Department of Statistics and Actuarial Science

BACHELOR OF SCIENCE

Major in Statistics
Major in Risk Management
Major in Decision Analytics

https://saasweb.hku.hk/
A theme underlying all 3 majors is...

STATISTICS

addresses an important human endeavour...

a desire to make “sense” of observations
The relationships between democratic experience, adult health, and cause-specific mortality in 170 countries between 1980 and 2016: an observational analysis
### Predicting Oscar winners

<table>
<thead>
<tr>
<th>Year</th>
<th>Winner</th>
<th>Probability</th>
<th>Predicted</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best Picture</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1948</td>
<td>Hamlet</td>
<td>0.01</td>
<td>Johnny Belinda</td>
<td>0.97</td>
</tr>
<tr>
<td>2004</td>
<td>Million Dollar Baby</td>
<td>0.01</td>
<td>The Aviator</td>
<td>0.97</td>
</tr>
<tr>
<td>1981</td>
<td>Chariots of Fire</td>
<td>0.01</td>
<td>Reds</td>
<td>0.88</td>
</tr>
<tr>
<td>Best Director</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>Steven Soderbergh</td>
<td>0.01</td>
<td>Ang Lee</td>
<td>0.95</td>
</tr>
<tr>
<td>1968</td>
<td>Carol Reed</td>
<td>0.02</td>
<td>Anthony Harvey</td>
<td>0.97</td>
</tr>
<tr>
<td>1972</td>
<td>Bob Fosse</td>
<td>0.03</td>
<td>Francis Ford Coppola</td>
<td>0.96</td>
</tr>
<tr>
<td>Best Actor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>Denzel Washington</td>
<td>0.00</td>
<td>Russell Crowe</td>
<td>0.99</td>
</tr>
<tr>
<td>1968</td>
<td>Cliff Robertson</td>
<td>0.00</td>
<td>Peter O’Toole</td>
<td>0.88</td>
</tr>
<tr>
<td>1974</td>
<td>Art Carney</td>
<td>0.02</td>
<td>Jack Nicholson</td>
<td>0.87</td>
</tr>
<tr>
<td>Best Actress</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>Nicole Kidman</td>
<td>0.07</td>
<td>Renée Zellweger</td>
<td>0.90</td>
</tr>
<tr>
<td>1985</td>
<td>Geraldine Page</td>
<td>0.07</td>
<td>Whoopi Goldberg</td>
<td>0.70</td>
</tr>
<tr>
<td>1950</td>
<td>Judy Holliday</td>
<td>0.09</td>
<td>Gloria Swanson</td>
<td>0.76</td>
</tr>
</tbody>
</table>
One Twin Committed the Crime — but Which One?
A New DNA Test Can Finger the Culprit
A handful of criminal prosecutions have stalled because DNA tests cannot distinguish between suspects who are twins. Then scientists decided to create one.
Different languages, similar encoding efficiency: Comparable information rates across the human communicative niche
Examples of applications

Focus article

Computer vision, archaeological classification and China's terracotta warriors
A public data set of spatio-temporal match events in soccer competitions

Examples of applications

Napoli (0)
connectivity = 14.74

Juventus (1)
connectivity = 19.89
Aliens may not exist – but that’s good news for our survival

A new study suggests that we could well be on our own in the universe. Yet loneliness might have its advantages
The run-up to the global financial crisis: A longer historical view of financial liberalization, capital inflows, and asset bubbles
Some days are more equal than others?
China, covid-19, 2020, new confirmed cases, by day

Hubei province

- New party leadership in Hubei and Wuhan
- New diagnostic guidelines issued
- Guidelines rescinded

All provinces, excluding Hubei

- Zhejiang province announces 335 new clinics and backup hospital
- Xi Jinping speech to the politburo
- Shandong provincial justice department chief removed

Source: China’s National Health Commission
a desire to make sense of “big data”
Netflix movie-rating challenge

Examples of applications

How to predict missing ratings of customers?

<table>
<thead>
<tr>
<th>Customer 1</th>
<th>Customer 2</th>
<th>Customer 3</th>
<th>Customer 4</th>
<th>Customer 5</th>
<th>Customer 6</th>
<th>Customer 7</th>
<th>Customer 8</th>
<th>Customer 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>•</td>
<td>•</td>
<td>•</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>•</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

17,770 movies

480,189 customers
Examples of applications involved many statistical techniques, of which most important is SVD (Singular Value Decomposition).

---

###Netflix Prize

**Leaderboard**

Showing Test Score. [Click here to show quiz score]

<table>
<thead>
<tr>
<th>Rank</th>
<th>Team Name</th>
<th>Best Test Score</th>
<th>% Improvement</th>
<th>Best Submit Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>BellKor's Pragmatic Chaos</strong></td>
<td>0.8567</td>
<td>10.06</td>
<td>2009-07-26 18:18:28</td>
</tr>
<tr>
<td>2</td>
<td>The Ensemble</td>
<td>0.8567</td>
<td><strong>10.06</strong></td>
<td>2009-07-26 18:38:22</td>
</tr>
<tr>
<td>3</td>
<td>Grand Prize Team</td>
<td>0.8582</td>
<td>9.90</td>
<td>2009-07-10 21:24:40</td>
</tr>
<tr>
<td>4</td>
<td>Opera Solutions and Vandelay United</td>
<td>0.8588</td>
<td>9.84</td>
<td>2009-07-10 01:12:31</td>
</tr>
<tr>
<td>5</td>
<td>Vandelay Industries I</td>
<td>0.8591</td>
<td>9.81</td>
<td>2009-07-10 00:32:20</td>
</tr>
<tr>
<td>6</td>
<td>PragmaticTheory</td>
<td>0.8594</td>
<td>9.77</td>
<td>2009-06-24 12:06:56</td>
</tr>
<tr>
<td>7</td>
<td>BellKor in BigChaos</td>
<td>0.8601</td>
<td>9.70</td>
<td>2009-05-13 08:14:09</td>
</tr>
<tr>
<td>8</td>
<td>Dace</td>
<td>0.8612</td>
<td>9.59</td>
<td>2009-07-24 17:18:43</td>
</tr>
<tr>
<td>9</td>
<td>Feeds2</td>
<td>0.8622</td>
<td>9.48</td>
<td>2009-07-12 13:11:51</td>
</tr>
<tr>
<td>10</td>
<td>BigChaos</td>
<td>0.8623</td>
<td>9.47</td>
<td>2009-04-07 12:33:59</td>
</tr>
<tr>
<td>11</td>
<td>Opera Solutions</td>
<td>0.8623</td>
<td>9.47</td>
<td>2009-07-24 00:34:07</td>
</tr>
<tr>
<td>12</td>
<td>BellKor</td>
<td>0.8624</td>
<td>9.46</td>
<td>2009-07-26 17:19:11</td>
</tr>
</tbody>
</table>
ChatGPT is a language model that can be accessed by anyone online. We asked it to tell us about itself and why it’s so significant in the field of AI.
Examples of applications

**Step 1**
Collect demonstration data, and train a supervised policy.

A prompt is sampled from our prompt dataset.

A labeler demonstrates the desired output behavior.

This data is used to fine-tune GPT-3 with supervised learning.

**Step 2**
Collect comparison data, and train a reward model.

A prompt and several model outputs are sampled.

A labeler ranks the outputs from best to worst.

This data is used to train our reward model.

**Step 3**
Optimize a policy against the reward model using reinforcement learning.

A new prompt is sampled from the dataset.

The policy generates an output.

The reward model calculates a reward for the output.

The reward is used to update the policy using PPO.

Leverages Proximal Policy Optimization (PPO)

A policy is a strategy that an agent uses in pursuit of goals

Kullback-Leibler penalty for SFT model to avoid overfitting
Risk Management is a logical and systematic methodology of studying the risks involved in any activity or process.

- Identifying risk
- Analyzing risk
- Treating risk
- Monitoring risk

Major Objectives of Risk Management:
- To avoid or minimize potential losses
- To help managers make best use of their available resources
Professional Qualification

- **Financial Risk Manager (FRM) Certificate Exam**

- **Professional Risk Managers (PRM) Exam**
  - awarded by Professional Risk Managers’ International Association (PRMIA) [http://www.prmia.org](http://www.prmia.org)

- **Chartered Enterprise Risk Actuary (CERA)**
  - awarded by CERA Global Association [https://ceraglobal.org](https://ceraglobal.org)
U.S. News Best Jobs Rankings 2022
https://money.usnews.com/careers/best-jobs/rankings

Statistician
• #3 in Best Business Jobs
• #7 in Best STEM Jobs
• #8 in 100 Best Jobs

Data Scientist
• #3 in Best Technology Jobs
• #6 in 100 Best Jobs
• #6 in Best STEM Jobs

Actuary
• #7 in Best Business Jobs
• #11 in Best STEM Jobs
• #20 in 100 Best Jobs
• #24 in Best Paying Jobs

Management Analyst
• #6 in Best Business Jobs
• #17 in 100 Best Jobs

Market Research Analyst
• #4 in Best Business Jobs
• #14 in 100 Best Jobs
https://www.careercast.com/jobs-rated/best-jobs-2021
1. University Professor

Median Salary: $80,790

Post-secondary teachers tend to enjoy flexible schedules. While some teach classes at night or on weekends, these professionals generally find their jobs rewarding and appreciate the opportunity to share their expertise with students, according to the BLS. CareerCast ranked university professor as one of the careers with the lowest stress level in 2019, the most recent year the job website compiled its list.

In addition to teaching, university professors advise students and conduct research in their fields. While most positions require you to hold a Ph.D., a graduate degree might be sufficient for community colleges, according to the BLS.

5. Statistician

Median Salary: $92,270

If you’re good with numbers, you might want to consider a career as a statistician. These individuals collect data to help solve problems in a variety of industries and generally work full time. They could need to work overtime to meet a deadline or fill a last-minute request for information.

Job growth for this profession is currently high, as an increasing number of businesses are using statistical analysis to make decisions, according to the BLS. Most opportunities require candidates to hold master’s degrees in statistics, mathematics or similar fields.

9. Mathematician

Median Salary: $110,860

Mathematicians utilize techniques to solve problems in business, engineering and other fields. U.S. News ranked mathematician as the sixth-best job in business in 2021 and noted that mathematicians enjoy a variety of professional opportunities.

To qualify for a mathematics position, you’ll need at least a bachelor’s degree in math. Some positions require further education.

10. Actuary

Median Salary: $111,030

An actuary analyzes the financial costs of risks taken by businesses and clients. However, pursuing a career as an actuary involves little risk and plenty of rewards. South Dakota State University touts the profession for its “high pay, low stress, good job security” and contribution in solving important problems.

Actuaries commonly hold bachelor’s degrees in math or related analytical fields. Additional certification is needed to achieve full professional status.
10 well paid jobs that are relatively low stress:

1. Statistician
2. Dental Hygienist
3. Librarian

1. Statistician
Glassdoor Average Salary: £39,473
Statisticians use mathematical techniques to interpret data to draw parallels or to come to conclusions. Statisticians can work across various sectors, including public, private and academic. Freelance statisticians - those who are self-employed and work on a project basis, are in high demand.
Using logical thinking, combined with mathematical techniques to draw facts from raw data, statisticians can work solo or in a collaborative team. Having this option means, being a statistician is a relatively low-stress job.
An interest in mathematics and the ability to understand complex mathematical functions is important. When hiring, employers look for candidates who have a degree in maths or a related subject.
Difference in focus between the 3 majors

- **Decision Analytics** –
  
  *heavy emphasis on both STATISTICS and COMPUTER SCIENCE*

- **Risk Management** –
  
  *courses focus primarily on business-related topics: e.g. investment, insurance, finance, banking, etc.*

- **Statistics** –
  
  *courses cover wide range of topics with emphasis on “METHODS”, their applications, and underlying theory.*
A few practical reasons for majoring in

Statistics / Risk Management / Decision Analytics

- Flexibility of the programme enables you to tailor-make your course of study.
- Develop your interest at your own pace.
- Pre-mature commitment not required.
Mathematical background adequate?

Students must have level 2 or above in

- HKDSE Extended Module 1 or 2 of Mathematics or equivalent

Otherwise, strongly advised to take

**MATH1011 University Mathematics I**
in Semester 1.
What do we need from your Mathematics?

- Set notation and theory
- Functions (incl. limits, continuity)
- Sequences, series
- Basic calculus (incl. partial differentiation, double integration)
- Vectors, matrices (basic operations)
New changes to curricula

Major in *Statistics*

<table>
<thead>
<tr>
<th>List A</th>
<th>List B</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>STAT3602</strong> Statistical inference (6)</td>
<td><strong>STAT3604</strong> Design and analysis of experiments (6)</td>
</tr>
<tr>
<td><strong>STAT3603</strong> Stochastic processes (6)</td>
<td><strong>STAT3605</strong> <strong>Quality control and management (6)</strong> To remove from 2022-23 and thereafter</td>
</tr>
<tr>
<td><strong>STAT3620</strong> Modern nonparametric statistics (6)</td>
<td></td>
</tr>
<tr>
<td><strong>STAT3621</strong> Statistical data analysis (6)</td>
<td></td>
</tr>
<tr>
<td><strong>STAT3655</strong> Survival analysis (6)</td>
<td></td>
</tr>
<tr>
<td><strong>STAT4601</strong> Time-series analysis (6)</td>
<td></td>
</tr>
</tbody>
</table>

At least 36 credits from Lists A and B, among which at least **18** credits from List A.
New changes to curricula

Major in *Decision Analytics*

<table>
<thead>
<tr>
<th>Disciplinary Electives (12 credits)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>At least 12 credits selected from the following courses:</strong></td>
</tr>
<tr>
<td>COMP3250</td>
</tr>
<tr>
<td>COMP3270</td>
</tr>
<tr>
<td>COMP3323</td>
</tr>
<tr>
<td>COMP3407</td>
</tr>
<tr>
<td>MATH3408</td>
</tr>
<tr>
<td>MATH3600</td>
</tr>
<tr>
<td>MATH3804</td>
</tr>
<tr>
<td>MATH3904</td>
</tr>
<tr>
<td>STAT3620</td>
</tr>
<tr>
<td>STAT3621</td>
</tr>
<tr>
<td>STAT3622</td>
</tr>
<tr>
<td>STAT3655</td>
</tr>
<tr>
<td><strong>STAT4011</strong></td>
</tr>
<tr>
<td><strong>STAT4023</strong></td>
</tr>
<tr>
<td>STAT4601</td>
</tr>
<tr>
<td>STAT4602</td>
</tr>
<tr>
<td>STAT4610</td>
</tr>
</tbody>
</table>

*To remove from 2022-23 and thereafter*

*To add from 2017-18 to 2022-23 and thereafter*
A useful introductory-level course

**STAT2604**

*Introduction to R programming and elementary data analysis*

- introduction to statistical programming language R
- basic programming skills in R with examples and applications in elementary statistical analysis
- management of different data types: input/output, manipulation, transformation
- random sampling, descriptive data analysis
- production of professional summary reports with high-quality graphs
Reminder

• plan ahead
  - major/minor, overseas exchange, internship, research project
  - career vs further study

• watch out for pre-requisites of individual courses

• courses **CANNOT** be double-counted to fulfill different majors/minors
  - (exception for double major in Science: SCNC1111 & SCNC1112 & up to 12 credits of compulsory courses REQUIRED by both Science majors can be double-counted)

• consult course selection advisors if necessary
Support from University and Department

- **HKU**: Centre of Development and Resources for Students
  - *NETmatch, NETjobs, JIJIS (Joint Institutions Job Info. System)*

- **Department**: Internship / Job Online Application System
Career Development Training

- Summer IT course:
  - Essential IT skills (certificate course)

- Career Advising Programme (CAP) to prepare students for:
  - Internships and job opportunities
  - Advancing resume and interview skills
Besides career…

- **Opportunity for further studies**
  - Recently our graduates had pursued Masters and PhD studies in universities including Harvard, UC Berkeley, Yale, Stanford, Cambridge

- **Scholarships/Awards**

- **Other learning opportunities**
  - *e.g. overseas exchange, mentorship, internship, research projects*
Contact Persons

■ Co-ordinators & Course Selection Advisors
  - Ke Zhu (Statistics)
  - Yuan Cao (Decision Analytics)
  - K P Wat (Risk Management)

■ Credit transfer
  - Chen Wang

■ Internship
  - Eric Li

■ Tel: 3917 2466

■ Email: ug_enquiry@saas.hku.hk
QUESTION AND ANSWER

Our Homepage: www.hku.hk/statistics