THE GALOIS EXTENSIONS INDUCED BY IDEMPOTENTS IN A GALOIS ALGEBRA

GEORGE SZETO and LIANYONG XUE

Received 7 June 2001

Let $B$ be a Galois algebra with Galois group $G$, $J_g = \{ b \in B \mid bx = g(x)b \text{ for all } x \in B \}$ for each $g \in G$, $e_g$ the central idempotent such that $BJ_g = Be_g$, and $e_K = \sum_{g \in K} e_g = e_{1g}$ for a subgroup $K$ of $G$. Then $Be_K$ is a Galois extension with the Galois group $G(e_K) = \{ g \in G \mid g(e_K) = e_{1K} \}$ containing $K$ and the normalizer $N(K)$ of $K$ in $G$. An equivalence condition is also given for $G(e_K) = N(K)$, and $Be_G$ is shown to be a direct sum of all $Be_i$ generated by a minimal idempotent $e_i$. Moreover, a characterization for a Galois extension $B$ is shown in terms of the Galois extension $Be_G$ and $B(1 - e_G)$.

2000 Mathematics Subject Classification: 16S35, 16W20.

1. Introduction. The Boolean algebra of idempotents for commutative Galois algebras plays an important role (see [1, 3, 6]). Let $B$ be a Galois algebra with Galois group $G$ and $J_g = \{ b \in B \mid bx = g(x)b \text{ for all } x \in B \}$ for each $g \in G$. Then, in [2], it was shown that the ideal $BJ_g = Be_g$ for some central idempotent $e_g$. By using the Boolean algebra of central idempotents $\{ e_i \}$ in the Galois algebra $B$, the following structure theorem of $B$ was shown. There exist some subgroups $H_i$ of $G$ and minimal idempotents of $\{ e_i \mid i = 1, 2, \ldots, m \}$ for some integer $m$ such that $B = \oplus \sum_{i=1}^m Be_i \oplus B(1 - \sum_{i=1}^m e_i)$ where $Be_i$ is a central Galois algebra with Galois group $H_i$ for each $i = 1, 2, \ldots, m$, and $B(1 - \sum_{i=1}^m e_i)$ is $C(1 - \sum_{i=1}^m e_i)$, a commutative Galois algebra with Galois group induced by and isomorphic with $G$ in case $1 \neq \sum_{i=1}^m e_i$ where $C$ is the center of $B$. Let $(B_a; +, \cdot)$ be the Boolean algebra generated by $\{ 0, e_g \mid g \in G \}$ where $e \cdot e' = ee'$ and $e + e' = e + e' - ee'$ for any $e$ and $e'$ in $B_a$. In the present paper, we study the Galois extension $Be_K$ where $e_K = \sum_{g \in K} e_{1g}$ for a subgroup $K$ of $G$. Let $G(e) = \{ g \in G \mid g(e) = e \}$ for a central idempotent $e$. Then it will be shown that $K \subset N(K) \subset G(e_K)$ and $Be_K$ is a Galois extension with Galois group $G(e_K)$ where $N(K)$ is the normalizer of $K$ in $G$. A necessary and sufficient condition for $G(e_K) = N(K)$ is also given so that $Be_K$ is a Galois extension of $(Be_K)^K$ with Galois group $K$, and $(Be_K)^K$ is a Galois extension of $(Be_K)^{G(e_K)}$ with Galois group $G(e_K)/K$. Let $S(K) = \{ H \mid H \text{ is a subgroup of } G \text{ and } e_H = e_{1K} \}$. Then the map $S(K) \to e_K$ from $\{ S(K) \mid K \text{ is a subgroup of } G \}$ to $B_a$ is one-to-one. In particular, when $K = G$, we derive an expression for $B$, $B = Be_G \oplus B(1 - e_G)$ such that $Be_G = \oplus \sum_{i=1}^m Be_i$, a direct sum of central Galois algebras with Galois subgroup $H_i$, and $B(1 - e_G) = B(1 - \sum_{i=1}^m e_i) = C(1 - e_G)$ which is a commutative Galois algebra with Galois group induced by and isomorphic with $G$. Moreover, a characterization for a Galois extension $B$ is shown in terms of the Galois extension $Be_G$ and $B(1 - e_G)$.
2. Definitions and notation. Let $B$ be a ring with $1$, $C$ the center of $B$, $G$ an automorphism group of $B$ of order $n$ for some integer $n$, and $B^G$ the set of elements in $B$ fixed under each element in $G$. We call $B$ a Galois extension of $B^G$ with Galois group $G$ if there exist elements $\{a_i, b_i \in B, \, i = 1, 2, \ldots, m\}$ for some integer $m$ such that $\sum_{i=1}^{m} a_i g(b_i) = \delta_{1,g}$ for each $g \in G$. We call $B$ a Galois algebra over $B^G$ if $B$ is a Galois extension of $B^G$ which is contained in $C$ and $B$ a central Galois extension if $B$ is a Galois extension of $C$. Throughout this paper, we will assume that $B$ is a Galois algebra with Galois group $G$. Let $J_g = \{b \in B \mid b x = g(x) b \text{ for all } x \in B\}$. In [2], it was shown that $BJ_g = B \delta_g$ for some central idempotent $\delta_g$ of $B$. We denote by $(B_a; +, \cdot)$ the Boolean algebra generated by $\{0, \delta_g \mid g \in G\}$ where $e \cdot e' = ee'$ and $e + e' = e + e' - ee'$ for any $e$ and $e'$ in $B_a$. Throughout, $e + e'$ for $e, e' \in B_a$ means the sum in the Boolean algebra $(B_a; +, \cdot)$ and a monomial $e$ in $B_a$ is $\Pi_{g \in S} \delta_g \neq 0$ for some $S \subseteq G$.

3. Galois extensions generated by idempotents. Let $K$ be a subgroup of $G$. The idempotent $\sum_{g \in K, e_g \neq 1} \delta_g \in B_a$ is called the group idempotent of $K$ denoted by $e_K$. Let $G(e) = \{g \in G \mid g(e) = e\}$ for $e \in B_a$. Then we will show that $K \subseteq G(e_K)$ and $e_K$ generates a Galois extension $B e_K$ with Galois group $G(e_K)$. A necessary and sufficient condition for $G(e_K) = N(K)$ is also given where $N(K)$ is the normalizer of $K$ in $G$. Thus some consequences for the Galois extension $B e_K$ can be derived when $K$ is a normal subgroup of $G$ or $K = G$.

\textbf{Lemma 3.1.} For any $g, h \in G$,
1. $g(e_h) = \delta_{g h g^{-1}}$.
2. $e_h = 1$ if and only if $\delta_{g h g^{-1}} = 1$.

\textbf{Proof.} (1) It is easy to check that $g(J_h) = J_{g h g^{-1}}$, so $B g(e_h) = g(B e_h) = g(B J_h) = B g(J_h) = B J_{g h g^{-1}} = B \delta_{g h g^{-1}}$. Thus $g(e_h) = \delta_{g h g^{-1}}$.
(2) It is clear by (1). \hfill \Box

\textbf{Theorem 3.2.} Let $K$ be a subgroup of $G$, $e_K = \sum_{g \in K, e_g \neq 1} \delta_g$, and $G(e_K) = \{g \in G \mid g(e_K) = e_K\}$. Then
1. $K$ is a subgroup of $G(e_K)$ and
2. $B = B e_K \oplus B(1 - e_K)$ such that $B e_K$ and $B(1 - e_K)$ are Galois extensions with Galois group induced by and isomorphic with $G(e_K)$.

\textbf{Proof.} (1) For any $g \in K$, by Lemma 3.1,
\[ g(e_K) = g \left( \sum_{k \in K, e_k \neq 1} e_k \right) = \sum_{k \in K} g(e_k) \]
\[ = \sum_{k \in K, e_k \neq 1} \delta_{g k g^{-1}} = \sum_{g k g^{-1} \in e_k k g^{-1} \neq 1} \delta_{g k g^{-1}} = e_k \delta_{k g^{-1}}. \]

Since $g \in K, g K g^{-1} = K$. Hence $g(e_K) = e_K$, and so $g \in G(e_K)$.

(2) We first claim that for any $e \neq 0$ in $B_a$, $Be$ is a Galois extension with Galois group induced by and isomorphic with $G(e)$. In fact, since $B$ is a Galois extension with Galois group $G$, there exists a $G$-Galois system for $B \{a_i, b_i \in B, \, i = 1, 2, \ldots, m\}$ for some
integer $m$ such that $\sum_{i=1}^{m} a_i g(b_i) = \delta_{1,\theta}$ for each $g \in G$. Hence $\sum_{i=1}^{m} (a_i e) g(e) g(b_i e) = e \delta_{1,\theta}$ for each $g \in G(e)$. Therefore, $\{a_i e, b_i e \in G(e), \ i = 1, 2, \ldots, m\}$ is a $G(e)$-Galois system for $Be$, and $e = \sum_{i=1}^{m} (a_i e) g(b_i e) = g(b_i e) g(b_i e)$ for each $g \neq 1$ in $G(e)$. But $e \neq 0$, so $g|_{Be} \neq 1$ whenever $g \neq 1$ in $G(e)$. Thus, $Be$ is a Galois extension with Galois group induced by and isomorphic with $G(e)$. Statement (2) is a particular case when $e = e_k$ and $e = 1-e_k$, respectively.

The proof of Theorem 3.2(2) suggests an equivalence condition for a Galois extension $B$.

**Theorem 3.3.** The extension $B$ is a Galois extension with Galois group $G(e)$ for a central idempotent $e$ of $B$ if and only if $B = Be \oplus B(1-e)$ such that $Be$ and $B(1-e)$ are Galois extensions with Galois group induced by and isomorphic with $G(e)$. In particular, $B$ is a Galois algebra with Galois group $G(e)$ for a central idempotent $e$ of $B$, if and only if $B = Be \oplus B(1-e)$ such that $Be$ and $B(1-e)$ are Galois algebras with Galois group induced by and isomorphic with $G(e)$.

**Proof.** ($\Rightarrow$) Since $B$ is a Galois extension with Galois group $G(e)$, $B = Be \oplus B(1-e)$ such that $Be$ and $B(1-e)$ are Galois extensions with Galois group induced by and isomorphic with $G(e)$ by the proof of Theorem 3.2(2).

($\Leftarrow$) Let $\{a_j^{(i)}; b_j^{(i)} \in Be \mid j = 1, 2, \ldots, n_i\}$ be a $G(e)$-Galois system for $Be$ and let $\{a_j^{(i)}; b_j^{(i)} \in B(1-e) \mid j = 1, 2, \ldots, n_i\}$ be a $G(e)$-Galois system for $B(1-e)$. Then we claim that $\{a_j^{(i)}; b_j^{(i)} \mid j = 1, 2, \ldots, n_i, \ i = 1, 2\}$ is a $G(e)$-Galois system for $B$. In fact, $\sum_{j=1}^{n_i} a_j^{(i)} b_j^{(i)} = e + (1-e) = 1$. Moreover, for each $g \neq 1$ in $G(e)$—noting that $g \neq 1$ in $G(e)$ if and only if $g|_{Be} \neq 1$ and $g|_{B(1-e)} \neq 1$ by hypothesis—we have that $\sum_{j=1}^{n_i} a_j^{(i)} g(b_j^{(i)}) = 0$, $i = 1, 2$, so $\sum_{i=1}^{2} \sum_{j=1}^{n_i} a_j^{(i)} g(b_j^{(i)}) = 0$. Therefore $\{a_j^{(i)}; b_j^{(i)} \mid j = 1, 2, \ldots, n_i, \ i = 1, 2\}$ is a $G(e)$-Galois system for $B$, and so $B$ is a Galois extension with Galois group $G(e)$.

Next, it is clear that $B^{G(e)} \subseteq C$ if and only if $(Be)^{G(e)} \subseteq C$ and $(B(1-e))^{G(e)} \subseteq C(1-e)$, so by the above argument, $B$ is a Galois algebra with Galois group $G(e)$ for a central idempotent $e$ of $B$ if and only if $B = Be \oplus B(1-e)$ such that $Be$ and $B(1-e)$ are Galois algebras with Galois group induced by and isomorphic with $G(e)$.

**Corollary 3.4.** An algebra $B$ is a Galois algebra with Galois group $G$ if and only if $B = Be_G \oplus B(1-e_G)$ such that $Be_G$ and $B(1-e_G)$ are Galois algebras with Galois group induced by and isomorphic with $G$.

**Proof.** By Theorem 3.2(1), $G(e_G) = G$, so the corollary is immediate by Theorem 3.3.

Now let $S(K) = \{H \mid H$ is a subgroup of $G$ and $e_H = e_K\}$ and $\alpha : S(K) \rightarrow e_K$. It is easy to see that $\alpha$ is a bijection from $\{S(K) \mid K$ is a subgroup of $G\}$ to the set of group idempotents in $B_\alpha$.

We are interested in an equivalence condition for $K$ such that $G(e_K) = N(K)$. We need the following lemma.

**Lemma 3.5.** Let $K$ be a subgroup of $G$, then for a $g \in G$, $g \in G(e_K)$ if and only if $gKg^{-1} \in S(K)$. 


Proof. Suppose $g \in G(e_K)$, then

$$e_K = g(e_K) = g \left( \sum_{k \in K \atop e_k \neq 1} e_k \right) = \sum_{k \in K \atop e_k \neq 1} g(e_k)$$

$$= \sum_{k \in K \atop e_k \neq 1} e_{gk^{-1}} = \sum_{gk^{-1} \in gK^{-1} \atop e_k \neq 1} e_{gk^{-1}} = e_{gK^{-1}}.$$

Thus $gK^{-1} \in S(K)$. On the other hand, suppose $gK^{-1} \in S(K)$. Then

$$g(e_K) = g \left( \sum_{k \in K \atop e_k \neq 1} e_k \right) = \sum_{k \in K \atop e_k \neq 1} g(e_k)$$

$$= \sum_{k \in K \atop e_k \neq 1} e_{gk^{-1}} = \sum_{gk^{-1} \in gK^{-1} \atop e_k \neq 1} e_{gk^{-1}} = e_{gK^{-1}} = e_K.$$  \hfill (3.3)

Thus $g \in G(e_K)$.

Theorem 3.6. $G(e_K) = N(K)$ if and only if $S(K)$ contains exactly one conjugate of the subgroup $K$.

Proof. ($\Rightarrow$) For any $g \in G$ such that $gKg^{-1} \in S(K)$, $g \in G(e_K)$ by Lemma 3.5. But $G(e_K) = N(K)$ by hypothesis, so $g \in N(K)$. Hence $gKg^{-1} = K$. Thus $S(K)$ contains exactly one conjugate of the subgroup $K$.

($\Leftarrow$) For any $g \in N(K)$, $gKg^{-1} = K$, so $gKg^{-1} \in S(K)$. Hence $g \in G(e_K)$ by Lemma 3.5. Thus $N(K) \subseteq G(e_K)$. Conversely, for each $g \in G(e_K)$, $gKg^{-1} \in S(K)$ by Lemma 3.5, so $gKg^{-1} = K$ by hypothesis. Thus $g \in N(K)$. This implies that $G(e_K) = N(K)$.

Corollary 3.7. Assume that the order of $G$ is a unit in $B$. If $S(K)$ contains exactly one conjugate of the subgroup $K$, then $B_{e_K}$ is a Galois extension of $(B_{e_K})^K$ with Galois group $K$ and $(B_{e_K})^K$ is a Galois extension of $(B_{e_K})^{G(e_K)}$ with Galois group $G(e_K)/K$.

Proof. By Theorem 3.2(2), $B_{e_K}$ is a Galois extension with Galois group $G(e_K)$. Hence $B_{e_K}$ is a Galois extension of $(B_{e_K})^K$ with Galois group $K$ for $K$ is a subgroup of $G(e_K)$ by Theorem 3.2(1). Moreover, by hypothesis, the order of $G$ is a unit in $B$, so the order of $K$ is a unit in $B_{e_K}$. Since $S(K)$ contains exactly one conjugate of the subgroup $K$, $K$ is a normal subgroup of $G(e_K)$ by Theorem 3.6. Thus $(B_{e_K})^K$ is a Galois extension of $(B_{e_K})^{G(e_K)}$ with Galois group $G(e_K)/K$.

Next are some consequences for an abelian group $G$ or $K = G$.

Corollary 3.8. If $B$ is an abelian extension with Galois group $G$ (i.e., $G$ is abelian) of an order invertible in $B$, then for any subgroup $K$ of $G$, $B_{e_K}$ is a Galois extension of $(B_{e_K})^K$ with Galois group $K$ and $(B_{e_K})^K$ is a Galois extension of $(B_{e_K})^{G(e_K)}$ with Galois group $G(e_K)/K$.

When $K = G$, we derive an expression for $B$ by using the set $\{e_i \mid i = 1, 2, \ldots, m\}$ of minimal idempotents in $B_a$. This gives detail descriptions of the components $B_{e_G}$ and $B(1 - e_G)$ as given in Corollary 3.4.
THEOREM 3.9. Let $B$ be a Galois algebra with Galois group $G$. Then $B = B e_G \oplus B(1 - e_G)$ such that $B e_G = \oplus \sum_{i=1}^m B e_i$ where each $B e_i$ is a central Galois algebra with Galois group $H_i$ for some subgroup $H_i$ of $G$ and $B(1 - e_G) = C(1 - e_G)$ which is a commutative Galois algebra with Galois group induced by and isomorphic with $G$ in case $e_G \neq 1$ where $\{e_i | i = 1, 2, \ldots, m\}$ are given in [5, Theorem 3.8].

PROOF. Since $e_i = \Pi_{h \in H_i} e_h$ where $H_i$ is the maximal subset (subgroup) of $G$ such that $\Pi_{h \in H_i} e_h \neq \{0\}$ or $e_i = (1 - \sum_{j=1}^t e_j)\Pi_{h \in H_i} e_h$ where $H_i$ is the maximal subset (subgroup) of $G$ for some $t < i$ such that $(1 - \sum_{j=1}^t e_j)\Pi_{h \in H_i} e_h \neq \{0\}$ (see [5, Theorem 3.8]), we have that $e_i(\sum_{g \in G, e_g \neq 1} e_g) = e_i$ for each $i$. Thus $\sum_{i=1}^m e_i \leq \sum_{g \in G, e_g \neq 1} e_g$. Noting that $e_g(1 - \sum_{i=1}^m e_i) = 0$ for each $g \neq 1$ in $G$ (see [5, Theorem 3.8]), we have that $(\sum_{g \in G, e_g \neq 1} e_g)(1 - \sum_{i=1}^m e_i) = 0$, that is, $(\sum_{g \in G, e_g \neq 1} e_g)(\sum_{i=1}^m e_i) = \sum_{g \in G, e_g \neq 1} e_g$. Hence $\sum_{g \in G, e_g \neq 1} e_g \leq \sum_{i=1}^m e_i$. Thus $\sum_{g \in G, e_g \neq 1} e_g = \sum_{i=1}^m e_i$, that is, $e_G = \sum_{i=1}^m e_i$. But then by [5, Theorem 3.8], $B = \oplus \sum_{i=1}^m B e_i \oplus B(1 - \sum_{i=1}^m e_i) = B e_G \oplus B(1 - e_G)$ such that $B(1 - e_G) = C(1 - e_G)$ which is a commutative Galois algebra with Galois group induced by and isomorphic with $G$, and $B e_G = \oplus \sum_{i=1}^m B e_i$ such that each $B e_i$ is a central Galois algebra with Galois group $H_i$ for some subgroup $H_i$ of $G$ where $\{e_i | i = 1, 2, \ldots, m\}$ are minimal idempotents of $B_a$. \hfill \Box

4. A relationship between idempotents. In this section, we show a relationship between the set of idempotents $\{e_g | g \in G\}$ and the set of minimal elements in $B_a$, and give an equivalence condition for a monomial idempotent $e_S = (\sum_{g \in S, e_g \neq 1} e_g)$ where $S$ is a subset of $G$, and a monomial $e$ in $B_a$ is $\Pi_{g \in S} e_g \neq 0$ for some $S \subset G$.

THEOREM 4.1. Let $S$ be a subset of $G$. Then there exists a unique subset $Z_S$ of the set $\{1, 2, \ldots, m\}$ such that $e_S = \sum_{i \in Z_S} e_i$.

PROOF. Since $C = \oplus \sum_{i=1}^m C e_i \oplus C f$ (see [5, Theorem 3.8]), $e_S = \sum_{i=1}^m c_i e_i + c f$ for some $c_i, c \in C$. It can be checked that $e_i$ are minimal elements of $B_a$, so $e_S e_i = e_i$ or $e_S e_i = 0$. Let $Z_S = \{i \mid e_S e_i = e_i\}$. Then for each $i \in Z_S$, $e_i = e_S e_i = c_i e_i$, and for each $i \notin Z_S$, $0 = e_S e_i = c_i e_i$. Hence $e_S = \sum_{i \in Z_S} e_i + c f$. Moreover, since $e_g f = 0$ for each $g \neq 1$ in $G$ (see [5, Theorem 3.8]), we have that $0 = e_S f = (\sum_{i \in Z_S} e_i + c f) f = c f$. Hence $e_S = \sum_{i \in Z_S} e_i$. The uniqueness of $Z_S$ is clear. \hfill \Box

Next is a description of the components $B e_K$ and $B(1 - e_K)$ for a subgroup $K$ of $G$ as given in Theorem 3.2.

COROLLARY 4.2. For any subgroup $K$ of $G$, $B = B e_K \oplus B(1 - e_K)$ such that $B e_K = \sum_{i \in Z_K} B e_i$ and $B(1 - e_K) = B(1 - \sum_{i \in Z_K} e_i)$ which are Galois extensions with Galois group induced by and isomorphic with $G(e_K)$.

PROOF. It is an immediate consequence of Theorems 3.2(2) and 4.1. \hfill \Box

In [4], let $K$ be a subgroup of $G$. Then $K$ is called a nonzero subgroup of $G$ if $\prod_{k \in K} e_k \neq 0$, and $K$ is called a maximal nonzero subgroup of $G$ if $K \subset K'$ where $K'$ is a nonzero subgroup of $G$ such that $\prod_{k \in K'} e_k = \prod_{k \in K} e_k$, then $K = K'$. It was shown that the set of monomials in $B_a$ and the set of maximal nonzero subgroups of $G$ are in a one-to-one correspondence (see [4, Theorem 3.2]). Also, any maximal nonzero
subgroup \( K = H_e = \{ g \in G \mid e \leq e_g \} \) where \( e = \Pi_{g \in K} e_k \) and \( H_e \) is a normal subgroup of \( G(e) \) (see [4, Lemma 3.3]). Next is a characterization of a monomial idempotent \( e_S \) (= \( \sum_{g \in S, e_g \neq 1} e_g \)) for a subset of \( G \).

**THEOREM 4.3.** Let \( S \) be a subset of \( G \) such that \( e_S = \sum_{g \in S, e_g \neq 1} e_g \neq 0,1 \). Then \( e_S \) is a monomial if and only if \( e_j \leq e_S \) whenever \( H_{e_S} \subset H_{e_j} \) for an atom \( e_j \).

**Proof.** \((\Rightarrow)\) By [4, Theorem 3.2], \( e \to H_e \) is a one-to-one correspondence between the set of monomials in \( B_a \) and the set of maximal nonzero subgroups of \( G \). Noting that \( e = \Pi_{g \in H_e} e_g \) when \( e \) is a monomial, we have for any monomials \( e \) and \( e' \), \( H_e \subset H_{e'} \) implies that \( e \geq e' \). Thus, \( e_j \leq e_S \) whenever \( H_{e_S} \subset H_{e_j} \) for an atom \( e_j \) because \( e_S \) is a monomial by hypothesis.

\((\Leftarrow)\) By Theorem 4.1, \( e_S = \sum_{e_l \in Z_S} e_l \) where \( Z_S = \{ e_l \mid e_l \leq e_S \} \). Let \( e = \Pi_{g \in H_{e_S}} e_g \). Then \( e_S \leq e \) and \( H_{e_S} = H_e \). Suppose \( e_S \neq e \). Then \( e_S = \sum_{e_l \in Z_S} e_l < e = \sum e_j \) where \( \sum e_l \in Z_S \) is a direct summand of \( \sum e_j \) by Theorem 4.1. It is easy to check that \( H_{e_S} = \cap_{e_l \in Z_S} H_{e_l} = H_e = \cap H_{e_j} \). Therefore there exists some \( e_j \notin Z_S \), that is, \( e_j \notin e_S \) such that \( H_{e_S} \subset H_{e_j} \). This is a contradiction. Thus \( e_S = e \), which is a monomial.

**Acknowledgements.** This paper was written under the support of a Caterpillar Fellowship at Bradley University. The authors would like to thank the Caterpillar Inc. for the support.

**References**


George Szeto: Department of Mathematics, Bradley University, Peoria, IL 61625, USA

E-mail address: szeto@hilltop.bradley.edu

Lianyong Xue: Department of Mathematics, Bradley University, Peoria, IL 61625, USA

E-mail address: lxue@hilltop.bradley.edu
Special Issue on
Intelligent Computational Methods for
Financial Engineering

Call for Papers

As a multidisciplinary field, financial engineering is becoming increasingly important in today’s economic and financial world, especially in areas such as portfolio management, asset valuation and prediction, fraud detection, and credit risk management. For example, in a credit risk context, the recently approved Basel II guidelines advise financial institutions to build comprehensible credit risk models in order to optimize their capital allocation policy. Computational methods are being intensively studied and applied to improve the quality of the financial decisions that need to be made. Until now, computational methods and models are central to the analysis of economic and financial decisions.

However, more and more researchers have found that the financial environment is not ruled by mathematical distributions or statistical models. In such situations, some attempts have also been made to develop financial engineering models using intelligent computing approaches. For example, an artificial neural network (ANN) is a nonparametric estimation technique which does not make any distributional assumptions regarding the underlying asset. Instead, ANN approach develops a model using sets of unknown parameters and lets the optimization routine seek the best fitting parameters to obtain the desired results. The main aim of this special issue is not to merely illustrate the superior performance of a new intelligent computational method, but also to demonstrate how it can be used effectively in a financial engineering environment to improve and facilitate financial decision making. In this sense, the submissions should especially address how the results of estimated computational models (e.g., ANN, support vector machines, evolutionary algorithm, and fuzzy models) can be used to develop intelligent, easy-to-use, and/or comprehensible computational systems (e.g., decision support systems, agent-based system, and web-based systems)

This special issue will include (but not be limited to) the following topics:

- **Computational methods**: artificial intelligence, neural networks, evolutionary algorithms, fuzzy inference, hybrid learning, ensemble learning, cooperative learning, multiagent learning
- **Application fields**: asset valuation and prediction, asset allocation and portfolio selection, bankruptcy prediction, fraud detection, credit risk management
- **Implementation aspects**: decision support systems, expert systems, information systems, intelligent agents, web service, monitoring, deployment, implementation

Authors should follow the Journal of Applied Mathematics and Decision Sciences manuscript format described at the journal site http://www.hindawi.com/journals/jamds/. Prospective authors should submit an electronic copy of their complete manuscript through the journal Manuscript Tracking System at http://mts.hindawi.com/, according to the following timetable:

<table>
<thead>
<tr>
<th>Manuscript Due</th>
<th>December 1, 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Round of Reviews</td>
<td>March 1, 2009</td>
</tr>
<tr>
<td>Publication Date</td>
<td>June 1, 2009</td>
</tr>
</tbody>
</table>

**Guest Editors**

**Lean Yu**, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing 100190, China; Department of Management Sciences, City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong; yulean@amss.ac.cn

**Shouyang Wang**, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing 100190, China; sywang@amss.ac.cn

**K. K. Lai**, Department of Management Sciences, City University of Hong Kong, Tat Chee Avenue, Kowloon, Hong Kong; mskklai@cityu.edu.hk