

Data, Research, and Analytics: Career Education as Exemplar

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2013 Data Conference

Younes Conference Center – Kearney, NE

April 30, 2013



NEBRASKA DEPARTMENT OF EDUCATION



Presentation Objectives

1. Realize the challenges in relying solely on federal accountability analyses
2. Identify the value in adopting and utilizing a CTE data diversification strategy
3. Gain practical analytic suggestions for diversifying CTE data analysis



The Power of Data

- “If the quality of life is to be improved in this modern world, its citizens must understand how to make sense out of numbers.”



– David A. Kenny

*Statistics for the Social
and Behavioral Sciences*



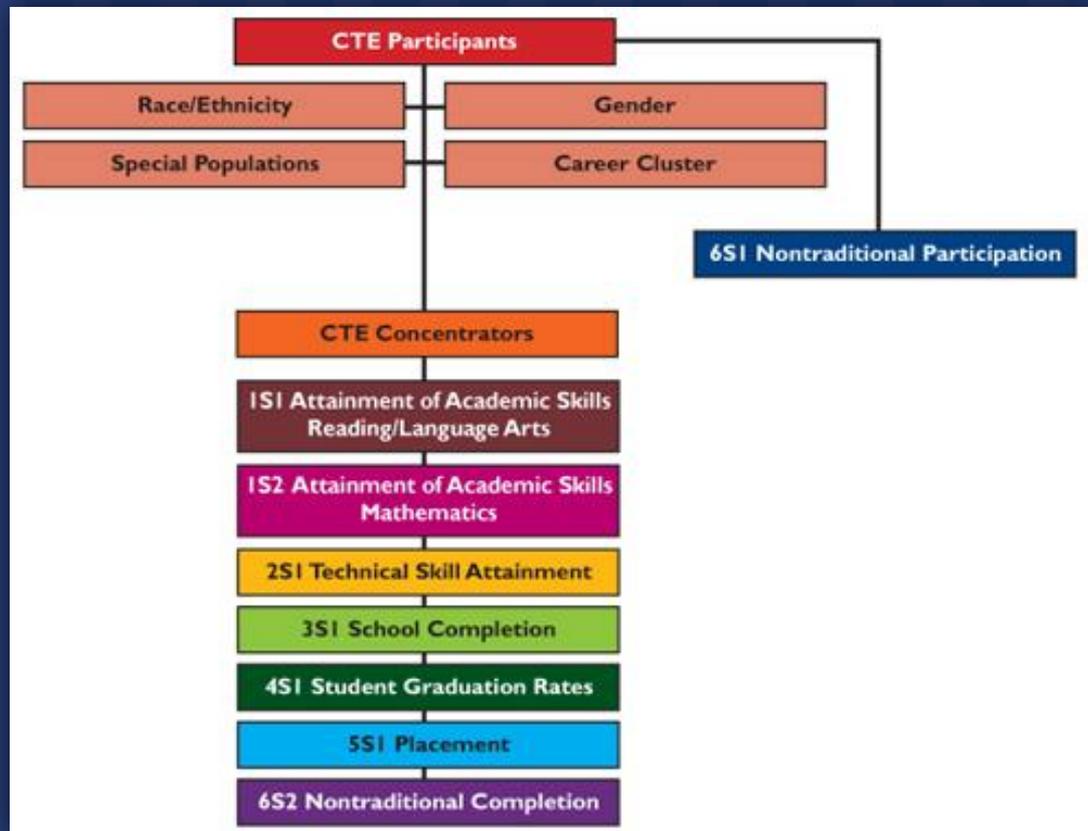
The Power of Data

- Numbers are not important in and of themselves. (Kenny 1987)
- They are important because they help us make decisions. (Kenny 1987)
- Decisions can be made without numbers, but if the right numbers are used, in the right way, the quality of decisions can be improved. (Kenny 1987)



Perkins IV Secondary Accountability Performance Indicator Framework

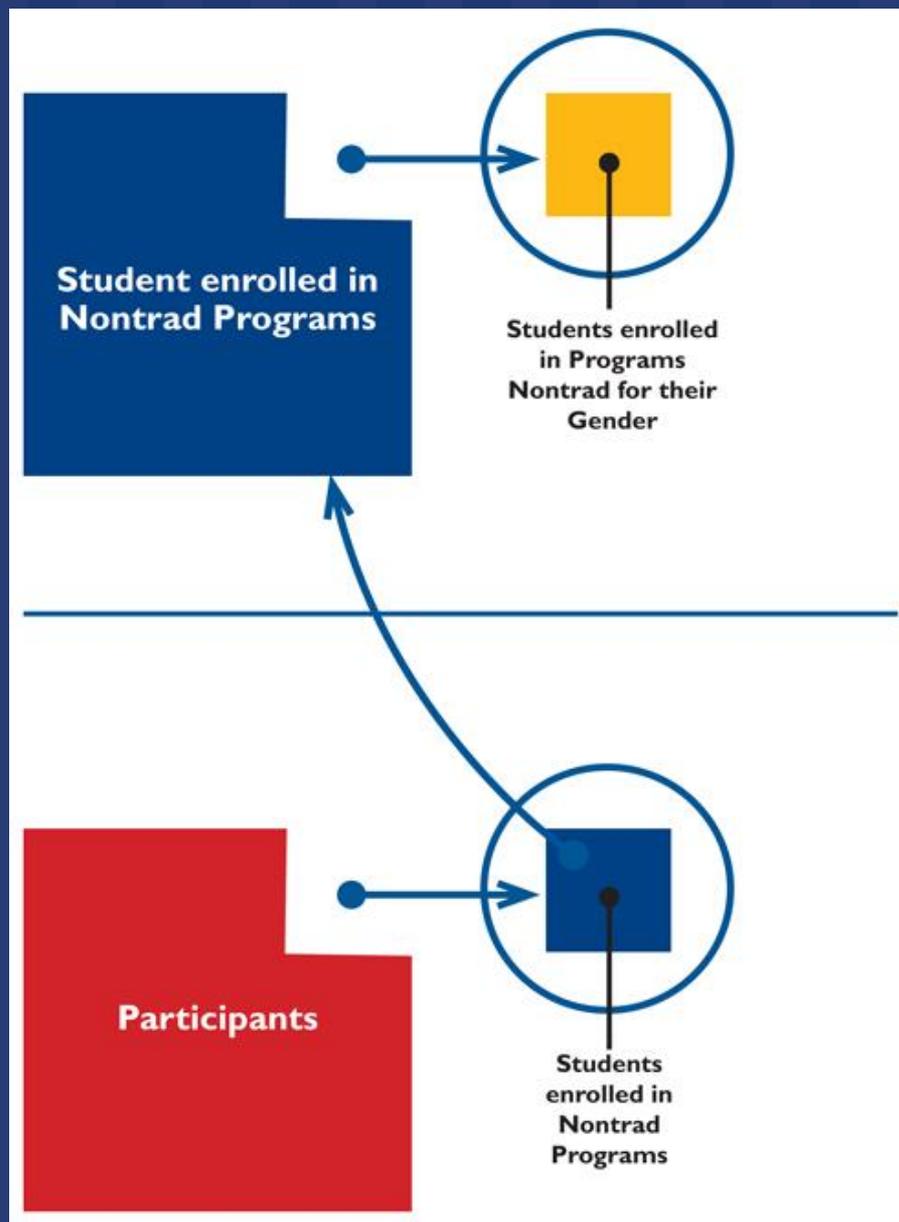
This graphic represents the relationship between the Perkins Secondary Performance Indicators and the CTE Participants and CTE Concentrators.



Fractions of Subpopulations (6S1)

Numerator: Number of CTE participants from underrepresented gender groups who participated in a program that leads to employment in nontraditional fields during the reporting year.

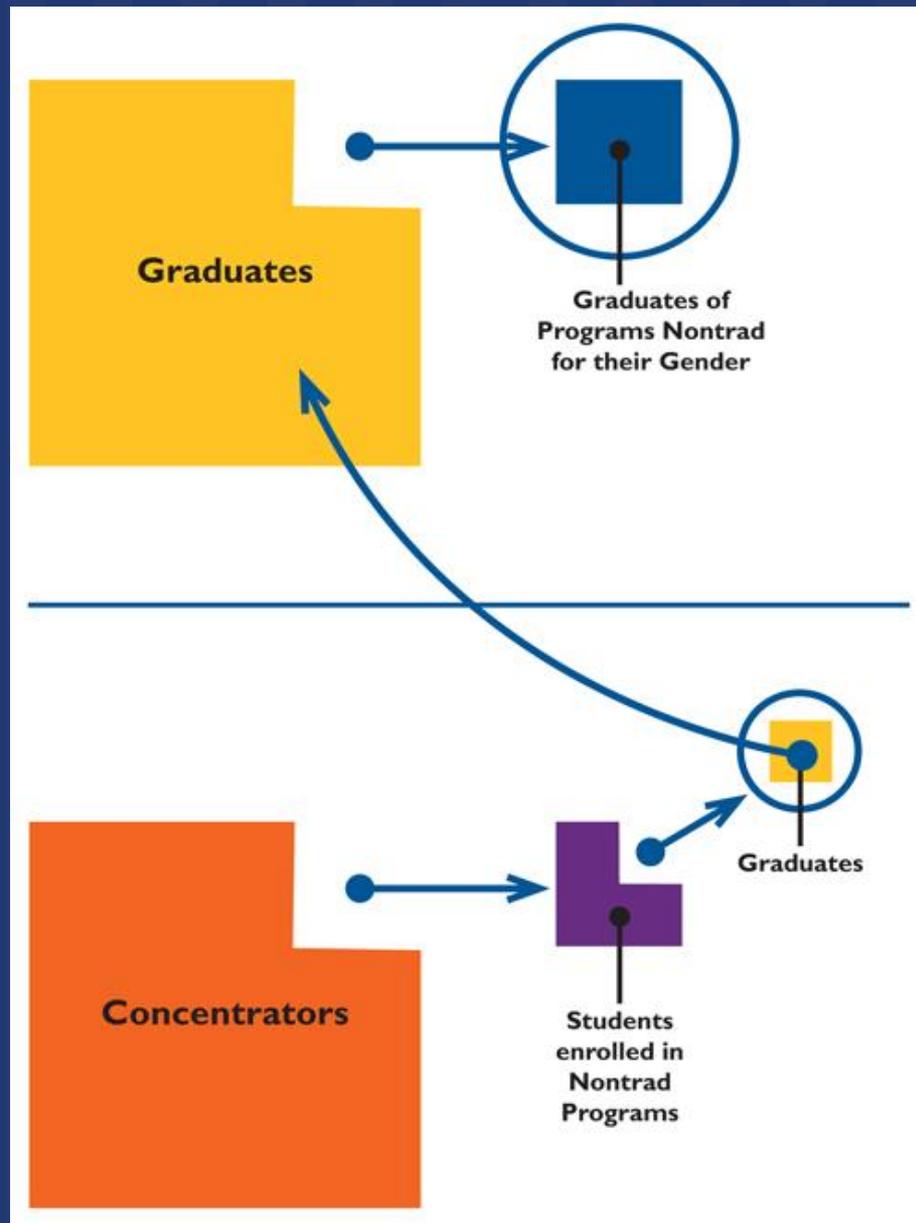
Denominator: Number of CTE participants who participated in a program that leads to employment in nontraditional fields during the reporting year.



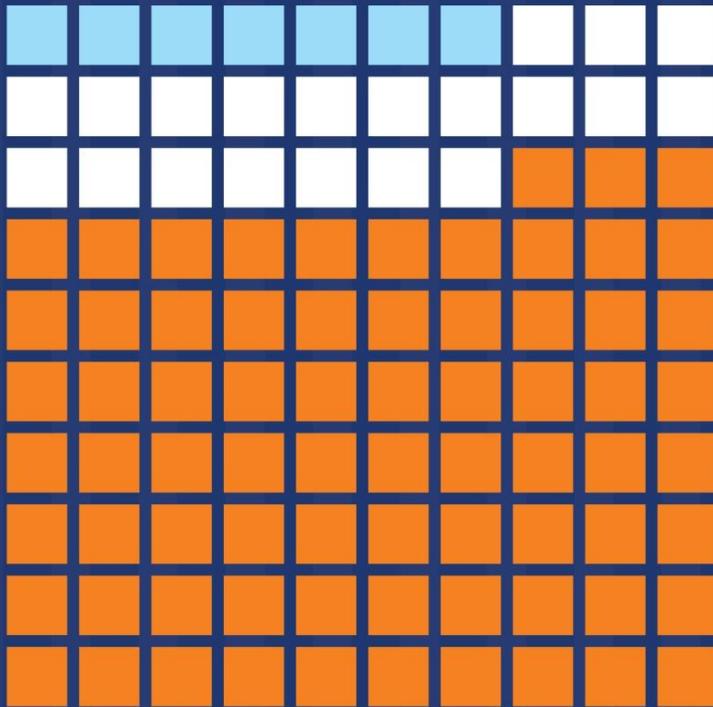
Fractions of Subpopulations (6S2)

Numerator: Number of CTE concentrators from underrepresented gender groups who completed a program that leads to employment in nontraditional fields during the reporting year.

Denominator: Number of CTE concentrators who completed a program that leads to employment in nontraditional fields during the reporting year.

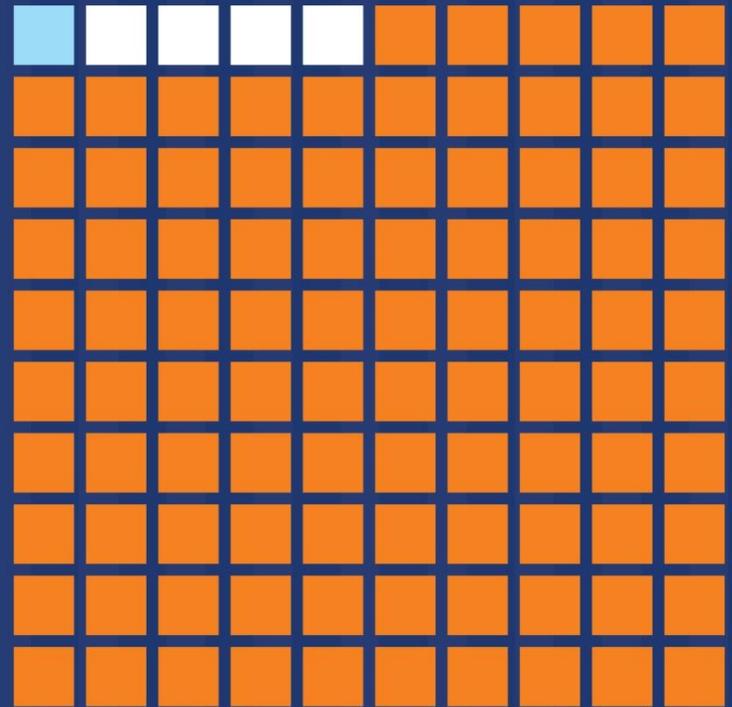


12th Grade



Total Membership: 22,161

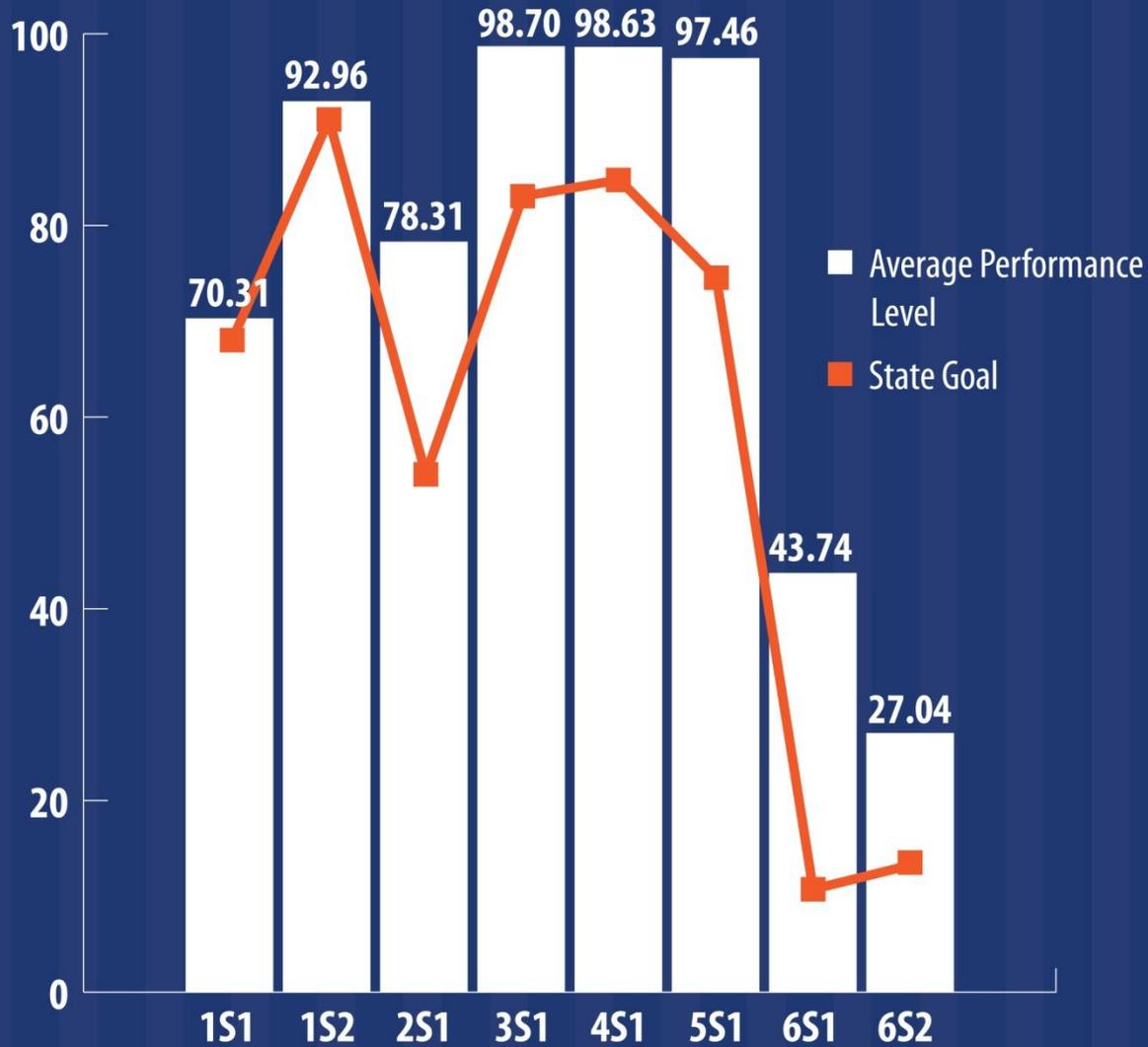
Grades 7-12



Total Membership: 129,759

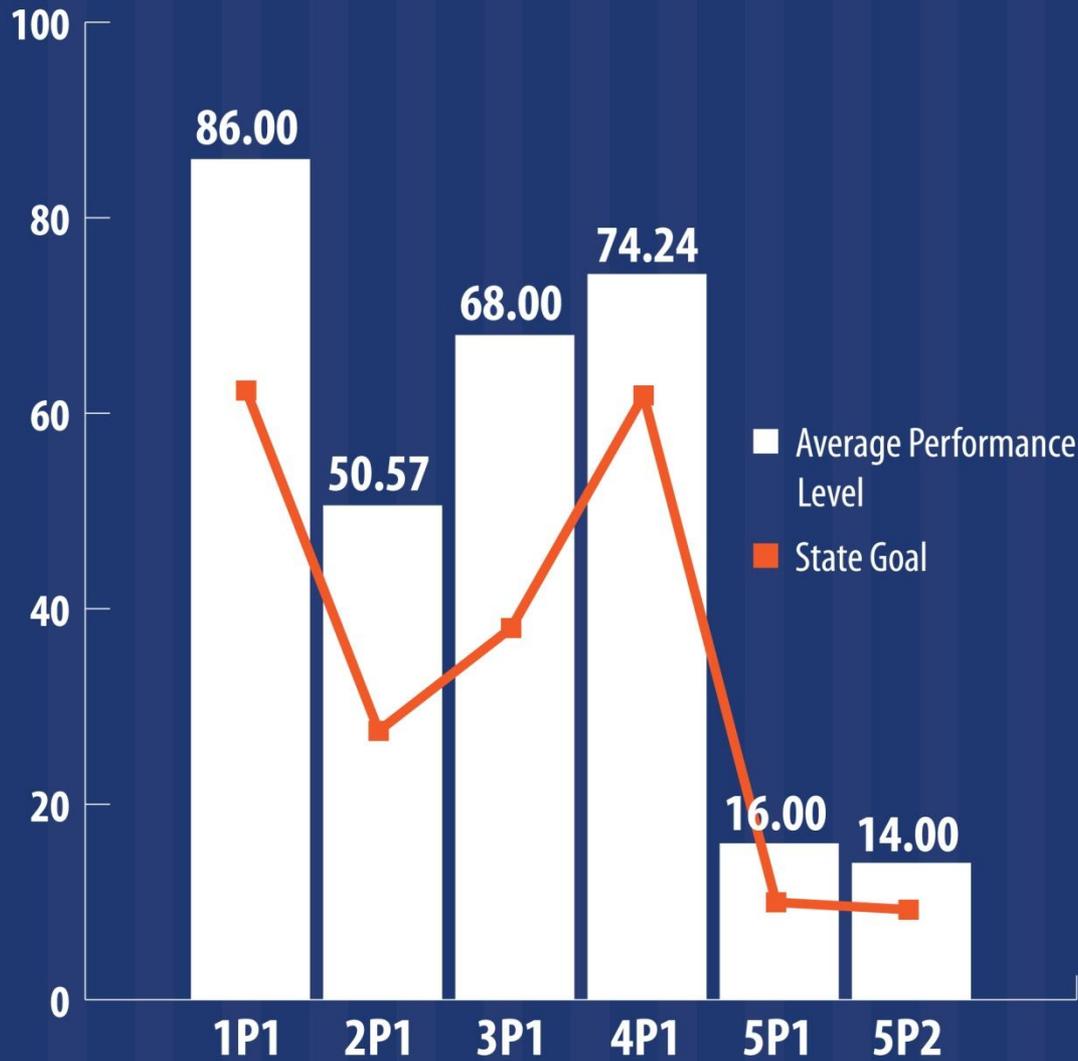
Nebraska Fall Membership 6S2: Nontraditional Completion





10-11 Secondary Average Performance





10-11 Postsecondary Average Performance



Challenges

1. Like many accountability frameworks, this system *becomes* the mechanism for understanding and evaluating CTE student performance/learning
 - “Performance” indicators
 - But, performance relative to what?
 - an arbitrary state goal
 - Tail wagging the dog?



Challenges (continued)

2. Force an accountability system into a dual-purpose role:
 - Accountable for a federal investment
 - Assessment of student learning/outcomes
 - But these are not the same thing – or at least it is quite challenging and costly to develop such a system



Challenges (continued)

3. Thus, we judge the success or failure of CTE student learning/outcomes based on an *accountability* system designed by policymakers for, perhaps, a very different purposes
 - And, because Perkins IV is the product of a legislative process, these policy objectives – while well intentioned – may not be fully coherent in practice



Data as Power?

- Do these accountability measures help us:
 - Make decisions about CTE?
 - Improve the quality of our decisions?
- Too often, we limit our use of education data to accountability purposes only.
- To enhance the quality of our decisions - more than numbers - diversify analytic strategies beyond the federal accountability framework.



Data Use Beyond Accountability

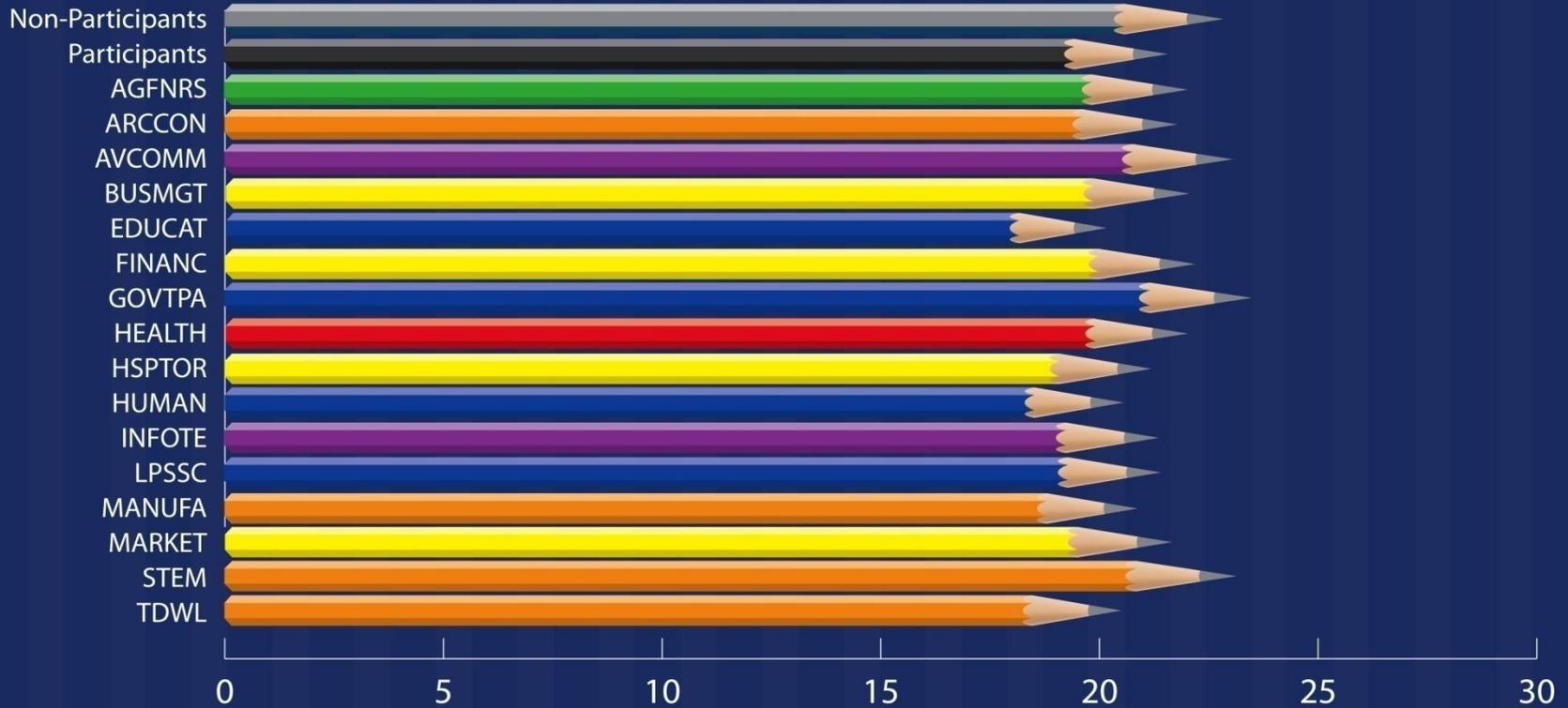
- Descriptive Analyses
 - Measures of Central Tendency
 - Mean, Median, Mode
 - Measures of Dispersion
 - Variance, SD, IQ Range
 - Measures of Association
 - Correlations
 - Probabilities
 - Odds Ratios
 - Relative Risk Ratios
- Inferential Analyses
 - Testing of Models
 - Linear Regression
 - Generalized Linear Model
 - Path and Structural Equation Models



Descriptive Analyses

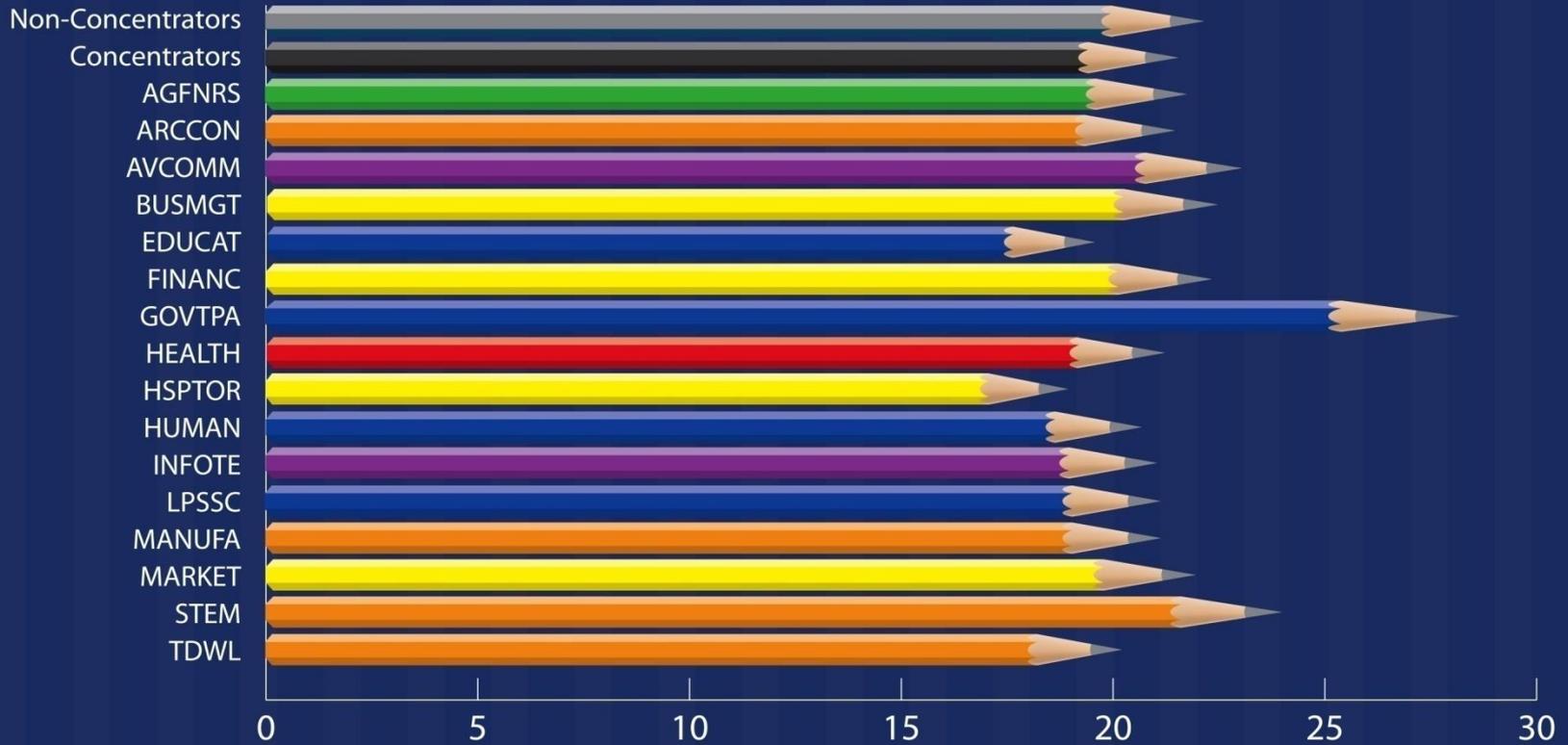
- Measures of Central Tendency
 - Mean, Median, Mode
 - Used to identify the “typical” value and represents all numbers
 - Two major uses:
 - Simplification
 - knowing the average number as opposed to all numbers in a data vector
 - Prediction
 - Knowing the average score for previous years for next year





Descriptive Statistics: Average ACT Composite Score By Participation | Career Field Status





Descriptive Statistics: Average ACT Composite Score By Concentrator | Career Field Status



Descriptive Analyses

- Measures of Association
 - Is there a relationship between two variables?
 - For our purposes, often these are nominal variables
 - That is, a situation where each person is a member of a discrete category as opposed to each person receiving a numeric score
 - Is Career Education Status related to dropout status?
 - » Participant – Non-Participant
 - » Concentrator – Non-Concentrator
 - » Dropout – Non-Dropout



Hypothetical Example

- The Contingency Table
 - AKA cross tabulation or “cross tabs”
 - For example, consider 100 students and their dropout statuses

	Non-Dropout	Dropout	Total
Non-Concentrator	20	40	60
Concentrator	20	20	40
Total	40	60	100



Risk or Probability

*But, the probability of dropout varies as a function of CTE Concentration status

	Non-Dropout	Dropout	
Non-Concentrators	a	b	a+b
Concentrators	c	d	c+d
	a+c	b+d	n=a+b+c+d

$$\textit{Probability that a student drops out} = \frac{b + d}{n} = 0.60$$

$$\textit{Probability a Concentrator drops out} = \frac{d}{c + d} = 0.50$$

$$\textit{Probability a Non – Concentrator drops out} = \frac{b}{a + b} = 0.67$$



Odds

*Again, the odds of dropout varies as a function of CTE Concentration status

	Non-Dropout	Dropout	
Non-Concentrators	a	b	a+b
Concentrators	c	d	c+d
	a+c	b+d	n=a+b+c+d

$$\text{Odds a student drops out} = \frac{b + d}{a + c} = 1.5$$

$$\text{Odds a Concentrators drops out} = \frac{d}{c} = 1$$

$$\text{Odds a Non – Concentrators drops out} = \frac{b}{a} = 2$$



Interpretation

- The difference is in the denominator
 - As a result, this influences the interpretation of these statistics
- Risk Interpretation
 - On average, concentrators drop out of school about 50% of the time
 - On average, non-concentrators drop out of school about 67% of the time
 - On average, students drop out of school about 40% of the time



Interpretation (cont.)

- Odds Interpretation
 - The odds of a concentrator dropping out of school is 1:1
 - The odds of a non-concentrator dropping out of school is 2:1
 - The odds of a student dropping out of school is 1.5:1
- Probabilities are relatively straight forward to understand while odds can be a bit more tricky



The Value of Ratios

- We are generally interested in ratios as opposed to probabilities or odds alone
 - Relative Risk (Probability) Ratios
 - Odds Ratios
- Hypothetical research question:
 - Are concentrators at greater risk of dropping out of school than non-concentrators?
 - Relative Risk – divide probability of concentrators by non-concentrators
 - Odds Ratio – divide odds for concentrators by non-concentrators



Risk or Probability Ratios

	Non-Dropout	Dropout	
Non-Concentrators	a	b	a+b
Concentrators	c	d	c+d
	a+c	b+d	n=a+b+c+d

$$\text{Risk (Probability) Ratio of concentrator dropping out} = \frac{\frac{d}{c+d}}{\frac{b}{a+b}}$$

$$= 0.75 \text{ or } 1.34 \text{ (reciprocal)}$$



Odds Ratio

	Non-Dropout	Dropout	
Non-Concentrators	a	b	a+b
Concentrators	c	d	c+d
	a+c	b+d	n=a+b+c+d

$$\text{Odds Ratio of concentrator dropping out} = \frac{\frac{d}{c}}{\frac{b}{a}}$$

$$= 0.50 \text{ OR } 2 \text{ (reciprocal)}$$



Interpretation (cont.)

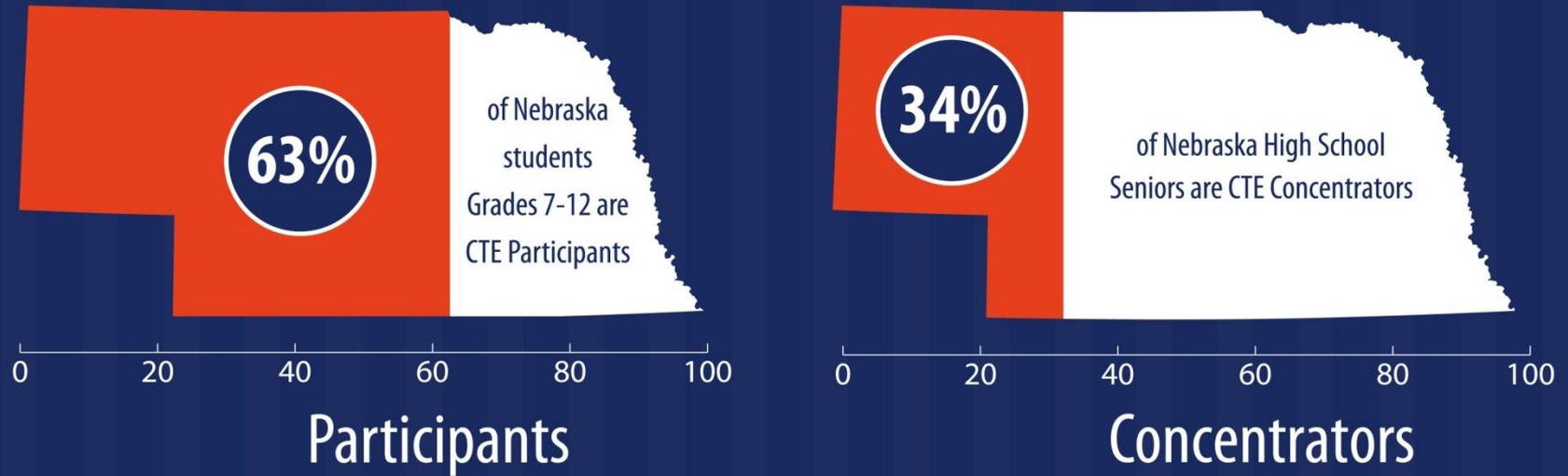
- Risk (Probability) Ratio
 - Concentrators are 0.75 time as likely to drop out of school than non-concentrators, or put another way
 - Non-concentrators are 1.34 as likely to drop out of school than concentrators (reciprocal)
- Odds Ratio
 - But we CANNOT say that non-concentrators are 2 times *as likely* to drop out of school
 - More accurately, the *odds* of dropping out of school are 2 times greater for non-concentrators relative to concentrators



Interpretation (cont.)

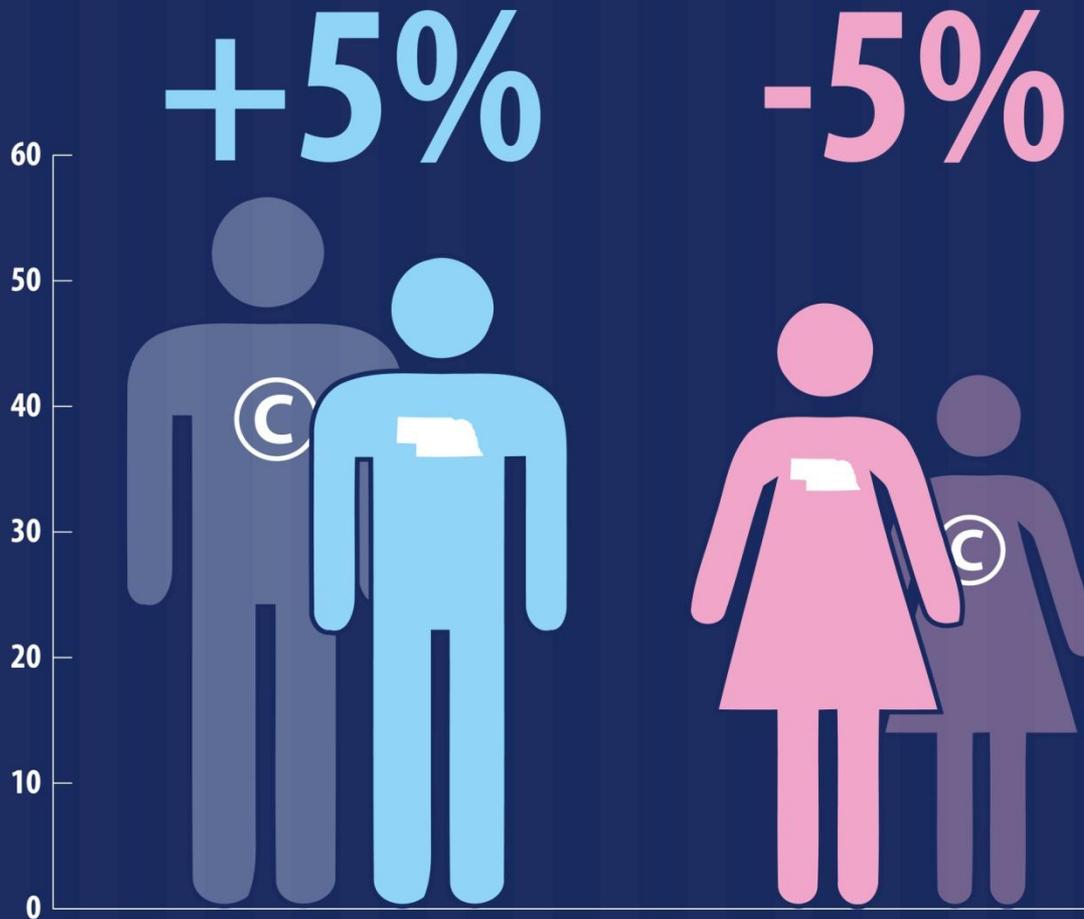
- For every non-concentrator *not dropping out* of school, 1.34 times as many non-concentrators will drop out than the number of concentrators.
- For most, risk (probability) ratios tend to be more straight-forward to interpret than odds ratios
- A value of 1.0 means no difference between groups for both risk and odds ratios
 - Ratios less than 1.0 mean that being in the selected group *decreases* the risk/odds of experiencing the outcome
 - Ratios greater than 1.0 mean that being in the selected group *increases* the risk/odds of experiencing outcome





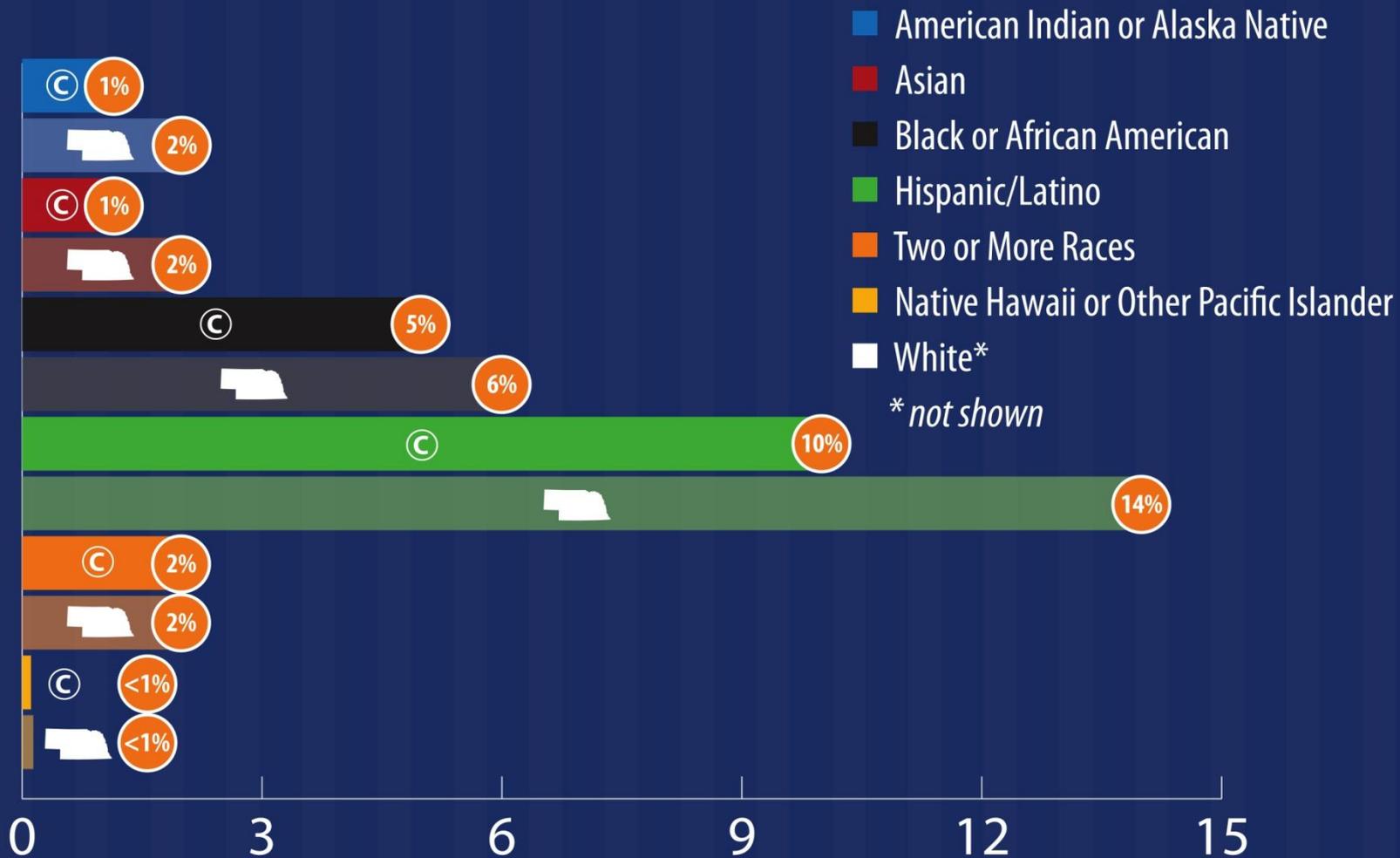
Descriptive Statistics: CTE Students Participants and Concentrators





Descriptive Statistics: Gender
Concentrators vs. All High School Seniors

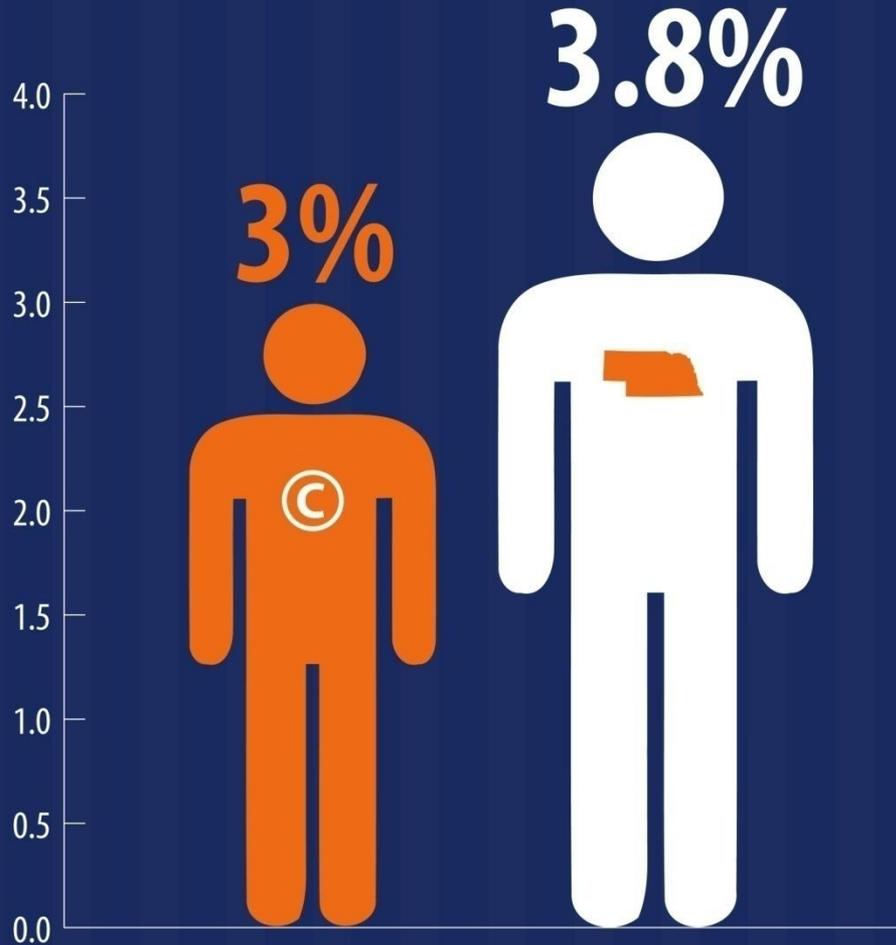




Descriptive Statistics: Ethnicity

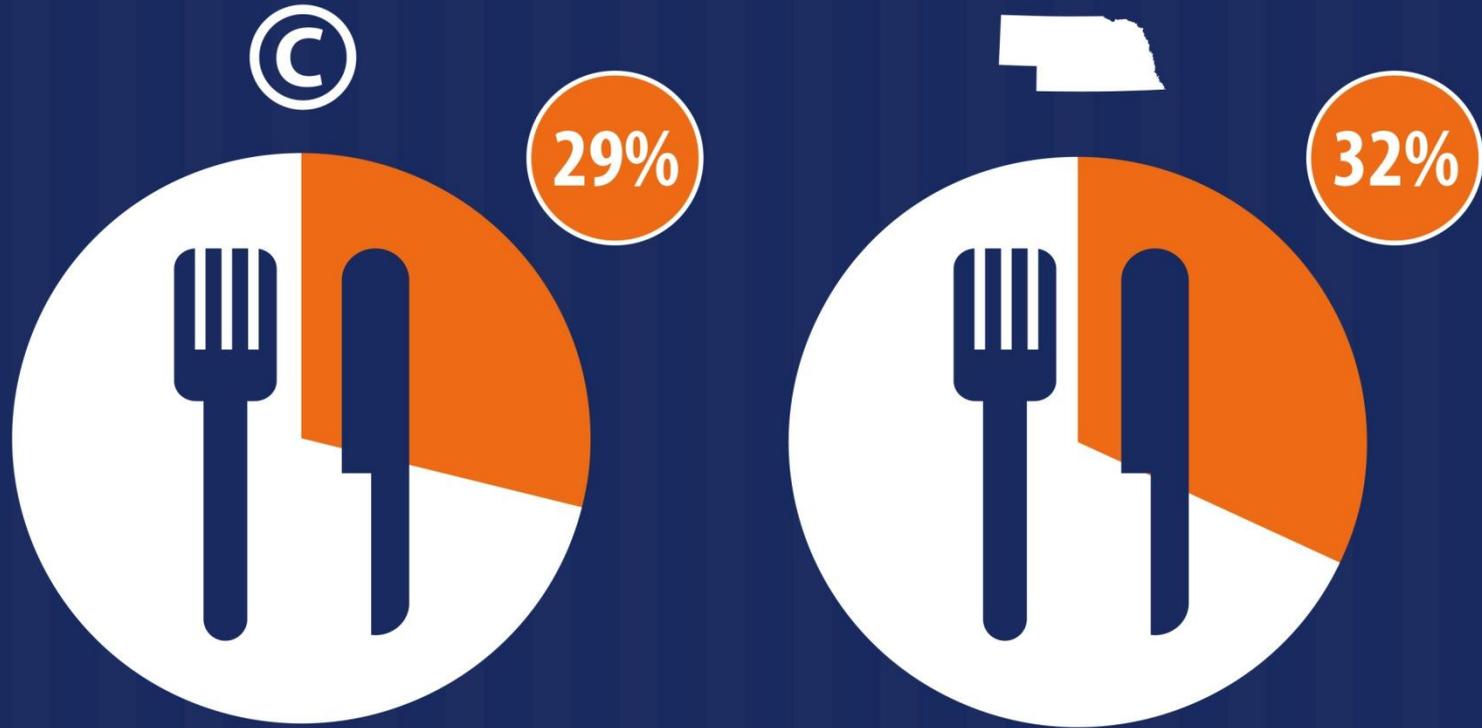
Concentrators vs. All High School Seniors





Descriptive Statistics: Immigration Status Concentrators vs. All High School Seniors





Descriptive Statistics: Food Program Eligibility Concentrators vs. All High School Seniors

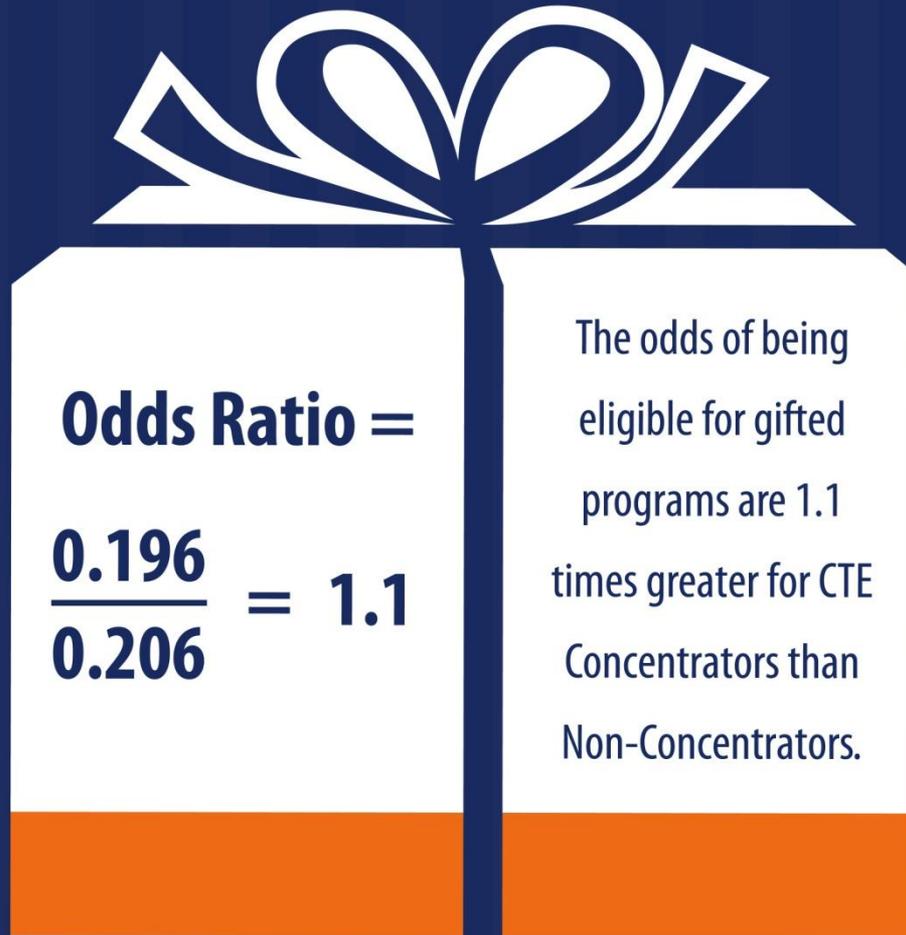




Descriptive Statistics: Gifted Eligibility

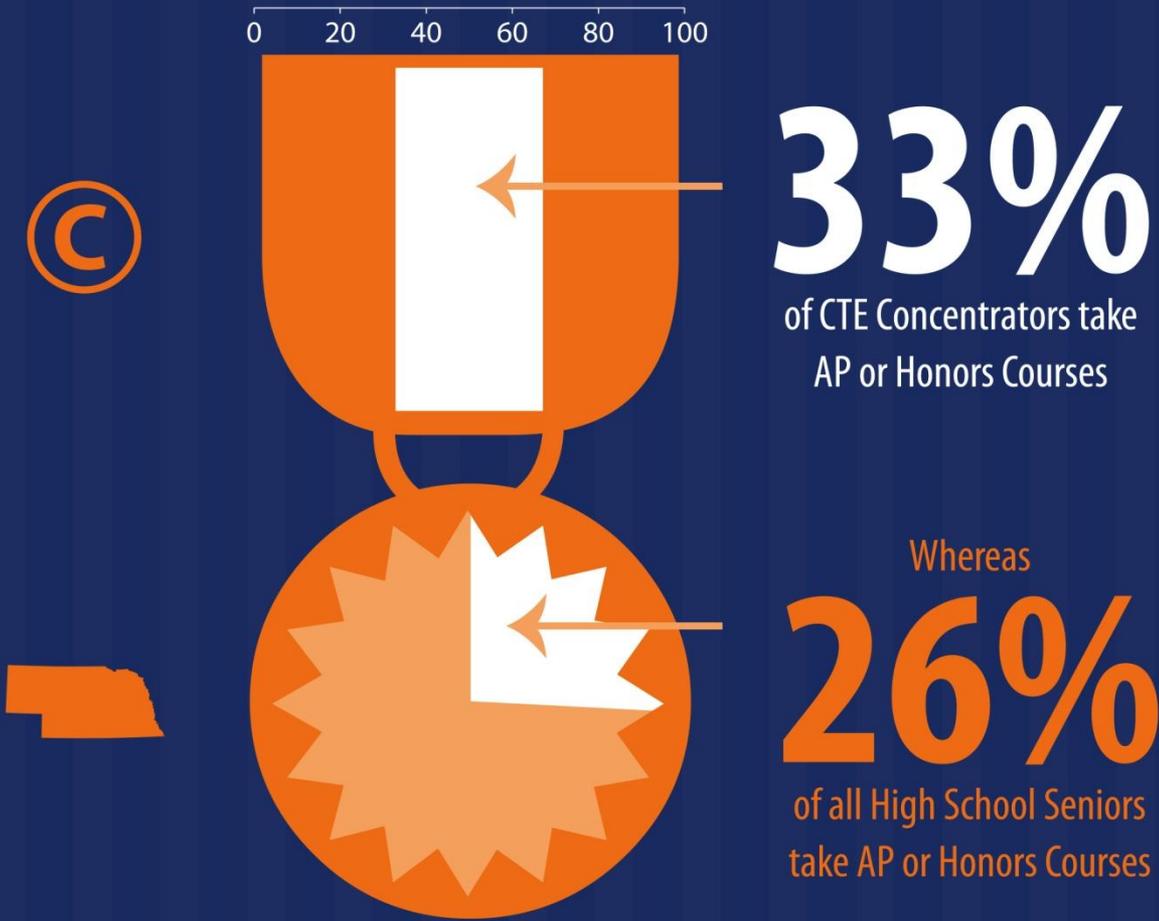
All High School Seniors vs. Concentrators





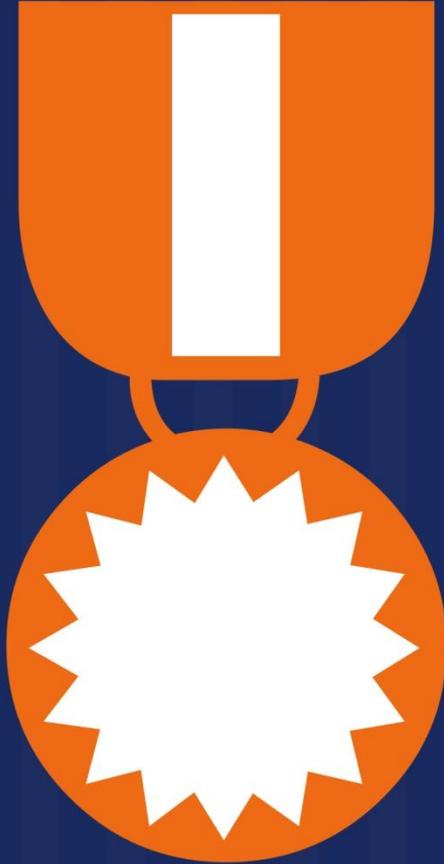
Descriptive Statistics: Gifted Eligibility Concentrators vs. Non-Concentrators





Descriptive Statistics: AP or Honors Courses Concentrators vs. All High School Seniors





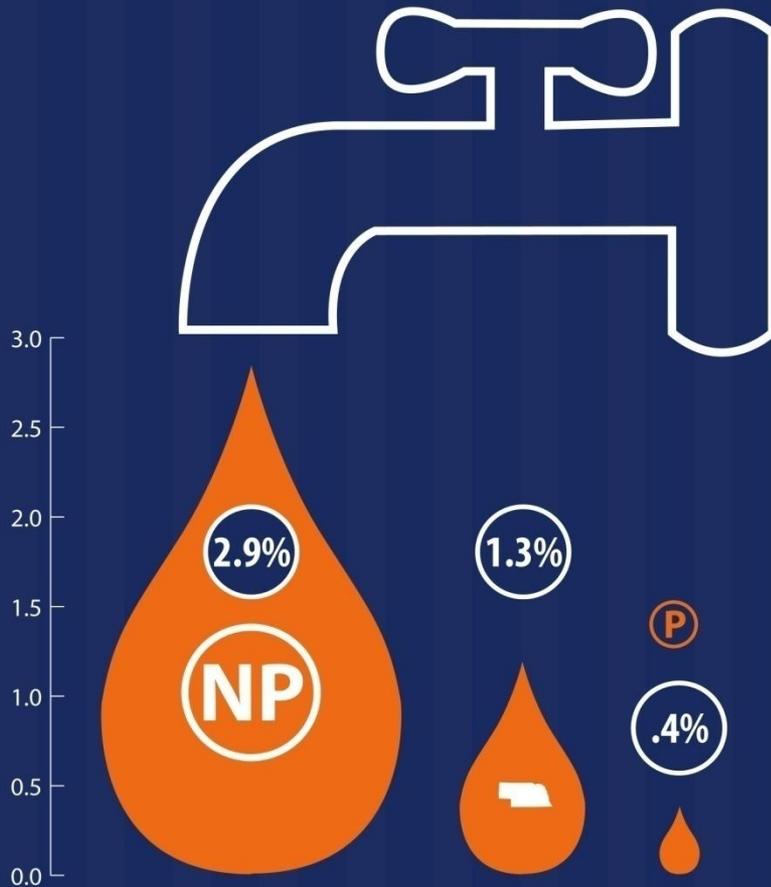
The odds of participating in AP or Honors Courses are 1.6 times greater for CTE Concentrators than Non-Concentrators.

Odds Ratio =

$$\frac{0.485}{0.295} = 1.6$$

Descriptive Statistics: AP or Honors Courses Concentrators vs. Non-Concentrators





0.4% of students grades 7-12 participating in Career Education dropped out of school

Compared to

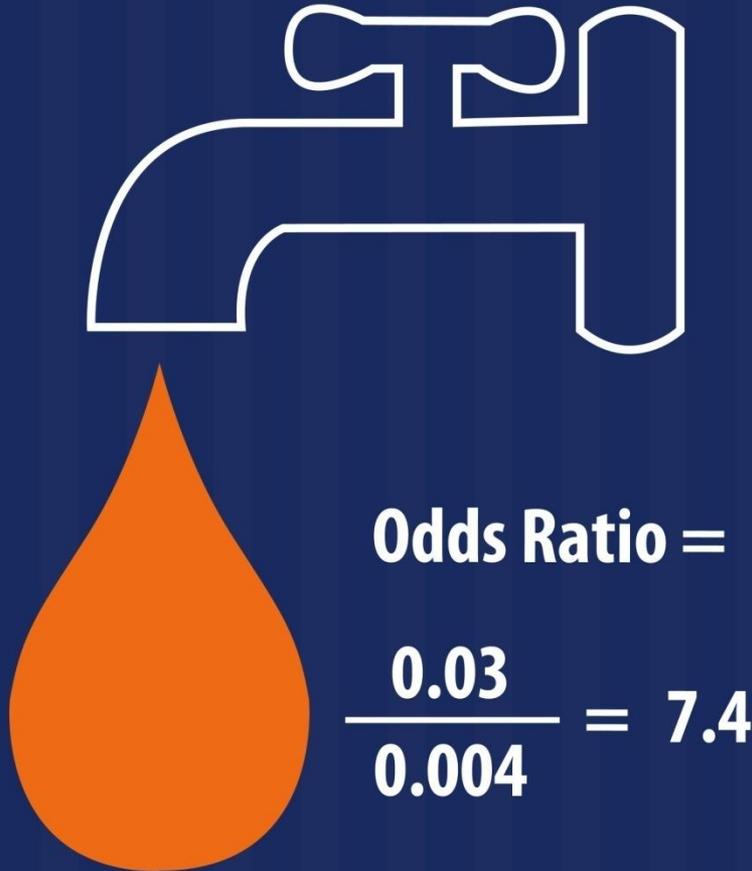
2.9% of students grades 7-12 *not* participating in Career Education.

Overall, 1.3% of all Nebraska students grades 7-12 dropped out of school.

Descriptive Statistics: Dropouts

Non-Participants, All Students Grades 7-12, Participants

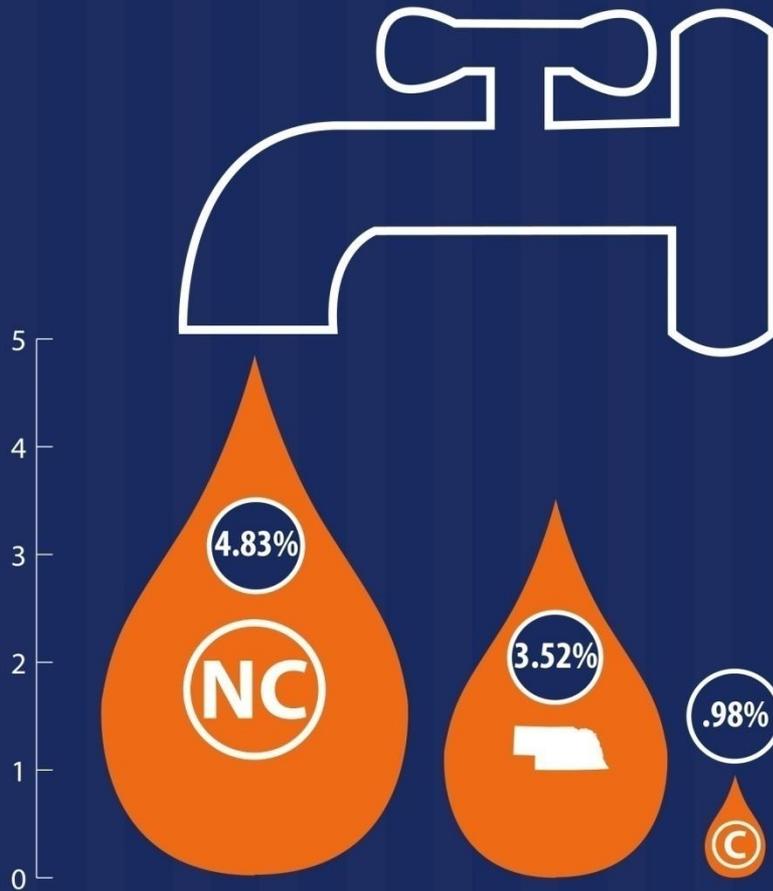




The odds of being classified as a dropout are 7.4 times greater for students not participating in CTE than CTE Participants.

Descriptive Statistics: Dropouts Non-Participants vs. Participants





0.98% of students in grade 12 concentrating in Career Education dropped out of school

Compared to

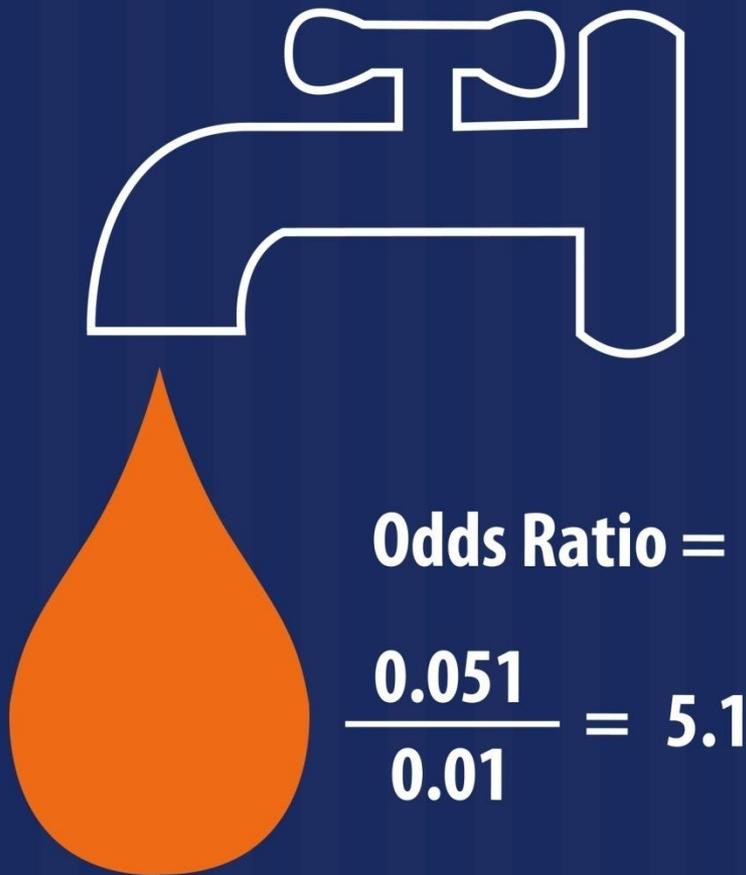
4.83% of students in grade 12 *not* concentrating in Career Education.

Overall, 3.52% of all Nebraska students in grade 12 dropped out of school.

Descriptive Statistics: Dropouts

Non-Concentrators, All Students Grade 12, Concentrators

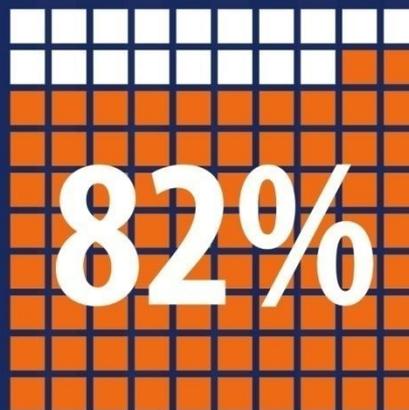
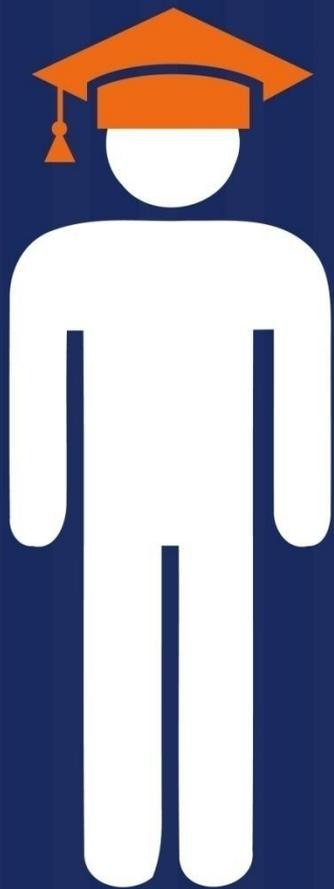




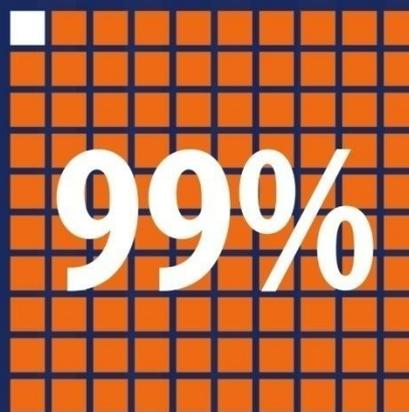
The odds of being classified as a dropout are 5.1 times greater for students not concentrating in CTE than CTE Concentrators.

Descriptive Statistics: Dropouts Non-Concentrators vs. Concentrators





Whereas

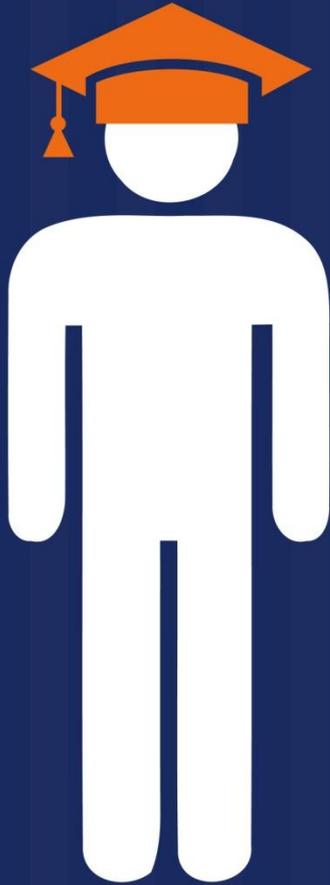


of Nebraska high school seniors completed an approved program of study and met district/system requirements for a high school diploma

of CTE Concentrators completed an approved program of study and met district/system requirements for a high school diploma

Descriptive Statistics: Completer with Diploma All High School Seniors vs. Concentrators





The odds of completing an approved program of study and meeting district/system requirements for a high school diploma are 25.6 times greater for CTE Concentrators than students not concentrating in CTE.

Odds Ratio =

$$\frac{72.09}{2.81} = 25.6$$

Descriptive Statistics: Completer with Diploma Concentrators vs. Non-Concentrators



Data Use Beyond Accountability

- Descriptive Analyses
 - Measures of Central Tendency
 - Mean, Median, Mode
 - Measures of Dispersion
 - Variance, SD, IQ Range
 - Measures of Association
 - Correlations
 - Probabilities
 - Odds Ratios
 - Relative Risk Ratios
- Inferential Analyses
 - Testing of Models
 - Linear Regression
 - Generalized Linear Model
 - Path and Structural Equation Models



Inferential Analyses

- Binomial Logistic Regression
 - An extension of the generalized linear model
 - Used to predict a discrete, dichotomous (takes the form of two categories) dependent variable
 - Dropout – Not a Dropout
 - Utilizes the logit link function:
 - $g(x)=\log(x/(1-x))$
 - Parameter estimation produced via maximum likelihood estimation



Inferential Analyses: Dropouts

Predictor	Coefficient	Standard Error	Odds Ratio
CTE Participant (No)	2.002***	0.0589	7.405
Constant	-5.520***	0.0528	0.0002

Note: n = 142,570, LR chi squared = 1541.38***, df = 1, *p < .05. **p < .01. ***p < .001

Predicted Logit (Dropout=1) = $\alpha + \beta_1 \times$ CTE Participant Status

Relative to CTE Participants, the odds of being classified as a dropout are 7.405 times greater for students NOT participating in Career Technical Education.



Predictor	Coef.	SE	OR	Predictor	Coef.	SE	OR
CTE Participant (No)	0.577***	0.0781	1.781	Single Parent	0.517***	0.1478	1.677
Female	-0.330***	0.0635	0.719	Food Program			
Days Membership	0.02***	0.0013	1.02	Free Meals	-0.422***	0.0671	0.656
FTE Percent	0.036***	0.0064	1.036	Reduce Meals	-0.387**	0.1469	0.679
AP or Honors Participant	-0.983***	0.1697	0.374	Ethnicity			
LEP Eligible	0.410***	0.1483	1.507	Asian	-0.465	0.2726	0.628
Gifted Participant	-0.781***	0.2592	0.458	Black	0.231*	0.0992	1.26
Imigrant				Hispanic	0.331***	0.0828	1.393
< 1 Year	0.277	0.2791	1.319	Multiple	-0.203	0.202	0.817
<=1 Year >= 3 Years	0.706**	0.2605	2.027	Pacific Islander	-0.268	0.752	0.767
> 3 Years	0.222	0.1615	1.248	American Indian	0.085	0.1514	1.089
Homeless	0.611***	0.1603	1.843	Grade Level	0.6794***	0.0258	1.973
Days Attendance	-0.049***	0.0015	0.952	Constant	-12.338***	0.7035	4.383

Note: n = 137,478, LR chi squared = 6662.88***, df = 22, *p < .05. **p < .01. ***p < .001



Conclusion

- Understand the realities of the Federal CTE accountability framework, including the benefits and drawbacks
- Recognize the value in adopting diverse data analytic strategies
- Gain practical suggestions for diversifying CTE data analyses to include larger populations of students



For more information, please contact:

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