













The development of effective measures of the value added to student performance would create a new metric of institutional performance. Quality assessment can have enormous educational value in that it can help:

- ( 1 ) faculty and their students make better sense of the teaching and learning in which they are mutually engaged;
- ( 2 ) institutions of higher education measure the cumulative impact of their curricular programming;
- ( 3 ) provide benchmark data for comparisons by sector ( e.g. community colleges, liberal arts colleges, research universities, and on-line instruction ), as well as create the potential basis for an incentive system focused on student learning;
- ( 4 ) public policy decision-makers concerned with issues of access, cost, accountability, and equity; and
- ( 5 ) students make better decisions regarding selection of appropriate colleges and universities, rather than relying on current invalid ranking systems.

More than fifteen states now have legislation requiring their public colleges and universities to provide evidence of student learning, and in some cases they tie this to funding. But no state has created a comprehensive value added assessment system. Nevada has the opportunity to develop such assessment of learning and lead the nation (See appendix A for more details).

### **Mission Differentiation**

The current two-tiered system in Nevada features two comprehensive universities and four community colleges. A decision to create a four-year college at Henderson has been made and consideration has been given to possible four-year programs within the community college campus setting.

This is the moment that Nevada must decide how it wishes to expand its system to resolve quality and access questions. Currently, the community colleges are geographically well deployed, with excellent staffs and facilities. But relatively few people transfer from these campuses to four-year programs, in part, we are told, because many students come to college inadequately prepared in high school, do not aspire to a four-year degree, and/or become alienated by virtue of lack of program and admissions articulation among the community colleges and the universities.

### **Option: Recognize the Community Colleges as a Central Mechanism for Meeting Access Goals**

However, as the analysis in part II suggests, a fundamental problem in Nevada is to improve the education level of underrepresented groups who, in the case of the Latino population, will eventually become the majority ethnic population in Nevada. Because community colleges offer post secondary education and training at the lowest cost, they will be even more important as the entry mechanism for a greater proportion of Nevada students in the future. Community colleges need to target their missions to multiple

constituencies, particularly workforce preparation, adult education, remedial education, and English as a Second Language. We endorse efforts to create long term partnerships between employers, high schools, and local governments and community colleges.

**Option: Establish multiple four-year colleges**

The Board of Regents faces the decision on how best to improve its system in terms of structure and mission differentiation. In using the criteria of improving quality, access, efficiency, and accountability, we believe the state would best be served by developing four-year campuses. A minimum of four to six four-year institutions might be established over the next decade.

At the same time, however, Nevada, as is true in all states, cannot afford to have each institution become all things to all people. There has been a history of “mission creep” and growth in size in most four-year colleges and comprehensive universities in the nation such that they have become increasingly ineffective, inefficient, and unmanageable. Nevada can avoid this by requiring clear mission specification, wisely deploying its campuses where needed, and utilizing technology as a way of enhancing access and quality as it becomes evident where *technology’s strengths* exist. To date, it is not clear how best to utilize technology optimally, but within the next several years better evidence and models will be available.

With mission differentiation comes the need for clear admissions and graduation standards for each level and sector in higher education. Such standards need to be made public, consistent, and translated in a way easily understood by elementary, secondary and college students, their parents, and their teachers. Moreover, graduate programs and research capabilities are both extremely important for the development of intellectual talent and economic growth. The Desert Research Institute, for example, stands out as exemplary and an internationally respected research institution in the right state at the right time. It serves as an excellent case study with regard to its relative autonomy and entrepreneurship regarding questions of quality, efficiency, and accountability.

Nevada is still a relatively small state and must develop its graduate research and professional programs carefully. With one research university in Reno (UNR), and the other in Las Vegas (UNLV), the possibility of duplication of programs resulting in a failure to achieve focus and high quality in either institution is dangerously high. Adding the Desert Research Institute to the mix creates more opportunity for confusion and turf wars among the institutions. The most negative scenario to avoid is where both universities pursue, on an equal basis, research Carnegie I status. Nevada does not have the resources to afford this scenario in which both universities end up being “...all things to all people.” Moreover, as the Battelle study recognizes, the needs of Nevada will only grow as the population and economy continue to grow dramatically. Fortunately, criteria to comparatively evaluate academic programs can be used by higher education leaders and the Board of Regents (See Appendix B for more details.)



### **Option: Support the Development of Two Differentiated Universities**

It is entirely possible to imagine a future in which each university is authorized to build a number of research programs and professional schools, perhaps five to seven each, into programs of nationally recognized excellence over the next decade. In order to do so, however, it will be as important for both institutions to decide what not to do as to what to focus on as their top priorities.

The Desert Research Institute (DRI) can add significantly to the quality of research programs and the amount of research dollars coming to Nevada. DRI researchers and their counterparts at UNR and UNLV should be encouraged to collaborate on joint research projects. By a greater sharing of existing resources, researchers from all three institutions would have more funding to pursue research projects.

What the State clearly needs are programs that serve the needs of its citizens, with specific programs of excellence that can attract students and funding from inside and outside the state, and can help attract and maintain economic development. The use of external visiting academic committees to assess the quality of current programs and recommend which should be supported and which new ones to begin might be a useful exercise over the next two years.

### **Financing Reforms**

Greater mission differentiation and using assessment to ensure greater quality and effectiveness would represent important improvements in the Nevada system of higher education. Financing reforms will also be key, particularly in the area of improving access and managing future growth of the system. Five possible financing reforms are discussed below: 1) separating the funding of research from teaching and operations; 2) further refining the funding formula to stress state priorities; 3) reassessing the process and the basis for setting tuition and fees; 4) devoting a higher proportion of state funds for higher education to student financial aid; and 5) using state policies to promote alternative education delivery through private institutions and distance learning.

***Separating the Funding of Research.*** The federal government is the primary funder of research in this country, spending more for campus-based research than for all the federal student aid programs combined. The state role in funding research typically is largely a subsidiary one in the U.S. In most states, including Nevada, research is funded as part of the overall funding of public institutions. One result of this arrangement is that decisions on how state research funds are spent effectively are being made by institutional officials as they decide how to allocate public and private funds within the institution.

### **Option: Separate Research Funding**

One important objective of reforming higher education in Nevada is to build and improve the research capacity of its two universities and specialized institute. But this objective is fundamentally at odds with the current financing structure in which research is funded as part of the basic funding formula. The experience in other countries and other states

indicates it is very difficult to focus public policy on the research function when it is mixed together in the funding process with instruction, operations, and various other activities as shorter term demands overwhelm longer term research priorities.

One way therefore to achieve the objective of improving the research capacity of universities within the state would be to separate research funding from the basic funding formula for instruction and operations. Under such an arrangement, the funding of research by the state might be made into a two-step process. First, the state could allocate a specific amount for the purpose of funding research proposals and indicate its priority areas of funding. The second step of the process would have the Research Affairs Council review proposals and recommend which proposals should be funded according to a set of criteria established by the state, including areas which constitute high state priorities such as particular high technology fields of study.

Under such an arrangement, the funding of research by the state would be more like the federal government's process for funding research – on a project, peer-reviewed basis. It would also move Nevada in the direction of some other countries, specifically the United Kingdom, which funds research separately from instruction on a strict performance basis. In the U.K. model, however, institutions are funded on the basis of their research track model and they then decide which projects to fund. To achieve the kind of selective research excellence suggested here, we would recommend more of the U.S. funding of peer-reviewed individual projects if research is funded separately from instruction.

***Further refining the funding formula.*** Until 1986, funding of public institutions in Nevada was based primarily on political negotiations between state and institutional officials, the kind of arrangement that has characterized funding of higher education in most states for most of this country's history. In 1986, following the lead of a number of other states, Nevada adopted a funding formula that that was largely based on enrollments and costs per student. In 1999, the state legislature authorized a study of the existing funding mechanism to see whether further modifications were needed. Based on the recommendations in that study, the state recently has modified the funding formula primarily to achieve greater regional equity in the distribution of state funds.

While the achievement of greater regional equity is an important goal, there are other objectives for a funding formula that also ought to be considered in assessing its effectiveness. For example, does the funding formula lead to cost moderation or are there features within the system that encourage cost escalation at the institutional level? When a funding formula is based on meeting a portion of the costs per student, there is implicitly pressure on institutions to increase their costs or limit the numbers of students as a means for increasing allocations from the formula. This upwards pressure on costs, of course, is not the intention of such a formula but it is nonetheless often the result.

Similarly, it is important to consider whether the funding formula contributes to the achievement of other goals in the higher education system such as greater access for the poor, or does it instead encourage the capping of enrollments and limiting access for students of limited means? It is important that these and other questions be addressed as part of a reassessment of the current system and in the development of future strategies.

Our initial assessment is that the new revised funding formula does represent progress in introducing greater regional equity in a reasonable way, but it does not appear to facilitate the achievement of other goals such as expanding access or improving quality. We believe these goals of improved access and quality should become integral components of the funding process as part of a broader strategic planning initiative.

### **Option: Further Revise Funding Formula**

To promote access through the funding process, Nevada could build access goals directly into the funding formula, for example, by paying institutions more for the disadvantaged students they enroll and graduate than for students who come to college with more substantial levels of family resources. The British funding system does this by paying institutions a premium of 5 percent for the at-risk students they enroll. Alternatively, the state could make supplemental payments to institutions on the basis of the number of needy student aid recipients they enroll. Either of these approaches is in contrast to the system currently in place in Nevada and virtually all other states in which no distinction is made among students in the funding process. Thus, paying institutions a premium for at-risk students or providing supplemental payments attached to the enrollment of these students would put Nevada in the vanguard of states in promoting access for disadvantaged students in ways other than simply providing financial aid.

We also recommend that consideration be given to using the funding formula to promote greater quality in the system. While understandable in their appeal, enrollment-based and cost-based funding systems can wreak havoc when they create incentives and rewards that are directly at odds with concerns for quality. For example, a formula that pays institutions for each student they enroll regardless of whether students are prepared to do college level work contributes to the growth in the need for remediation among college students and a consequent decline in resources available for regular academic activities. Similarly, the fact that almost all states use formulas that fund institutions on the basis of the number of students enrolled in the fall rather than the numbers who complete the year in the spring may be contributing to low degree completion rates in the U.S. Contrast this to the British funding formula that is based on the number of students who complete their year of study and the much higher completion rates at English universities. In short, a “body count” mentality can corrupt the decision-making and priority setting process.

As part of its strategic planning process, the Board should consider changes in the funding formula that might change the incentives for institutions with regard to degree completion or other indicators of quality. A portion of funds, for example, might be provided to institutions on the basis of the number of graduates each year or the number of “completers,” as in the British system. Policy priorities could also be built into the “prices” that the state pays for seats in different fields of study or at different institutions based on assessments of quality, as described in the “Learning Outcomes” section.

The Board may also want to recommend the development of a program budgeting model, like those used in the best private colleges and universities in the U.S. and in the corporate sector. A program budgeting model is more complex and difficult at first—its start-up costs in terms of time and energy are high—but in the long run it leads to greater quality, efficiency, and pride. Such a model requires that an institution’s mission be clear,

priorities and standards are public and well understood, and an assessment system is in place that provides continuous data for formative and summative evaluation.

A move toward changing the funding formula or adopting program budgeting, however, is not sufficient. Additional fiscal incentives and procedures ought to be put in place to promote greater quality. For example, suppose the legislature created a pool of funds to be allocated to institutions that demonstrate elimination of unneeded or poor quality programs in which the savings garnered not only could be kept but perhaps matched in order to improve other programs or create new ones. Perhaps, too, there could be a pool of innovation funds for campuses to experiment with new programs, pedagogy, technology, entrepreneurship, etc.

***Reevaluating the Fee Setting Structure.*** Like most Western states, Nevada has a long tradition of charging little or no fees for state residents who attend Nevada institutions. While this low fee approach has a great deal of political appeal, the actual record on its effectiveness is far more mixed. Based on the experience of many other states and other countries, it is clear that low fee approaches are only successful in expanding access to higher education when public funding of institutions is sufficient to ensure an adequate supply of seats. Without adequate state funding, low fees simply increase competition for the limited number of seats, thus denying access to the flagship public institutions to students with good grades who do measure up to other students with better grades. Thus, low fees matched by relatively low levels of state support of higher education typically result in low levels of college participation. This would appear to be the case in Nevada, as it has one of the lowest fee structures and lowest participation rates in the country.

Aside from the level of fees, there is also a concern about how they are set in Nevada. International experience suggests that transparency is one of the critical features of a successful higher education system. Transparency means that a broad range of policy makers and the public at large understand the policies underlying the allocation of funds and the setting of fees. At least with respect to the setting of fees, transparency is not in evidence in Nevada. In the interviews we conducted, few participants indicated that they understood how fees were set in Nevada, either the basis for fee decisions or how those decisions were made. We believe this lack of transparency represents a real obstacle to the future success of higher education policies in the state.

Another potential problem with fee setting in many states occurs when economic growth slows or the economy goes into a recession. The national experience in this regard is clear. We have had three recessions over the past quarter-century. In each case, public sector tuition and fees on average rose at double digit annual percentages during those downturns as state funding faltered and fees were increased to make up for the shortfall. While Nevada, with its strong low fee tradition resisted these national trends, it would still be prudent for the state to take steps that minimize the pressure to raise fees when the economy falters. One way to do this is to have a process of setting aside reserves during economic good times to be used to supplement funding during economic slowdowns.

### **Option: Create A More Transparent Fee Setting Process**

In short, the problem with the fee setting process is that it is not well coordinated with other financing decisions and it not easily understood. The problem with the fee levels is that they may be serving as an obstacle to access rather than improving participation as is obviously the goal of a low fee policy. We recommend that both the process for setting fees and the level at which they are set be reexamined as part of a long-term strategic planning process. We also recommend consideration be given to the establishment of a state-wide reserve fund to provide greater stability to fee setting in the future.

***Investing More in Student Financial Aid.*** Nevada, like most other Western states, traditionally has ranked below the national average in its commitment to student financial aid. Whereas states on average collectively spend about 5 percent or more of their higher education budgets on student aid, Nevada traditionally has spent 2-3 percent of its budget for higher education on its Student Incentive Grant and Student Access programs. This is consistent with the tradition of low tuition/low aid so prevalent in the West.

All this changed recently, however, with the creation of the Millennium Scholarship, program as Nevada followed the lead of Georgia and a number of other states by adopting broad-based student aid efforts geared to rewarding student achievement. While some have been critical of the lack of a need-based focus in these efforts, we believe that these merit-based aid programs can help meet an important goal in states like Nevada, which have below-average college participation and graduation rates. For Nevada, this new program should help to raise participation rates in the state.

This does not mean, however, that Nevada leaders should rest on their laurels and consider that they have done enough with regard to student financial aid. Merit-based programs are by their nature not well-designed to meet the needs of traditionally under served populations, which leads to much of the criticism of them. States which have enacted merit-based programs should also expand their need-based programs to ensure a balanced student aid approach. Thus, we recommend consideration of expansion of need-based aid programs in Nevada that matches and precedes any further expansion in the Millennium program.

### **Option: Expand Need-Based Aid Programs**

We also recommend consideration of possible program design modifications that would ensure that financial aid policies are better integrated with other financing policies. For example, it is important that financial aid relate to the fees that students are charged in the future. Therefore, the need-based financial aid programs in Nevada should be designed so that awards increase for the most disadvantaged students as fees rise in the future.

***Promoting Alternative Education Delivery.*** Nevada, like most other western states, has a strong tradition of public higher education, and any strategic plan for higher education in the state will undoubtedly rely primarily on traditional public institutions. But responsible policy-making requires considering whether alternative education delivery might also be used to accommodate some future demand for higher education in Nevada.

One possible complement to the traditional reliance on public higher education in Nevada would be the development of a private higher education sector in the state, either in the form of non-profit or for-profit institutions. In many other states and in countries around the world, private higher education plays a much more prominent role in accommodating demand than in Nevada. In the U.S., these private institutions are most typically non-profit entities, but a growing number of countries are relying more on for-profit institutions than on non-profits to meet the ever-growing demand for higher education.

In the case of Nevada, there is little justification for public support of the operations of private institutions. Whatever state taxpayer dollars are used to support higher education institutions should remain focused on existing or new public institutions. But a strong case can be made for allowing Nevada student aid dollars to be used at private institutions, as long as these institutions meet the same accreditation and licensing criteria that are imposed on public institutions in the state. Such a student aid policy would at least not preclude the development of private institutions in the state.

Another alternative to traditional institutions is the use of new technologies and distance learning. This is the area that many states and countries are looking toward to allow them to meet burgeoning demands for higher education because new technologies and distance learning hold the promise of cost-effective education that does not require the huge capital costs entailed in providing more traditional means of higher education. But these assertions of the greater cost effectiveness of distance learning and new technologies remain just that – assertions which still must be proved in reality. Decisions about whether to rely more on new technologies and distance learning require careful consideration of the relative short-term operation and longer-term infrastructure costs and the educational impact on these alternatives compared to more traditional modes.

If policy makers in Nevada decide to pursue strategies that contemplate the greater use of new technologies and distance learning, then they must also decide how to make it happen. One approach would entail directly funding the development of new institutions either within the state or, more likely, within the region that rely entirely on the use of new technologies and distance learning. A second would entail enhancing existing institutions by supplementing their traditional curriculum with distance offerings in areas that require strengthening. A third approach would allow students enrolled in nontraditional programs or institutions to participate fully in the state student aid programs, again as long as they meet accreditation and licensing standards. Each of these approaches should be considered as part of the strategic planning process in Nevada, with a full consideration of both the possible costs and benefits that are likely to result.

## **Governance**

The necessary condition and the key to enhancing quality, access, efficiency, and accountability, is how well the University and Community College System of Nevada is governed and managed. The development of clear standards, systems of assessment, funding and finance policies, and appropriate reward and incentive systems is dependent on the principles and rules of management each institution is governed by and how well

the Board of Regents functions. We found in our interviews considerable dissatisfaction in the current governance system.

While the current Board of Regents is historically grounded in the founding of Nevada's higher education system, it is clear from the interviews and projections from the data analysis that it may be time to explore alternative governance arrangements by the Board in anticipation of the changed environment it will face in the future. As the postsecondary world of Nevada becomes more complex, so too will the functions and institutional arrangements of the Board of Regents evolve. There is the need to think through how the Board of Regents might improve its function as a Board in the coming world of greater complexity, and in particular, its relationship to the management of each campus and the redesigned vision for higher education it will want to present to the state at large.

An elected Board of Regents is part of Nevada's Constitution and democratic tradition and one needs to be sensitive to that fact. At the same time, however, in the opinion of most of those we interviewed, the current elected Board model may have outlived its usefulness. The Board of Regents is perceived to be inordinately involved in micro-management and political decision-making. The current structure is blamed for the intense and increasingly dysfunctional rivalry between the north and south. Most of this criticism focused on the issue of an *elected* Board of Regents as the fundamental problem to be remedied. There are a number of alternative ways to restructure the Board of Regents that we believe may help resolve these problems, and we suggest several using the model of governance in private higher education as an alternative standard.

***Consideration of the Private Sector Model.*** Higher education is a public system in Nevada with no tradition of private institutions. Paradoxically, we believe Nevada may find it useful to look at the private higher education sector model of governance as it considers changes. Within the private sector reside elements of possible use in creating a hybrid model of governance that would combine the best of public and private sector management and better serve Nevada's goals of quality, access, efficiency, and accountability.

The United States may be unique in the world in that we have vibrant public and private systems of higher education. One of the distinguishing differences between these two systems is how they are governed. The private system of higher education is much like the corporate sector in that each institution has its own Board with ultimate fiduciary responsibility for the welfare of the particular college or university. Governance is based on advocacy for the institution and trust in its administration and faculty to provide the best quality possible. Generally speaking, such Boards delegate management responsibility to the campus, specifically the president, and remain at arm's length in terms of daily and yearly operations, reserving to itself the tasks of setting broad priorities and engaging in data-based policymaking in consultation with administration, faculty, and students.

State systems, while intending to operate in a similar manner, too often find themselves beleaguered with governance and management issues rarely encountered in the private college and university sector. The reasons for this are clear. Public colleges and

universities receive significant public dollars from the legislature and are governed in “public trust” usually by an appointed or, in a few cases, by an elected Board. The governor, the legislature, and the Board operate in and for that public trust and all have been given responsibility in differing degrees for oversight of the State’s colleges and universities with the predictable political consequences of competing claims and priorities.

The normal politics of public systems is a significant reality rarely encountered in the private sector but this difference, as experience and research have demonstrated, has made the quest for quality in public systems much more problematic and elusive. Campuses in public systems experience this difference as one of distrust in them and often suffer a paralyzing and demoralizing level of micro-management that results in far less effectiveness and efficiency. This is exactly how Nevada campuses perceive their own situation.

The fundamental lesson from the private sector is that it is possible and desirable to create as parsimonious a system as possible, one that places responsibility for excellence in the hands of professional educators in each institution and then holds them strictly accountable for publicly agreed-to system goals and criteria. One principle to consider using as a guide in making any governance changes is decentralization. Decentralization suggests the importance of giving each campus, through their president, as much autonomy as possible to reach the goals agreed upon between the offices of the president and the chancellor. Regulations are to be eliminated or reduced wherever possible. Increased accountability through assessment and a statistical information system hosted on an Internet-based technology platform will give the Regents the possibility to manage the University and Community College System in an improved manner.

An elected Board of Regents is mandated by Nevada’s Constitution, and thus the State must construct its educational system in the context of its own history and needs. Yet, there are myriad possibilities for improving the Board of Regents governance structure for the future, and we recommend two such models for consideration during the Board’s strategic planning process.

### **Option 1: Multiple Boards**

This model is patterned after a number of other states in which separate boards of trustees are created for each university and a third board for all of the community college and four-year colleges. These Boards would be originally appointed and then self-renewing. The current Board of Regents would be reduced in size to perhaps five members and elected state-wide to serve a coordinating function and help establish broad-based higher education policy in consultation with the Chancellor, legislative leaders, the Governor, and the new Boards of Trustees. The principle here is to maximize decentralized authority as suggested in the private sector model yet maintain the constitutionally mandated Board of Regents in an important macro-policy formulation role.



## **Option 2: A Board of Regents With Both Elected and Appointed Members**

While a move to a completely self-perpetuating, appointed Board, as is the case in the private sector, offers particular advantages, amending the Constitution for this purpose would be very difficult if not impossible. Thus, we suggest consideration of a Board comprised of eleven members, four elected and seven appointed. The key here is to create an election and appointment process that would be perceived as politically diminished as possible.

We note here, that in most states, Boards are appointed either by the governor or the legislature but that this too has often been politically problematic. Nevada might consider the creation of a Blue Ribbon Nomination Commission whose sole purpose would be to nominate potential candidates for the Board to the governor or to the Board itself for appointment. Indeed, such a commission might also screen nominations for election.

These are but two out of many possible examples. Nevada has a unique opportunity. With a relatively youthful system and buoyant future, it has the potential to do what few other states have been unable to do --to create a hybrid-- a public higher education system that incorporates the virtues and benefits of both the public the private sectors' governance models.

## **Part II**

### **Achieving the Access Goals of Nevada Higher Education**

One of the most pressing issues facing Nevada higher education is contending with the large population increases Nevada expects over the next decade. RAND was asked to explore the possible ramifications of various levels of increased undergraduate enrollment. For this purpose, we employed computer models that project enrollment and other attributes of Nevada's higher education system into the future, based on Nevada's projected demography and data on the current flows of students through Nevada higher education. Because the future is often highly unpredictable, we consider a wide range of scenarios and report conclusions robust across these scenarios. Such an "exploratory modeling" process can be useful for strategic planning because it reveals the key driving forces and tradeoffs any strategy must address. It can also allow decision-makers to "test drive" choices across key scenarios before committing to action.

The findings of our exploratory modeling exercise strongly suggest that Nevada must make significant changes in its higher education system to meet its goals in the face of rapid population growth. Accommodating this population growth within the current structure could require heroic increases in the rates at which students enter and progress through existing institutions. Changing the structure of the Nevada higher education system can meet goals with other, less aggressive changes.

These findings confirm the qualitative assessment discussed in the first part of this draft report that the Regents need a strategic plan, a road map giving them stronger decision-making tools and a logic for the management of growth.

Goal	Definition	Current Performance	Benchmark		
			10 Largest States	WICHE States	All 50 States
Access	Enrollment per Population	4.1%	5.1%	4.9%	4.2%
Attainment (BA)	Annual BA Degrees per Population	0.19%	0.26%	0.36%	0.29%
Attainment (AA)	Annual AA Degrees per Population	0.08%	0.17%	0.20%	0.17%
Diversity	Black & Hispanic enrollment per Population / White enrollment per population	0.58	0.89	0.82	0.84

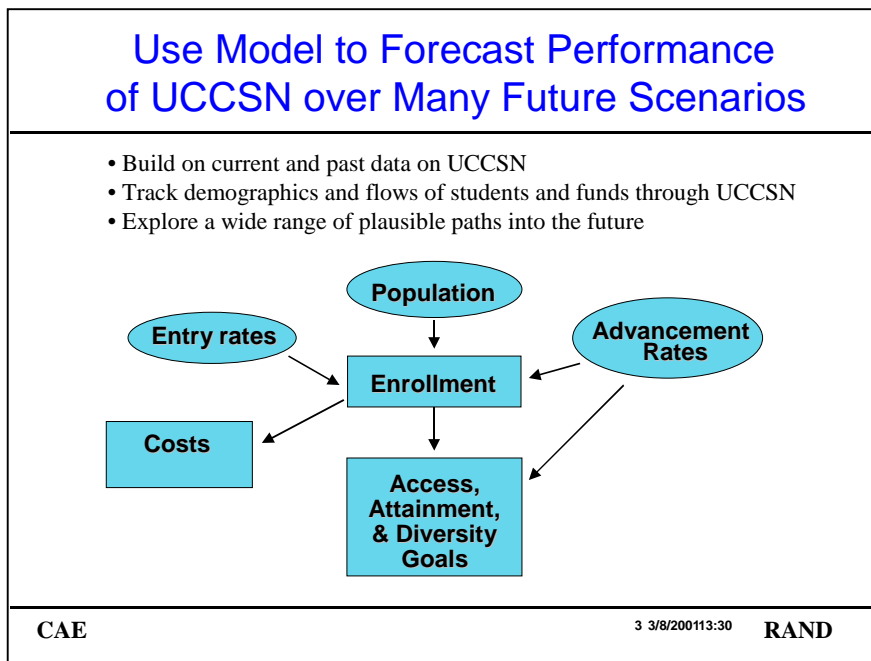
**Table 1**  
**Some Goals for Nevada Higher Education**

Nevada must set clear goals for its higher education system to successfully manage its growth. We choose four goals for the modeling exercise (Table 1), based on our discussions with decision-makers and stakeholders throughout the system. These are **Access**, which we define as UCCSN enrollment as a fraction of the Nevada population; **Attainment (BA)**, which we define as the annual number of bachelors degrees awarded as a fraction of the population; **Attainment (AA)**, which we define as the annual number of associate degrees awarded as a fraction of the population; and **Diversity**, which we define as the ratio of the enrollment of Hispanics and African Americans as a fraction of Nevada’s Hispanic and African American population to the enrollment of whites as a fraction of Nevada’s white population.

All four of these goals relate to Nevada’s ability to provide equal opportunity to its citizens. The two Attainment goals are particularly relevant to Nevada’s ability to build a vibrant, diversified economy.

At present, Nevada is behind other states for each of these goals. The above table compares Nevada’s performance to the averages for the nation, the Western Interstate Commission for Higher Education (WICHE) states, and the nation’s ten largest states for each of these goals. Nevada scores a 4.1% on the access goal, compared to 4.9% for the WICHE states; 0.19% and 0.08% on the BA and AA Attainment goals, compared to 0.29% and 0.17% for the national average; and a 0.58 for the Diversity goal, compared to the WICHE score of 0.82. In this report, we will use this mix of WICHE and national benchmarks (shaded gray in the above table) as the goals for Nevada higher education over the next ten years. However, this choice is illustrative. The goals for Nevada education can only be set by its elected leaders.

In addition, these four goals do not exhaust the full set of goals Nevada should use to manage its higher education system. For instance, quality is an important goal we do not explicitly consider in our modeling exercise. We implicitly assume it stays at least constant across all the scenarios we consider.



**Figure 1**  
**The Model**

We use a computer simulation model to project the performance of UCCSN, assessed by these goals, from the present through 2010 over a wide range of future scenarios. The model uses data and projections for Nevada’s population to determine the pool of people who need to be served. The model calculates the rate at which individuals enter Nevada higher education and then advance through the system based on data from the various institutions. We project future enrollment and degrees based on various assumptions about how these rates may change in the future and what capacity constraints may affect the systems. From these projects we assess UCCSN’s performance according to the various goals. The Appendix describes the model in more detail. We use this model to create a wide range of plausible future scenarios for Nevada higher education. The model ensures that each future is consistent with the available data and basic “accounting” facts we know for certain hold in the future. For instance, students must either remain in the system, drop out, or graduate. Institutions must have the capacity to support their enrollment.

**Rationale for Development of Scenarios**

We create multiple scenarios because everyone knows that any specific ten-year forecast is likely to be wrong. It is easy to find faulty assumptions behind any such forecast, inviting debates over the “trees” at the expense of the “forest.” As an alternative, we show “maps” of many plausible futures and look for patterns that are robust across all the paths Nevada might take into the future. These maps should help Nevadans focus on **key** issues that their higher education system will face.

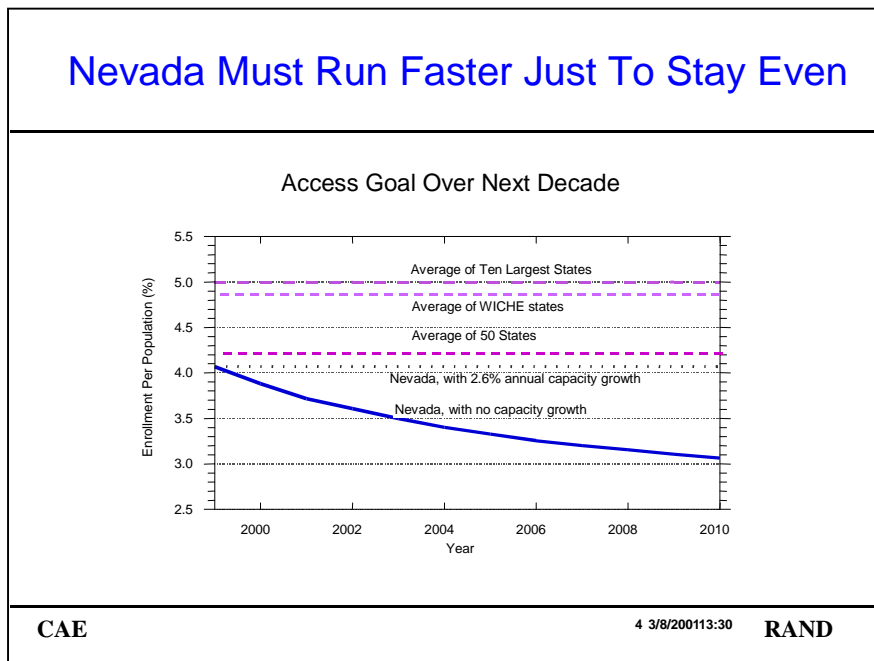
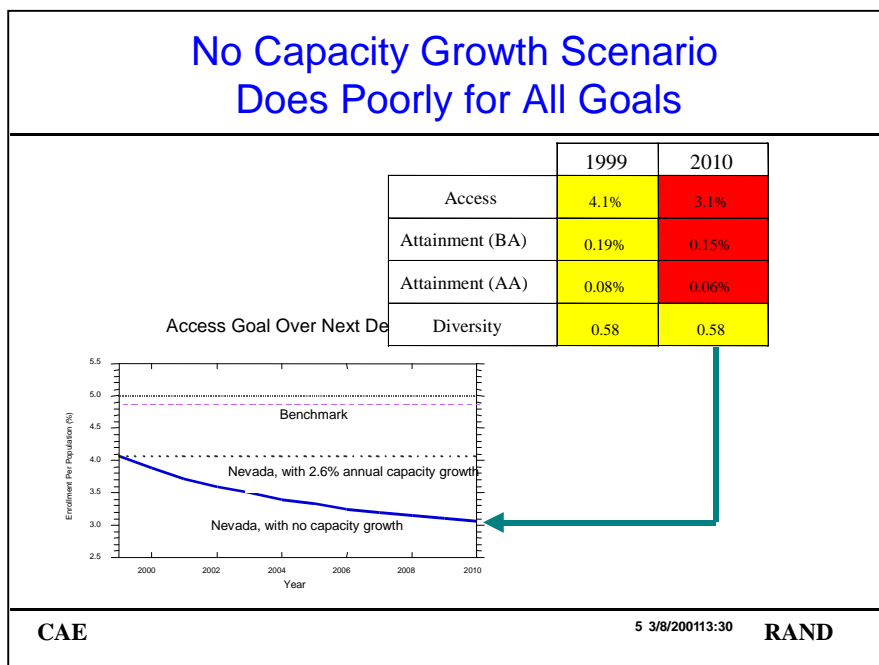


Figure 2

The first message from our analysis is that with Nevada’s large expected population growth over the next decade, UCCSN must move faster just to stay even.

Figure 2 tracks access to UCCSN through 2010, assuming there is no increase in capacity, so that total enrollment stays constant. This scenario is not likely, but it provides an important comparison to the challenging actions scenarios where Nevada takes aggressive action to improve access, attainment, and diversity.

In the no-capacity growth scenario, access falls from the current 4.1% of the population to 3.2% of the population, reflecting the projected 33% population growth over that period. In order to keep access at its current 4.1%, and assuming all else remains the same, UCCSN must increase its capacity by 2.6% annually over the decade. Even with such aggressive expansion, access to Nevada higher education will still remain below the WICHE-based goal of 4.9%, as well as the national and ten largest states’ averages.



**Figure 3**  
**No Capacity Growth Scenario**

Not surprisingly, Nevada also fares poorly in the other goals in this no-capacity growth scenario.

Here (Figure 3), we show a color-coded scorecard for each of the access, attainment, and diversity goals. In 1999, we label Nevada’s current levels with yellow. In 2010 in the no-capacity growth scenario, Nevada drops significantly in both the access and attainment goals, which we indicate by red color, and makes no improvement in diversity, which we indicate by the yellow.

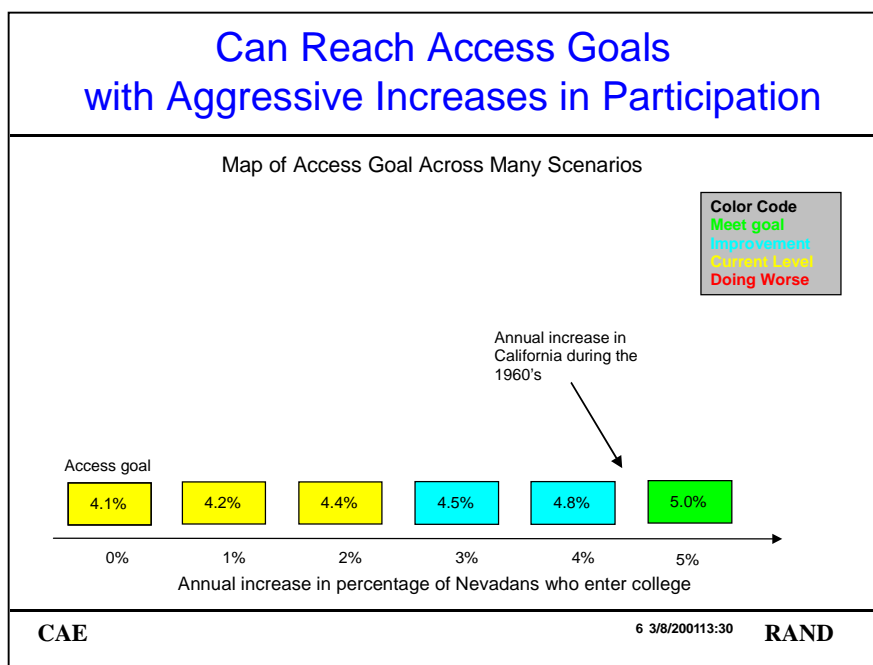


Figure 4

How might Nevada meet access, attainment, and diversity goals over the next decade? To answer this question, we will use our model to create maps of a wide variety of paths Nevada higher education might take into the future. These maps will help the Regents better understand the options available to them.

We begin by considering the access goal. As one important condition for improving access, Nevada must increase the rate at which its citizens access higher education. Currently, this rate is among the lowest in the nation. There are a number of ways to increase participation rates. At a minimum, additional capacity must be made available. Figure 4 shows how much Nevada must increase participation rates in order to achieve access rates similar to those of the WICHE average by 2010. We have color coded each scenario to indicate whether Nevada in 2010 has reached the goal (green), made significant improvements short of the goal (turquoise), remained at or near current levels (yellow), or is doing worse (red).

We assume here that additional capacity is made available by growing the current system, rather than make any significant changes in its structure. If participation rates stay the same, access will remain relatively constant at 4.1% in 2010. Participation must grow at roughly 5% per year to achieve the average level of other states. This is an aggressive rate of increase, even more than needed to absorb the doubling of the number of high school graduates expected in Nevada over the next decade. To put this increase in context, we note that during its heyday expansion from 1964 to 1970, California increased the percentage of its residents entering its higher education system by 4.4% per year.

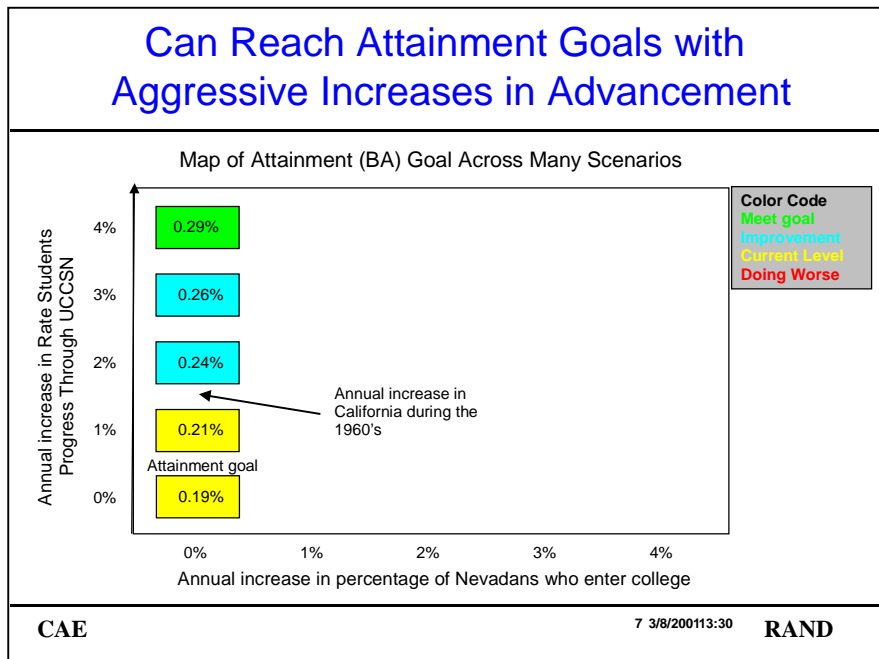


Figure 5

Next we consider the attainment goal. One of the most effective means to increase the number of Nevadans who leave UCCSN with the skills needed for the new economy is to increase the rates at which students already in the system move through the system and then go on to graduate. The more entering students who eventually leave with a degree, the less capacity the system needs to produce each degree.

Figure 5 shows how much Nevada must increase such advancement and graduation rates from their current levels in order to achieve levels of BA attainment similar to the national average by 2010. As before, we have color-coded each scenario to indicate whether Nevada in 2010 has reached the goal (green), made significant improvements short of the goal (turquoise), remained at current level (yellow), or is doing worse (red). Nevada must increase these advancement rates by 4% a year in order to meet these BA attainment goals by 2010. To put this increase in a comparative context, we note that from 1964 to 1970, California increased the rate at which students advanced through its public higher education system at about 1.3% per year. Could Nevada increase advancement rates at a 4% per year level? It would appear to be very difficult to achieve.



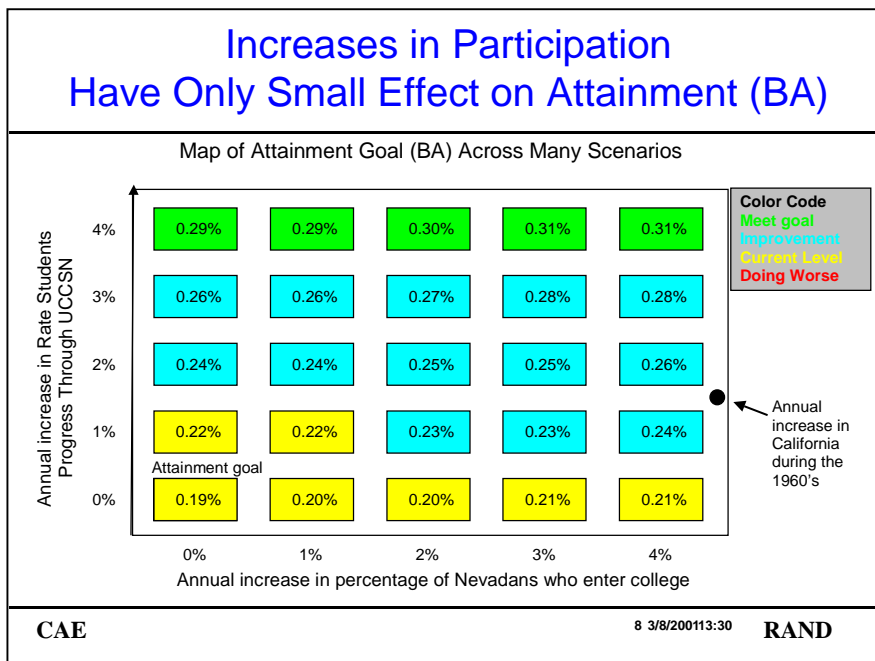


Figure 6

It is important to understand whether any particular actions serve one goal or several. Does increasing participation rates also improve attainment? Only a little. This map, Figure 6, shows the impact of increasing advancement rates on Nevada’s BA attainment performance in 2010. Increasing participation rates only have a small impact on Nevada’s performance on attainment.

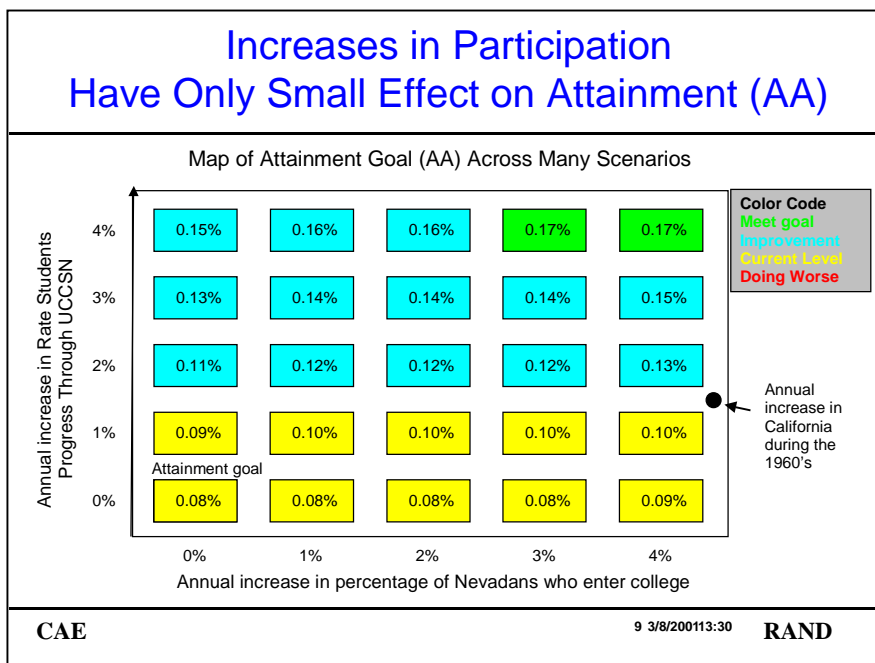


Figure 7

Figure 7 shows similar results for the AA attainment goal. This goal focuses on the performance of the community colleges. We see that Nevada needs significant increases in both advancement and participation rates to meet the goals for AA attainment. The AA attainment goals are harder to reach than the BA attainment goals because Nevada’s current AA performance is further from the national average.

(It is important to note, however, that an AA degree is not the only goal of students attending community colleges. For instance, some students attend seeking particular skills that they can gain in one or two classes. Currently available data does not support a computer model with performance measures based on addressing such student needs. If such data were available, it could support a richer view of future community college performance.)

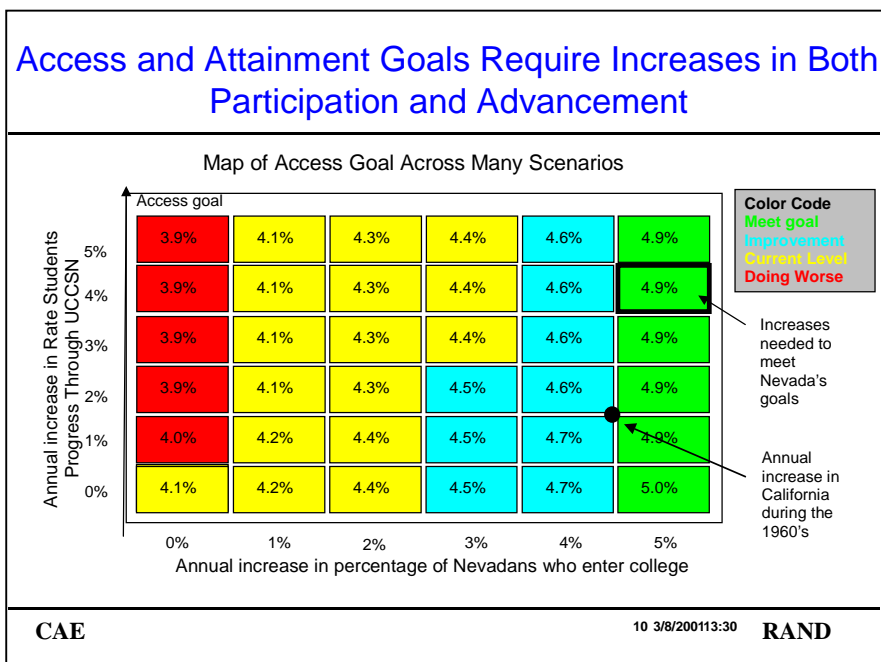


Figure 8

Increasing advancement rates have even less impact on Nevada’s access goal. Figure 8 shows the impact of increasing both the advancement rates and the percentage of Nevadans who attend college on Nevada’s access goal in 2010. Note that increasing advancement rates can decrease enrollment because students may spend less time in school. This may free up capacity, but only helps access if participation rates also increase.

Comparing Figure 8 with the previous two figures, we see that, all other things being equal, Nevada must increase participation rates by 5% per year and advancement rates at 4% per year in order to meet its access and attainment goals by 2010. This is a very aggressive rate of improvement and success, which is problematic. By comparison, during its 1960s expansion, California’s higher education system only increased participation and advancement rates, respectively, by 4.4% and 1.3% annually.

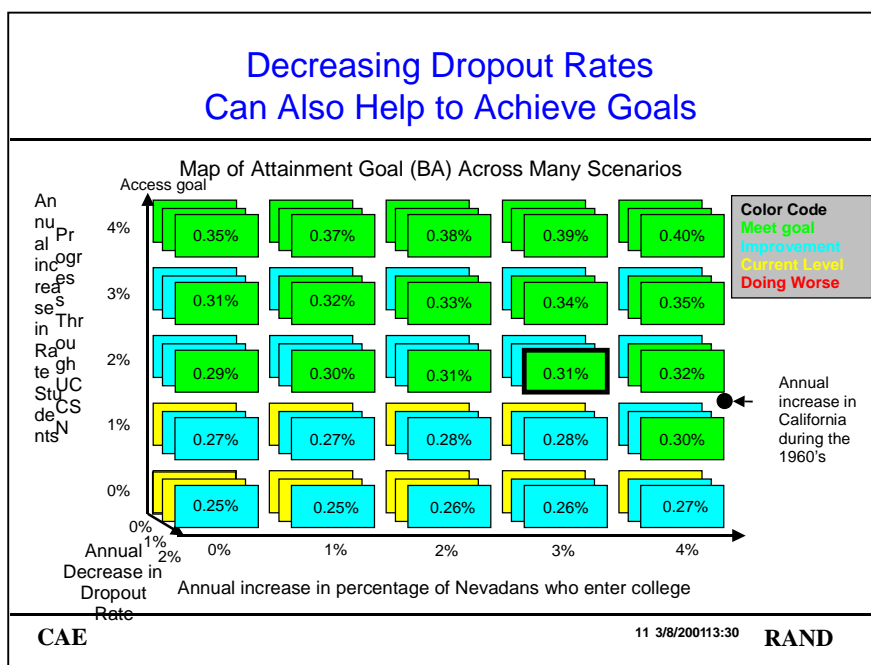


Figure 9

There are various ways Nevada might ease the task of meeting its access and attainment goals. Figure 9 suggests one possibility -- reducing the dropout rate in addition to increasing participation and advancement rates.

This chart shows the impact of increases in participation rate (horizontal axis), increases in advancement rates (vertical axis), and decreases in dropout rates (axis going into the page) on BA attainment in Nevada higher education in 2010. As shown by the scenario with the thick border, if the dropout rate also decreases at 2% per year, Nevada could meet its BA attainment, as well as its AA attainment and access goals by increasing its participation rates by 3% per year and its advancement rates by 2% per year. This is still a significant challenge, but much closer to that met in the past by other states.

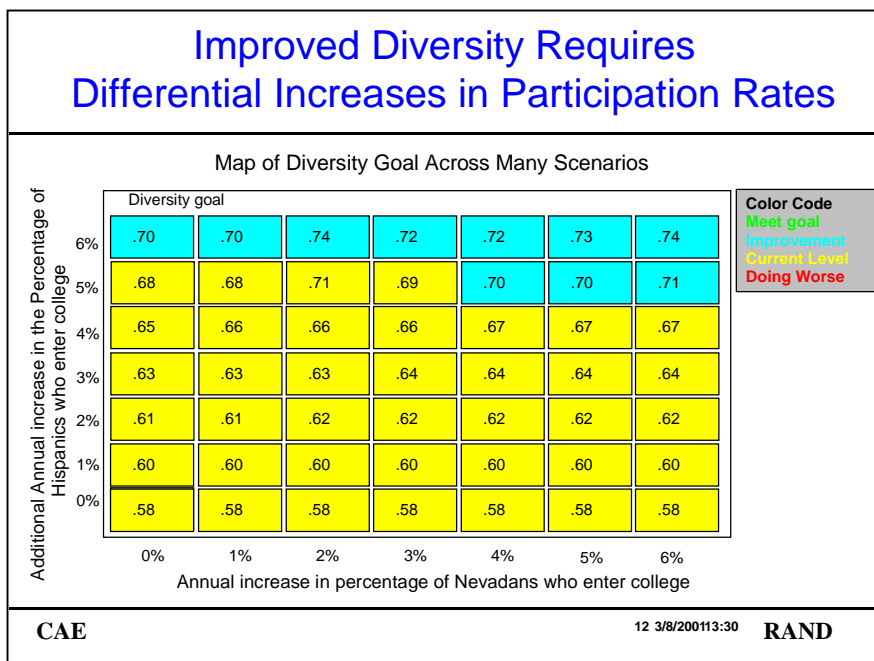


Figure 10

Now we consider the diversity goal. Significant improvements in diversity require additional increases in the participation rates of Hispanic and other individuals who currently enroll in college at rates less than whites, above and beyond any increases in the participation rates for the entire population.

Figure 10 shows the impact of increasing, across the board, participation rates and of additional increases in Hispanic participation rates, on Nevada’s diversity goal in 2010. This map shows that it will be very difficult for Nevada to reach parity with the other WICHE states in diversity by 2010. Increasing annual Hispanic participation rates by 6% more than general participation rates provides significant improvements, but does not achieve the goals.

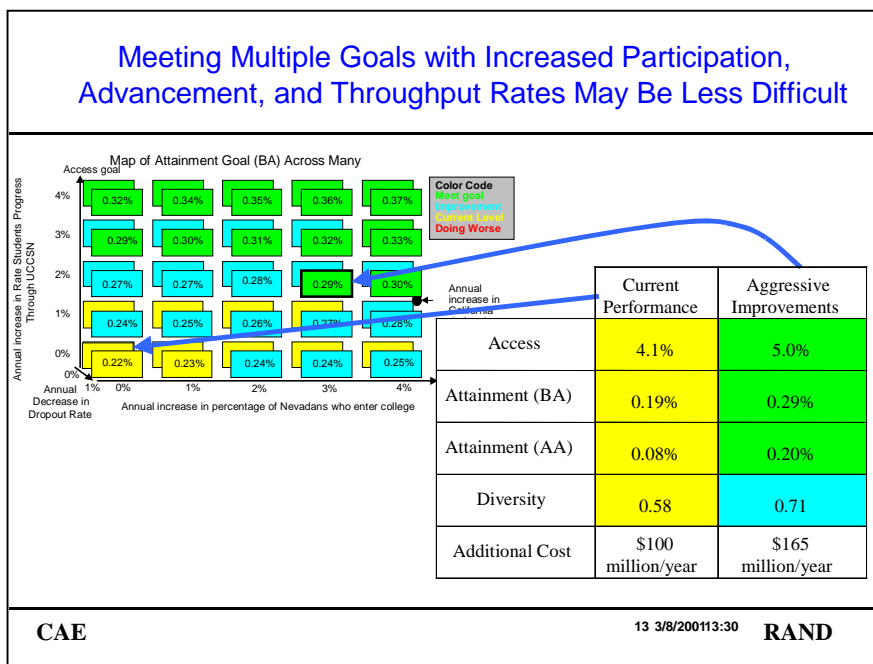


Figure 11

Summarizing the information on the previous charts, we see that Nevada can significantly improve its access, attainment, and diversity performance by sustaining large annual improvements in participation, advancement, and dropout rates. However, such large sustained improvement rates could be extremely difficult to achieve. Meeting the access and attainment goals without major changes to the UCCSN system -- that is meeting goals only by improving advancement, participation, and dropout rates -- may be very challenging.

Here, Figure 11 shows a color-coded scorecard for each of the four access, BA attainment, AA attainment, and diversity goals. The inset map combines the maps on the previous pages with the access goal at the top of each box and the advancement rate goal at the bottom of each box. We also assume that annual Hispanic participation rates increase, and Hispanic dropout rates decrease, at twice the rate of the general population. The scenario in the lower left-hand corner is the current system with no changes in participation and advancement. As we have seen, it shows no improvement in access, attainment, or diversity. Nonetheless, it requires an average budget increment of \$100 million. The scenario in the upper right-hand corner meets both access and attainment goals with 3% annual increases in participation rates and 2% annual improvements in advancement and dropout rates. In this scenario, Nevada reaches in 2010 the access and attainment goals shown in slide 2 and shows significant improvement in diversity. This scenario requires a budget increment that averages roughly \$160 million per year over the coming decade. Depending how the capital costs are financed, this represents a roughly 7% per year increase in the state contribution to higher education. This figure is consistent with recent ten-year forecasts by the Governor's Office.

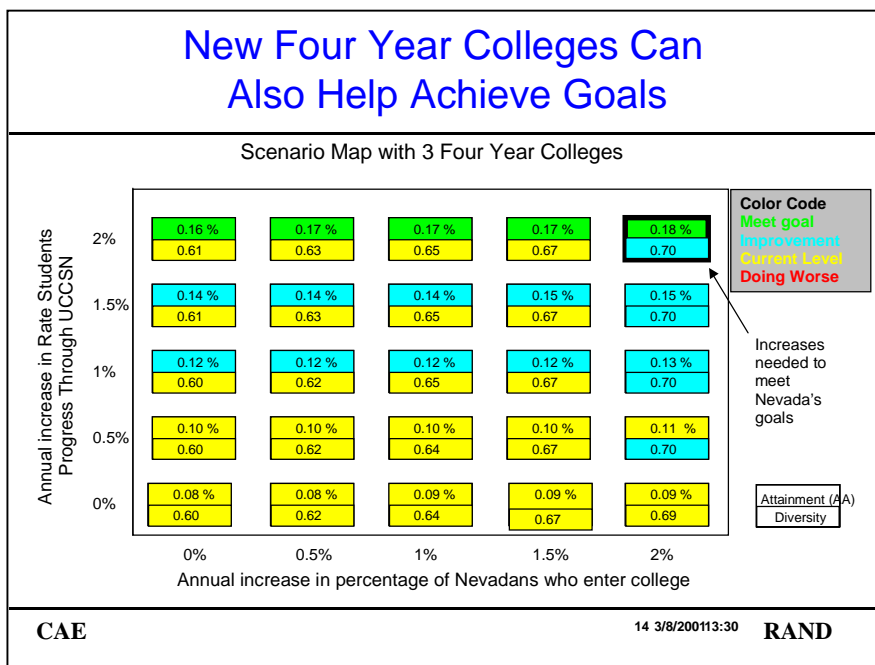


Figure 12

The scenarios we have considered up until now all assume that the current structure of UCCSN remains the same. Now we consider the potential impact of adding four-year colleges to the Nevada system. We assume each college would have a capacity of 10,000 students (headcount) and would begin with advancement rates similar to other such institutions nationwide and participation rates about half those of similar institutions nationwide. Currently Nevada universities and community colleges have about half the participation rates of similar institutions in other states.

Figure 12 shows the impact on Nevada’s attainment and diversity goals in 2010 in a scenario where Nevada builds three such four-year colleges over the next decade, all serving the southern portion of the state. We illustrate these two goals, because they are the most difficult to achieve. These new four-year colleges offer significant improvement in Nevada’s performance on these goals. Even if participation and advancement rates remain unchanged (lower left-hand corner), Nevada’s performance improves compared to the scenario with these new colleges. If participation and advancement rates both increase by 2% annually, Nevada’s access reaches parity in AA attainment with the national average and significant improvement in diversity by 2010. With these increases, it will also reach parity in access with WICHE averages and in BA attainment with the national average.

Building three four-year colleges is clearly one of many such options. The best plan will depend on numerous factors, many of which are not treated in the model. The map shows how the AA attainment and diversity goals will vary as participation and advancement rate change. We assume that Hispanic participation rates increase, and Hispanic dropout rates decrease, twice as fast as the rates for the general participation rates, and that increases in participation at the four-year colleges decrease participation at the universities. These scenarios achieve the goals at relatively low additional cost.

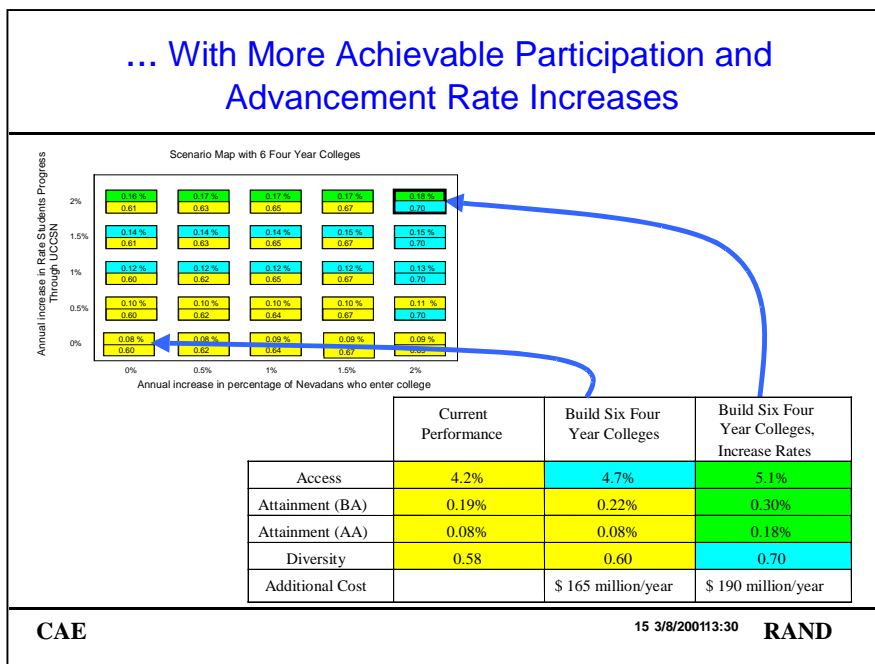


Figure 13

Here, Figure 13 compares a color-coded scorecard for each of the four access, attainment, and diversity goals for the scenarios with six new four-year colleges with UCCSN’s current performance.

In the scenario with no changes in advancement and participation rates, UCCSN still achieves significant improvements in access and modest improvements in attainment and diversity. The cost averages \$165 million above the current UCCSN budget.

In the scenario where advancement and participation rates improve by 2% annually, UCCSN meets the access, BA attainment, and AA attainment goals, and significantly improves diversity with an average budget increase of roughly \$190 million per year over the next decade.

**Conclusion**

These scenarios will not be easy to achieve. They involve significant increases in spending and significant increases in the performance of existing institutions. But for roughly the same costs, these scenarios achieve Nevada’s goals with more realistic increases in the participation and advancement rates of existing Nevada institutions. We have used our computer models to look over a very wide range of scenarios. The message that consistently emerges is the same as that seen in the comparisons here. Nevada higher education faces impressive challenges and meeting these challenges with bold changes may be less challenging than attempting to meet them with incremental changes to the current system.



## **Part III**

### **Summary: Issues, Options, and Action Items**

#### **Specific Issues and Options**

- **Quality and Access.** How should the goals of access and quality be balanced and achieved? This question grounds the visioning discussions in the initial part of the strategic planning process. The issues of quality and access are in tension with great cost implications. Such a discussion should include as much as possible a group of wide-ranging leaders within and outside the higher education system. A Blue Ribbon Commission working in tandem with, for example, a subcommittee of the Board of Regents and Chancellor may be appropriate here.
- **Efficiency and Accountability.** Efficiency and accountability need to be defined and structures put in place that are clear, fair, and parsimonious.
- **Develop an effective assessment of student learning** by focusing on the consequences of productivity improvements on the outcomes of student learning.
- **Expand and change the current two-tier mission differentiation** by developing four-year institutions and making clear mission distinction between research and teaching institutions.
- **Adopt a number of finance reforms to improve access and quality.**
- **Separate the funding of research from instruction.**
- **Refine the funding formula by focusing on how to improve access and quality** through a program budgeting model.
- **Reevaluate the fee setting structure by changing fees, e.g., consider changing to a higher fees/higher aid strategy and make setting of fees more transparent.**
- **Alter student financial aid by considering the adoption of a need-based financial aid program** in addition to the Millennium Scholarship program.
- **Governance.** Adopt private higher education governance model principles by creating as simple a system as possible, one that is decentralized, and in the hands of professional educators who are held accountable for the goals set for their institutions.

## **Action Items for Board Consideration**

*Strategic Planning and Priority Setting Process.* In order to begin the strategic planning task we recommend a visioning process and the creation of a statistical information system.

### **Visioning Process**

In order for the Regents to develop a successful strategic plan that responds to the issues raised above, there must be agreement on the contours of the current system of higher education in Nevada. There must be an underlying consensus on a vision for the goals the University and Community College System of Nevada should pursue. By vision, we mean an organization's unique sense of its identity and shared sense of purpose. As Nevada leaders think about the future, what role should the University and Community College System play? For example, if the state as a whole, rather than a region, is the unit to be served by each institution, then the Regents must describe the whole system entity as comprehensive and coherent even while they need to justly address legitimate and pressing regional needs.

### **Statistical Information System**

In order for an effective strategic planning and priority setting process to even be contemplated, one must have a statistical profile of the academic programs of the higher education sector. This will allow an assessment of where overlap and duplication in academic programs exists, and where academic programs key to Nevada's future should be developed, as for example, suggested by the Battelle Study. Such a profile is needed by the Regents to make any decisions regarding budgetary adjustments from one part of the system to another.

The most appropriate place to locate the statistical information system is within the Chancellor's office. The Chancellor's office is the only clear neutral site where statistical data deemed legitimate by all constituencies in the higher education sector could reside. The statistical information system can be collected and accessed via an Internet web-based system to the benefit of everyone associated with Nevada higher education. (We have examples of such statistical information systems.)

## **Appendix A**

### **Development of Value Added Measurement of Undergraduate Education**

#### **Phase I: Experimentation, Incentives, and Rewards**

Nevada has an opportunity to play a lead role in an emerging coalition of states that are joining together to implement the value added approach. Hence, Nevada faculty, administrators, and staff members of the Office of the Chancellor of the Higher Education and Community College System of Nevada would work with their colleagues in other states to do the following:

In the first phase, value added measures need to be borrowed and/or developed and experimented with by faculty and administrators in a variety of colleges and universities within and across states. There is a wealth of material available but not widely known or shared. The goal in this phase is to establish an appreciation for a culture of evidence of learning within the institutions. Faculty and staff must develop confidence in the system of value added measures they develop that will provide them with the way to engage in continuous improvement of curriculum and pedagogy.

Given the barriers described above, the state may wish to create a program for the development of a value added assessment system. Crucial to any such endeavor, however, is the need to provide appropriate incentives for the institutions and the faculty, with significant rewards to encourage experimentation and develop trust in the state's motives.

#### **Phase II: Development and Diffusion**

Through a process of trial and error, state policymakers and higher education leaders eventually reach a confidence level in the system of measures developed within institutions. These can then be widely shared among institutions – a diffusion of best practices phase. As the usefulness of the value added measures is established, some institutions will want to publicly record their progress as individual institutional benchmarks become articulated. This allows for a statewide conversation to begin about the standards and expectations appropriate to each institution's mission. Individual states may wish to establish commissions or committees under the aegis of their governors, legislative higher education committees or higher education coordinating boards, to lead these studies, establish benchmarks, and report progress. The key here is to develop a coalition of academic and state system partners.

#### **Phase III: Comprehensive Assessment System Development and Implementation**

In this phase, well-defined outcomes for general education and majors, performance measures of those outcomes, and a significant sample of students to be assessed are agreed to across the state system of higher education. Data are collected and utilized by each institution for internal educational program improvement.

#### **Phase IV: Value Added Data Used to Inform State Policy**

Once individual institutions are comfortable in the development and use of an assessment system for educational improvement purposes, the state, with value added data, can craft policies that better inform questions of quality, cost, accountability, and productivity. A number of productivity enhancements could be implemented linked to an evaluation of the costs and benefits of the enhancements as they impact student learning. For example:

- 1) One could provide incentives for faculty and define and evaluate faculty productivity in terms of student learning as well as research performance. This is particularly relevant to non-research colleges and universities where research incentives are not primary.
- 2) One could begin to better evaluate mission differentiation among the state's colleges and universities on the basis of student learning as a variable in the reallocation of system resources.
- 3) One could compare the cost-effectiveness of distance learning compared to similar content taught on campus.

At the risk of repetition, a final caution. Assessment of value added requires a radical cultural shift within higher education, a great deal of time, effort, cooperation, risk-taking, and funding. It takes more time, more skill, more trust at all levels, and more safeguards than are currently extant. It is, however, an investment with potential large payoff because, for the first time, many proposed changes would be evaluated against their positive or negative impact on student learning.

## Appendix B

### The Planning and Priority Setting Process: Goals and Criteria for Evaluation

The fundamental goal of the planning process is to provide the office of the Chancellor and Regents with a detailed understanding and appreciation of each institution's academic priorities. The results of the planning process will be used by the Regents to preserve programs of nationally and regionally recognized excellence and to improve programs that have already demonstrated high quality and potential to continue. Additionally, the results may be used to improve commitments to other existing programs or authorize new ones and to authorize new higher education institutions that are aligned with the goals of the Regents.

Basic priorities among academic programs will be developed through specification of the following comparative evaluation criteria for use in the Nevada context:

**Quality:** Inevitably a subjective measure, quality includes the quality of the faculty (in teaching, research, and service as reflected in peer national or regional ratings), the quality of the students, library collections, and so on.

**Centrality:** Each program should be evaluated in terms of its contribution to the college and University and Community College System mission: specifically, the degree to which the program is an essential component of a challenging liberal, pre-professional, or professional education which instills an understanding of the major ideas and achievements of humankind and a sense of the values of our own and other cultures and ages. Moreover, each program should be evaluated in the context of its contribution to the college or University and Community College System's goal, for example, of providing equal opportunity to all of the citizens of the state.

**Demand and Workload:** Both short and long term demands (increasing, stable, or declining) for each program should be considered. Demand indicators might include applicant flow rates, quality of acceptances, services performed in support of other programs, instruction of students and/or research for the solution of pressing problems, and the prospective market for graduates. If a program has incurred a substantial decline in workload, the program should be asked to justify its existence and its budget.

**Cost Effectiveness:** Because aspirations are always limited by the resources available, programs must be continually examined to see if more economical or more efficient ways are possible to accomplish the same ends. Yet, cost alone must not govern the decision: The effectiveness of the program must also be weighed. When taken together, cost and

effectiveness provide one important measure of whether funds are being put to the best use.

**Comparative Advantage:** What is the rationale for the program at the college? What are the unique characteristics of each program that make it essential to the community, region, state, and or other University and Community College System programs?

Assuming the Regents have a map of the existing academic priorities of all elements of the University and Community College System, they will then be in a position to use the comparative evaluation criteria, minus the quality criterion not yet pertaining to new institutions. As the overall enrollment in Nevada's higher education system approaches 200,000 over the next several years, it will be important to gauge the pressures for enrollment increases that will be most severe in the Las Vegas area.

Each time a new campus is contemplated, the questions associated with the comparative evaluation criteria should be examined carefully. The potential comparative advantages of the proposed campus should be weighed in terms of its potential contribution to the mission and goals of the overall University and Community College System. And this will mean comparing the potential benefits and costs of establishing a new campus with the benefits and costs of using the same scarce resources to fund other top system priorities.

## APPENDIX C

### DESCRIPTION OF DATA AND COMPUTER SIMULATION MODEL

This appendix describes the data and computer simulation model we use to project the performance of UCCSN, as measured by the goals of access, attainment, and diversity goals, over the course of the next decade in a wide variety of scenarios.

#### DESCRIPTION OF DATA

Most of the data used in this effort was provided to us by the state of Nevada, the UCCSN staff and by the individual UCCSN campuses. In some cases where the required data was not available, we used analogies to other states, as described in detail below.

#### Region

In our model we divide Nevada into two geographic regions: North and South. The counties included in the northern region are Carson City, Churchill, Douglas, Elko, Eureka, Humboldt, Lander, Lyon, Pershing, Storey, Washoe and White Pine. The counties included in the southern region are Clark, Esmeralda, Lincoln, Mineral and Nye. One university and three community colleges are located in the northern region: University of Nevada, Reno (UNR), Great Basin College (GBC), Truckee Meadows Community College (TMCC), and Western Nevada Community College (WNCC). One university and one community college are located in the southern region: University of Nevada, Las Vegas (UNLV), and Community College of Southern Nevada (CCSN).

#### Population projection

We estimate the population projection at a cohort level that is broken down by three ethnicities, two genders and two regions between 2000 and 2010 based on the population projection at county level made by the Nevada State Demographer's Office.<sup>1</sup> We estimate the population projection at cohort level simply by multiplying the 1) population projection at region level (this is the sum of population projection at county level), 2) projection of population share of each ethnicity, and 3) projection of population share of each gender.

$$\begin{aligned}
 &Pr\ oportionofGivenEthnicityandGender(Year, Ethnicity, Gender) \\
 &\approx Pr\ oportionofGivenEthnicity(Year, Ethnicity) \times Pr\ oportionofGivenGender(Year, Gender) \quad (1) \\
 &Population(Year, Re\ gion, Ethnicity, Gender) \approx Population(Year, Re\ gion) \\
 &\quad \times Pr\ oportionofGivenEthnicityandGender(Year, Ethnicity, Gender)
 \end{aligned}$$

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<sup>1</sup> Two data sources are "Nevada County Population Projections 2000 to 2010", June 2000, prepared by the Nevada State Demographer's Office for the Nevada Department of Taxation in Conjunction with the Nevada Small Business Development Center, and "Nevada Age Sex Race and Hispanic Origin Estimates and Projections 1990 to 2010" June 2000, prepared by the Nevada State Demographer's Office for the Nevada Department of Taxation in Conjunction with the Nevada Small Business Development Center.

The assumption is that 1) the proportion of population in terms of ethnicity is the same in the northern and southern regions, 2) the proportion of population in terms of gender is the same in the northern and southern regions, and 3) the gender proportion is the same in all ethnicity categories as the Nevada state average. "White not of Hispanic origin," "American Indian, Eskimo, or Aleut not of Hispanic Origin" and "Asian or Pacific Islander not of Hispanic Origin" are included in the "white and others" category used in our model; "Black not of Hispanic origin" is in the "black" category, and "Hispanic origin of any race" is in the "Hispanic" category. See figure 1 on population projection in each region, and figure 2 on projection of population share of each ethnicity category.

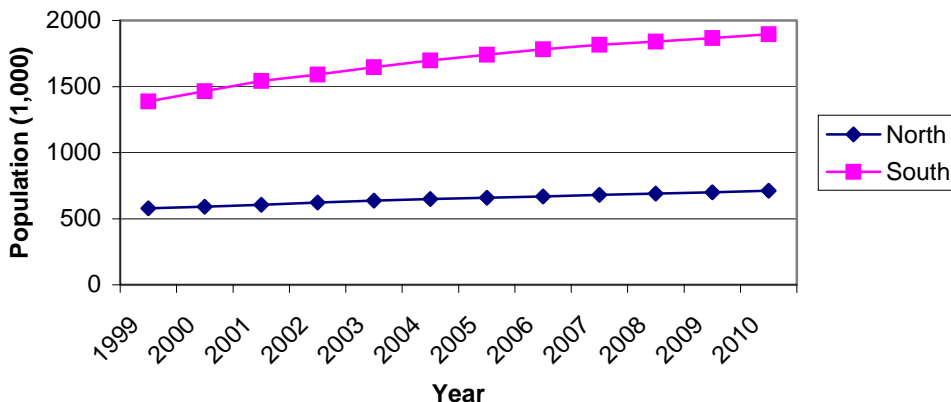


Figure 1--Population Projection in Nevada (North and South region)

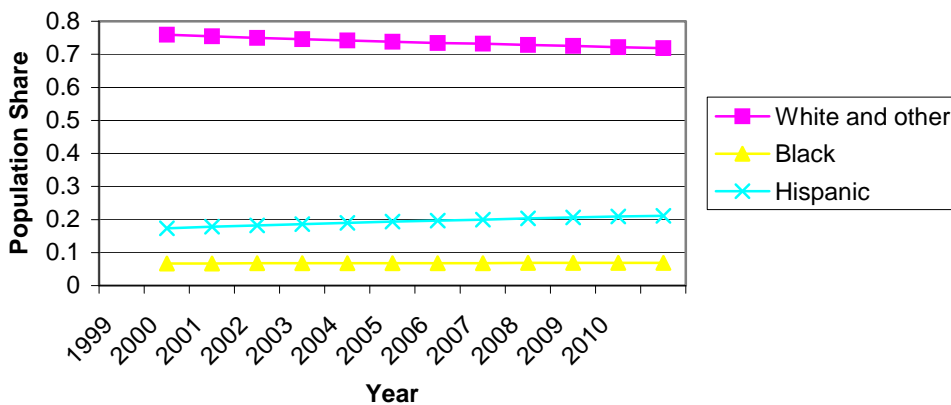


Figure 2--Population Projection in Nevada (Ethnicity)



## First-time Freshmen

The number of first-time freshmen (headcount) at each institution in 2000 was obtained from the UCCSN. As for universities, we count degree-seeking first-time students, and as for community colleges we count both degree-seeking and non-degree-seeking first-time students. Since we neither have direct information regarding from which region (North or South) those first-time freshmen derive, nor their ethnicity and gender category, we estimate the number of first-time freshmen at cohort level by using the data on ethnicity and gender composition of total enrollment at each institution.

$$\begin{aligned}
 &Pr\ oportionofGivenEthnicityandGender( Institution, Ethnicity, Gender ) \\
 &\approx EnrollmentofGivenEthnicity( Institution, Ethnicity ) / Enrollment( Institution ) \\
 &\quad \times GenderShareofNevadaHigherEducation( Gender ) \qquad (2) \\
 &FirstTimeFreshmen( Institution, Ethnicity, Gender ) \approx FirstTimeFreshmen( Institution ) \\
 &\quad \times Pr\ oportionofGivenEthnicityandGender( Institution, Ethnicity, Gender )
 \end{aligned}$$

The "White" ethnicity category includes "White," "Asian/Pacific Islander," "Non-resident alien," "American Indian/Alaskan Native," and "Unknown." The "Black" category includes "Black," and the "Hispanic" category includes "Hispanic." We assume that 1) the share in terms of ethnicity and gender are the same between first-time students and total enrollment at each institution, and 2) the gender proportion is the same across all ethnicity groups and all institutions as that for total enrollment in Nevada; that is, 55% female and 45% male. We also assume that 4%<sup>2</sup> of first-time students come from other regions, that is, from the northern region for institutions located in the southern region and from the southern region for institutions located in northern region.

## Enrollment

We obtained enrollment data for each institution from the UCCSN. The data are broken down by grade, but not broken down by ethnicity and gender at each grade. Since we have data on ethnicity and gender proportion of total enrollment at each institution, we estimate enrollment at cohort level by multiplying enrollment of each grade with ethnicity and gender proportion of total enrollment at each institution. We assume that the proportion in terms of ethnicity and gender is the same for enrollment in all grades.

$$\begin{aligned}
 &Pr\ oportionofGivenEthnicityandGender( Institution, Ethnicity, Gender ) \\
 &= EnrollmentofGivenEthnicity( Institution, Ethnicity ) / Enrollment( Institution ) \\
 &\quad \times GenderShareofNevadaHigherEducation( Gender ) \qquad (3) \\
 &Enrollment( Institution, Grade, Ethnicity, Gender ) \\
 &\approx Enrollment( Institution, Grade ) \times Pr\ oportion( Institution, Ethnicity, Gender )
 \end{aligned}$$

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<sup>2</sup> According to *1999 UNR DATABOOK* (p.93, prepared by Office of Planning, Budget and Analysis, University of Nevada, Reno), among the 1288 high school graduates in 1999 who are enrolled at UNR by fall 1999, 51 students, or 4.0 percent of the students, come from the high school in the counties in southern area (Clark, Lincoln, Mineral and Nye county). We do not have the data on the size of cross-regional enrollment for other institutions.

## Graduates

We have data on the number of graduates for UNR (1,428, 1998-99), UNLV (2,354, 1998-99), TMCC (361, 1997-98) and GBC (164, 1998-99).<sup>3</sup> Since we do not have data on the number of graduates of CCSN and WNCC, we estimate the number of graduates of CCSN and WNCC by assuming that the sum of certificates (153) and associate degrees (1,442) awarded in 1997-98<sup>4</sup> minus the number of graduates from TMCC and GBC gives the number of graduates from CCSN and WNCC. We allocate those numbers between CCSN (906) and WNCC (164) according to the size of enrollment of each community college (33,164 and 5,983). Since we do not have the data on composition in terms of ethnicity and gender of the graduates from each institution, we estimate the number of graduates at cohort level based on the ethnicity and gender composition of total enrollment in each institution. We assume that all university graduates are seniors and all graduates from community colleges are sophomores. See Table 1 on ethnicity composition at each institution.

$$\begin{aligned}
 & \text{Proportion of Given Ethnicity and Gender ( Institution, Ethnicity, Gender )} \\
 &= \text{Enrollment of Given Ethnicity ( Institution, Ethnicity )} / \text{Enrollment ( Institution )} \\
 &\quad \times \text{Gender Share of Nevada Higher Education ( Gender )} \qquad (4) \\
 &\text{Graduates ( Institution, Ethnicity, Gender )} \approx \text{Graduates ( Institution )} \\
 &\quad \times \text{Proportion of Given Ethnicity and Gender ( Institution, Ethnicity, Gender )}
 \end{aligned}$$

**Table 1**  
**Ethnicity Composition of Nevada Higher Education**

	Universities			Community Colleges					System Total
	University of Nevada, Las Vegas	University of Nevada, Reno	University Sub-Total	Community College of Southern Nevada	Great Basin College	Truckee Meadows Community College	Western Nevada Community College	Community College Sub-Total	
white and other	86.3%	93.1%	88.7%	76.1%	93.4%	89.6%	93.0%	81.7%	84.7%
black	6.2%	1.9%	4.6%	9.6%	0.3%	2.0%	1.1%	6.6%	5.8%
hispanic	7.5%	5.0%	6.5%	14.3%	6.4%	8.3%	5.9%	11.7%	9.5%
	100.0%	100.0%	99.8%	100.0%	100.1%	99.9%	100.0%	100.0%	100.0%

## Transfer Rates

We have the data on the number of transfers from community colleges to universities, but do not have the data on their composition in terms of ethnicity and gender. So we assume that their composition is the same as the ethnicity and gender composition of total enrollment of each community college. The implicit assumption is that once enrolled in

<sup>3</sup> Those numbers come from *1999 UNR DATABOOK* (p.184-85), *Selected Institutional Characteristics* (p.70-74, The Office of Institutional Analysis and Planning, University of Nevada, Las Vegas, Fall 1999), *FactBook 98* (p.SP-12, The Office of Institutional Effectiveness & Research, Truckee Meadows Community College, 1998), and *Selected Statistics for Review* (p.17, Great Basin College, August 1999).

<sup>4</sup> Integrated Postsecondary Education Data System (IPEDS) Completions Survey / UCCSN, Planning Report 1999-2003

one of the community colleges, the chance of being able to transfer to universities is the same for cohorts of all ethnicities and genders. In the Texas higher education system, for example, out of 30,233 students who transferred from community colleges to universities, 58.6% are freshmen and 41.4% are sophomores. Because the demographic composition of Texas is similar to that of Nevada, we assume that this proportion also applies to the transfer of community college students in Nevada. See Table 2 on the number of transfers from community colleges to universities.

**Table 2**  
**Transfer from Community Colleges to Universities (Fall 1999)**

	<b>CCSN</b>	<b>GBC</b>	<b>WNCC</b>	<b>TMCC</b>
Transfer to UNR	34	26	125	304
Transfer to UNLV	911	18	9	44

Source: 1999 UNR Databook, p.94,95, Selected Institutional Characteristics, p.13

$$\begin{aligned}
 &Pr\ oportion\ of\ Given\ Ethnicity\ and\ Gender( Institution, Ethnicity, Gender ) \\
 &= Enrollment\ of\ Given\ Ethnicity( Institution, Ethnicity ) / Enrollment( Institution ) \\
 &\quad \times Gender\ Share\ of\ Nevada\ Higher\ Education( Gender ) \\
 Transfer( Community\ College\ i, University\ j, Grade, Ethnicity, Gender ) & \quad (5) \\
 &\approx Transfer( Community\ College\ i, University\ j ) \\
 &\quad \times Pr\ oportion\ of\ Given\ Ethnicity\ and\ Gender( Community\ College\ i, Ethnicity, Gender ) \\
 &\quad \times Pr\ oportion\ Transfer\ Grade( Grade )
 \end{aligned}$$

### Advancement, dropout, and repeat rates

We do not have data on the number of dropouts. It is possible to calculate the ratio of freshmen to sophomore or sophomore to juniors by using the enrollment data at each grade. But without knowing how many students dropout at each grade, it is not possible to calculate how many students advance to the next grade and how many students stay at the same grade for another year. We estimate advancement, dropout and repeat rates of the Nevada higher education system based on the same kinds of rates in the Texas higher education system, as shown in the tables below.

**Table 3**

**Advancement Rate in Texas Higher Education**

	Doctoral University	Communiy College	Regional University
Freshmen	52.7%	13.0%	33.8%
Sophomore	65.2%	-	51.6%
Junior	69.2%	-	57.0%
Senior	-	-	-

**Table 4**

**Dropout rate in Texas Higher Education**

	Doctoral University	Communiy College	Regional University
Freshmen	12.2%	48.0%	27.6%
Sophomore	11.1%	33.3%	18.9%
Junior	9.3%	-	15.8%
Senior	10.0%	-	12.2%

**Table 5**

**Repeat Rate in Texas Higher Education**

	Doctoral University	Communi y College	Regional University
Freshmen	35.1%	35.4%	38.4%
Sophomore	23.5%	37.1%	28.4%
Junior	18.4%	-	22.0%
Senior	38.0%	-	40.3%

The ratio of sophomore to freshmen in 1998 is 0.70 for Texas regional universities (36,617/52,473) and 0.30 for Texas community colleges (89,094/293,101). The same ratios are 0.60 for Nevada universities (4,630/7,704) and 0.12 for Nevada community colleges (5,545/44,448). The ratios of the Nevada ratio to the Texas ratio are 0.86 for universities and 0.41 for community colleges. Although there are an infinite number of possible combinations of repeat rates and advancement rates for achieving the difference

of these Texas and Nevada ratios, we assume that both advancement rates and repeat rates in Nevada have the same relationship to the Texas ratios, 0.86 and 0.41 times as large, as the class-size ratios in the two states. Dropout rates can be calculated as the difference between 1 and the sum of those rates plus transfer rates and graduation rates.

$$\begin{aligned}
 & \text{AdvancementRate}_{\_Nevada}(\text{University, Grade, Ethnicity, Gender}) \\
 & = 0.86 \text{ AdvancementRate}_{\_Texas}(\text{University, Grade, Ethnicity, Gender}) \\
 & \text{AdvancementRate}_{\_Nevada}(\text{CommunityCollege, Grade, Ethnicity, Gender}) \\
 & = 0.41 \text{ AdvancementRate}_{\_Texas}(\text{CommunityCollege, Grade, Ethnicity, Gender})
 \end{aligned} \tag{6}$$

$$\begin{aligned}
 & \text{RepeatRate}_{\_Nevada}(\text{University, Grade, Ethnicity, Gender}) \\
 & = 0.86 \text{ RepeatRate}_{\_Texas}(\text{University, Grade, Ethnicity, Gender}) \\
 & \text{RepeatRate}_{\_Nevada}(\text{CommunityCollege, Grade, Ethnicity, Gender}) \\
 & = 0.41 \text{ RepeatRate}_{\_Texas}(\text{CommunityCollege, Grade, Ethnicity, Gender})
 \end{aligned} \tag{7}$$

$$\begin{aligned}
 & \text{DropoutRate}_{\_Nevada}(\text{University, Grade, Ethnicity, Gender}) \\
 & = 1 - \text{AdvancementRate}_{\_Nevada}(\text{University, Grade, Ethnicity, Gender}) \\
 & \quad - \text{RepeatRate}_{\_Nevada}(\text{University, Grade, Ethnicity, Gender}) \\
 & \quad - \text{GraduationRate}_{\_Nevada}(\text{University, Grade, Ethnicity, Gender})
 \end{aligned} \tag{8}$$

$$\begin{aligned}
 & \text{DropoutRate}_{\_Nevada}(\text{CommunityCollege, Grade, Ethnicity, Gender}) \\
 & = 1 - \text{AdvancementRate}_{\_Nevada}(\text{CommunityCollege, Grade, Ethnicity, Gender}) \\
 & \quad - \text{RepeatRate}_{\_Nevada}(\text{CommunityCollege, Grade, Ethnicity, Gender}) \\
 & \quad - \text{GraduationRate}_{\_Nevada}(\text{CommunityCollege, Grade, Ethnicity, Gender}) \\
 & \quad - \text{TransferRate}_{\_Nevada}(\text{CommunityCollege, Grade, Ethnicity, Gender})
 \end{aligned}$$

Estimated dropout rates of universities in Nevada are 1.9-2.3 times as large as those in Texas depending on grades. Estimated dropout rates of community colleges in Nevada are 1.6-2.0 times as large as those in Texas.<sup>5</sup> See table 6-8 on the estimated rates (average).

**Table 6**  
**Estimate of Advancement Rate in Nevada**  
**Higher Education System (weighted average)**

	University	Community College
Freshman	45.3%	5.3%
Sophomore	56.1%	-
Junior	59.5%	-
Senior	-	-

<sup>5</sup> The estimated graduation rates in Nevada are 46% and 21% for universities (senior) and community colleges (sophomore) respectively. The estimated transfer rates of community colleges in Nevada are 1.7% (freshman) and 1.2% (sophomore).

**Table 7**

**Estimate of Dropout Rate in Nevada Higher Education System (weighted average)**

	University	Community College
Freshman	24.5%	74.8%
Sophomore	23.5%	66.0%
Junior	21.6%	-
Senior	19.4%	-

**Table 8**

**Estimate of Repeat Rate in Nevada Higher Education System (weighted average)**

	University	Community College
Freshman	30.2%	14.5%
Sophomore	20.2%	15.2%
Junior	15.8%	-
Senior	32.7%	-

## Comparison to California in the 1960s

It is useful to compare the rates at which Nevada may have to increase its participation and advancement rates over the next decade to the rates at which other states undertook significant expansions of their higher education systems. In particular, we compare the task facing Nevada to the rates of expansion of the California higher education system during the 1960s.

During the 1960s in California, the number of bachelors degrees awarded per enrollment increased from 6.5% in 1964 to 7.0% in 1970 with an average annual growth rate of 1.3% (Source: Digest of Educational Statistics by the National Center for Educational Statistics, various years). During the same period, the number of first-time students (our estimate) per population increased from 1.1% to 1.4% with an average annual growth rate of 4.4%.

The average annual growth rate of the former, 1.3%, can be interpreted as the rate of annual growth of which students progressed through the system during that period in California. This assumes that improvement in the graduation rate was the average in improvement in all the rates related to progress of students, including advancement rates and graduation rates. The average annual growth rate of the latter, 4.4%, can be interpreted as the annual growth rate of participation.

## Modeling Enrollment and Degrees

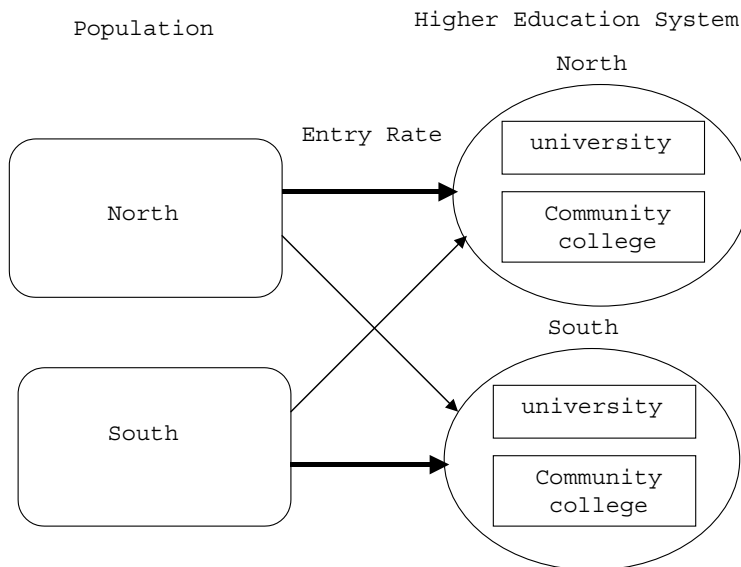
We project the future performance of the UCCSN system using a computer simulation model that tracks the flow of students through the various components of the system. This model is similar to those we have used in our previous work (Park and Lempert, 1998).

## Calculation of Freshmen Enrollment

We model the number of first-time freshmen (FTF) of a given ethnicity (white/other, black or Hispanic) and gender (female or male) in a system (university, community college or four-year college) in a region (i) (North or South) and year (2000-2010),

$$\begin{aligned}
 &FTF(\text{region } i, \text{system}, \text{year}, \text{ethnicity}, \text{gender}) \\
 &= \sum_{\text{region } j=1}^2 [ \text{Demog}(\text{region } j, \text{year}, \text{ethnicity}, \text{gender}) \\
 &\quad * cENTRY(\text{region } j, \text{region } i, \text{system}, \text{ethnicity}, \text{gender}) ]
 \end{aligned} \tag{1}$$

where  $Demog(\text{region } j, \text{year}, \dots)$  is the projected population for the population cohort of the given ethnicity and gender in region j (either the northern or southern region in Nevada) in a given year; and the entry rate  $cENTRY(\text{region } j, \text{region } i, \text{system}, \dots)$  represents the fraction of each population cohort in region j that become freshmen in a given system located in region i. First-time freshmen of a institution in region i is the sum of the number of first-time freshmen who come from region i and region j. See Figure 1.



**Figure 1--Student Admissions**

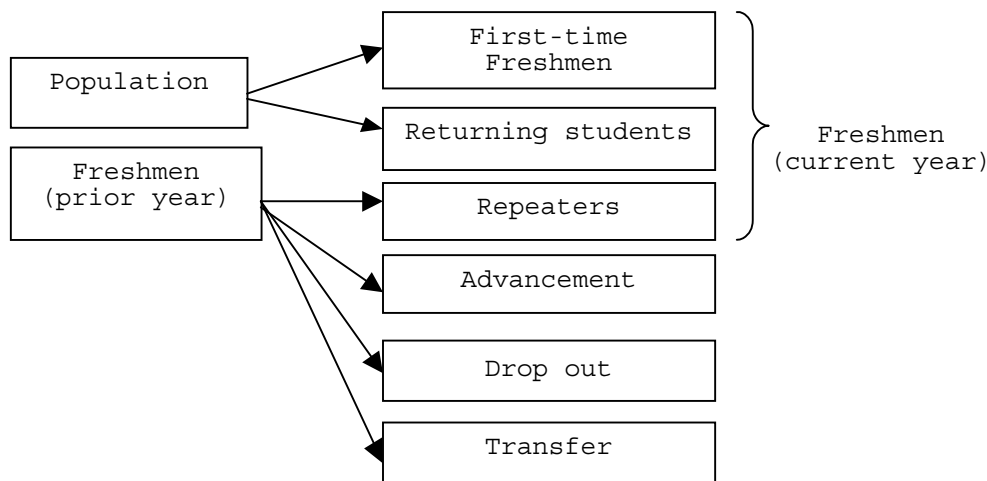
We use the state demographic data in 1999 to calculate the entry rate as

$$cENTRY(\text{region } i, \text{region } j, \text{system}, \text{ethnicity}, \text{gender}) = \frac{FTF(\text{region } i, \text{region } j, \text{system}, \text{year} = 2000, \text{ethnicity}, \text{gender})}{Demog(\text{region } i, \text{year} = 1999, \text{ethnicity}, \text{gender})} \quad (2)$$

The entry rate calculated from the enrollment record in 2000 and demographic data in 1999 is used as a baseline case for further exploration, for example, on the effect of the change in entry rate on enrollment, as is explained below.

The body of enrolled freshmen *FRS* includes, other than first-time freshmen *FTF*, students who are absent for a while and return as freshmen (returning students) and students who repeat freshmen class (repeaters). We model first-time students and returning students as fractions of the population and repeaters as a fraction of the freshmen class in prior year. See Figure 2.





**Figure 2--Freshmen flow**

We use the value for the  $FTF$  (from Eq. (1)) to calculate the total number of enrolled freshmen  $FRS$  as

$$\begin{aligned}
 & FRS(\text{region}, \text{system}, \text{year}, \text{ethnicity}, \text{gender}) \\
 & = FTF(\text{region}, \text{system}, \text{year}, \text{ethnicity}, \text{gender}) \\
 & + cRPT_1(\text{region}, \text{system}, \text{ethnicity}, \text{gender}) * FRS(\text{region}, \text{system}, \text{year} - 1, \text{ethnicity}, \text{gender}) \quad (3) \\
 & + Return_1(\text{region}, \text{system}, \text{year}, \text{ethnicity}, \text{gender})
 \end{aligned}$$

where  $cRPT_1$  is the percentage of freshmen in each region and system who repeat their freshman year, and  $Return_1$  is the number of students who return school.

Because we do not have the data on the number of students who return, we adjust the return rate so as to make the predicted number of enrolled students in 2000 equal to the number of students in 1999 (base year) in each cohort on the condition that there is no increase of population between 1999 and 2000; in other words,  $FTF$  is the same for both years. The assumption is that enrollment is stable in 1999.

$cReturn_1(\text{region } i, \text{region } j, \text{system}, \dots)$  is calculated for each cohort from the Eq. (3) and (4).

$$\begin{aligned}
 & Return_1(\text{region}, \text{system}, \text{year}, \text{ethnicity}, \text{gender}) \\
 & = \sum_{\text{region } i=1}^2 \{ cReturn_1(\text{region } i, \text{region}, \text{system}, \text{ethnicity}, \text{gender}) \\
 & \quad * Demog(\text{region } i, \text{year}, \text{ethnicity}, \text{gender}) \} \quad (4) \\
 & FRS(\text{region}, \text{system}, \text{year} = 2000, \text{ethnicity}, \text{gender}) \text{ [with no population growth]} \\
 & = FRS(\text{region}, \text{system}, \text{year} = 1999, \text{ethnicity}, \text{gender})
 \end{aligned}$$

## Calculation of Sophomore, Junior, and Senior Enrollment

Students either 1) advance to the next class, 2) repeat the same class, 3) dropout of the system, or 4) transfer to another system. The student body next year can be calculated by adding students who advance, students who repeat the same class, and students who are transferred to the system, plus students who return to the system. We write the number of students enrolled as sophomores, juniors and seniors in each region and system, if we omit ethnicity and gender from the equation, as:

$$\begin{aligned}
 SPH(\text{region}, \text{system}, \text{year}) &= cADV_2(\text{region}, \text{system}) * FRS(\text{region}, \text{system}, \text{year} - 1) \\
 &+ cRPT_2(\text{region}, \text{system}) * SPH(\text{region}, \text{system}, \text{year} - 1) \\
 &+ TRF_2(\text{region}, \text{system}) + Return_2(\text{region}, \text{system}) \\
 JNR(\text{region}, \text{system}, \text{year}) &= cADV_3(\text{region}, \text{system}) * SPH(\text{region}, \text{system}, \text{year} - 1) \\
 &+ cRPT_3(\text{region}, \text{system}) * JNR(\text{region}, \text{system}, \text{year} - 1) \\
 &+ TRF_3(\text{region}, \text{system}) + Return_3(\text{region}, \text{system}) \\
 SNR(\text{region}, \text{system}, \text{year}) &= cADV_4(\text{region}, \text{system}) * JNR(\text{region}, \text{system}, \text{year} - 1) \\
 &+ cRPT_4(\text{region}, \text{system}) * SNR(\text{region}, \text{system}, \text{year} - 1) \\
 &+ Return_4(\text{region}, \text{system})
 \end{aligned} \tag{5}$$

where the first term on the right side of each equation is the number of students who advance into that class from a lower class and the second term is the number who remain in the same class from the previous year.  $TRF_n$  is the number who transfer into that class from another system.  $Return_n$  is the number of students who return to school. We assume that the number of students shifting from universities to community colleges is small enough to be ignored in our model. We include in the model only the transfer of students from community colleges to universities. We assume that freshmen and sophomores at community colleges transfer to sophomore and junior classes at universities respectively. The transfer rate  $cTRF_n(\text{region}_i, \text{system}_i, \text{region}_j, \text{system}_j)$  that represents the fraction of students in  $\text{system}_i$  in  $\text{region}_i$  who transfer to  $\text{system}_j$  in  $\text{region}_j$  is calculated from 1999 enrollment records. By using this rate, the number of transfer students is calculated as

$$\begin{aligned}
 &TRF_2(\text{region}, \text{system}) \\
 &= \sum_{\text{region}_i} \sum_{\text{system}_j} cTRF_2(\text{region}_i, \text{system}_j, \text{region}, \text{system}) * FRS(\text{region}_i, \text{system}_j, \text{year}) \\
 &TRF_3(\text{region}, \text{system}) \\
 &= \sum_{\text{region}_i} \sum_{\text{system}_j} cTRF_3(\text{region}_i, \text{system}_j, \text{region}, \text{system}) * SPH(\text{region}_i, \text{system}_j, \text{year}) \\
 &cTRF(\text{region}_i, \text{system}_j, \text{region}, \text{system}) = 0 \\
 &\quad (\text{if } \text{system}_j \neq \text{Community College (CC)} \text{ or } \text{system} = \text{CC})
 \end{aligned} \tag{6}$$

Return rate  $cReturn_n$  is calculated by using the same procedures as is used for calculating the return rate for freshmen.

$Return_n( region, system, ethnicity, gender, year )$

$$= \sum_{region\ i=1}^2 \{ c\ Return_n( region_i, region, system, ethnicity, gender ) \quad (7)$$

$$* Demog( region_i, year, ethnicity, gender, year )\}$$

The model used for the community college system is basically the same as the model described above for the four-year university system. Classes at community college are either freshmen or sophomore.

### Degrees Awarded

We calculate the number of bachelor's degrees awarded each year as

$$BachelorsDegrees( region, system, year ) \quad (8)$$

$$= cGRAD( region, system ) * SNR( region, system, year - 1 )$$

where  $cGRAD$  is the graduation rate for each system, broken down into the various student cohorts. We use the ratio of the number of degrees awarded to the number of senior students for  $cGRAD$ . The number of associate degrees

$AssociatesDegrees( region, system, year )$ , awarded by the community college system, is calculated in the same manner.

### Modeling Costs

We use the sum of operating cost and capital cost as the cost necessary for accepting the projected enrollment in each system and in each region.

$$Enrollment( system, year ) = FRS( system, year ) + SHP( system, year ) + JNR( system, year )$$

$$+ SNR( system, year )$$

$$OperatingCost( system, year ) = pOperatingCost( system ) * Enrollment( system, year )$$

$$CapitalCost( system, year ) = pCapitalCost( system ) * \{ Enrollment( system, year )$$

$$- Enrollment( system, year - 1 )\}$$

$$Cost( system, year ) = OperatingCost( system, year ) + CapitalCost( system, year )$$

where  $pOperatingCost( system )$  is the average operating cost per student in each system. We assume that there is no regional difference in the average cost per student in each system, and  $pCapitalCost( system )$  is the average capital cost for increasing the enrollment by one student (headcount) in each system. We use  $pOperatingCost( University ) = \$6300$ ,  $pOperatingCost( CommunityCollege ) = \$2000$ ,  $pOperatingCost( 4YearCollege ) = \$5000$ <sup>6</sup>, and

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<sup>6</sup> Expenditure (operating budget) is \$98,467 at UNR, \$111,967 at UNLV and \$96,487 at community colleges in Nevada in 1999 ("Students, Faculty, and Expenditures" URL: <http://www.state.nv.us/budget/sauccsn99.htm>) Dividing those numbers by the headcount of students, 12,303, 21,312, and 49,051 respectively, expenditure per student (headcount) is \$8,003 at UNR, \$5,254 at UNLV (\$6260 at university), and \$1967 at community colleges. We assume that expenditure per student (headcount) at four-year colleges is \$5,000; that is, the level between university and community college.

$pCapitalCost(University) = \$36,750$ ,  $pCapitalCost(CommunityCollege) = \$7,350$ , and  $pCapitalCost(4YearCollege) = \$15,000$ .<sup>7</sup>

### Creation of Four-year Colleges

One of the policy options we model is a decision by Nevada to create four-year colleges over the next decade. We simulate the flow of students through such institutions similarly to our treatment of the existing universities. As described above, we assume that the operating and capital costs for such four-year colleges are higher than community college but lower than universities. Because Nevada does not currently have such colleges, we need to infer the parameters describing their properties from similar institutions in other states. In particular, we assume that entry, advancement, graduation, and throughput rates are the same as in the regional colleges in Texas. We note that the entry rate of existing Nevada universities and community colleges may decrease to a certain degree after the creation of four-year colleges. We write the entry rates into the existing institutions after the creation of four-year colleges as

$$cENTRY( regioni, regionj, university, ethnicity, gender )$$

$$= cENTRY^*( regioni, regionj, university, ethnicity, gender )$$

$$* \{ 1 - cENTRY( regioni, regionj, 4YearCollege, ethnicity, gender ) \} * prt\_cannibalize\_univ$$

$$cENTRY( regioni, regionj, CommunityCollege, ethnicity, gender )$$

$$= cENTRY^*( regioni, regionj, CommunityCollege, ethnicity, gender )$$

$$* \{ 1 - cENTRY( regioni, regionj, 4YearCollege, ethnicity, gender ) \} * prt\_cannibalize\_cc$$

where  $cENTRY^*(...)$  is the entry rate that is used in the scenario where four-year colleges are not created, and  $prt\_cannibalize\_univ$  and  $prt\_cannibalize\_cc$  are parameters between 0 and 1. When  $prt\_cannibalize\_univ$  or  $prt\_cannibalize\_cc$  approaches 1, a larger proportion of entry into universities or community colleges will be shifted toward the entry into four-year colleges.

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<sup>7</sup> According to the assumption used in *Providing for Progress: California Higher Education Enrollment Demand and Resources into the 21<sup>st</sup> Century* (by California Postsecondary Education Commission, February 2000, p.93-97), needed ASF (assignable square feet) per FTES (full time equivalent students) is 140 and estimated cost per ASF is \$525 for University of California. Thus, cost per FTES is  $140ASF/FTES * \$525/ASF = \$73,500/FTES$ . Assuming that the ratio of FTES to headcount students is 0.5, cost per headcount is  $\$36,500/headcount$ . In the same way, as for California State University and community colleges, cost per headcount are  $75ASF/FTES * \$390/ASF * 0.5FTES/headcount = \$14,625$ , and  $42ASF/FTES * \$350/ASF * 0.5FTES/headcount = \$7,350$ , respectively. We use those numbers for university, four-year colleges, and community colleges in Nevada.

## Modeling Alternative Scenarios

For exploratory analysis, we consider scenarios different in terms of entry rates, throughput-related rates, and retention-related rates.

### Change in Entry

We change the annual growth rate  $p_1$  of entry rate  $cENTRY$ .

$$cENTRY(\text{region}, \text{system}, \text{year}) = cENTRY(\text{region}, \text{system}, 1999) * [1 + p_1]^{year-1999} \quad (11)$$

### Change in Throughput

We change the throughput of the system by changing the advancement rate for freshmen, sophomore and junior students and the graduation rate for senior students. The decrease or increase of these rates is compensated by the change of the repeat rate  $cRPT_n$  in the opposite direction.

1)  $n=1,2,3$  ( $n=1$  for Community College)

$$cAVD_n(\text{region}, \text{sys}, \text{year}) = cAVD_n(\text{region}, \text{sys}) * [1 + p_2]^{year-1999}$$

$$cRPT_n(\text{region}, \text{sys}, \text{year}) = cRPT_n(\text{region}, \text{sys}) - cAVD_n(\text{region}, \text{sys}) * \left[ (1 + p_2)^{year-1999} - 1 \right] \quad (12)$$

2)  $n=4$  ( $n=2$  for Community college)

$$cGRD_n(\text{region}, \text{sys}, \text{year}) = cGRD_n(\text{region}, \text{sys}) * [1 + p_2]^{year-1999}$$

$$cRPT_n(\text{region}, \text{sys}, \text{year}) = cRPT_n(\text{region}, \text{sys}) - cGRD_n(\text{region}, \text{sys}) * \left[ (1 + p_2)^{year-1999} - 1 \right] \quad (13)$$

### Change in Retention

We change the retention of each system by changing the dropout rate for freshmen, sophomores, junior and seniors. Half of the decrease or increase of these rates is compensated by the change of the advancement rate for freshmen, sophomore and juniors and the graduation rate for seniors in the opposite direction, and the other half is by the change in repeat rate:

1)  $n=1,2,3$  ( $n=1$  for community college)

$$cDRP_n(\text{region}, \text{sys}, \text{year}) = cDRP_n(\text{region}, \text{sys}) * (1 - p_3)^{year-1999}$$

$$cADV_n(\text{region}, \text{sys}, \text{year}) = cADV_n(\text{region}, \text{sys}) + 0.5 * cDRP_n(\text{region}, \text{sys}) * \left[ 1 - (1 - p_3)^{year-1999} \right]$$

$$cRPT_n(\text{region}, \text{sys}, \text{year}) = cRPT_n(\text{region}, \text{sys}) + 0.5 * cDRP_n(\text{region}, \text{sys}) * \left[ 1 - (1 - p_3)^{year-1999} \right]$$

2)  $n=4$  ( $n=2$  for community college)

$$cDRP_n(\text{region}, \text{sys}, \text{year}) = cDRP_n(\text{region}, \text{sys}) * (1 - p_3)^{year-1999}$$

$$\begin{aligned} & cGRD_4(\text{region}, \text{sys}, \text{year}) \\ & = cGRD_n(\text{region}, \text{sys}) + 0.5 * cDRP_n(\text{region}, \text{sys}) * \left[ 1 - (1 - p_3)^{\text{year} - 1999} \right] \\ & cRPT_4(\text{region}, \text{sys}, \text{year}) \\ & = cRPT_n(\text{region}, \text{sys}) + 0.5 * cDRP_n(\text{region}, \text{sys}) * \left[ 1 - (1 - p_3)^{\text{year} - 1999} \right] \end{aligned}$$