind.
```

The above input produces the citation: "... refined version of [CE1]; the minimality...". Then the `\bibitem` entry of the `thebibliography` environment should read:

```
\begin{thebibliography}{[MT1]}
.
.
\bibitem[CE1]{clar:eke}
Clarke, F., Ekeland, I.:
Nonlinear oscillations and boundary-value problems for
Hamiltonian systems.
Arch. Rat. Mech. Anal. {\bfseries 78} (1982) 315--333
.
.
\end{thebibliography}
```

The complete bibliography looks like this:

References

[CE1] Clarke, F., Ekeland, I.: Nonlinear oscillations and boundary-value problems for Hamiltonian systems. Arch. Rat. Mech. Anal. **78** (1982) 315–333

[CE2] Clarke, F., Ekeland, I.: Solutions périodiques, du période donnée, des équations hamiltoniennes. Note CRAS Paris **287** (1978) 1013–1015

[MT1] Michalek, R., Tarantello, G.: Subharmonic solutions with prescribed minimal period for nonautonomous Hamiltonian systems. J. Diff. Eq. **72** (1988) 28–55

[Ta1] Tarantello, G.: Subharmonic solutions for Hamiltonian systems via a $\mathbb{Z}_p$ pseudoindex theory. Annali di Matematica Pura (to appear)

[Ra1] Rabinowitz, P.: On subharmonic solutions of a Hamiltonian system. Comm. Pure Appl. Math. **33** (1980) 609–633

Number-Only System. For this preferred system do not use the optional argument in the `\bibitem` command: then, only numbers will appear for the citations in the text (enclosed in square brackets) as well as for the marks in your bibliography (here the number is only end-punctuated without square brackets).

Subsequent citation numbers in the text are collapsed to ranges. Non-numeric and undefined labels are handled correctly but no sorting is done.

E.g., `\cite{n1,n3,n2,n3,n4,n5,foo,n1,n2,n3,?,n4,n5}` – where nx is the key of the x^{th} `\bibitem` command in sequence, `foo` is the key of a `\bibitem` with an optional argument, and `?` is an undefined reference – gives 1,3,2-5,foo,1-3,?,4,5 as the citation reference.

```
\begin{thebibliography}{1}
\bibitem {clar:eke}
Clarke, F., Ekeland, I.:
Nonlinear oscillations and boundary-value problems for
Hamiltonian systems.
Arch. Rat. Mech. Anal. {\bfseries 78} (1982) 315--333
\end{thebibliography}
```

9.2 Author-Year System

References are cited in the text by name and year in parentheses and should look as follows: (Smith 1970, 1980), (Ekeland et al. 1985, Theorem 2), (Jones and Jaffe 1986; Farrow 1988, Chap. 2). If the name is part of the sentence only the year may appear in parentheses, e.g. Ekeland et al. (1985, Sect. 2.1) The reference list should contain all citations occurring in the text, ordered alphabetically by surname (with initials following). If there are several works by the same author(s) the references should be listed in the appropriate order indicated below:

a) One author: list works chronologically;
b) Author and same co-author(s): list works chronologically;
c) Author and different co-authors: list works alphabetically according to co-authors.

If there are several works by the same author(s) and in the same year, but which are cited separately, they should be distinguished by the use of “a”, “b” etc., e.g. (Smith 1982a), (Ekeland et al. 1982b).

How to Code Author-Year System. If you want to use this system you have to specify the option `[citeauthoryear]` in the `documentclass`, like:

```
\documentclass[citeauthoryear]{llncs}
```

Write your citations in the text explicitly except for the year, leaving that up to LaTeX with the `\cite` command. Then give only the appropriate year as the optional argument (i.e. the label in square brackets) with the `\bibitem` command(s).

Sample Input

```
The results in this section are a refined version
of Clarke and Ekeland (\cite{clar:eke}); the minimality result of
Proposition~14 was the first of its kind.
```

The above input produces the citation: "... refined version of Clarke and Ekeland (1982); the minimality...". Then the `\bibitem` entry of `clar:eke` in the `thebibliography` environment should read:

```
\begin{thebibliography}{}  % (do not forget {})
.
.
\bibitem[1982]{clar:eke}
Clarke, F., Ekeland, I.:
Nonlinear oscillations and boundary-value problems for
Hamiltonian systems.
Arch. Rat. Mech. Anal. {\bfseries 78} (1982) 315--333
.
.
\end{thebibliography}
```

Sample Output

References

Clarke, F., Ekeland, I.: Nonlinear oscillations and boundary-value problems for Hamiltonian systems. Arch. Rat. Mech. Anal. **78** (1982) 315–333