



Careers in Biostatistics

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Dr. Poritz, a practicing statistician in an industrial setting (aerospace), has also worked as a biostatistician planning and analyzing clinical studies for pharmaceuticals and medical devices. He is willing to advise SU students about statistics and biostatistics fields.

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What are the occupations?

- Statistical Programmer
 - Usually has a Master's in statistics or biostatistics
 - Writes analysis code in SAS, R, or S-Plus
- Biostatistician
 - Master's or Ph.D. (preferred) in statistics or biostatistics
 - Requires good oral and written English
 - Writes statistical plans for conduct and analysis of designed experiments and human studies
 - Analyzes data and writes final statistical reports

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What is statistics?

- The goal of statistics is to draw general conclusions from a limited number of uncertain observations
- The mathematics of probability is used to model the uncertainty of the observations.
- Statistics is an inferential science, not a branch of mathematics, although statistics is highly mathematical because it uses probability
- Hence, Sir Ronald A. Fisher, one of statistics' founders, entitled a major work *Statistical Methods and Scientific Inference*

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What is statistics?

Statistical methods are used

- to design experiments, surveys, and observational studies
- to analyze data from controlled experiments and from uncontrolled observations
- Most sciences consider well-drawn statistical inferences to be the gold standard of scientific evidence

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What is biostatistics?

- Biostatistics is the science of statistics applied to biology, medicine, surgery, clinical psychology, pharmaceuticals, and medical devices
- Biostatisticians work with clinical scientists to design clinical trials for new pharmaceuticals, medical devices, or medical procedures, that is, experimental studies with humans
- Biostatisticians often have had courses or other educational background in anatomy, physiology, oncology, or pharmacology

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Why is statistics required?

- All national and multinational regulatory authorities, such as the US Food and Drug Administration or the European Medicines Agency, require
 - statistically valid study protocols before human studies begin
 - statistically valid scientific evidence of efficacy and safety of new medicines or devices before market approval is granted

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Tasks and skills

- The biostatistician working for a study sponsor, say, a pharmaceutical company, is like an attorney
- The biostatistician works within the laws of mathematics, statistics, and professional ethics to present the best possible view for study protocols and data submitted to regulatory authorities
- Nevertheless, the biostatistician must keep his independence and integrity, often requiring considerable diplomatic skills, when confronted with inappropriate organizational pressures

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Tasks and skills

- The biostatistician interviews clinical scientists in depth in order to determine the correct statement of a clinical study's objectives
- The biostatistician needs to exercise excellent interpersonal, logical, verbal, and written skills
- The biostatistician observes strict confidentiality with clinical data not only outside the sponsoring organization but also within it, since this information often has enormous financial value

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Education

- Statistics is largely a graduate field of study
- Undergraduate mathematical study includes
 - differential and integral calculus
 - linear algebra, including spectral theory and Jordan forms
 - systems of ordinary differential equations
 - first and second order partial differential equations
 - differential forms and multivariable integration
 - abstract algebra of finite fields
 - numerical analysis
 - linear and nonlinear optimization

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Education

- Undergraduate statistical study includes
 - Introductory mathematical probability and statistics
- Undergraduate science includes
 - Biology
 - Chemistry
- Graduate or undergraduate study includes
 - SAS, R, or S-Plus programming
 - Regression analysis
 - Introductory experimental design and analysis
 - Human anatomy and physiology

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Education

- Graduate study includes

<ul style="list-style-type: none"> ■ Theories of statistical inference ■ Applied stochastic processes ■ Multivariable normal theory ■ Exploratory data analysis ■ Time series analysis ■ Survival distributions and statistics ■ Analysis of categorical and ordinal data 	<ul style="list-style-type: none"> ■ Sample survey design and analysis ■ Advanced experimental design and analysis <ul style="list-style-type: none"> ■ Oncology and pharmacology ■ Actuarial mathematics ■ Advanced numerical analysis ■ Advanced linear and nonlinear optimization ■ Abstract measure and
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More information

- Professional societies:
 - American Statistical Association, www.amstat.org
 - International Biometric Society, www.enar.org and www.wnar.org
- Clinical trials: International Conference on Harmonisation of Technical Requirements of Pharmaceuticals for Human Use, www.ich.org
- Job search: www.medzilla.com

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