ºÒÈ®½Ç¼º ÇÏ¿¡¼ÀÇ ½Å½ÃÀå °³Ã´À» À§ÇÑ ÃÖÀû ¸¶ÄÉÆÃ ÀÚ¿ø ¹èºÐ

ÀÌµ¿ÁÖ[1], ¾ÈÀçÇö
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Abstract

Firms pursue new business opportunities for growth. Market development strategy is one of the growth strategies, which develops new market segments with current products. However, new market generally has high uncertainty, or high risk. Firms should consider the risk in making and implementing the market development strategy.

In this paper, an optimal marketing resource allocation model is developed, taking into account the risk attitude of a firm in market development. Under the assumption of exponential utility function, the global optimal solution is derived, and the implications are provided.

1. ¼·Ð

±â¾÷Àº ÇöÀçÀÇ »ç¾÷¿¡¸¸ ¸Ó¹«¸£Áö ¾Ê°í, ¼ºÀå À» À§ÇÑ »õ·Î¿î »ç¾÷ ±âÈ¸¸¦ Ã£±¸ÇÑ´Ù. ¼ºÀåÀ» À§ ÇÑ Àü·« ÁßÀÇ ÇÏ³ª°¡ ±âÁ¸ÀÇ Á¦Ç°À¸·Î »õ·Î¿î ½Ã Àå¿¡ ÁøÀÔÇÏ´Â ½ÃÀå °³Ã´(market development) Àü·«ÀÌ´Ù(Kotler & Armstrong, 1999). »õ·Î¿î ½Ã ÀåÀº ÀþÀº Ãþ ½ÃÀå, ³ëÀÎ Ãþ ½ÃÀå, ¿©¼º ½ÃÀå µî ÀÎ±¸Åë°èÇÐ Àû¸éÀÇ Â÷ÀÌ¿¡ ÀÇÇÑ ½ÃÀå, »õ·Î¿î Áö ¿ª ½ÃÀå, »õ·Î¿î ±¹°¡ ½ÃÀå µîÀÇ Áö¸®Àû Â÷ÀÌ¿¡ ÀÇÇÑ ½ÃÀåÀ» °ñ·ÔÇÏ¿© ¿©·¯ Ãø¸é¿¡¼ Á¤ÀÇ¸¦ ³»¸± ¼ö°¡ ÀÖ´Ù.

½ÃÀå °³Ã´ Àü·«Àº ÇöÀç±îÁö ¼Ò°ñÀÚ¿¡°Ô Á¦°ø ÇØ ¿Â Á¦Ç°À» È°¿ëÇÏ¿© ½ÃÀåÀ» °³Ã´ÇÏ±â ¶§¹®¿¡, Á¦Ç°¿¡ ´ëÇÑ È¸»çÀÇ ÃàÀûµÈ °æÇèÀ» È°¿ëÇÒ ¼ö ÀÖ ´Ù´Â ÀåÁ¡ÀÌ ÀÖ´Ù. ¹Ý¸é, ±âÁ¸¿¡ »ç¾÷À» ¼öÇàÇÏÁö ¾Ê¾Ò´ø »õ·Î¿î ½ÃÀå¿¡ ÁøÀÔÇÏ°Ô µÇ¹Ç·Î, ½ÃÀå¿¡ ´ëÇÑ Áö½Ä°ú °æÇèÀÌ °ÅÀÇ ¾ø°í ºÒÈ®½Ç¼ºÀÌ Á¸ÀçÇÑ´Ù´Â ´ÜÁ¡ÀÌ ÀÖ´Ù. ÀÌ¸¦ ±Øº¹ÇÏ±â À§ÇØ, ±âÁ¸¿¡ ´Ù¥ Á¦°øÀ» ÆÇ¸Å ÇÏ°í ÀÖ´ø ½ÃÀå¿¡ ¿ì¼±ÀûÀ¸·Î ÁøÀÔÇÑ´ÙµçÁö »çÀü ¿¡ Ã¶ÀúÇÑ ½ÃÀå Á¶»ç¸¦ ¼öÇàÇÏ±âµµ ÇÏÁö¸¸, »õ·Î ¿î ½ÃÀå¿¡ ´ëÇÑ Áö½ÄÀº ±âÁ¸ÀÇ ½ÃÀå¿¡ ´ëÇÑ Áö½Ä °ú´Â ¿©ÀüÈ÷ °Ý÷°¡ ÀÖÀ¸¸ç, ÀÌ·Î ÀÎÇÑ ºÒÈ®½Ç¼º À º ±â¾÷¿¡ ÀÖ¾î¼ À§Çè ¿äÀÎÀ¸·Î ÀÛ¿ëÇÏ¸ç, ±â¾÷ ÀÌ ½ÃÀå °³Ã´ Àü·«À» ¼ö¸³ÇÏ°í ½ÇÇàÇÏ´Âµ¥ ÀÖ¾î¼ ÀÇ Áß¿äÇÑ °í·Á »çÇ×ÀÌ µÈ´Ù.

ÀÏ¹ÝÀû¸·Î, ºÒÈ®½Ç¼º ÇÏ¿¡ À§ÇèÀ» °¡Áø »ç¾÷ ±âÈ¸¿¡ ´ëÇÑ ¼±È£µµ´Â ±â¾÷º°·Î Â÷ÀÌ°¡ ³´Ù. ÇÏ¿©, °³º° ±â¾÷Àº ±â¾÷ ³ª¸§ÀÇ À§Çè¿¡ ´ëÇÑ ÅÂµµ(risk attitude)¸¦ °¡Áö°í ÀÖ´Ù. ±×·¯¹Ç·Î, À§ÇèÀ» ³»Æ÷ÇÏ °í ÀÖ´Â »ç¾÷ ±âÈ¸¿¡ ´ëÇÑ ±â¾÷ÀÇ À§Çè¿¡ ´ëÇÑ ÅÂµµ¸¦ °í·ÁÇÑ ÀÇ»ç °áÁ¤ÀÌ ÇÊ¿äÇÏ´Ù.

»õ·Î ÁøÀÔÇÏ·Á´Â ½ÃÀå¿¡¼ ±âÁ¸ÀÇ ½ÃÀå°ú´Ù ³ôÀº ¸ÅÃâÀ³ª ¼öÀÍÀ» ¿Ã¸± ¼ö °¡´É¼º°ú ¹Ý´ëÀÇ °¡´É¼º ÀÌ °øÁ¸ÇÑ´Ù°í ÇÏÀÚ. ±â¾÷ÀÌ °¸Â¯ÇÑ ÀÚ¿øÀº ÇÑ Á¤µÈ ÀÚ¿øÀ» ±âÁ¸ÀÇ ½ÃÀå °ú »õ·Î¿î ½ÃÀå¿¡ ¾î¶»°Ô ¹èºÐÇÏ´À³Ä¿¡ °ü·Ã ¹®Á¦°¡ µÈ´Ù. À§Çè Ãß±¸Çü(risk-preferring) ±â¾÷Àº »õ·Î¿î ½ÃÀå¿¡¼ÀÇ ³ôÀº ¼öÀÍÀÇ °¡É¼ºÀ» º¸°í ¸¹Àº ÀÚ¿øÀ» ÅõÀÔÇÏ·Á ÇÒ °ÍÀÌ´Ù. ¹Ý¸é À§Çè È¸ÇÇÇü(risk-averse) ±â¾÷º µÎ ½ÃÀå¿¡¼ÀÇ ±â´ë ¼öÀÍÀÌ Å« Â÷ÀÌ°¡ ¾ø´Â °æ¿ì °¡´ÉÇÏ¸é ¾ÈÁ¤ÀûÀÎ ±âÁ¸ ½ÃÀå¿¡ ¸¹Àº ÀÚ¿øÀ» ÅõÀÔÇÏ·Á ÇÒ °ÍÀÌ´Ù. ±× ·¯¹Ç·Î, ½ÃÀå °³Ã´¿¡ ÀÖ¾î, À§Çè¿¡ ´ëÇÑ ÅÂµµ¸¦ ¹Ý ¿µÇÏ¿©¾ß º¸´Ù ÇÕ¸®ÀûÀÎ Àü·«À» ¼ö¸³ÇÒ ¼ö°¡ ÀÖÀ» °ÍÀÌ´Ù.

º» ¿¬±¸´Â ºÒÈ®½Ç¼ºÀ» ³»Æ÷ÇÑ ½ÃÀå °³Ã´¿¡ ÀÖ ¾î¼ ±â¾÷ÀÇ À§Çè¿¡ ´ëÇÑ ÅÂµµ¸¦ °í·ÁÇÏ¿© ¸¶ÄÉÆÃ ÀÚ¿øÀÇ ÃÖÀû ¹èºÐÀ» °áÁ¤ÇÏ´Â ¸ðÇüÀÇ °³¹ßÀ» ¸ñÀû À¸·Î ÇÑ´Ù. ÀÌ¸¦ À§ÇÏ¿©, Von Neumann°ú MorgensternÀÇ È¿¿ë ÀÌ·ÐÀ» È°¿ëÇÏ¿´´Ù. 2Àý¿¡¼ ´Â ±âÁ¸ÀÇ °ü·Ã ÀÌ·ÐÀ» »ìÆìº¸°í, 3Àý¿¡¼´Â ÃÖÀû ÀÚ¿ø ¹èºÐ ¸ðÇüÀ» °³¹ßÇÑ´Ù. 4Àý¿¡¼´Â ¼öÄ¡ ¿¹Á¦ ¸¦ »ìÆìº¸°í, 5Àý¿¡¼ °á·ÐÀ» ¸Î´Â´Ù.

2. ±âÁ¸ ¿¬±¸ÀÇ °íÂû

¿©·¯ ½ÃÀå¿¡ ¸¶ÄÉÆÃ ÀÚ¿øÀ» ÇÒ´çÇÏ´Â ¹®Á¦¿¡ ´ëÇÑ ¿¬±¸´Â ´Ù¾çÇÏ°Ô ÁøÇàµÇ¾î ¿Ô´Ù. ±×·±µ¥, ´ë ºÎºÐÀÇ ¿¬±¸¿¡¼´Â ½ÃÀåÀÇ ºÒÈ®½Ç¼ºÀÌ °í·ÁµÇÁö ¾Ê°í ÀÖ´Ù (Carroll, Green, & DeSarbo, 1979; Doyle & Saunders, 1990; Freeland & Weinberg, 1980; Luss & Gupta, 1975; Rao & Rao, 1983). Áï, ÇÏ³ªÀÇ ½ÃÀå¿¡¼´Â ÇÏ³ªÀÇ È®Á¤ÀûÀÎ (deterministic) ½ÃÀå ¹ÝÀÀ ÇÔ¼ö(market response function)¸¦ °®´Â °ÍÀ¸·Î ¸ðÇüÈ µÇ°í ÀÖ´Ù. ±×·± µ¥, È®Á¤ÀûÀÎ ½ÃÀå ¹ÝÀÀ ÇÔ¼ö·Î ¸ðÇüÈ ÇÏ´Â °ÍÀº ºÒÈ®½ÇÇÑ ½ÃÀå ¹ÝÀÀÀ» Æò±ÕÇÑ ±â´ë ¹ÝÀÀÀ¸·Î ¸ðÇü È ÇÏ´Â °ÍÀÌ¸ç, ÀÌ´Â ±â¾÷ÀÌ À§Çè Áß¸³ÀûÀÎÀ» °¡ Á¤ÇÏ´Â °ÍÀ» ÀÇ¹ÌÇÑ´Ù. ±×·¯³ª, ½ÇÁ¦ ±â¾÷÷ ¹× ±â¾÷ ³» ÀÇ»ç°áÁ¤ÀÚÀÇ ÇàµîÀº À§ÇèÁß¸³ÀûÀÌÁö ¾Ê°í º¸¿ì°¡ ÀÏ¹ÝÀûÀÌ¸ç, ÀÌ¿Í °°Àº ¸ðÇüÈ´Â ÇöÀ½ÀÛ Á¤È®ÇÏ°Ô ¹Ý¿µÇÏÁö ¸øÇÏ¸ç, µû¶ó¼ ÀÇ»ç°áÁ¤ÀÇ ¿Ö °îÀ» °¡Á®¿Ã µÈ´Ù(Aykac, Corstjens, Gautschi, & Horowitz, 1989).

Nguyen(1985)°ú Aykac, Corstjens, Gautschi, & Horowitz(1989)´Â ÇÏ³ªÀÇ ½ÃÀå¿¡ ´ëÇØ¼ ºÒÈ® ½Ç¼ºÀ» °í·ÁÇÑ ¸ðÇüÈ¸¦ ÇÏ°í ÀÖ´Ù. ÀÌ¸¦ ÅëÇØ, ±â ¾÷ÀÇ À§Çè¿¡ ´ëÇÑ ÅÂµµ¿¡ µû¶ó ¸¶ÄÉÆÃ ÀÚ¿øÀÇ ÃÖ

ÀÛ ÅõÀÔ·®ÀÌ ´Þ¶óÁüÀ» º¸¿©ÁÖ°í ÀÖ´Ù.

Mantrala, Sinha, & Zoltners(1992)´Â ÀüÃ¼ ¸¶ÄÉÆÃ ÀÚ¿øÀÇ ±Ô¸ð¸¦ °áÁ¤ÇÏ´Â »ç¶÷(investor)°ú ÀÌ¸¦ °¢ ½ÃÀå¿¡ ¹èºÐÇÏ´Â »ç¶÷(allocator)ÀÇ À§Çè¿¡ ´ëÇÑ ÅÂµµÀÇ Â÷ÀÌ°¡ Á¸ÀçÇÏ´Â °æ¿ì Áß´ëÇÑ ¿À·ù°¡ ¹ß»ýÇÒ ¼ö ÀÖÀ½À» ÀÔÁõÇÏ¿´´Ù. ±×¸®°í, ¸ÅÃâÀÌ³ª ÀÌÀÍÀº ÀüÃ¼ ¸¶ÄÉÆÃ ÀÚ¿ø ±Ô¸ðÀÇ º¯Èº¸´Ù´Â ÀÚ¿ø ¹èºÐ ±ÔÄ¢ÀÇ º¯È¿¡ ´õ ¹Î°¨ÇÏ¸ç, µû¶ó¼ ¹èºÐ ¹æ¹ý º³¼±ÀÇ Áß¿ä¼ºÀ» º¸¿©ÁÖ°í ÀÖ´Ù.

±âÁ¸ÀÇ ¿¬±¸¿¡ ÀÖ¾î¼ »ç¿ëµÈ ½ÃÀå ¹ÝÀÀ ÇÔ¼ö´Â ´ëºÎºÐ ¿À¸ñ(concave)ÇÔ¼ö ¶Ç´Â S °î¼±ÀÌ¾ú´Ù. Simon & Arndt(1980)Àº 100¿© Æí ÀÌ»óÀÇ ½ÇÁõ ¿¬±¸¿¡ ´ëÇÑ ºÐ¼®À» ÅëÇÏ¿©, ±â¾÷µéÀÇ Á¤»óÀûÀÎ ÀÚ¿ø ÅõÀÔ ¹üÀ§ ³»¿¡¼´Â ½ÃÀå ¹ÝÀÀ ÇÔ¼ö°¡ ¿À¸ñ ÇÔÀ» º¸¿©ÁÖ¾ú´Ù. ¶ÇÇÑ, ±âÁ¸ÀÇ °ü·Ã ¿¬±¸¿¡¼µµ S °î¼±ÀÌ »ç¿ë(Freeland & Weinberg, 1980; Rao & Rao, 1983)µÇ±âµµ ÇßÀ¸³ª, ´ëºÎºÐÀÇ °æ¿ì ¿À¸ñ ÇÔ¼ö¸¦ »ç¿ë(Carroll, Green, & DeSarbo, 1979; Doyle & Saunders, 1990; Luss & Gupta, 1975; Mantrala, Sinha, & Zoltners, 1992; Holthausen & Assumus, 1982)ÇÏ¿´´Ù. º» ¿¬±¸¿¡¼´Â ¿À¸ñÇÑ ½ÃÀå ¹ÝÀÀÀ» Ç¥ÇöÇÏ±â À§ÇÏ¿© ³Î¸® »ç¿ëµÇ´Â ¼öÁ¤ Áö¼ö ÇÔ¼ö¸¦ ÀÌ¿ëÇÏ¿© ¸ðÇüÈ¸¦ ÇÑ´Ù.

3. ¸ðÇüÀÇ °³¹ß

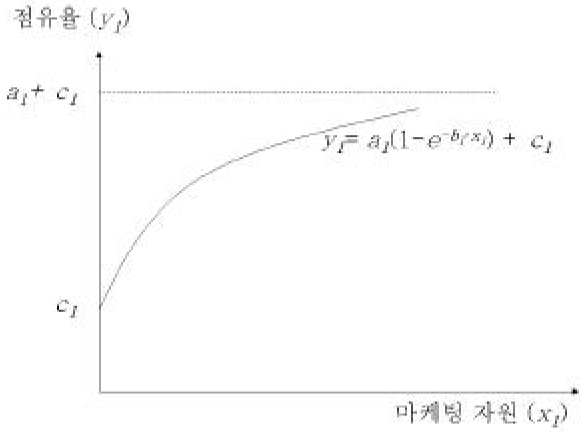
º» Àý¿¡¼´Â ÀÌÀÍÀ» ÃÖ´ëÈÇÏ°íÀÚ ÇÏ´Â ±â¾÷¿¡ ´ëÇØ, ½ÃÀå °³Ã´¿¡ ÀÖ¾î¼ ÀüÃ¼ ÃÖÀû(global optimal)ÀÇ ¸¶ÄÉÆÃ ÀÚ¿ø ¹èºÐÀ» ÇÒ ¼ö ÀÖ´Â ¸ðÇüÀ» °³¹ßÇÏµµ·Ï ÇÑ´Ù. ÀüÃ¼ ¸¶ÄÉÆÃ ÀÚ¿øÀº Á¤ÇØÁ®ÀÖÀ¸¸ç, ÇÏ³ªÀÇ ±âÁ¸ ½ÃÀå(½ÃÀå 1)°ú, ÁøÀÔÀ» °í·ÁÇÏ´Â ÇÏ³ªÀÇ »õ·Î¿î ½ÃÀå(½ÃÀå 2)ÀÌ ÀÖÀ¸¸ç, ±âÁ¸ÀÇ ½ÃÀå¿¡ ´ëÇØ¼´Â ÇÏ³ªÀÇ ½ÃÀå ¹ÝÀÀ ÇÔ¼ö¸¦, »õ·Î¿î ½ÃÀå¿¡ ´ëÇØ¼´Â ¿©·¯ °³ÀÇ ½ÃÀå ¹ÝÀÀ ÇÔ¼ö¸¦ È®·üÀûÀ¸·Î ÃßÁ¤ÇÒ ¼ö ÀÖ´Ù°í °¡Á¤ÇÑ´Ù. ±×¸®°í, ½ÃÀå ¹ÝÀÀ ÇÔ¼ö´Â ¼öÁ¤ Áö¼ö ÇÔ¼öÀÇ ÇüÅÂ¸¦, ±â¾÷ È¿¿ë ÇÔ¼ö´Â Áö¼ö È¿¿ë ÇÔ¼ö(exponential utility function)¸¦ °®´Â´Ù°í °¡Á¤ÇÑ´Ù..

¼öÁ¤ Áö¼ö ÇÔ¼ö´Â ¾Æ·¡ ½Ä°ú °°Àº ÇüÅÂ·Î Ç¥ÇöµÇ¸ç, ÇÏÇÑ °ª c¿Í »óÇÑ °ª(saturation level) $a+c$¸¦ °¡Áø´Ù.

$$y = a(1 - e^{-bx}) + c$$

<±×¸² 1>¿¡ º» ¸ðÇüÀÌ Ç¥ÇöµÇ¾î ÀÖ´Ù. ½ÃÀå 1ÀÇ °æ¿ì´Â ±âÁ¸ ½ÃÀåÀÌ¹Ç·Î ¸¶ÄÉÆÃ ÀÚ¿øÀ» ÅõÀÔ ÇÏÁö ¾Ê¾Æµµ ¾çÀÇ ¸ÅÃâÀ» ±â´ëÇÒ ¼ö ÀÖÀ¸¹Ç·Î c_1Àº 0º¸´Ù Å¬ ¼ö°¡ ÀÖ´Ù. ¹Ý¸é ½ÃÀå 2´Â ¸¶ÄÉÆÃ ÀÚ¿øÀ» ÅõÀÔÇÏÁö ¾ÊÀ¸¸é ¸ÅÃâÀ» ±â´ëÇÒ ¼ö ¾øÀ¸¹Ç·Î, ±×·¡ÇÁ´Â ¿øÁ¡À» Áö³ª´Ù(½ÇÁ¦ y ÀýÆíÀº ÃÖÀû ÇØ¿¡ ¿µÇâÀ» ¹ÌÄ¡Áö ¾Ê´Â´Ù.). ¶ÇÇÑ ½ÃÀå 2ÀÇ ¹ÝÀÀ ÇÔ¼ö´Â p_iÀÇ È®·ü·Î $y_2 = a_{2i}(1 - exp(-b_{2i}x_2))$¸¦ µû¸¥´Ù. ¸¶ÄÉÆÃ ÀÚ¿øÀº ½ÃÀå 1°ú 2¿¡ °¢°¢ ¥á : 1-¥á (0¡Â¥á¡Â1)ÀÇ ºñÀ²·Î ¹èºÐµÈ´Ù. ÀÌ ¶§, ÀÌÀÍÀÇ ±â´ë È¿¿ëÀ» ÃÖ´ëÈÇÏ´Â ¥á¸¦ ±¸ÇÏ´Â ¸ðÇüÀ» µµÃâÇÏµµ·Ï ÇÑ´Ù. ¸ðÇüÀÇ ±âÈ£´Â ¾Æ·¡¿Í °°ÀÌ Á¤ÀÇµÈ´Ù.

B : ÃÑ ¸¶ÄÉÆÃ ÀÚ¿ø
¥á : ÃÑ ¸¶ÄÉÆÃ ÀÚ¿ø Áß ½ÃÀå 1¿¡ ÅõÀÔµÇ´Â ºñÀ²
V_1 : ½ÃÀå 1ÀÇ Å©±â (´ÜÀ§ : ÆÇ¸Å Á¦Ç°ÀÇ °³¼ö)
V_2 : ½ÃÀå 2ÀÇ Å©±â (´ÜÀ§ : ÆÇ¸Å Á¦Ç°ÀÇ °³¼ö)
P : ÃÑ ÀÌÀÍ
c : ÇÑ °³¸¦ ÆÇ¸ÅÇÒ ¶§ÀÇ ÀÌÀÍ ±â¿© ±Ý¾×
R : Áö¼ö È¿¿ë ÇÔ¼öÀÇ risk tolerance



<±×¸² 1> ½ÃÀå 1ÀÇ ¹ÝÀÀ ÇÔ¼ö

<±×¸² 2> ½ÃÀå 2ÀÇ ¹ÝÀÀ ÇÔ¼ö

±â´ë ÀÌÀÍ $E(P)$¿Í ±â´ë È¿¿ë $E(U)$´Â ´ÙÀ½°ú °°´Ù.

$$E(P) = cV_1\{a_1 - a_1\exp(-b_1\alpha B) + c_1\} + cV_2\{\sum_i p_i[a_{2i} - a_{2i}\exp(-b_{2i}(1-\alpha)B)] - B$$
$$= \sum_i p_i\{cV_1[a_1 - a_1\exp(-b_1\alpha B) + c_1] + cV_2[a_{2i} - a_{2i}\exp(-b_{2i}(1-\alpha)B)]- B\}$$

$$cV_1[a_1 - a_1\exp(-b_1\alpha B) + c_1] + cV_2[a_{2i} - a_{2i}\exp(-b_{2i}(1-\alpha)B)] - B = g_i(\alpha)$$

¶ó µÎ¸é,

$$E(U) = 1 - \sum_i p_i \exp(-g_i(\alpha)/R)$$

¿©±â¼ g_i'(¥á)¿Í g_i"(¥á)´Â ´ÙÀ½°ú °°ÀÌ ±¸ÇØ Áø´Ù.

$$g_i'(\alpha) = cV_1a_1b_1B\exp(-b_1\alpha B) - cV_2a_{2i}b_{2i}B\exp(-b_{2i}(1-\alpha)B)$$
$$g_i''(\alpha) = -cV_1a_1b_1^2B^2\exp(-b_1\alpha B) - cV_2a_{2i}b_{2i}^2B^2\exp(-b_{2i}(1-\alpha)B) < 0$$

ÀÌ °á°ú¸¦ ÀÌ¿ëÇÏ¸é, $d^2E(U)/d¥á^2$ ´Â ´ÙÀ½°ú °°ÀÌ Ç×»ó À½ÀÇ °ªÀ» °®´Â´Ù.

$$\frac{d^2E(U)}{d\alpha^2} = \sum_i \frac{p_i}{R}\{g_i''(\alpha)\exp(-g_i(\alpha)/R) - (1/R)(g_i'(\alpha))^2\exp(-g_i(\alpha)/R)\} < 0$$

$d^2E(U)/d$¥á^2´Â Ç×»ó À½ÀÌ¹Ç·Î $E(U)$´Â ¿À¸ñÇÏ°í µû¶ó¼, ±¹¼Ò ÃÖÀûÇØ´Â ÀüÃ¼ÃÖÀûÇØ°¡ µÈ´Ù.

4. ¼öÄ¡ ¿¹Á¦

4Àå¿¡¼´Â 3Àå¿¡¼ °³¹ßÇÑ ¸ðÇüÀ» È°¿ëÇÏ¿© ¼öÄ¡ ¿¹Á¦¸¦ Á¦½ÃÇÏ°í ÃÖÀû ¥á°ªÀÇ Æ¯¼ºÀ» »ìÆì°¸µµ·Ï ÇÏ°Ú´Ù. ±â°» ¸ð¼ö°ªÀº ´ÙÀ½°ú °°´Ù.

$a_1=0.3$ $b_1=0.000015$ $c_1=0.1$
$p_1=0.25$ $p_2=0.50$ $p_3=0.25$
$a_{21}=0.2$ $b_{21}=0.000005$ $c_{21}=0$
$a_{22}=0.3$ $b_{22}=0.000010$ $c_{22}=0$
$a_{23}=0.4$ $b_{23}=0.000010$ $c_{23}=0$
$B=100{,}000$ $R=100{,}000$
$V_1=V_2=200{,}000$

°á°ú°¡ °Î·ÏÀÇ Ç¥¿¡ ³ªÅ¸³ª ÀÖ´Ù. <Ç¥ 1>°ú <Ç¥ 2>´Â a_{23}, R, p_i °ªÀÇ °¯È¿¡ µû¸¥ ÃÖÀû ¥á¹× ÀÌÀÍÀÇ °¯È¸¦ º¸¿©ÁÖ°í ÀÖ°í, <Ç¥ 3>¿Í <Ç¥ 4>´Â b_{23}, R, p_i °ªÀÇ °¯È¿¡ µû¸¥ ÃÖÀû ¥á¹× ÀÌÀÍÀÇ °¯È¸¦ º¸¿©ÁÖ°í ÀÖ´Ù.

<Ç¥ 1>°ú <Ç¥ 3>Àº ÇÑ ´ÜÀ§ ÆÇ¸Å ´ç ÀÌÀÍ ±â¿©°¡ 5ÀÎ °æ¿ì¸¦, <Ç¥ 2>¿Í <Ç¥ 4>´Â 3ÀÎ °æ¿ì¸¦ º¸¿©ÁØ´Ù. ÀÌ °á°ú·Î°ÍÅÍ ´ÙÀ½°ú °°Àº ÃÖÀû ¥á°ªÀÇ Æ¯¼ºÀ» ÆÄ¾ÇÇÒ ¼ö ÀÖ´Ù.
¨ç ¸ð¼öÀÇ °ªÀÌ Å©°Ô °¯ÈÇÏ¿©µµ ¥á°ªÀº ´ë°Î°ÐÀÇ °æ¿ì 0.5-0.7 »çÀÌÀÇ °ªÀ» °®´Â´Ù. Áï, À§Çè È¸ÇÇÀû ÅÂµµ·Î ÀÎÇÏ¿© »õ·Î¿î ½ÃÀåÀÇ Æ¯¼ºÀÌ °¯ÇÏ´õ¶óµµ ÀÚ¿ø ¹è°ÐÀº Å« Â÷ÀÌ°¡ ¾øÀ¸¸ç, »ó´ëÀûÀ¸·Î ¸¹Àº ÀÚ¿øÀ» ±âÁ¸ ½ÃÀå¿¡ ÅõÀÔÇÏ´Â °ÍÀ¸·Î º¸ÀÎ´Ù.
¨è R°ªÀÌ Áõ°¡ÇÔ¿¡ µû¶ó Áï, ±â¾÷ÀÌ ´ú À§Çè È¸ÇÇÀûÀÏ¼ö·Ï ¥á°ªÀÌ °¨¼ÒÇÑ´Ù. ÀÌ´Â Á÷°üÀûÀ¸·Î ¿¹ÃøÇÒ ¼ö ÀÖ´Â °á°ú·Î, ´ú À§Çè È¸ÇÇÀûÀÏ¼ö·Ï ±âÁ¸ ½ÃÀå°¸´Ù ¸¹Àº ¸ÅÃâÀÇ °¡´É¼ºÀÌ ÀÖ´Â µû¶ó¼, ´õ ¸¹Àº ÀÌÀÍÀÇ °¡´É¼ºÀÌ ÀÖ´Â »õ·Î¿î ½ÃÀå¿¡ ÀÚ¿ø ÅõÀÔÀ» Áõ°¡½ÃÅ°´Â °ÍÀÌ ÃÖÀûÀÓÀ» º¸¿©ÁØ´Ù.
¨é p_3°ªÀÌ Áõ°¡ÇÏ¸é ¥á°ªÀÌ °¨¼ÒÇÑ´Ù. p_3°ªÀÌ Áõ°¡ÇÏ¸é »õ·Î¿î ½ÃÀåÀÇ ¸Å·Âµµ°¡ Áõ°¡ÇÏ°Ô µÇ¸ç, ÀÌ °æ¿ì »õ·Î¿î ½ÃÀå¿¡ ´ëÇÑ ¸¶ÄÉÆÃ ÀÚ¿ø ÅõÀÔÀ» Áõ°¡½ÃÅ°´Â °ÍÀÌ ¹Ù¶÷Á÷ÇÔÀ» º¸¿©ÁØ´Ù.
¨ê <Ç¥ 1>°ú <Ç¥ 2>¸¦ ±×¸®°í, <Ç¥ 3>°ú <Ç¥ 4>¸¦ ºñ±³ÇÏ¿© º¸¸é, ´Ù¸¥ Á¶°ÇÀÌ µ¿ÀÏÇÒ ¶§, c°ªÀÌ ÀÛÀ»¼ö·Ï, ¥á°ªÀÌ ÀÛÀ½À» ¾Ë ¼ö ÀÖ´Ù. Áï, ´ÜÀ§ ÆÇ¸Å´ç ÇÑ°èÀÌÀÍÀÌ °¨¼ÒÇÏ¸é ÀáÀç·ÂÀÌ Å« »õ·Î¿î ½ÃÀåÀ¸·ÎÀÇ ÀÚ¿ø ÅõÀÔÀ» Áõ°¡½ÃÅ°´Â °ÍÀÌ ÃÖÀûÀÓÀ» º¸¿©ÁØ´Ù. ±âÁ¸ ½ÃÀå¿¡¼ °æÀïÀÌ °ÝÈµÇ°Å³ª, ¼º¼÷±â¿¡ ÀÌ¸£·¯ ¼öÀÍ·üÀÌ °¨¼ÒÇÏ°Ô µÇ¸é, À§Çè È¸ÇÇÀûÀÎ ±â¾÷µµ ½ÃÀå °³Ã´À» Àû±ØÀûÀ¸·Î ¼öÇàÇÏ´Â °ÍÀÌ ¹Ù¶÷Á÷ÇÔÀ» ÀÇ¹ÌÇÑ´Ù°í ÇØ¼®ÇÒ ¼ö ÀÖ´Ù. ±×·¯³ª, R=1,000,000ÀÎ °æ¿ì¸¦ »ìÆì°¸¸é c°ªÀÇ °¯È¿¡ µû¸¥ ¥á°ªÀÇ °¯È°¡ ¹Ì¹ÌÇÏ´Ù´Â °ÍÀ» ¾Ë ¼ö ÀÖ´Ù. ÀÌ °æ¿ì R¡íB ÀÌ¹Ç·Î ±â¾÷Àº À§Çè Áß¸³Àû À¸·Î Àü·«À» ¼ö¸³ÇÏ´Â °ÍÀÌ ÃÖÀûÀÌ µÇ¸ç, µû¶ó¼ ÀÌÀÍ ±â¿© ±Ý¾×(c)°ú À§ÇèÀÇ »óÃæ(trade-off)ÀÌ ¾à ÇÑ Æ¯¼ºÀ» º¸ÀÌ¹Ç·Î cÀÇ °¯È°¡ ÃÖÀû ÀÚ¿ø ¹è°Ð¿¡ Å« ¿µÇâÀ» ¹ÌÄ¡Áö ¾Ê´Â °ÍÀ¸·Î ÇØ¼®µÈ´Ù. ÇÑÆí, <Ç¥ 1>°ú <Ç¥ 2>¸¦ ºñ±³ÇÏ¿© º¸¸é, c°ªÀÌ °¨¼ÒÇÒ °æ¿ì, a_{23}°ªÀÌ Áõ°¡ÇÒ¼ö·Ï Áï, »õ·Î¿î ½ÃÀåÀÇ ¸Å·Â ÀÌ Ä¿Áú¼ö·Ï ÀÚ¿øÀ» ¸¹ÀÌ ÅõÀÔÇÏ´Â °ÍÀÌ ¹Ù¶÷Á÷ÇÔÀ» ¾Ë ¼ö ÀÖ´Ù.

ÀÌ»óÀÇ ¼öÄ¡¿¹Á¦¸¦ ÅëÇÏ¿©, ÃÖÀû ¥á°ªÀÌ ´Ù¾ç ÇÑ ¸ð¼ö°ª¿¡ µû¶ó ¾î¶»°Ô °¯ÈÇÏ´ÂÁö¸¦ »ìÆì°¸°í ±× ÀÇ¹Ì¿¡ ´ëÇØ¼ ÇØ¼®À» ¼öÇàÇÏ¿´´Ù.

5. °á·Ð

°» ¿¬±¸¿¡¼´Â °ÒÈ®½Ç¼ºÀ» ³»Æ÷ÇÑ ½ÃÀå °³Ã´¿¡ ÀÖ¾î¼ ±â¾÷ÀÇ À§Çè¿¡ ´ëÇÑ ÅÂµµ¸¦ °í·ÁÇÏ¿© ¸¶ÄÉÆÃ ÀÚ¿øÀÇ ÃÖÀû ¹è°ÐÀ» °áÁ¤ÇÏ´Â ¸ðÇüÀÇ °³¹ßÇÏ¿´´Ù. ¼°ÀåÀ» Ãß±¸ÇÏ´Â ±â¾÷¿¡ ÀÖ¾î¼ ½ÃÀå °³Ã´ Àü·«Àº Áß¿äÇÑ Àü·« ¼ö´Ü ÁßÀÇ ÇÏ³ªÀÌ¸ç, ÀÌ·¯ ÇÑ Àü·«ÀÇ ¼öÇà¿¡¼ ¹Ýµå½Ã °í·ÁµÇ¾î¾ß ÇÒ °ÍÀÌ ±â¾÷ÀÇ À§Çè¿¡ ´ëÇÑ ÅÂµµÀÌ´Ù.
°» ¿¬±¸¿¡¼´Â Áö¼ö È¿¿ë ÇÔ¼ö¿Í ¼öÁ¤ Áö¼ö ½ÃÀå ¹ÝÀÀ ÇÔ¼ö¸¦ °¡Á¤ÇÏ¿© ÀüÃ¼ ÃÖÀû ÀÚ¿ø¹è°ÐÀ» ÇÒ ¼ö ÀÖÀ½À» º¸¿´´Ù. ¶ÇÇÑ ¼öÄ¡ ¿¹Á¦¸¦ ÅëÇÏ¿©, ÃÖÀû ¥á°ªÀÌ ¸ð¼ö°ª¿¡ µû¶ó ¾î¶»°Ô °¯ÈÇÏ´ÂÁö¸¦ »ìÆì°¸°í ±× ÀÇ¹Ì¿¡ ´ëÇØ¼ ÇØ¼®À» ¼öÇàÇÏ¿´´Ù.
°» ¿¬±¸¿¡¼ Á¦½ÃµÈ ¸ðÇüÀº ±âÁ¸ ½ÃÀå°ú »õ·Î¿î ½ÃÀåÀÌ °¢°¢ 1°³ÀÎ °æ¿ì¸¦ °í·ÁÇÏ¿´À¸³ª, º¸´Ù Çö½ÇÀûÀÎ ¸ðÇüÀ» À§ÇØ¼´Â ´Ù¼öÀÇ ½ÃÀåÀÌ Á¸ÀçÇÏ´Â °æ¿ì¿¡ ´ëÇÑ ºÐ¼®ÀÌ ÇÊ¿äÇÒ °ÍÀÌ´Ù. ¶ÇÇÑ, ´Ù¾ç ÇÑ ½ÃÀå ¹ÝÀÀ ÇÔ¼ö¿¡ ´ëÇÑ ºÐ¼®µµ ÇÊ¿äÇÏ´Ù.

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ºÎ·Ï

<Ç¥ 1> a_{23}, R, p_i°ªÀÇ °¨È-¿¡ µû¸¥ ÃÖÀû a ¹× ÀÌÀÍÀÇ °¨È-: c=5

±¸ºÐ	R	a_{23}							
		0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
p_1 = 0.25	50,000	0.70	0.69	0.70	0.70	0.71	0.71	0.72	0.72
p_2 = 0.50	100,000	0.66	0.64	0.63	0.63	0.64	0.64	0.64	0.65
p_3 = 0.25	1,000,000	0.63	0.59	0.56	0.54	0.51	0.49	0.47	0.46
p_1 = 0.20 p_2 = 0.50 p_3 = 0.30	100,000	0.64	0.62	0.61	0.61	0.61	0.62	0.62	0.63

<Ç¥ 2> a_{23}, R, p_i°ªÀÇ °¨È-¿¡ µû¸¥ ÃÖÀû a ¹× ÀÌÀÍÀÇ °¨È-: c=3

±¸ºÐ	R	a_{23}							
		0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00
p_1 = 0.25	50,000	0.67	0.65	0.65	0.65	0.65	0.66	0.66	0.67
p_2 = 0.50	100,000	0.65	0.62	0.60	0.59	0.59	0.59	0.59	0.59
p_3 = 0.25	1,000,000	0.63	0.59	0.56	0.53	0.50	0.48	0.46	0.44
p_1 = 0.20 p_2 = 0.50 p_3 = 0.30	100,000	0.63	0.60	0.58	0.57	0.56	0.56	0.57	0.57

<Ç¥ 3> b_{23}, R, p_i°ªÀÇ °¨È-¿¡ µû¸¥ ÃÖÀû a ¹× ÀÌÀÍÀÇ °¨È-: c=5

±¸ºÐ	R	b_{23}					
		0.00001	0.00002	0.00003	0.00004	0.000005	0.00010
p_1 = 0.25	50,000	0.69	0.71	0.72	0.73	0.73	0.73
p_2 = 0.50	100,000	0.64	0.65	0.66	0.67	0.68	0.69
p_3 = 0.25	1,000,000	0.59	0.56	0.57	0.58	0.60	0.67
p_1 = 0.20 p_2 = 0.50 p_3 = 0.30	100,000	0.62	0.63	0.64	0.65	0.66	0.68

<Ç¥ 4> b_{23}, R, p_i°ªÀÇ °¨È-¿¡ µû¸¥ ÃÖÀû a ¹× ÀÌÀÍÀÇ °¨È-: c=3

±¸ºÐ	R	b_{23}					
		0.00001	0.00002	0.00003	0.00004	0.000005	0.00010
p_1 = 0.25	50,000	0.65	0.66	0.68	0.69	0.69	0.70
p_2 = 0.50	100,000	0.62	0.61	0.62	0.64	0.65	0.68
p_3 = 0.25	1,000,000	0.59	0.56	0.56	0.58	0.60	0.67
p_1 = 0.20 p_2 = 0.50 p_3 = 0.30	100,000	0.60	0.59	0.60	0.62	0.63	0.66